International Institutions and the Volatility of International Trade

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Abstract

During the past half-century, states have established a large number of international trade institutions, both multilateral and regional in scope. The existing literature emphasizes that these agreements are chiefly designed to liberalize and increase the flow of overseas commerce. Yet such institutions have another function that has been largely ignored by researchers, namely, reducing volatility in trade policy and trade flows. Exposure to global markets increases terms-of-trade volatility. Governments seek to insulate their economies from such instability through membership in international trade institutions, particularly the World Trade Organization (WTO) and preferential trading arrangements (PTAs). We hypothesize that these institutions reduce the volatility of overseas commerce. We further hypothesize that, because market actors prefer price stability, trade institutions increase the volume of foreign commerce by reducing trade variability. This paper conducts the first large-scale, multivariate statistical tests of these two hypotheses, using annual data on exports for all pairs of countries from 1951 through 2001. The tests provide strong support for our arguments. PTAs and the WTO regime significantly reduce export volatility. In so doing, these institutions also increase export levels.

<u>Introduction</u>

During the past half-century, states have concluded a large number of international trade agreements. Some of these agreements have been multilateral in scope, particularly the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO). Others have been bilateral or regional, most notably the preferential trading arrangements (PTAs) that have proliferated with striking speed in recent years. What do such trade institutions accomplish, and why do states form them? The existing literature emphasizes that they enhance market access for goods, services, and investment. Trade agreements, in this view, are chiefly designed to liberalize and increase the flow of overseas commerce.

Yet such institutions have another function that has been largely ignored by researchers. Specifically, we argue that trade institutions are designed as much to stabilize and reduce volatility in trade policy and trade flows as they are to liberalize and expand trade. Exposure to global markets increases terms-of-trade volatility and governments seek to insulate their economies from such instability. Various domestic institutions can serve this purpose, as recent studies underscore. However, international trade institutions – particularly the GATT/WTO and PTAs – can also reduce the volatility of overseas commerce. They constrain member-states from introducing new trade barriers; they foster policy transparency and convergence in expectations, standards, and policy instruments; and they shift the structure of markets in ways that promote greater stability in commercial transactions over time.

Furthermore, by reducing the volatility of international trade, commercial agreements help stabilize the price of traded goods. Firms and other market actors have a strong preference for price stability. As such, they are likely to respond to lower trade variability between the country in which they are located and another state by expanding overseas commerce and investment

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with that state. If trade agreements do indeed reduce volatility, then they should correspondingly increase the amount of trade conducted among the contracting parties as well. This indirect effect of trade agreements on the flow of overseas commerce stands apart from any direct effect of the agreements on trade flows stemming from member-states' expanded access to foreign markets. In fact, this indirect effect is likely to be important even if agreements lock in rather than cut members' trade barriers. Studies of the relationship between trade institutions and trade flows that ignore their influence on the volatility of foreign commerce therefore risk arriving at misleading conclusions.

In this paper, we conduct the first large-scale, multivariate statistical tests of these two hypotheses using annual data on exports for all pairs of countries from 1951 through 2001. The tests, which are based on four different measures of trade volatility, provide strong support for our arguments. Specifically, PTAs and the GATT/WTO significantly reduce export volatility. In so doing, these institutions also increase export levels. Indeed, a considerable part of the impact of trade agreements on trade levels stems from their tendency to dampen commercial volatility, rather than from their expansion of market access alone. Our results therefore indicate that a critical function of preferential and multilateral trade agreements is to make trade policy and flows more predictable.

Our study makes several important contributions to the literature on international institutions and the international political economy. First, a number of analyses of international regimes and institutions argue that these arrangements reduce the variance of international outcomes (e.g., Martin and Simmons 1998, 753; Braumoeller 2006). Ours is one of the first studies to test this argument. Second, our analysis helps to clarify some limitations of prior empirical research on the links between trade institutions and trade flows. This research has been marked by stark

disagreement about whether membership in the GATT/WTO, if not PTAs, promotes overseas trade (Rose 2003, 2004; Gowa and Kim 2005; Milner with Kubota 2005; but see Özden and Reinhardt 2005a; Goldstein, Rivers, and Tomz 2007). These debates reflect the existing literature's predominant focus on the level – and its inattention to the volatility – of trade flows and policies. Once the volatility of trade is taken into account, there is clear evidence that trade agreements are beneficial. Finally, our analysis highlights an underappreciated function of international institutions of any stripe. Whereas many observers have argued that such institutions improve the status quo policies of member-states, their chief role may be to lock in and enhance the predictability of these policies.

