Interaction between trade, conflict and cooperation: the case of Japan and China

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Abstract

The complex interaction between trade and politics is analysed using Granger causality tests. The purpose is to determine the presence and direction of causation between trade and political events, both positive and negative, and to gauge an idea of the lag length of causality. The focus of the study is on the Japan-China relationship where trade is growing quickly despite long standing political distance between the two countries. The other important political and economic partner for both countries, the United States, is also examined by way of comparison. Evidence of Granger causality is found with the presence of lag lengths, and direction of causality being different for each bilateral relationship. The economic relationship underpins and constrains the political relationship between Japan and China while an increase in positive political news and a decrease in negative political news promote trade to some degree.

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1. Introduction

The bilateral relationship between Japan and China is often characterised as one of cold politics and hot economics; the economic relationship continues to boom while historical issues and political tensions continue to strain the relationship.

After six years of suspended visits between leaders, the last year has seen an effort by both sides to mend relations, perhaps in recognition of the growing importance of their economic relationship. Trade in 2006 was as high as US$211 billion on some estimates. China is Japan's largest trading partner (measured in terms of the sum of trade flows both ways) and Japan is China's third largest partner, after the United States and Europe.

Do political events have any effect on the economic relationship? Does increased trade and dependence cause countries to get along better? Or do the increased interactions through trade, or asymmetry in trade such as that seen in the United States-China case, cause political conflict to rise?

The view that increased trade and economic interdependence will result in increasingly cooperative political relations is shared by many scholars and policy makers (Mansfield and Pollins, 2004). There is also a view that increased imbalance in trade and economic interdependence will cause political tensions to rise.

The purpose of this paper is to investigate the relationship between trade and political conflict (or cooperation) between China and Japan. The paper also looks at both countries' relationships with their other major trading partner, the United States. The expectation is that the economic relationship is interdependent with how well countries are getting along. The Japan-China relationship is expected to be different from both the United States-China and the United States-Japan relationships, the latter of which is a lot more stable politically.

Although the probability of war, or high intensity conflict, between Japan and China is low, there are occasional flash points in the relationship such as Taiwan, territorial claims and history that have the potential to escalate. Extreme conflict (economic and

trade sanctions, or even war) and high level cooperation (such as customs union or security alliance) are at the opposite ends of the spectrum in a scale of conflict or cooperation events. These extremes do not occur in the China-Japan relationship over the period analysed in this study but the relationship is one of low intensity conflict and cooperation.

China's relationship with its other major trading partner, the United States, is also complicated but does not perhaps share the historical complexity of the Japan-China relationship. The asymmetry in trade flows, stemming from the growing US bilateral trade deficit with China, is straining relations. On the other hand, the mutual recognition of the importance of the relationship, and the increased trade and interdependence, is causing the two to negotiate their way through the imbalance carefully and there are substantial efforts to keep relations stable.

Conflict is defined in this paper as an unfriendly or negative political action or stance of one country towards another and can be thought of interchangeably as the negative of cooperation.

An index of net cooperation is created. This index is a measure of cooperation minus conflict, and is used as a single variable to describe the political distance between two countries. Although not all events or news in the data are created by the actions of authorities on either side, and many are instead events that are a product of independent actors, they all have some positive or negative political impact. Thus the index of net cooperation derived from the record of these events can serve as a measure of the political distance between the two countries in the study.

An alternative net conflict variable, a measure of conflict minus cooperation, is commonly used in the literature. This differencing of the two variables imposes some limitations and assumptions on the event data and can alter results[2]. A distinction is made between trade and interdependence in this study and, unlike previous studies, both are tested for their relationship with net cooperation here.

[2] I thank Bruce Chapman for this point.

The study uses monthly data up to 2004 whereas previous studies for other countries have used quarterly data, analysed much earlier periods and not examined the relationship between Japan and China. Sub-periods of the data are analysed for the Japan-China relationship to capture any changing dynamics in the trade-cooperation relationship. In addition nonlinear causality is tested to find further evidence of the interdependence of conflict/cooperation and trade.

The next section sets out the main arguments in the trade-conflict debate and then reviews some of the growing empirical evidence supporting various arguments. Section 3 provides a description and explanation of the conflict/cooperation and trade data. Section 4 explains the Granger causality model, presents the results and discusses other tests that were carried out. Section 5 discusses implications and Section 6 concludes.

2. Trade, Conflict and Cooperation

There has been a rich debate for centuries about the link between conflict/cooperation and economic interdependence (Mansfield and Pollins, 2003). In the last few decades, the debate has seen the growth of a vast amount of systematic empirical analysis which has added to the understanding of the issue but there remain many unanswered questions (Mansfield and Pollins, 2001). The broad line of thinking associated with the 'liberal' school is that as trade and interdependence between nations grow, there is a greater opportunity cost to conflict and so the chances of conflict are reduced. Another view point, associated with the realist school, argues that countries also go to war to acquire resources as an alternative to international trade and that asymmetries in trade relationships can cause tensions to rise. These views, and the supporting empirical evidence, is briefly reviewed below, as are other factors affecting the link between conflict and interdependence such as the proximity of countries and the level of their political liberalisation.

Interdependence can mean vulnerability towards another nation (for example, through exposure to a dominant resource or strategic goods supplier) and/or sensitivity to dependence (for example, through the effect of economic shocks such as inflation or exchange rate volatility in one country on another) and quite often trade flows are the

best quantitative measure of these independencies available[3]. There is of course a high correlation between trade and interdependence as a large component of interdependence is due to trade. But interdependence will generally include other forms of trade, such as in services, as well as the flow of people and investment.

As early as 1748 Montesquieu, the French social commentator and political thinker, famously said

> *Peace is the natural effect of trade. Two nations who traffic with each other become reciprocally dependent; for if one has an interest in buying, the other has an interest in selling: and thus their union is founded on their mutual necessities*' (de Secondat, 1748 [1989], p. 316).

This is an insight that is often quoted in studies of interdependence and cooperation. The basic idea is that mutual dependence leads to increased cooperation and a decrease in hostilities, or conflict. Cooperation has a positive relationship with interdependence or trade.

Trade flows are influenced significantly by broad political relations of amity and enmity between nations (Pollins, 1989b). The argument for a positive relationship between trade and cooperation runs both ways: trade fosters peace and peace fosters trade. As trade increases between two countries, the opportunity cost of conflict rises. Trade is seen as being driven by politics and the political distance between nations. It is easy to see that allies may trade more and sign trade agreements (for example, the North American Free Trade Agreement) whereas in general countries reduce trade with their enemies (for example, the United States and Cuba).

Countries, and the actors within those countries, trade because they gain from it and it is in their interest to do so. Disputes and conflict may lead to a loss in trade and therefore a loss in welfare. Highly interdependent states rarely engage in full blown war because the costs of doing so are too high.

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[3] For a discussion of this see Mansfield and Pollins (2001).

Hirschman (1945) describes the politics of foreign trade and notes that there is 'the possibility of using trade as a means of political pressure…in the pursuit of power' (p. xvi). The gains from trade between nations can have unequal distribution within countries as well as between countries (Hirschman, 1945/1980). This unequal distribution of gains from trade can lead to a change in the structure of power within a country and between countries. Therefore, asymmetry in the gains from trade, which occurs quite naturally and regularly, especially if it causes a shift in power relations, can lead to military conflict in extreme cases (Gilpin, 1981; Levy, 1989; Mearsheimer, 1990).

An example of conflict (mainly low intensity conflict) arising from asymmetric trade is the case of the United States and the trade disputes it has with some of its largest trade partners – Japan in the 1980s and the current United States-China tensions over a rapidly growing bilateral trade imbalance.

There have been other characteristics identified that influence the direction of conflict and cooperation. Countries with elected democracies, it is argued, do not go to war with each other[4] (Kant, 1795/1999; Wright, 1942); and there are ambiguous effects of enduring rivalries on the trade-conflict relationship.

Distance is very important in analysing the link between political distance and economic interdependence (O'Loughlin, 1993; Robst et al., 2006). On one hand, distance is an important determinant of trade and has been used extensively in gravity models of trade since Tinbergen (1962) to explain trade dependence. On the other hand, closer countries interact more with each other and neighbours tend to have more disputes (Vasquez, 1995). Further, neighbours may be more likely to have enduring rivalries (Stinnett and Diehl, 2001). The origin of such neighbourhood rivalries can include territorial disputes, disputes from increased trade (the closer countries are, the higher trade is, on average, as the gravity model attests) and the ability of countries to wage war on a neighbour as opposed to a distant country.

[4] For a discussion of the literature, including empirical studies, see Polachek and Seiglie (2006).

Of course countries that trade often have many interactions and it is easy to see how even the closest of allies have disputes and low intensity conflict from time to time. If the relationship of two countries is secure economically, incentives to create low intensity conflict for domestic political reasons can arise. In fact, trade, or the threat of restrictions of trade, can be used as a signal to resolve disputes and avoid more serious conflict (Gartzke, Li and Boehmer, 2001). So trade can reduce military conflicts but increase non-military conflict, 'particularly if one country is more hesitant to fight' (Robst et al., 2006 p. 4). From this perspective, interdependence may foster a high degree of low-intensity conflict that is less likely to escalate (Gartzke, 1998).

To complicate matters, history is littered with counter-examples of adversaries trading during war time and countries changing the way they interact with the rest of the world. At first it is counter-intuitive to think of conflict or a negative action towards another country causing trade, but there are examples in history such as when Commodore Perry forced a then closed Japan to open its ports to international trade.

Many studies do not recognize that the nature of the complex interactions between trade (or interdependence more broadly) and conflict change over time, both in intensity and direction, and that the relationship may depend on both domestic and international factors (Mansfield and Pollins, 2001). This dynamic is revealed in the non linear relationships between these variables but it is beyond the scope of this paper to shed light on such aspects in the Japan-China-United States trade relationships.

Empirical Evidence

Polachek (1978) was the first to analyse the relationship between trade and conflict with a cross section study of the affect of trade on conflict. He found that increased trade reduces net conflict, thus finding evidence of the liberal view. Polachek (1980) constructed a model from microeconomic foundations in an important paper showing the negative relationship between conflict and trade. His work generated a proliferation of empirical papers testing both realist and liberal theories.

While Polachek (1978) accounted for causality running from trade to conflict, Pollins (1989a, 1989b) is often recognized as the first to show the effect of conflict on trade in a single equation cross section.

The importance of causality both ways between trade (or interdependence) and conflict has been recognized since Polachek (1980), and two-staged least squares regression models are used to estimate these relationships. Reuveny and Kang (2003) and Polachek (1997) have since derived simultaneous equations models.

Barbieri and Schneider (1999) contain a summary table of the main findings of the most significant empirical work in the field. It is clear from their review in the table that the results are mixed, methodologies are wide ranging, the countries covered differ, and in general, the analyses are conducted on periods long before the papers were written.

The most common conflict data sets used are events data such as the Cooperation and Peace Data Bank (COPDAB), World Events Interaction Survey (WEIS), and war data sets such as Militarised Interstate Disputes (MID) data, the latter of which are compiled by the Correlates of War Project. There is a stream in the literature testing the compatibility of many of these measures, the biases in the coding (King and Lowe, 2003) and whether these measures accurately reflect reality (Pevehouse, 2004). One such example shows the high level of compatibility between the COPDAB and WEIS data sets (Reuveny and Kang, 1996).

Barbieri (1996) finds strong evidence of economic interdependence increasing the likelihood of militarised interstate disputes. She finds this applies to symmetric as well as asymmetric interdependence between nations. In her study, the only form of interdependence that seems to mitigate conflict is low to moderate interdependence. Her data for conflicts is from 1870 to 1938 and she may have captured the different nature of countries in a different time from now.

Robst et al. (2006) estimate the effects of distance on cooperation and conflict separately and find that trade reduces conflict to a greater extent when two countries are geographically close, but trade has a greater effect on cooperation when countries

are distant. They also find that proximity increases the number and severity of both conflict and cooperation events more among non-trading countries than countries with large trade. Their second finding does not relate to the study here as Japan and China are close but trade is large – Robst et al. do find that although 'proximity provides incentives for conflict, trade mitigates these incentives' (p. 5).

The literature suggests that the causality is bilateral-relationship dependent and the existence of causality often reciprocal – if conflict affects trade from country X to Y, then often conflict will affect trade from country Y to X (Reuveny and Kang, 1998).

Results in the literature also point to causality running in different directions in different bilateral trade relationships, and the interactions depend on the type of traded good (for example, strategic goods versus non-strategic goods) (Reuveny and Kang, 1998).

Gasiorowski and Polachek (1982) and Reuveny and Kang (1996) test for Granger causality between conflict and trade using time series data. Gasiorowski and Polachek analyse Warsaw pact countries' trade with the United States and find relatively little evidence of Granger causality. Reuveny and Kang look at some of the most important and politically and economically significant relationships from the 1960s to early 1990s, concluding that the Granger causality is dependent on the relationships analysed and tends to be reciprocal. Similar methodology is used here for the Granger causality tests but with monthly data instead of quarterly data, with fewer relationships covered but in more detail.

To better understand how politics or conflict can affect trade, we take a look at the extreme case. Conflict leading to a trade embargo or war will obviously affect trade adversely. The other extreme is that a customs union or high level economic cooperation will increase trade. How does low level political conflict or cooperation affect trade relations? A one-off territorial dispute may have little direct effect on trade but it adds to perceived trade risk and increases overall country risk. The cumulative effects of continued low intensity conflict will add to negative perceptions of, and attitudes towards, that country. At the margin it is to be expected that this can

make a significant difference in the decision to undertake trade and other economic transactions.

Increased trade can foster cooperation and peace. Increased imbalances in trade or a shift in power relations sometimes due to trade can cause tensions[5]. Hence there is feedback relationship from trade to conflict and cooperation and vice versa.

3. Data

Conflict/Cooperation Events Data

The conflict/cooperation data used in this study is from King's (2003)[6] dataset of Integrated Data for Events Analysis (IDEA) which is an extension and refinement of the WEIS data set. There are more categories of conflict and cooperation in IDEA than in WEIS or COPDAB. Monthly bilateral conflict and cooperation variables for Japan-China, Japan-United States and United States-China were extracted for the period 1990-2004. A net cooperation variable constructed by differencing conflict from cooperation and results below show that this practice, which is common in the literature, places too much of a restriction on the data, when compared to results of analysing conflict and cooperation separately.

Cooperation is represented by positive political or non-political event in a relationship, generally from one country towards another. A report of 'Japan increasing overseas development aid (ODA) to China' would be a cooperative event from Japan towards China. Conflict is represented by a negative political or non-political event such as 'nation-wide protests in China against Japanese interests' or 'Japanese Prime Minister's visit to Yasukuni shrine angers China'. For the net cooperation variable, a value of zero means no event or the weighted positive event (cooperation) has cancelled out the equally weighted negative event (conflict).

The events are machine coded from Reuters Business Briefs using Virtual Research Associates (VRA) software and the results are shown to be more accurate and

[5] A good example of the comfortable co-existence of the liberal and realist schools is Richard Nixon's opening up to China. Nixon was known as a realist but his opening up of relations with China was a liberal prescription.
[6] Available at http://gking.harvard.edu/events/

consistent than high skill human coders (King and Lowe, 2003). The events covered report most actions from one country towards another including such events categorised as comment, consult, approve, promise, grant, reward, agree, request, propose, reject, accuse, protest, deny, demand, warn, threaten and demonstrate. All events are given weights consistent with Goldstein (1992) to capture severity and extended from WEIS.

Net cooperation is used in this study. The assumption here is that a positive event will to some extent cancel out, or have the opposite effect on, a negative effect. The variables are analysed separately to confirm the importance of a net measure. Net conflict (conflict minus cooperation as opposed to the other way around) is used in other studies (Polachek, 1980; Pollins 1989a).

Figures 1 and 2 show the net cooperation indexes between Japan and China, and China and the United States for the sub period 2002-2004 to illustrate what the data picks up and what the data looks like. The fifteen years from 1990 to 2004 covers many events and the sub period is used here purely for illustration. Cooperation is positive and conflict is negative on the vertical axes in Figures 1 and 2.

Some of the peaks and troughs that can be noted from Figure 1 include:

Cooperation

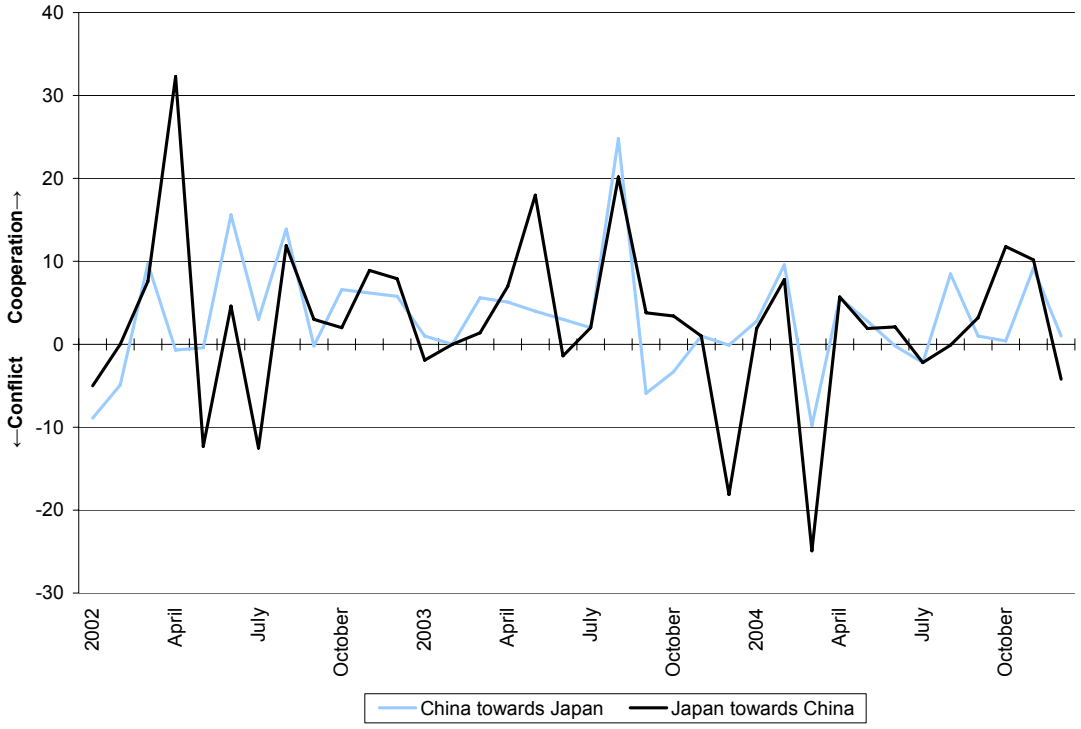
- April 2002: Chinese leader Li Peng meets Prime Minister Koizumi in Japan.
- August 2003: China and Japan participate and work together in 6 party talks to solve the North Korean nuclear problem. Also there is news of foreign direct investment (FDI) hitting record highs.

Conflict

- May 2002: diplomatic rift over North Korean asylum seekers
- July 2002: sunken North Korean ship in East China Sea creates tension between Japan and China
- December 2003: 400 Japanese businessmen organise an orgy in South China with 500 prostitutes. This is significant and shows up as such a large event because of ongoing discomfort over the war time sex slavery.