Theory

It is widely accepted that exposure to global markets increases volatility in the terms of trade (or relative prices), in the business cycle, and thus in cross-border commercial and investment flows. For workers, employment and wages become less secure (Scheve and Slaughter 2004). For firms, profits and competitiveness in domestic and foreign markets become less certain (Aizenman 2003). Hence, as Frieden (2002, 839) notes, private market actors "with substantial cross-border contractual interests" prefer predictability in these flows.[1] Central to such predictability are government policies concerning trade, investment, and currencies, all of which affect relative international prices. "Business planners," Abbott (2000, 528) observes, "generally prefer to operate under stable economic conditions under which the rules applicable to transactions are known in advance." In an open economy, governments will thus face substantial

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[1] Of course, hedging exchange rate risk on the forward market is an essential part of any internationalized firm's global strategy. But this adds a significant transaction cost regardless, and few firms in any case are fully hedged. For a small- to medium-sized business, the potential downside from exchange rate risk can dwarf any profits it may make from the actual sale of its product. See, for example, the discussion of the Markel Corporation in the *Wall*

pressure to insulate workers and firms from the vagaries of volatile global markets.

Recent studies have suggested a variety of domestic institutions and policies that states can use to reduce the volatility stemming from increased exposure to the international economy (Rodrik 1998; Quinn and Woolley 2001; Adserà and Boix 2002; Bernhard and Leblang 2006). Our argument is that international institutions can play a similar role, reducing the volatility stimulated by heightened economic integration. More specifically, trade institutions help stabilize trade policy and trade flows. Indeed, they help states lock in access to overseas markets even if they do not always lead member-countries to decrease trade barriers. This argument is hardly new, although it has been largely ignored in the empirical literature on international institutions and regimes. For example, Keohane (1983, 167) points out that various international regimes – including the GATT – are explicitly designed to promote "orderly patterns of behavior among members," implying that they should enhance stability and reduce volatility in interactions among members. For Martin and Simmons (1998, 746), international institutions "lock in a particular equilibrium, providing stability." Abbott (2000, 528-29) argues that trade agreements, at least those with "hard law," are adopted to reduce risk premia for private traders and investors. Perroni and Whalley (2000, 3) maintain that "countries see it in their interests to form insurance-based regional blocs, even if the barrier changes relative to the … status quo are small."[2]

Governments themselves place considerable emphasis on the ability of trade institutions to reduce commercial volatility. As New Zealand argued in its third party submission during Canada's 1984 *Newsprint* complaint against the European Community (EC), "the [GATT] disciplines and rules…[should] be used in a way which would foster the stability and security of

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international trade" (GATT 1984, 12). Going further, Brazil's WTO representative pointed out that the Uruguay Round had done little to improve Brazil's access to foreign markets, but that WTO membership was nonetheless beneficial because the "rules-based multilateral trading system ensured predictability, stability, and security to its economic agents" (WTO 2000, 5). Indeed, this function is emphasized in the WTO treaty itself: Article 3.2 of the Dispute Settlement Understanding (DSU) characterizes its primary purpose as "providing security and predictability."[3]

Preferential trading arrangements also aim to reduce the volatility of trade policies and the flow of overseas commerce between members. These institutions include agreements that partially liberalize commerce, free trade areas (FTAs), customs unions, common markets, and economic unions. All PTAs vest each member with preferential access to the markets of the other participants.[4] Members also recognize, however, that such arrangements can reduce the volatility of international trade. For example, two chief objectives of the 2003 Singapore-Australia FTA, as stated in its Article 1, were to "create a predictable...trading environment" and to "establish a framework of transparent rules to govern trade and investment."[5] The preamble to the 2001 Mexico-European Free Trade Area states that its goals are "to create an expanded and *secure* market for goods and services" and "to ensure a stable and predictable environment for investment."[6] Similarly, the Chile-European Union (EU) Association Agreement strives to enhance the transparency of trade and customs "procedures... in order to reduce costs and