- March 2004: Japan cuts aid to China by 20 per cent. There are also disputes over Senkaku/Diaoyu islands. These events lead to a cancellation of bilateral talks on a maritime treaty.

Figure 1 Net Cooperation and Conflict between Japan and China, 2002-2004



Note: Calculated as cumulative positive news scores less cumulative negative news scores.
Source: King, Gary and Will Lowe, (2003) '10 Million International Dyadic Events'.

Figure 1 shows that the net cooperation index does not appear to pick up one of the most important and significant events between the two countries: the Yasukuni shrine visits by Koizumi. The annual visits to the shrine between 2001 and 2006 created a great deal of tension as the shrine is supposed to house the spirits of 14 class A war criminals and Koizumi's visits were very public and were seen by the Chinese public as honouring these war criminals. The visits during this sub period took place on 21 Apr 2002, 14 Jan 2003 and 1 January 2004 but do not show up in the net cooperation index. The reason the shrine visits do not register in Figure 1 or in the net cooperation variable used in this study, is that the negative reportage of the shrine visit is cancelled out by positive cooperation news (such as record high FDI or trade numbers being reported). Indeed, if the conflict variable is viewed independently, the shrine visits do show up as significant conflict events (see Appendix A). The 2002 and 2003 visits are the most significant and the reasons for the 2001 and 2004 visits not

showing up strongly even in the conflict data in those exact months are explained in the Appendix.

Also common in the literature is the use of relative conflict/cooperation rather than absolute conflict/cooperation to control for some countries having more events reported than others. Data sets such as COPDAB which use the New York Times exclusively might bias the reporting of US events upwards, and no news source is bias free. Countries like the United States will naturally have more events as well, as they are engaged in more international activities and have more interactions with other countries. Converting the events into a relative measure by dividing the scale by the total number of events is not appropriate for this study because it will negate the fact that some countries interact more with other countries.

Some of the peaks and troughs from the United States-China relationship in Figure 2 include:

Cooperation

- October 2002: China and the United States agree to work together on nuclear disarmament of North Korea.
- April 2004: Trade talks result in satisfactory outcome for both countries.

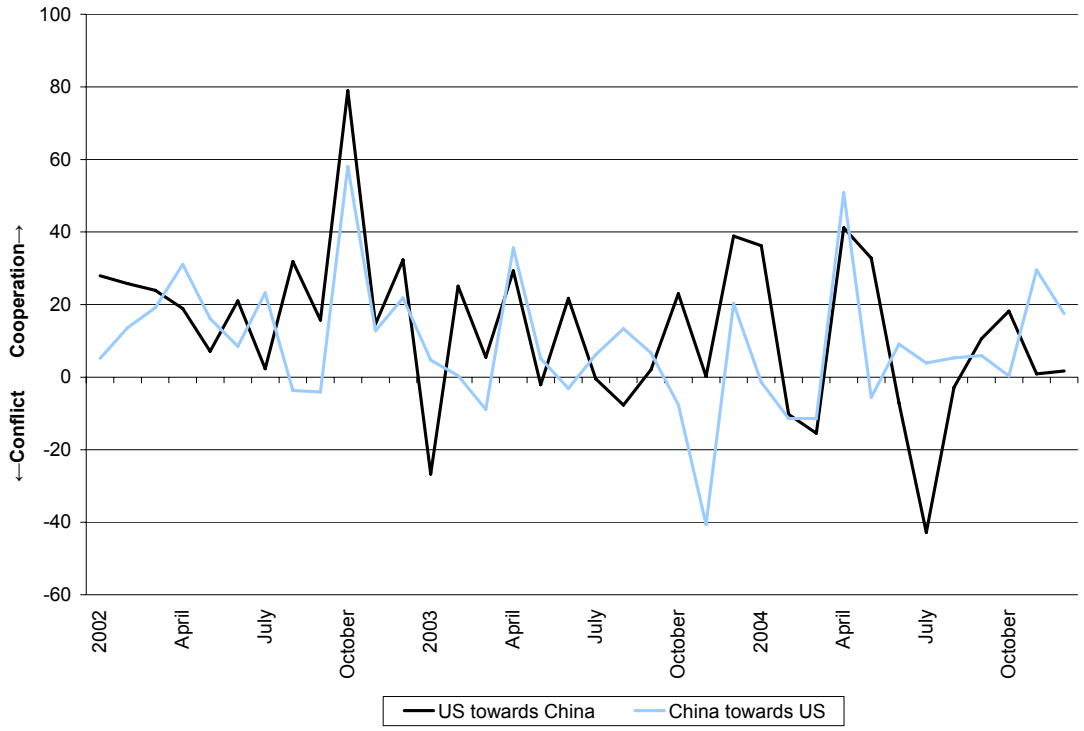
Conflict

- November 2003: Trade dispute leading to US antidumping measures being put in place on Chinese TVs, textiles, steel and soy beans (this is shown only as conflict from China towards the United States).
- July 2004: reports of avian influenza in China; China announces military manoeuvres in the Taiwan Straits and presses the United States to stop arms sales to Taiwan.

The conflict/cooperation data are not perfect and the creation of a net cooperation variable may be inappropriate as note previously, as some important events do not show up. Also, large events only show up as spikes in the data whereas quite often they have lasting consequences. Relying on one news source, as the data set used here does, misses news from some countries and over-reports from others. This is a difficult problem as Chinese events perhaps have better coverage, than other sources,

in news sources such as the China Daily, but then this data source is also far from bias free. Reuters is seen as acceptable, more international, and bias free than other news sources traditionally used such as the New York Times which is the exclusive source for the COPDAB database. WEIS and KEDS use a number of different sources and are flexible as they allow coders to specify the data sources. There is also difficulty in isolating reporting bias for countries such as the United States as they have more international interactions and hence appear in the news the most.

Figure 2 Net Cooperation and Conflict between China and the US, 2002-2004



Note: Calculated as cumulative positive news scores less cumulative negative news scores.
Source: King, Gary and Will Lowe, (2003) '10 Million International Dyadic Events'.

Trade data

Trade data are monthly and from the IMF's Direction of Trade Statistics (2007). As is common practice, import data are used as there is incentive to under-report exports. The data are adjusted for seasonality and de-trended to make them into stationary series where necessary and the appropriate tests for unit roots carried out.

Two variables are used for trade and compared: nominal, absolute US dollar value trade flow from one country to another and a trade index constructed by Hirschman (1945), which is

$$Trade_{ij} = \frac{\left(X_{ij} + M_{ij}\right)}{\left(X_{iw} + M_{iw}\right)}$$

where subscripts *i* and *j* on *Trade* indicate trade from country *i* to *j*, X_{ij} is exports from country *i* to *j*, M_{ij} is imports of country *i* from *j* and subscript w indicates world (so X_{iw} is total exports of country *i*). This shows the importance of country *j* to country *i*.

Here, Hirschman's (1945) index of trade is used as it captures both types of interdependence: vulnerability (Keohane and Nye, 1977) and dependence (Hirschman, 1945). This measure is used in other studies (Reuveny and Kang, 1996 and Barbieri, 1996). Although this index is useful for capturing aspects of interdependence, a flaw in its use is discussed below. The results from using both trade variables are compared.

4. Granger Causality

Granger causality is defined as the past values of one variable being useful in explaining the current value of another, given an information set that includes past values of both variables (Granger, 1977). A variable *X* is said to Granger cause a variable *Y* if lagged values of *X* help explain values of *Y*. Granger causality is not deep causality but a method that can show there exists a relationship between variables.

The availability of rich monthly data is taken advantage of here and Granger causality is used to test the hypothesis that there is no Granger causality between trade and the net cooperation index. The direction of causality and the lag lengths are expected to be different across country pairs (Gasiorowski and Polachek, 1982; Reuveny and Kang, 1996).

The model is a vector autoregressive (VAR) model which looks like

$$T_t = \sum_{i=1} \alpha_i T_{t-i} + \sum_{i=1} \beta_i C_{t-i} \quad (1)$$

$$C_t = \sum_{i=1} \alpha'_i T_{t-i} + \sum_{i=1} \beta'_i C_{t-i} \quad (2)$$

where *T* is trade (the index or exports) and *C* is net cooperation, with the subscript indicating time.

There is Granger Causality if we reject the null hypothesis of

β_i's = 0 in Equation 1 [conflict or cooperation will help forecast trade in future]

or

α'_i's = 0 in Equation 2 [trade helps forecast conflict or cooperation]

The existence of a third variable which Granger causes both net cooperation and trade will give the result that net cooperation Granger causes trade or vice versa when a relationship does not exist (Sims, 1980; Granger 1980). Sims found causality is unidirectional from money to income but not vice versa in his famous 1972 paper and later showed the addition of the interest rate to the vector autoregression effectively explains away his earlier finding (1980). Here it is difficult to think of another variable that could be explaining both variation in the political distance between two countries and variation in their trade volumes. A third country's influence or presence could affect the results from time to time during shocks but this would be difficult to capture consistently over time and to isolate. The Japan-China relationship could be affected by the involvement of European countries, the United States, or even the multilateral landscape in general. However, it is a stretch to think of the general trend in news items between two countries to be driven by a third country. This study does not analyse the effects of external factors on the trade-cooperation/conflict relationship.

Another potential problem that Sims points out is the existence of serial correlation which can cause problems in this sort of estimation when 'some elements of optimal control enter' the model (Sims, 1972 pp. 542). If one variable in a bivariate system is chosen optimally, the values of that variable become structural elements of the system

(Sims, 1972). The only sense where that could potentially be a problem in this case is when conflict or cooperation is controlled to influence trade. This is somewhat plausible but the conflict and cooperation variables include actions by many actors in each country and events out of control of leaders, governments and authorities.

Sims (1972) points out that presence of uni-directional Granger causality can be thought of as causality but bi-directional Granger causality shows a feedback mechanism and cannot be called causality. As discussed above, it is assumed that there is a bi-directional relationship between trade and conflict and cooperation and the results below would seem to confirm this. Causality is used to refer to the direction of influence but as in the case of Granger causality analysis, it is not deep causality.

Why Granger Causality and not Cross-Sectional Analysis?

It is common in the literature to find single equation cross-sectional analysis to estimate the effect of various measures of trade or interdependence on conflict and cooperation. Pollins (1989a, 1989b) is generally given credit for popularizing the estimation of the effect of conflict and cooperation on trade. The recognition of causality running both ways between conflict/cooperation and trade led to many studies estimating simultaneous equations. The problem with two stage least squares or three stage least squares estimation in analysing the relationship between conflict/cooperation and trade simultaneously is that exogenous variables are needed to identify the equations. Defence expenditure has been used to identify conflict and cooperation and development indicators such as education levels and highway vehicles per capita have been used to identify trade (Polachek, 1992). Using defence expenditure may be useful when analysing high intensity conflicts with data sets such as MID, but in this study it is problematic for the analysis of China-Japan relations. China's defence expenditure is unclear and Japan's defence expenditure is uniquely constrained constitutionally. Also, there have not been any significant military related conflicts and nothing worthy of showing up in the MID data set. China also trades a lot more than its level of development would suggest, if such indicators were used to identify trade. For these reasons, the most common variables used to allow a simultaneous equation to work do not perform adequately for the case of Japan-China.

The results below here suggest that cross section analysis, often only possible with annual data and depending on the country pairs, may not capture the true dynamics of international trade and political interactions, as reflected in the differing lag structures in the results.

The advantage of time series methodology is that there is greater freedom in terms of finding different lag structures among different bilateral relationships. There are some problems with this methodology that Kim and Rousseau (2005) summarise. First, the results seem to be sensitive to the number of lags included (Geweke, 1984). Secondly, as mentioned, the inclusion of a third variable can alter the results (Granger, 1980). Finally, de-trending a series (in this case the trade data) may lead to different causality conclusions (Kang, 1985). Moreover, Granger causality is not deep causality.

Results

The main results of the Granger causality tests are shown in Tables 1 to 3. An increase in the net cooperation index in the tables is either an increase in cooperation or a decrease in conflict relative to the other variable. 'Japanese net cooperation' in the tables means a rise, on balance, in reports of positive over events that relate to country *Y*, where *Y* is the other country in the bilateral analysis. There is no strong evidence of increased conflict causing trade to increase (which does not make sense, except in the event of some countervailing action) but there is evidence of cooperation (or a reduction in conflict) causing trade to increase.

Two tests are carried out. The first is for Granger causality: that the coefficients are jointly statistically different to zero. This is testing the joint significance of all β's in Equation 1 or joint significance of all α''s in Equation 2 (null: $\beta_1 = \beta_2 = \beta_3 = \ldots = 0$). The statistical significance is shown with a star next to the number of lags. The second test is whether the sum of the coefficients is statistically different to zero (null: $\beta_1 + \beta_2 + \beta_3 + \ldots = 0$). This is a test of wether we can confidently claim the long run multiplier effect of one variable on the other is positive, negative, or indeed whether there is any overall statistical effect at all. This statistical significance is denoted with a star next to the sum of coefficients.

The results in Tables 1 to 3 show the sum of coefficients even if they are not statistically different to zero as in many cases, the sign is consistent over a number of lags where Granger causality was found, and it will show the general trend and is therefore useful in interpreting the results. The magnitude of the sum of coefficients is not of great value in interpreting the results as they are coefficients between de-trended and differenced trade values and an index. In Table 2 they are of less importance as they reflect the correlations between two indices.

Table 1 ***Trade and net cooperation, 1990-2004***

Japan-China	*Lags*	*Sum of coefficients*
a. Japanese exports to China	7***	13.55
= *f*(Chinese net cooperation)	8***	8.72
	9**	6.88
	10***	12.80
	11**	5.87
	12**	0.55
b. Japanese net cooperation	12*	-0.024
= *f*(Chinese exports to Japan)	13*	-0.019
	14*	-0.023

China- US	*Lags*	*Sum of coefficients*
c. US net cooperation	11*	-0.036**
= *f*(Chinese exports to US)	12*	-0.043**
	13**	-0.032*
	14**	-0.028
	15**	-0.035*
	16**	-0.044**
	17**	-0.038
d. Chinese exports to US	6*	-2.48
= *f*(Chinese net cooperation)	9*	-3.57
e. US net cooperation	2**	-0.014**
= f(US exports to China)	3**	-0.012*
	4*	-0.014**
	5***	-0.017***
	6**	-0.018***
	7**	-0.018**
	8**	-0.013*
	13**	-0.008
	19**	-0.004

Japan-US	*Lags*	*Sum of coefficients*
f. Japanese net cooperation	3*	0.005
= *f*(Japanese exports to US)	4*	-0.001
	10*	-0.023
	11*	-0.026
	12**	-0.020
	13*	-0.015
g. US exports to Japan	14**	3.60*
= *f*(Japanese net cooperation)	15**	3.61*
	16**	2.37
	17**	2.17
	18**	1.81
h. US exports to Japan	3**	2.31
= f(US net cooperation)	4*	2.54
	5*	2.89
	6*	3.47*

Notes: * = 10% level of significance, ** = 5% level of significance and *** = 1% level of significance. Statistical significance on the lag number signifies *joint statistical significance of all the lags* from one lag up to that number (presence of Granger causality) and significance on the sum of coefficients is a test whether the *sum of all the lags are significant*.

The lag lengths differ for each country pair in the study and this is consistent with results in other studies (Reuveny and Kang, 1996). Trade contracts are in general longer term than monthly or quarterly, and the effects of large or significant events, good or bad, take time to affect trade and investment numbers. The cancellation of most contracts cannot be effected immediately. Similarly, an increase in trade is not followed immediately by cooperative actions or a diminution in negative actions because it takes time to initiate trade transactions. There is a lag in causality and it varies for each relationship.

The first result in Table 1 shows an increase in the index of Chinese net cooperation towards Japan (Granger) causes Japanese exports to China. This can be thought of in a number of ways. As the political climate in China towards Japan improves, China is likely to import more from Japan. Another interpretation is that as the political climate

in China improves towards Japan, Japanese companies are likely to be more confident and inclined to sign contracts to supply to the Chinese market[7].

The second Japan-China result (Table 1b) is that increasing Chinese exports to Japan help explain a fall in the index of cooperation from Japan towards China. Increased Japanese imports of Chinese goods after 12 months can be seen to worsen the climate in Japan towards China. This is consistent with what the media often refers to as the *China fear* in Japan of industry hollowing out and jobs being lost to China as well as Japan's fear of losing its economic dominance in the region. Table 3 below shows stronger evidence of this result.

The United States-China results show strong evidence that trade flows reduce net cooperation in the United States towards China. The sum of the coefficients are mostly statistically significant and both an increase in Chinese exports to the United States and United States exports to China cause the United States' stance towards China to worsen.

Finally for Table 1, that Japanese exports to the United States help explain a reduction in the Japanese net cooperation index towards the United States is unexpected (Table 1f). The sum of the lag coefficients are very small and closer inspection of the data shows a mix of positive and negative coefficients for different lags[8]. The other results (Table 1g and h) show increases in the index of cooperation in both directions help explain increased United States trade to Japan.

[7] It could be argued that the political climate in China towards Japan will be affected by the political climate in Japan towards China.
[8] The coefficients of each lag are not reported here as they are in some other papers (Sims, 1972) because the sheer amount of data and the relationships for which they may be interesting (Japan-United States) are not the main aim of this paper.

Table 2 ***Interdependence and net cooperation, 1990-2004***

Japan-China	*Lags*	*Sum of coefficients*
a. Japanese net cooperation	5**	810
= *f*(Chinese dependence on Japan)	6**	1264**
	7**	1516**
	8***	2244***
	9**	2323***
	10**	1983**
	11**	2719**
	12**	2025*
	13**	2735*
b. Japanese net cooperation	12*	-752
= *f*(Japanese dependence on China)	13*	-180
	14*	286
	15*	622
c. Japanese dependence on China	2*	-0.00012
= *f*(Japanese net cooperation)		

Japan-US	*Lags*	*Sum of coefficients*
d. Japanese net cooperation	6**	5313***
= *f*(Japanese dependence on US)	7**	6173***
	8**	7790***
	9**	8320***
e. US net cooperation	6**	2918
= *f*(Japanese dependence on US)	18**	15380***
	19**	14835**
	20**	18568***
	21**	24198***
	22***	28415***
f. US net cooperation	2*	418**
= *f*(US dependence on Japan)	3***	581***
	4***	602***
	5*	542***
	6*	517**

Notes: * = 10% level of significance, ** = 5% level of significance and *** = 1% level of significance. Statistical significance on the lag number signifies *joint statistical significance of all the lags* from one lag up to that number (presence of Granger causality) and significance on the sum of coefficients is a test whether the *sum of all the lags are significant*.

In Table 1b Chinese exports to Japan were explaining falls in Japanese net cooperation (or increasing tensions) towards China; in Table 2a an increase in China's dependence on Japan helps explain the opposite effect, a positive movement on the net cooperation scale. The results are not inconsistent as the dependence index used here captures the increasing importance of Japan for China, reflected in its rising dependence and vulnerability in relation to Japan. This nuanced story is only picked up with the use of both the nominal export variable and the trade index of dependence.