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[3] In a decision which has since been cited frequently as precedent, the WTO's Appellate Body ruling in the *Computer Equipment* case (DS 62/67/68) broadens the legal reference for this objective, concluding that "the security and predictability of 'the reciprocal and mutually advantageous arrangements...' is an object and purpose of the WTO Agreement," not just of the DSU per se (WTO 1998, paragraph 82).
[4] We restrict our attention to reciprocal PTAs, in which all parties make concessions, as opposed to nonreciprocal arrangements, such as the Generalized System of Preferences (GSP), which are granted and removed unilaterally.
[5] http://www.mti.gov.sg/public/PDF/CMT/FTA_SAFTA_Agreement.pdf.
[6] http://www.sice.oas.org/Trade/mexefta/mexefta1.asp#PREAMBLE; emphasis added.

increase predictability for economic operators."[7]

Despite its *prima facie* grounding in existing trade agreements, this volatility-reducing function has received little attention in studies of trade institutions. Bagwell and Staiger (2002), for instance, maintain that the purpose of trade agreements is to allow states with market power to reach more efficient market access exchanges. In their view, reciprocity and nondiscrimination – key features of institutions like the GATT/WTO – promote such exchanges. Other scholars have emphasized different institutional features that also serve to increase market access. For example, Davis (2004) points to an institution's ability to facilitate linkage bargaining.[8]

This perspective, however, is at odds with recent evidence that many PTAs (Foroutan 1998) and the WTO itself (Rose 2004) do not actually induce members to lower their trade barriers. Various post-Communist countries, for example, liberalized trade unilaterally *prior to* the implementation of the WTO's Uruguay Round agreements; their WTO bindings remain far higher than their applied tariff levels (Finger, Ingco, and Reincke 1996; Drabek and Bacchetta 2004). Further, Japan left its heavily protected rice market entirely off the table in its 2005 FTA talks with Thailand and Malaysia, leading critics to claim that these FTAs "fall well short of promoting real free trade" (*Financial Times*, January 18, 2005, 9). Indeed, most trade accords include exceptions designed to maintain protection for politically sensitive sectors that, if liberalized, would generate especially sizable gains from trade. Many agreements, therefore, are not primarily intended to swap market access in areas of complementary comparative advantage.

Nevertheless, we do not take issue with the widespread claim that trade agreements make the

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[7] http://www.sice.oas.org/Trade/chieu_e/chieu1_e.asp, Article 79, paragraph 3(d).
[8] The recent empirical debate about whether the GATT/WTO actually increases trade (Rose 2003, 2004; Gowa and Kim 2005; Goldstein, Rivers, and Tomz 2007) also implicitly accepts this market access-centric view of the institution's functions.

reciprocal exchange of market access more efficient. It is obvious that such agreements typically aim to reduce trade barriers among participants. Yet this claim ignores another central function of commercial institutions, namely, reducing the variance in trade policy and trade flows. A number of recent studies have explicitly called for a greater focus on whether international institutions and regimes influence the variance of global outcomes (Martin and Simmons 1998; Braumoeller 2006). To that end, we make one of the first efforts to determine whether international institutions designed to regulate trade actually reduce the volatility of overseas commerce.

Three Mechanisms

We argue that trade institutions reduce the variability of trade flows in three complementary ways. First, institutions help enforce existing market access commitments and deter the erection of new protectionist barriers that could otherwise precipitate fluctuations in trade. Second, trade institutions foster transparency and policy convergence among member-states. Third, such institutions change certain characteristics of markets, precipitating responses by private traders that reduce the volatility of cross-border transactions.

One of the most important functions of trade agreements is to constrain member-states from introducing new protectionist policies. As long as members view the costs of violating the agreement as fairly high, locking in trade policies through this sort of external mechanism can help governments to "tie their hands" and resist protectionist pressures from domestic groups (Finlayson and Zacher 1981, 600; Krueger 1999, 118; Abbott 2000).