The results of increased Japanese dependence on China are mixed (Table 2b). Although one could interpret the change in sign after 13 months, from a negative to a positive effect on Japan's stance towards China, as the change over time of the effect of Japan's integration with China on the country as a whole, the sum of the coefficients are not statistically significant and the results cannot be interpreted as confidently as other results. All that can be said is that Japanese dependence on China Granger causes a movement in the index of Japanese net cooperation towards China.

The Granger causality estimations carried out on interdependence and cooperation using the trade index do not include the United States-China case because the highly unbalanced trade relationship distorts the trade index[9].

The results showing a positive relationship between net cooperation and dependence for Japan and the United States are strong (Table 2d, e and f). There is unidirectional causality from dependence to net cooperation showing that mutual interdependence fosters cooperation – the classic liberal hypothesis.

As the causality, direction of causality and lag lengths vary by country pair, it is reasonable to assume that even within a country pair the dynamics and interactions change over time. To take account of, and to test for this, two additional steps are taken. The first is to test whether the longer term relationships in Tables 1 and 2 are

[9] Hirschman's index of trade dependence does not perform well for highly unbalanced trade or rapidly growing imbalances in trade. The direction of trade is irrelevant in the index so it does not treat China's growing surplus (the United States' growing deficit) as trade increasing in one direction. As the theories and literature tell us, it is the asymmetry in trade, or the growing imbalance that is the driver of conflict and so the index would only appear to perform well for trade that is relatively even.

consistent over time, or whether the nature of the interactions changes over time, the fifteen year period was split roughly into half. In order to keep the number of observations high, the eight and seven year split represents the only sub-periods analysed. Table 3 shows that the results are significantly different between the two time sub-periods.

The other method used is the nonlinear Granger causality which is detailed in Appendix B and discussed below.

Table 3 Japan-China Trade/Interdependence and Net Cooperation by sub periods, 1990-1997 and 1998-2004

	1990-1997		1998-2004	
Trade and Net Cooperation coeffs	*Lags*	*Sum of coeffs*	*Lags*	*Sum of*
a. Japanese exports to China = *f*(Chinese net cooperation)	7**	6.30	2*	-0.79
	8**	-1.35	3*	-0.54
	9**	-0.73	7*	22.12
	10***	6.48	12**	8.85
	16*	-12.0	13*	7.44
b. Japanese net cooperation = *f*(Chinese exports to Japan)			12*	-0.07***
			13*	-0.06**
			14**	-0.08***
			15**	-0.08***
			16*	-0.07**
c. Japanese exports to China = *f*(Japanese net cooperation)			12***	24.7
			13**	25.4
			14**	20.5
			15**	22.4
			16*	22.5
d. Japanese net cooperation = *f*(Japanese exports to China)			13*	-0.16*
e. Chinese net cooperation = *f*(Japanese exports to China)	22**	0.317	2*	0.003
	23*	0.220	4*	-0.006
	24*	0.358	5**	0.003
			6*	-0.002
f. Chinese exports to Japan = *f*(Japanese net cooperation)	11*	26.7***		

g. Chinese net cooperation	6**	0.030	6*	0.002
= *f*(Chinese exports to Japan)	7**	0.027		
	8*	0.034		
	12*	0.111**		
	13*	0.126**		
	15*	0.181***		
h. Chinese exports to Japan			17**	5.44
= *f*(Chinese net cooperation)			18*	6.37
			19*	11.18
			20*	10.59

	1990-1997		1998-2004	
Dependence and Net Cooperation coeffs	*Lags*	*Sum of coeffs*	*Lags*	*Sum of*
i. Japanese net cooperation	2*	-374		
= *f*(Chinese dependence on Japan)	3**	-866		
	4*	-466		
	5**	54		
	6***	985		
	7**	1069		
	8**	1719		
	9**	1696		
	10*	1733		
	11*	2279		
	12*	1672		
j. Chinese dependence on Japan	3**	-0.0002		
= *f*(Chinese net cooperation)				
k. Chinese net cooperation	20**	3942*		
= *f*(Chinese dependence on Japan)	21**	4140		
	22***	5678*		
	23***	6397*		
	24**	6198		
l. Chinese net cooperation	8*	1991*		
= *f*(Japanese dependence on China)	20**	4851*		
	21*	3985		
	22*	4201		
	23*	3738		

Notes: * = 10% level of significance, ** = 5% level of significance and *** = 1% level of significance. Statistical significance on the lag number signifies *joint statistical significance of all the lags* from one lag up to that number (presence of Granger causality) and significance on the sum of coefficients is a test whether the *sum of all the lags are significant*.

Table 3 reveals more evidence of the existence of a trade-cooperation nexus which is perhaps hidden in the longer series. It is interesting to note there is a stronger link between trade and net cooperation in the period 1998-2004 while there is a stronger dependence-net cooperation link in the earlier period 1990-1997. For example, there is no evidence found of Granger causality between trade dependence and net cooperation in the 1998-2004 period. The result from Table 1a that Chinese net cooperation towards Japan Granger causes Japanese exports to China is present in both periods in Table 3a but with ambiguity of the sign of the effect. Analysis of the longer time period may better capture the direction of the effect, if there is one at all.

The most significant result is that an increase in Japanese net cooperation appears to lift Japanese exports to China (Table 3c). This is the same as saying an increase in conflict from Japan towards China Granger causes a reduction in Japanese exports to China. Again, the sum of coefficients is not significantly different to zero but are consistently positive and well above the magnitude of the individual lag coefficients which range from 1.8 to 13 in this case.

The other result from Table 1b, that Chinese exports to Japan are causing the measure of conflict from Japan to China to rise, is confirmed in Table 3b but with evidence only found in the latter period. It is reasonable to expect that the China fear that is a product of China's rise is more pronounced in the second period analysed as China became a much bigger player internationally and in trade with Japan, and the direct threat to Japan's regional dominance became more apparent.

The main Japan-China result from Table 2a, that growing Chinese dependence on Japan is causing Japanese net cooperation to rise towards China, is also found in Table 3i but is only apparent in the earlier period.

The nuanced story from Table 1 can be extended to: Japanese net cooperation towards China is positively affected in the earlier period by Japan's growing importance to China and negatively affected in the latter period by the growing exports of China to Japan, as China's dominance grows and becomes more visible.

Net cooperation as the appropriate measure of political distance

The net cooperation variable used in this study follows the seminal papers of Polachek (1980) and Pollins (1989a). Other studies use only conflict and it could be argued a ratio of cooperation to conflict could pick up different dynamics between conflict and cooperation and not restrict it to one functional form. It is reasonable to assume that it is not conflict (negative news) alone, or cooperation (positive news) that drives trade, but the net effect of both. To subtract conflict from cooperation imposes the assumption that they are additive and that the reporting of certain events cancels out the reporting of others. One approach might be to test the robustness of the results with the ratio of cooperation to conflict. This, however, is difficult as there are frequent zero values in the news events where no positive or negative news item was reported in that month for the bilateral relationship. Also, despite the fact that this would test another shape of the relationship between cooperation and conflict, and its relationship with trade, it seems more appropriate to think of cooperation and conflict as additive, as positive and negative utility towards another country.

The Granger causality tests from Tables 1 and 2 were repeated but with conflict and cooperation separately. While some results confirm the results in Tables 1 and 2, and even some in Table 3, a majority of results were not consistent and did not make sense with what is observed in reality.

Nonlinear analysis

Since the nature of interactions, the structure of interactions and the time taken for actors in economies to respond to interactions change over time, and some events cause quicker responses than others, a non parametric analysis is also carried out for the study of trade and conflict.

Traditional Granger causality methods find correlations between conditional means of two variables. Nonlinear Granger causality finds relationships between conditional distributions of two variables. The linear VAR causality tests strip out the linear causality and the non parametric methods test whether the remaining VAR residuals have any remaining structural relationship. So although useful in finding a relationship between two variables, the exact nature of the relationship is difficult to

determine. It is unclear whether it is the variance (volatility) of one series, or any other aspect of that series, affecting the mean, variance or other characteristics of the other variable. In that sense the methodology is a black box. Perhaps the biggest weakness of the nonlinear tests is that the presence of a relationship between two variables does not say anything about the effect of the relationship. That is, if it appears trade causes a movement in the net cooperation variable, it cannot be determined whether it is a positive or negative movement.

Nevertheless, the results show there is further evidence, in addition to the linear results, of trade affecting conflict/cooperation and vice versa. The methodology and results are presented in the Appendix.

Although the signs of the relationships are unclear, the existence of causality is a significant result and means that:

1. Japan's stance towards China has implications for its trade relationship (trade in both directions) with China.
2. Japan's trade flows to China cause potentially mixed reactions from both sides.

The first of these conclusions would appear more important as it shows the political relationship is constrained by the economic relationship. This result confirms the findings from Table 3 (results c and f). Japanese leaders have to be aware of the ramifications of this constraint when taking actions that could raise political tensions.

The United States-China and United States-Japan nonlinear test results also show evidence of a nonlinear relationship between trade and net cooperation and causality in more directions, compared to just the linear results.

5. Discussion

The three relationships covered here include neighbours (Japan and China), rivals (the United States and China; China and Japan), allies (the United States and Japan), democracies and a one-party state. No generalisations are made here about the characteristics of the countries and their effect on the trade-conflict/cooperation relationship as is done elsewhere – there is often a lack of sensible bounds on

conclusions and results are generalised across time and countries (Mansfield and Pollins, 2001).

The results in this study are not completely consistent with Reuveny and Kang (1996). Reuveny and Kang find that causality tends to be reciprocal whereas in this study causality seems to be unidirectional when only applying the linear results that they use. The conclusion Reuveny and Kang draw that the nature of the interaction between politics and economics differs for each country relationship is, however, supported by this study.

There is evidence in the present study that supports both the liberal and realist schools. The findings are consistent with the theories described previously of low intensity conflict in a relationship underpinned by strong economics, of enduring rivalries, and neighbourly disputes that are mitigated by trade (Robst et al., 2006). The structure of Japan-China relations at this point makes them relatively low intensity in conflict.

The Japan-China relationship

This analysis leads to a number of important conclusions. The economic relationship underpins the relationship between China and Japan, and the results here show that the economic relationship constrains the political relationship.

Yasukuni Shrine is the most talked about issue and is most symbolic of the difficulties between Japan and its largest neighbours, China and South Korea. In a sign of the recognition of the importance of the relationship, Prime Minster Abe did not visit the shrine while he was leader and in the contest for leadership after Abe, Fukuda who eventually won the contest, gave a clear message that in order to mend relations with Asian neighbours, a Yasukuni Shrine visit will not take place[10]. Recognition of the implications of shrine visits is now clear and even if future leaders do seek to increase political tensions for domestic political reasons, it would appear these actions would be taken in a manner so as to minimise the damage to Japan-China relations. As the

[10] There has been increasing talk of either removing the souls of the 14 class A war criminals from Yasukuni, or failing that technically, creating another memorial for Japan's war dead that does not include the war criminals.

results here suggest, politics or variations in political do distance appear to have an effect on the bilateral trade relationship and trade affects political distance (See Table 1a and 1b; Table 3a, b and c).

There is some evidence of increased low intensity conflict from Japan towards China as Chinese trade to Japan increases, but this can be explained by the underlying economic relationship's being strong enough that the Japanese leaders and some actors in the economy can cause low intensity conflict for domestic political reasons. This is consistent with the media reports of *China fear* and with the findings of Robst et al. (2006) and Gartzke (1998). Tensions may rise significantly if trade started to become unbalanced like in the United States-China case. The Japan-China trade relationship is currently relatively balanced and a growing Japanese deficit with China would have to be managed carefully to dampen tensions and rising nationalism between the two countries.

Thus, these low intensity conflicts between Japan and China would seem unlikely to escalate as the countries become more integrated economically, unless trade becomes largely lopsided. Increased trade, and also investment, have meant that both forms of interdependence, vulnerability and dependence, have grown. The increased vulnerability of one country towards the other and the unresolved historical issues complicate and fuel domestic sentiments in some segments of both countries and from time to time it would appear that both governments play these up for domestic political gain.

The results of this study suggest that Japanese exports to China are increasingly affected by Japanese political distance from China (Tables 1a, 3a and 3c). A rise in negative Chinese sentiments towards Japan and increasingly a rise in Japan's negative sentiments towards China adversely affect Japanese exports. Japan's politicians are increasingly constrained in their actions that might affect China and Chinese sentiments.

The economic relationship is now being driven by market forces and not significantly directed by policy intervention (Drysdale, 2007) as the highly complementary industrial structures and proximity of both countries drives the growth in trade. And

the politics affect the economic relationship in some areas more than others as some Japanese companies feel they are global brands that can de-link themselves from their country of origin (Armstrong, 2007). But the Chinese economy, especially after WTO accession, is much more of a level playing field for companies from Japan, the United States and Europe and Japan's advantage of being in China early is diminishing rapidly. The evidence of Japanese net cooperation affecting Japanese exports to China after 1998 shows that it is important for Japanese actors in the Chinese economy not to have to carry Japanese political baggage in competing with others in that market (Armstrong, 2007). The interaction between politics and trade would appear to be more pronounced in the later period analysed.

As the bilateral economic relationship between the two countries becomes even more important than it is already is, its effect on the politics between the two countries is likely to grow. The last year has seen political tensions ease with visits by both leaders to the other country and efforts from both governments to resolve some important issues. Significant examples include the joint experts commission set up to agree on disputed interpretations of history and an agreement to pursue jointly, and eventually commit to, a bilateral trade agreement (free trade agreement or a broader economic partnership agreement). A trade agreement of the kind that is being talked about between Japan and China would be a significant political commitment.

Further work

Economic relationships between countries involve a lot more than just trade in goods. An obvious next step would be to undertake a similar systematic study that included services trade. Also of particular importance in the China-Japan relationship is foreign direct investment (FDI) as it is a big part of the relationship and is likely to be equally responsive to the political climate, if not more so.

Another extension the analysis is to take account of multilateral, or third party, effects of political distance and trade. It is not difficult to see why the influence of the United States could have an effect on Japan-China trade, or that as the political distance between Japan and China increases, trade through Hong Kong or other countries will increase.

The results show evidence of nonlinear Granger causality and an obvious extension is to find the shape and nature of this nonlinearity. The methodology of Baek and Brock (1992) is limited to finding evidence of nonlinear causality only, not whether the causality has a positive or negative effect and where these turning points may be. Quadratic and other shaped functional forms could be tested in future to see whether trade interacts differently to low intensity conflict and higher intensity conflict. The effects of volatility in the political relationship on the trade relationship are also of interest. The structure of the non linear relationships is potentially important in understanding the dynamics of the relationships between trade and politics and politics and trade.

6. Conclusion

The purpose of this paper was to test whether there is any relationship between trade and political conflict or cooperation, and the direction of its causality in the Japan-China relationship. Both countries' interactions with the United States were analysed by way of comparison. The study uses the latest events data available (up to 2004), uses monthly data and extends the analysis from testing the null hypothesis that there is no linear Granger causality by testing the null hypothesis of no nonlinear Granger causality.

The main results are that an increase in China's level of cooperation helps explain an increase in Japanese exports to China; in the 1990-1997 period, growth in Japan's importance to China increases Japanese cooperation towards China; and in the 1998-2004 period an increase in Japanese cooperation towards China helps explain an increase in Japanese exports to China.

Chinese imports of Japanese products do not appear to be independent of how well the countries are getting along.

Growing Chinese exports to Japan and the United States are causing a rise in the measure of negative sentiment towards China, but the growth of Japanese trade to China dampens this effect. The large imbalance in the trade relationship between

China and the United States is causing tensions to rise in the United States from increased trade in both directions.

The stable and rapidly growing economic relationship, of which trade flows are a big part, constrain political behaviour between China and Japan. The rising interdependence between the nations and concomitant opportunity cost of serious conflict has led to an easing of political tensions and even some movement towards increased cooperation. The structure of the political relationship appears likely, from this analysis, to be increasingly affected by the economic relationship.

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Appendix

Appendix A Conflict data for Japan-China

Table 4 Conflict data from China towards Japan

Month→ Year↓	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1990	0	5	0	0	10.4	2.2	5.1	0	0	9.9	0	0	32.6
1991	4	0.1	0	0	0	9.8	0	0.1	0	0	0	0	14
1992	0	0	9.2	5	0	0	0.1	0	0.1	0	0	0	14.4
1993	0	11.1	9.3	0	0	0	0.1	0	0	0	0	0	20.5
1994	0	0	0	0	0	0	0	0	20.5	7.1	0	0	27.6
1995	8.8	0	17.7	4.9	0	2.2	0	4.9	8.7	0	9.3	0	56.5
1996	4.9	0	0	6	0	2.2	12	12.3	36.2	7.4	0	6.7	87.7
1997	0	4	0	2.3	9.1	12	0.1	9.3	8.5	0	0	0	45.3
1998	0	0	0	0.1	5.2	17.2	0	5	2.3	8	10.3	0	48.1
1999	0	0	0	0.1	2.3	0	3	0	0.1	0	4.9	0	10.4
2000	5	3	4	6.2	2.2	0	0	0	2.2	0	0	6.4	29
2001	0	9	3	13	**21.2**	7.6	9.4	0.2	4.9	0	4	8.2	80.5
2002	9.9	4.9	0	19.9	12.4	0	0	4.9	4	0	7	0	63
2003	11.2	0	0	4.9	0	0	0	14.2	8.8	4.9	0	0.1	44.1
2004	0	0	14.2	2.2	0	4.4	4.6	3	0	8	2.2	10.6	49.2

Notes:

- shaded months indicate a Yasukuni shrine visit by Prime Minister Koizumi. The first visit, in 2001 was proceeded by an announcement in May that year which got all the press. The visit itself was not reported so highly and did not cause as much negative news as in May perhaps because Koizumi gave in to Chinese pressure in August and did not visit the shrine on the highly significant anniversary of the end of the war, 15 August, but instead on 13 August. The visit on 2004 happened on New Year's day when it is tradition for Japanese to visit shrines and temples and this could be the reason it was not reported as a negative event. Indeed, there is much less news coverage of this visit then the others.

- The largest conflict month is September 1996 with a score of 36.2. This is when Japan, China and Taiwan all claimed ownership of uninhibited islands in the East China Sea, thought to have oil. From the International Herald Tribune: 'Japan's persistent moves to assert sovereignty over the islands, known as the Senkakus in Japanese and the Diaoyus in Chinese, have whipped up a storm of nationalist fervor by angering Chinese in China, Taiwan, Hong Kong and Macau — despite their political differences. But analysts say that the main reason Japan and China will continue to press their claims, even at the risk of confrontation, is that both countries want access to energy resources close to their shores.' (September 17, 1996)[11].