In addition, trade institutions serve as informational clearinghouses, sometimes even autonomously monitoring members' trade policies. Such information helps focus reputational or

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retaliation costs on members that abrogate their treaty commitments by introducing trade

barriers. These costs may arise domestically if the institution reveals that a government is

implementing such barriers or other rent-seeking policies and citizens punish the government as

a result (Keefer and Stasavage 2002; Mansfield, Milner, and Rosendorff 2002). These costs may

also arise internationally if, for instance, member-states bring grievances against participants that

violate their treaty obligations. The WTO's highly legalized dispute settlement procedures have

long been considered the gold standard in this regard (Hudec 1993; Jackson 2001), but most

PTAs also contain such provisions.[9] If one member introduces a protectionist policy, the

affected member-state can initiate a dispute settlement proceeding to collect damages.

How much does the threat of these proceedings prevent the introduction of protection by

parties to a trade agreement? Little research has been conducted on this issue. However, there is

evidence that even a country with as much market power as the United States is deterred from

imposing antidumping (AD) duties against WTO members (Blonigen and Bown 2003),

regardless of the target's countervailing market power (Busch, Raciborski, and Reinhardt

2005).[10] That such procedures weigh heavily on states tempted to introduce protection is also

implied by the outcomes of GATT/WTO disputes. For example, economically powerful states

often settle disputes prior to official rulings, and small countries have frequently succeeded in

using dispute settlement procedures to induce large countries to remove protectionist barriers

(Reinhardt 2001; Busch and Reinhardt 2003). Further, Desai and Hines (2004) show that the

stock prices of protected firms drop after a WTO complaint is filed against the barriers shielding

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[9] No comprehensive data yet exists on variation across PTAs in specific provisions for dispute settlement. The best available data, from Smith (2000), covers 62 of the most prominent PTAs. Only 18 of these contain no provisions for formal dispute settlement of any type, and all but five of the remainder incorporate legally binding third-party review procedures. More recent agreements, in particular, tend to have more clearly defined provisions for dispute settlement.

[10] Francois and Niels (2004) demonstrate the same finding as applied to Mexico's AD investigations.

them from foreign competition. Hence, market actors seem to believe that this enforcement

mechanism is politically credible. More generally, trade agreements can help states commit to a

given level of market access, decreasing the chances they will take actions that degrade that

access over time. By reducing the probability of new protectionist barriers, trade institutions

reduce the volatility of trade flows.

Anecdotal evidence in support of this proposition is easy to find. Australia's Trade Minister

acknowledged in 2001 that a chief motivation for establishing the US-Australia FTA was to

create an "insurance policy" that limited the possibility of increases in US trade barriers (*The

Australian*, June 26, 2001, 15). Facing a proliferation of unfair trade actions initiated by the US,

Canada had a similar objective in forming its free trade agreement with the US (Mansfield and

Reinhardt 2003, 846). Chile's agreement with Mercosur was also designed to secure Chile's

existing level of market access in the Southern Cone (*Financial Times*, December 8, 1995, 7).

Likewise, a central reason why China pressed to join the WTO was to guarantee access to the US

market; heretofore, the extent of this access had been subject to annual and highly politicized

Congressional reviews (Drabek and Bacchetta 2004, 1091). States thus view trade institutions as

devices to secure their existing access to their partners' markets, even if additional access is not

forthcoming.

The second way that trade agreements reduce volatility is by fostering transparency and

policy convergence among contracting parties. Trade agreements increase transparency – that is,

the ease with which governments and private actors can monitor policy developments – by

clarifying the obligations of each participant (e.g., by establishing precise schedules of tariff

bindings). Equally, these agreements create clearinghouses for members' notifications about

policy developments, and they specify procedures for addressing disputes. "Transparency," as

one GATT committee chairman emphasized, "is not an end in itself. It is a means to build confidence in and provide security and stability to the multilateral trading system, to minimize trade restriction and distortion, to assist private market operators to adjust to changing trade policies…" (GATT 1994, 9). For this reason, Canada insisted on increasing the precision of the rules of origin regarding automobiles and auto parts during the negotiations over the North American Free Trade Agreement (NAFTA). The prior rules had been vague and susceptible to interpretation by the US, thereby deterring foreign firms from locating investments in Canada in order to produce finished goods for sale in the US market (Abbott 2000, 528-29).