Table 5 Conflict data from Japan towards China

Month→ Year↓	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1990	0.1	0	3	0	0.1	0.1	8.8	0	0	14	0	0	26.1
1991	0.2	0	0	0	2.4	4.9	0	0	0	0	0	0	7.5
1992	9.8	2.4	0	4.4	4.4	2.4	4.4	14.4	0	0	0	0	42.2
1993	12.2	0	0	0	0	4.9	0	0	0	0	0.1	0	17.2
1994	0	0	0.1	0	4.9	0.1	2.2	4.9	4.1	15.5	0	0	31.8
1995	0	0	0	4	4.6	2.3	4.2	22.4	0.1	0	0	6.6	44.2
1996	0	5.9	18.8	0	2.3	6.3	4.6	0.1	8.3	1	0	4.4	51.7
1997	0	8.9	0	0	0	4.4	4.9	4	0	0	4.9	9.2	36.3
1998	0	0	0	0	7.6	9.3	0	0	0	0	0	0	16.9
1999	0.2	5	0	0	0	4.9	0.1	2.4	4	0	0.1	0	16.7
2000	0	0	0.1	0	0	0.1	0	9.3	0	14.8	0	0	24.3
2001	0	0	12.8	10.4	0	4.3	0	0	0	4.9	8	12.5	52.9
2002	9	0	8.1	4	27.6	0	16.3	0	2.3	0	0	0	67.3
2003	4.9	0	4	0	10.3	4.4	0	0	0	0	0	18.1	41.7
2004	0	0	26.8	5	0	0	2.2	0.3	0	0	4.8	14	53.1

Total conflict from China towards Japan was 623 units and total conflict from Japan towards China was 530 units over the period.

[11] http://www.iht.com/articles/1996/09/17/isles.t_4.php

Appendix B Nonlinear Granger Causality

There is recognition that linear Granger causality tests may only capture some of the causality relationship between two variables depending on the nature of interactions between the two variables (Baek and Brock, 1992; Hiemstra and Jones, 1993; Hiemstra and Jones, 1994; Diks and Panchenko, 2006). The linear VAR causality tests strip out the linear causality and the non parametric methods test whether the remaining VAR residuals have any remaining structural relationship. The methodology is predominantly used in finance literature where futures prices, trading volumes and other time series show nonlinear causal relationships due to complex feedback and feed-forward loops, as well as the fact that they are mostly self regulating systems generally characterised by nonlinear processes (Fujihara and Mougoue, 1997). The appropriateness of the methodology for finding causal relationships in the complex nexus between cooperation and trade is discussed in Section 6.

The test as first developed by Baek and Brock in 1992 was modified by Hiemstra and Jones in 1994, and the Hiemstra and Jones version of the test appears to be the most widely used since. Diks and Panchenko (2006) have made some improvements on the test statistic after showing that the Hiemstra and Jones test statistic over-rejects the null hypothesis of 'no nonlinear Granger causality' with larger numbers of observations. The over-rejection is particularly important in most uses of the methodology, such as in daily financial data, where sample sizes are large, but would not appear to be a problem in monthly data over a period of 15 years as is the case here[12].

The following nonparametric methodology is based mainly on Hiemstra and Jones (1994).

[12] Diks and Panchenko (2006) show the over rejection becomes an issue when the number of observations is 1,000 and serious when the number starts to reach 10,000. This study has less than 200 observations. The relatively small sample size here mean the Hiemstra and Jones test is appropriate.

Using the two stationary time series of exports (X_t) and net cooperation (C_t) where t = 1, 2, … n, let the m-length lead vector of X_t be designated X_t^m and denote the Lx-length and Lc-length lag vectors of X_t and C_t by $X_t^{Lx}{}_{Lx}$ and $C_t^{Lc}{}_{Lc}$.
For given values of m, Lx, $Lc \geq 1$ and for $e > 0$, C does not strictly Granger cause X if:

$$\begin{aligned}&\Pr\left(\left\|X_t^m - X_s^m\right\| < e \,\middle|\, \left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e, \left\|C_{t-Lc}^{Lc} - C_{s-Lc}^{Lc}\right\| < e\right)\\ &\quad = \Pr\left(\left\|X_t^m - X_s^m\right\| < e \,\middle|\, \left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e\right)\end{aligned} \tag{3}$$

where $Pr(.)$ denotes probability and $\|\cdot\|$ denotes maximum norm.

Hiemstra and Jones (1994) explain the Baek and Brock (1992) formula:

> The first line in Equation 3 is the conditional probability that two arbitrary m-length lead vectors of $\{X_t\}$ are within a distance e of each other, given that the corresponding Lx-length lag vectors of $\{X_t\}$ and Lc-length lag vectors of $\{C_t\}$ are within e of each other. In other words, it is the probability measure of $\left\|X_t^m - X_s^m\right\| < e$ (the difference between the two vectors is less than a certain bandwidth, e), given the pair of Lx-histories of X differ by less than e and the pair of Lc-histories of C also differ by less than e (Baek and Brock, 1992).

The second line is the conditional probability that two arbitrary m-length lead vectors of $\{X_t\}$ are within e of each other given that their corresponding Lx-length lag vectors are within e of each other.

From Baek and Brock (1992) the above equation can be explained: given an arbitrary bandwidth, e, Lc lags of C does not incrementally help predict the next period's value of X given Lx lags of X. If $X_t = G(X_{t-Lx}, C_{t-Lc})$ for some deterministic continuous function G, then it is easy to see why the event "C_{t-Lc} close to C_{s-Lc}" would help nonlinearly incrementally predict "X_t close to X_s". How 'close' one vector is to another is defined by e.

To test Equation 3 we can rewrite the conditional probabilities in Equation 3 as corresponding ratios of joint probabilities using the law of total probability:

$$\begin{aligned}&\frac{\Pr\left(\left\|X_t^m - X_s^m\right\| < e, \left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e, \left\|C_{t-Lc}^{Lc} - C_{s-Lc}^{Lc}\right\| < e\right)}{\Pr\left(\left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e, \left\|C_{t-Lc}^{Lc} - C_{s-Lc}^{Lc}\right\| < e\right)} \\ &= \frac{\Pr\left(\left\|X_t^m - X_s^m\right\| < e, \left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e\right)}{\Pr\left(\left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e\right)}\end{aligned} \tag{4}$$

which then simplifies to

$$\begin{aligned}&\frac{\Pr\left(\left\|X_{t-Lx}^{m+Lx} - X_{s-Lx}^{m+Lx}\right\| < e, \left\|C_{t-Lc}^{Lc} - C_{s-Lc}^{Lc}\right\| < e\right)}{\Pr\left(\left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e, \left\|C_{t-Lc}^{Lc} - C_{s-Lc}^{Lc}\right\| < e\right)} \\ &= \frac{\Pr\left(\left\|X_{t-Lx}^{m+Lx} - X_{s-Lx}^{m+Lx}\right\| < e\right)}{\Pr\left(\left\|X_{t-Lx}^{Lx} - X_{s-Lx}^{Lx}\right\| < e\right)}\end{aligned} \tag{5}$$

Equation 5 can be rewritten as

$$\frac{C_1(m+Lx, Lc, e)}{C_2(Lx, Lc, e)} = \frac{C_3(m+Lx, e)}{C_4(Lx, e)} \tag{6}$$

where C_1, C_2, C_3 and C_4 are the correlation-integral estimators of the joint probabilities which are discussed in detail in Hiemstra and Jones (1994). The basic idea of the test is that if Equation 6 holds, that is, the left hand side is equal to the right hand side, one residual series has predictive power over the other.

The test statistic and test is: for given values m, Lx, $Lc \geq 1$ and for $e > 0$ under the assumption that $\{X_t\}$ and $\{C_t\}$ are strictly stationary and weakly dependent, if $\{C_t\}$ does not strictly Granger cause $\{X_t\}$ then,

$$\sqrt{n}\left[\frac{C_1(m+Lx, Lc, e, n)}{C_2(Lx, Lc, e, n)} - \frac{C_3(m+Lx, e, n)}{C_4(Lx, e, n)}\right] \to N\left(0, \sigma^2(m, Lx, Lc, e)\right) \tag{7}$$

where $\sigma^2(m, Lx, Lc, e)$ is an estimator discussed in detail in Hiemstra and Jones (1994) and → means has an asymptotically normal distribution.

The point of the test is that after removing the linear predictive power with a linear VAR model (as described in Section 4), any remaining incremental predictive power of one residual series over another can be considered nonlinear predictive power (Baek and Brock, 1992; Hiemstra and Jones, 1994). One problem is that the direction of causality is undeterminable.

Consistent with other instances of using the nonlinear Granger causality test of Baek and Brock, only the case where $m = 1$ (m is the lead lag length) and $Lx = Lc$ (lag lengths of $\{X_t\}$ and $\{C_t\}$ are equal) is considered. The tests are carried out for different values of *e* as the choice tends to be arbitrary.

Results

The results for Japan and China are presented in Table 5. The results for the United States and China, as well as for Japan and the United States are presented in Appendix E due to the large number of results.

Table 6 Nonlinear Causality between Net Cooperation and Trade for China and Japan

a. Net cooperation from China to Japan causes trade from China to Japan

e = 1.46

Lx = Lc	CS	t-value	
1	0.48	0.515	
2	0.3	0.22	
3	0.95	0.506	
4	0.255	-1.98	**
5	0.19	0.63	
6	0.174	0.481	
7	0.19	0.497	
8	0.22	0.474	
9	0.248	0.485	
10	0.166	0.245	
11	0.168	0.225	
12	0.496	0.441	
13	0.1402	1.57	*
14	0.1079	0.731	
15	0.2523	4.581	***
16	0.25	3.767	***

b. Trade from Japan to China causes net cooperation from China to Japan

e = 1.25

Lx = Lc	CS	t-value	
1	0.65	0.851	
2	0.24	0.168	
3	0.6	0.298	
4	0.117	0.431	
5	0.192	0.591	
6	0.401	1.18	
7	0.649	1.332	*
8	0.868	1.485	*
9	0.888	1.21	
10	0.543	0.52	
11	0.1361	1.582	*
12	0.1642	4.77	***
13	0.1769	4.667	***
14	0.1759	4.143	***
15	0.1792	3.854	***
16	0.1856	3.812	***
17	0.1898	3.501	***

c. Net cooperation from Japan to China causes trade from China to Japan

e = 1.25

Lx = Ly	CS	t-value	
1	0.134	0.961	
2	0.28	0.155	
3	0.12	0.55	
4	0.291	-1.166	
5	0.324	-1.47	*
6	0.564	-1.447	*
7	0.897	-1.858	**
8	0.1015	-1.348	*
9	0.534	0.451	
10	0.1196	0.659	

d. Trade from China to Japan causes net cooperation from Japan to China

e = 0.96

Lx = Ly	CS	t-value	
1	0.158	-1.404	*
2	0.73	0.352	
3	0.403	-1.428	*
4	0.633	-1.412	*
5	0.666	0.896	
6	0.2428	-2.264	**

e. Trade from Japan to China causes net cooperation from Japan to China

e = 1.42

Lx = Lc	CS	t-value	
1	0.3	0.341	
2	0.57	0.373	
3	0.48	0.296	
4	0.111	0.648	
5	0.4	0.165	
6	0.105	0.371	
7	0.348	-1.69	**
8	0.389	-1.35	*
9	0.479	-1	
10	0.1085	-1.597	*
11	0.1806	-1.831	**
12	0.2133	-1.684	**
13	0.1821	-1.542	*

f. net cooperation from Japan to China causes trade from Japan to China

e = 1.25

Lx = Lc	CS	t-value	
1	0.1	0.81	
2	0.335	1.661	**
3	0.306	1.382	*
4	0.123	0.438	
5	0.371	1.84	**
6	0.657	1.584	*
7	0.669	1.344	*
8	0.1241	2.151	**
9	0.2005	3.297	***
10	0.2159	2.997	***
11	0.1965	2.326	**
12	0.1376	0.994	

* indicates 10% level of significance, ** indicates 5% level of significance and *** indicates 1% significance.

Notes: Lx=Lc are the lag lengths. CS is the difference between the left hand side and the right hand side in Equation 6. The t-ratios are asymptotically standard normal. The bandwidth values, e, were chosen where the most causality was found.

Panels (d) and (e) are consistent with the linear causality tests in the cases of trade from Japan to China and in general causing change in the net cooperation index from Japan to China (from the linear results it is safe to assume that the sign is mostly negative even though nonlinear overall, and that the trade causes cooperation to increase) and trade from China to Japan causing net cooperation to decrease from Japan to China. The other results are additional evidence of the relationship between trade and net cooperation. Although we cannot tell the signs of the causality

relationships, the linear causality results are consistent with what we would expect and there is no reason to expect unusual results here. It is tempting to interpret the results in panel (c) as net cooperation causing trade but the interpretation is that the net cooperation index, positive or negative, has a causal relationship with the trade variable of unknown sign. It would make sense to interpret this as a rise in net cooperation increases trade or a fall in net cooperation reduces trade – the other way around does not make sense as there is no realist theory that states an increase in conflict, or a reduction in cooperation, causes trade.

The cases for which there was no causality present were trade from China to Japan causing net cooperation to change from China to Japan, a change in net cooperation from China towards Japan having an affect on trade from Japan to China and net cooperation from Japan to China causing a change in trade from Japan to China.

The China-United States relationship as shown in Appendix E has many more lag structures statistically significant and the causal relationship appears to be more robust. Again, the lag lengths differ between country pairs.

Table 7 Nonlinear Results for China-US

a. Trade from China to US causes net conflict from China towards US

e = 1.46

Lx = Lc	CS	t-value	
1	0.19	0.237	
2	0.122	0.797	
3	0.322	-1.575	*
4	0.249	-1.169	
5	0.273	-1.77	**
6	0.201	0.722	
7	0.214	0.706	
8	0.5	0.16	
9	0.153	0.344	
10	0.2	0.6	
11	0.192	0.601	
12	0.617	3.16	***
13	0.634	2.98	***
14	0.622	2.853	***
15	0.624	2.814	***
16	0.625	2.786	***
17	0.65	2.791	***
18	0.661	2.833	***
19	0.659	2.868	***
20	0.654	2.858	***

b. Trade from China to US causes net conflict from US to China

e = 1.25

Lx = Lc	CS	t-value	
1	0.26	0.276	
2	0.45	0.309	
3	0.99	0.44	
4	0.391	-1.653	**
5	0.655	-2.51	***
6	0.794	-2.351	***
7	0.1041	-2.82	***
8	0.399	0.599	
9	0.206	0.333	
10	0.748	0.978	
11	0.1167	-1.65	**
12	0.38	0.37	
13	0.101	3.308	***
14	0.978	3.219	***
15	0.102	3.23	***
16	0.1042	3.156	***
17	0.1047	3.39	***
18	0.1011	2.891	***
19	0.1	3.6	***
20	0.1014	2.97	***

c. net conflict from US to Chin causes trade from US to China

e = 1.46

Lx = Lc	CS	t-value	
1	0.83	0.798	
2	0.235	1.603	*
3	0.152	1.67	**
4	0.275	1.809	**
5	0.325	1.714	**
6	0.435	2.85	***
7	0.38	1.829	**
8	0.606	2.428	***
9	0.799	2.952	***
10	0.1071	3.345	***
11	0.1153	3.186	***
12	0.945	3.884	***
13	0.954	3.303	***
14	0.732	2.906	***
15	0.534	2.311	**
16	0.501	2.51	***
17	0.366	1.87	**
18	0.335	1.728	**
19	0.36	1.684	**
20	0.265	1.316	*

d. Trade from US to China causes net conflict from China to US

e = 1.125

Lx = Lc	CS	t-value	
1	0.53	0.481	
2	0.244	1.315	*
3	0.322	1.82	**
4	0.325	0.836	
5	0.849	2.132	**
6	0.74	1.586	*
7	0.579	0.941	
8	0.815	1.498	*
9	0.1177	2.527	***
10	0.1384	3.106	***
11	0.1522	3.87	***
12	0.1439	3.634	***
13	0.1361	3.401	***
14	0.1259	3.192	***
15	0.1298	3.97	***
16	0.1312	3.29	***
17	0.1263	2.906	***
18	0.1313	2.885	***
19	0.1362	2.901	***
20	0.1424	2.867	***

e. Trade from US to China causes net conflict from US to China

e = 1.5

Lx = Lc	CS	t-value	
1	0.85	1.475	*
2	0.144	1.779	**
3	0.195	1.794	**
4	0.285	2.91	***
5	0.306	1.879	**
6	0.264	1.429	*
7	0.363	1.883	**
8	0.469	2.278	**
9	0.411	1.657	**
10	0.47	1.973	**
11	0.445	1.796	**
12	0.398	1.935	**
13	0.462	2.744	***
14	0.48	3.31	***
15	0.471	2.879	***
16	0.444	2.762	***
17	0.433	2.688	***
18	0.379	2.457	***
19	0.36	2.333	***
20	0.393	2.441	***

Table 8 Nonlinear Results for Japan-US

a. Net conflict from US to Japan causes trade from Japan to US

e = 1.5

Lx = Lc	CS	t-value	
1	0.9	0.162	
2	0.109	-1.77	**
3	0.74	0.503	
4	0.97	0.571	
5	0.32	-1.266	
6	0.65	0.212	
7	0.309	0.797	
8	0.106	0.198	
9	0.139	0.24	
10	0.45	0.71	
11	0.185	0.284	
12	0.486	0.724	
13	0.67	1.24	
14	0.1063	1.592	*
15	0.1016	1.231	
16	0.1317	1.697	**
17	0.1321	1.545	*
18	0.1378	1.45	*
19	0.156	1.434	*
20	0.1286	1.39	*

b. Trade from Japan to US causes net conflict from Japan to US

e = 1.46

Lx = Lc	CS	t-value	
1	0.12	0.175	
2	0.58	0.545	
3	0.152	0.907	
4	0.386	1.818	**
5	0.238	0.852	
6	0.276	0.817	
7	0.11	0.294	
8	0.339	0.684	
9	0.475	0.85	
10	0.1031	1.549	*
11	0.1428	2.55	***
12	0.1263	1.434	*
13	0.1495	1.74	**
14	0.1544	1.42	*
15	0.1112	0.82	
16	0.2449	3.369	***
17	0.2	2.927	***
18	0.2459	2.921	***
19	0.2128	2.88	***

c. Trade from Japan to US causes net conflict from US to Japan

e = 1.5

Lx = Lc	CS	t-value	
1	0.83	1.29	*
2	0.198	1.675	**
3	0.105	0.702	
4	0.147	0.804	
5	0.206	0.889	
6	0.378	1.233	
7	0.352	0.955	
8	0.596	1.559	*
9	0.463	0.953	
10	0.711	1.416	*
11	0.1106	1.976	**
12	0.975	1.622	*
13	0.1055	1.614	*
14	0.714	0.854	
15	0.1128	1.402	*

d. Net conflict from US to Japan causes trade from US to Japan

e = 1.25

Lx = Lc	CS	t-value	
1	0.23	0.3	
2	0.38	0.308	
3	0.19	0.87	
4	0.21	0.67	
5	0.316	0.697	
6	0.901	-1.346	*
7	0.507	0.561	
8	0.2	0.2	
9	0.1447	1.357	*
10	0.2646	6.857	***
11	0.255	5.872	***
12	0.2435	5.126	***
13	0.2333	4.606	***

e. Trade from US to Japan causes net conflict from US to Japan

e = 1.38

Lx = Lc	CS	t-value	
1	0.114	1.81	**
2	0.192	1.286	*
3	0.367	2.68	***
4	0.337	1.529	*
5	0.516	1.884	**
6	0.244	0.702	

* indicates 10% level of significance, ** indicates 5% level of significance and *** indicates 1% significance.