Convergence occurs as regulatory instruments, practices, and procedures grow increasingly similar across member-states. Trade agreements circumscribe the range of protectionist policies that participants can impose, thereby channeling protection to a common set of instruments, the domestic implementation of which draws on harmonized international standards and regulatory definitions. As such, trade agreements cause their members to protect their markets in similar and more transparent ways.[11] A classic example is the Uruguay Round's effort to convert diverse trade protection schemes into tariff equivalents. International institutions and their bureaucrats may "teach norms" (Finnemore 1993) or act as "purveyor[s] of global policy knowledge" (Morrissey and Nelson 2001). The transparency they provide helps members emulate one another's apparently successful practices (Simmons and Elkins 2004, 179). For instance, the widely observed spread of AD actions is partly attributable to their acceptability (under tightly defined conditions) based on WTO law (Morrissey and Nelson 2001, 21-24; Kucik and Reinhardt 2007). As Martin and Simmons (1998, 752) put it, "once policy is delegated to an

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[11] Botcheva and Martin (2001) usefully highlight the potential for international institutions to encourage *divergence* rather than convergence where cross-state externalities in the relevant domain are low. Trade protection, however, has well-known, and very high, cross-state externalities, which make institutions in our setting strongly suited to promote convergence rather than the opposite.

international institution, state behavior will converge: members will tend to adopt similar monetary, trade, or defense policies." Blackhurst (1998, 44), Finlayson and Zacher (1981, 602), and others concur with this assessment, maintaining that the reduction of policy-related uncertainty through the establishment of rules and procedures guiding trade relations has been the GATT/WTO's chief accomplishment.[12]

Transparency and convergence in policy instruments reduce the volatility of trade flows by stabilizing the expectations of private traders. With trade institutions in place, private actors have less difficulty obtaining information about trade policy and monitoring the behavior of member governments. They also have clearer avenues of recourse in disputes over members' regulatory actions. In an environment of greater and more reliable information, private actors are thus less likely to exhibit herd behavior, overreacting to the inevitable vicissitudes in global markets. By fostering transparency and convergence, international trade institutions should dampen boom and bust cycles in international commercial and investment flows.

The third mechanism through which trade institutions reduce trade volatility is by restructuring investment and commerce in ways that promote greater long-term predictability. A trade agreement invites greater foreign direct investment (FDI) in member-states where firms might otherwise rely on arms-length trade to serve these markets, since the agreement bolsters investors' confidence that member-governments will not engage in predatory activities that jeopardize their assets (Yarbrough and Yarbrough 1992). Commerce driven by such fixed-cost investments tied to a global production network is less variable than that resulting from a continual search for the lowest-cost foreign supplier.

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[12] Many observers have argued that domestic institutions can help filter or re-route international sources of pressure for generalized policy convergence. We do not take issue with this claim, but it emphasizes international integration's spillover effects on traditionally *domestic* policy domains, such as old age pension schemes and welfare systems. Our point is that international trade agreements cause states to converge on a common set of

Besides increasing FDI, trade institutions also shift the nature of the investment a country attracts. Specifically, trade agreements disproportionately promote export-platform and vertical FDI over FDI aimed at increasing sales in the host market (Hanson, Mataloni, and Slaughter 2001, 262; Markusen and Maskus 2001, 35; Aizenman 2003). The latter type of investment is often designed to circumvent a host country's trade barriers. Firms making such investments have a stake in supporting the host country's protectionist policies, which place them at an advantage over their competitors located abroad. Firms engaged in vertical or export-platform FDI, in contrast, should lobby the host to forgo increased protectionism that would raise transaction costs within their global production network. Through this domestic mechanism, a trade agreement's impact on the type of investment a country attracts reinforces the institution's ability to provide market access security, thereby stabilizing commercial flows.

Finally, by increasing the range of products that are granted preferential market access, trade agreements generally help countries diversify their portfolio of exports. There is evidence that greater concentration of exports heightens the volatility of a country's terms of trade (Razin, Sadka, and Coury 2003). Conversely, export diversification is likely to decrease terms-of-trade volatility (Hausmann, Panizza, and Rigobon 2004, 14) and accordingly the volatility of commercial flows. Thus, by changing characteristics of the market itself, trade agreements are likely to reduce trade volatility.

Hypotheses

The three mechanisms described above form the basis for our primary hypothesis:

> *H1: Joint membership in a reciprocal trade agreement ― a PTA or the*
>
> *GATT/WTO ― should decrease the volatility of a country's exports to a trade*

policy instruments, practices, and standards in the *international* domain specifically covered by the agreement.

partner.

Our argument, however, has an important corollary concerning the level of trade. It is widely argued that volatility in relative prices reduces the profitability of cross-border commerce and thus dampens trade (e.g., Klein and Shambaugh 2004).[13] As noted earlier, cross-border contracting arrangements are more costly for firms if they are uncertain about prices. By reducing this uncertainty and promoting predictability in economic relations, trade agreements should indirectly increase the volume of trade. Moreover, this effect should be realized even if the trade agreement does not significantly lower protectionist barriers. Increasing the stability of economic actors' expectations may prompt them to engage in more foreign commerce, regardless of whether trade barriers change. This argument gives rise to a secondary hypothesis:

> *H2: Greater expected volatility of exports from a given country to a trade partner*
>
> *should decrease the level of those bilateral exports.*

Our argument is silent on the relative weights of the direct (protection-reducing) versus indirect (volatility-reducing) effects of trade agreements on trade levels. However, we suspect that the substantive impact of volatility is considerable. As far as we are aware, the following results are the first to bear directly on this important issue.

Research Design

To test our hypotheses, we construct a dataset with one observation per ordered pair ("directed dyad") of states, i and j, for each year, t, from 1951 to 2001. We include Hong Kong and Macao, in addition to all country-years on the Correlates of War interstate system membership list, version 2002.1 (Correlates of War Project 2003). This yields a total of

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[13] Volatility may have a stronger dampening effect on trade in differentiated goods, which presumably have lower pass-through, and whose producers must therefore continue to sell at the local price even when relative price

1,082,652 possible directed-dyad-years; however, gaps in trade data for some countries reduce

the sample that is actually analyzed below to about half of this size, or 527,883 observations.[14]

This sample includes 162 countries and a panel of 21,167 unique ordered pairs, for an average of

24.9 years each.

Dependent Variable: Volatility

There is no universally accepted measure of volatility and little precedent in the literature for

scoring volatility in trade. Studies of the impact of *exchange rate* volatility on trade (e.g.,

Devereux and Lane 2003; IMF 2004, 30; see also Rose 2005) tend to operationalize volatility as

the variance within a time series (of observations of $X_{i,j,t}$) for a given country over a long

period. This technique, however, conflates *predictable* changes in trade with *unexpected*

shocks.[15] It is also unable to furnish time-specific values of volatility *within*, not merely *across*,

series.

We consider four different measures of volatility, all of which correct for these limitations.

Our measures are applied to the goods exports of state *i* to state *j* in year *t* ($X_{i,j,t}$), expressed in

constant 1995 US dollars.[16] The last of these is the most direct and has priority as the chief

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movements are disadvantageous (Frieden 2002, 839).

[14] It is worth noting that the observations excluded due to missing (trade) data are similar in many important respects to those included in the regression sample. The two sets of observations have nearly identical values of (a) GDP growth rates and growth volatility, (b) military conflict participation, and (c) landlocked geography. There appears to be virtually no difference in the years covered in the missing and nonmissing observations as well. However, the missing observations tend to involve somewhat less democratic states (a 2-point average difference on a 21-point scale) with slightly lower average per capita incomes ($4481 compared to $6027 for the states included in the sample, where these values are expressed in constant 1995 US dollars).

[15] To illustrate this distinction, consider two hypothetical time series, each with ten observations. Series A is a linear increase from 1 to 10. Series B is a normally-distributed random variable with the same mean (5.5) and a variance of 8. Despite the fact that Series A is entirely predictable, whereas B's series oscillates widely and totally randomly, A's variance of 8.25 is greater than B's. A measure of volatility that aggregates long periods of years makes a radical conceptual error by failing to distinguish between these two obviously different situations.

[16] We obtain data on (goods) exports, $X_{i,j,t}$, from a hierarchical set of sources, including, from highest to lowest

priority, the UN COMTRADE dataset, the OECD, *Statistics Canada*, and the International Monetary Fund's (IMF)

indicator of volatility used in this paper. However, we first present three more accessible

alternatives, to build up the intuitions involved and to facilitate some simpler robustness tests.

Our first measure, used in Model 1, is the absolute value of the change in the logged value of

real exports from state i to state j, between years t-1 and t:[17]

$$Abs(\Delta \ Log \ Exports)_{i,j,t} = \left| \ln X_{i,j,t} - \ln X_{i,j,t-1} \right| \tag{1}$$

One advantage of this measure is that it varies from year to year within the export series for each

country-pair. As a result, we can control for time-varying factors affecting the level of trade,

thereby enhancing our ability to isolate the effects of trade agreements. Larger values of this

measure represent wider fluctuations from year to year and thus greater trade volatility. Of

course, analyzing the logarithm of exports compresses high values, so that the same real

deviations would appear smaller at higher levels of trade than at lower ones. We address this

issue by controlling for the prior level of exports ($\ln X_{i,j,t-1}$).

Our second measure of volatility, used in Model 2, is the absolute value of the change in the

supplier's export share in the importer's market, expressed as a percentage:

$$Abs(\Delta \ Export \ Share)_{i,j,t} = 100 \times \left| \left(\frac{X_{i,j,t}}{GDP_{j,t}} \right) - \left(\frac{X_{i,j,t-1}}{GDP_{j,t-1}} \right) \right| \tag{2}$$

Direction of Trade Statistics. Where these sources, after compilation, did not report a value for i's exports to j in
year t, but *did* provide a value for j's imports from i (as reported by state j) in that year ($M_{j,i,t}$), we fill in
$X_{i,j,t} = M_{j,i,t}$. Trade data are often subject to reporting errors. Volatility scores could be greatly affected by such
errors. Hence we screened the data by identifying the directed-dyads that contained the 2000 largest annual percent
changes in exports. We then compared the orders of magnitude reported in the multiple sources above, and where
an obvious disagreement existed, we used the source with the more reasonable order of magnitude. In no case did
we fill in or average data; every observation of X is from one of the above sources. We convert $X_{i,j,t}$ from the
source units, current US dollars, to constant 1995 US dollars using the US Consumer Price Index (All-Urban,
www.bls.gov).

[17] The annual volume of exports is zero in many cases (27 percent of the regression sample, to be precise). In these
cases, we follow the common practice of replacing zero with $1000 (which is just a bit smaller than $2300, the
minimum nonzero sample value) before taking the log (Eichengreen and Irwin 1995).

This measure scales exports by the importing country's gross domestic product (GDP).[18]

Our third measure, *Export Drop*$_{i,j,t}$, used in Model 3, is dichotomous. It equals one if state i's real exports to state j drop by 50 percent or more from year t-1 to year t, that is, if

$$\frac{100 \times \left(X_{i,j,t} - X_{i,j,t-1}\right)}{X_{i,j,t-1}} \leq -50.$$ It equals zero otherwise. Fifteen percent of the observations in our sample experience such a dip. (We can alternatively draw the cutoff at 10 or 25 percent with no consequence for our results.) Unlike the previous two measures of volatility, this variable taps the direction of trade volatility. Doing so is important because we expect trade institutions to reduce the probability of year-to-year *collapses* in the flow of exports.

Our final technique for assessing the links between trade agreements and export volatility is the most direct. We begin by assuming that the level of exports from one state to another in year t is given by:

$$\ln X_{i,j,t} = \beta_0 + \beta_1 WTO_{i,j,t-1} + \beta_2 PTA_{i,j,t-1} + \mathbf{Z}_{i,j,t}\boldsymbol{\varphi} + \mu_{i,j} + \delta_t + \varepsilon_{i,j,t}, \tag{3}$$

where $\mathbf{Z}$ is a vector of control variables with $\boldsymbol{\varphi}$ as their coefficients, $\mu_{i,j}$ is a directed-dyad-specific fixed effect, δ_t is a year-specific fixed effect, and $PTA_{i,j,t}$ and $WTO_{i,j,t}$ are dummy variables indicating whether countries i and j are, respectively, members of the same PTA or the GATT/WTO in year t-1. We also assume that the error term, $\varepsilon_{i,j,t}$, follows a normal distribution with mean zero and, crucially, observation-specific variance, $\sigma^2_{i,j,t}$. Higher error variance in a given case indicates that the deviations in the actual levels of exports are greater. This error variance, then, is the embodiment of observation-specific volatility.

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[18] Normalizing by the size of the importer's GDP captures the overall revealed market access granted by the importer country to the supplier country. Normalizing by the importing country's total *imports* would only address the extent to which the supplier was the target or beneficiary of changes in discrimination across suppliers (i.e., *relative* rather than *absolute* levels of market access). This is not the issue addressed by our theory.

To capture the impact of trade agreements on volatility, we estimate a heteroskedastic regression, Model 4, which parameterizes the variance function as:

$$\sigma^2_{i,j,t} = \exp\!\big(\alpha_0 + \alpha_1 \ln X_{i,j,t-1} + \alpha_2 PTA_{i,j,t-1} + \alpha_3 WTO_{i,j,t-1} + \mathbf{W}_{i,j,t}\gamma + \tau_t\big), \qquad (4)$$

where $\mathbf{W}$ is a vector of control variables and τ_t is a year-specific fixed effect. Our argument will be supported if $\alpha_2, \alpha_3 < 0$, indicating that trade agreements reduce the variance in export levels. As with the first measure of volatility, this procedure uses a logarithmic scale; accordingly, to correct for the compression at high values, we control in the variance equation for the level of exports from country i to country j in year t-1.

Estimating the Direct and Indirect Effects of Trade Agreements on Export Levels

Model 4 does not differentiate between the direct and indirect impact of trade agreements on export levels, which are merged into single coefficients in equation 3 (β_1 or β_2, the coefficients of $WTO_{i,j,t\text{-}1}$ and $PTA_{i,j,t\text{-}1}$, respectively). Indirectly, trade institutions can boost export flows by stabilizing policies even if they do not directly increase market access, since economic actors are expected to engage in more cross-border trade when relative prices are less volatile. To separate these direct and indirect effects of trade agreements on export levels, we estimate an ARCH-in-mean model. Model 5 generalizes the heteroskedastic regression framework by adding the observation-specific conditional error variance term, $\sigma^2_{i,j,t}$, as a causal variable in our model of the level of exports (ARCH.M) and by allowing for first-order autoregressive-conditional heteroskedasticity (ARCH.1) in the variance equation. Specifically, underlining what has been added to equations 3 and 4,

$$\ln X_{i,j,t} = \beta_0 + \beta_1 WTO_{i,j,t-1} + \beta_2 PTA_{i,j,t-1} + \underline{\beta_3 \sigma^2_{i,j,t}} + \mathbf{Z}_{i,j,t}\varphi + \mu_{i,j} + \delta_t + \varepsilon_{i,j,t} \qquad (5)$$

and

$$\sigma^2_{i,j,t} = \exp\!\left(\alpha_0 + \alpha_1 \ln X_{i,j,t-1} + \alpha_2 WTO_{i,j,t-1} + \alpha_3 PTA_{i,j,t-1} + \mathbf{W}_{i,j,t}\boldsymbol{\gamma} + \tau_t\right) + \underline{\alpha_4 \varepsilon^2_{i,j,t-1}}. \qquad (6)$$

Model 5 further allows for first-order autocorrelation (AR.1), such that $Cov\!\left(\varepsilon_{i,j,t}, \varepsilon_{i,j,t-1}\right) \neq 0$. A

simpler version of this modeling technique was devised by Engle, Lilien, and Robins (1987) to

analyze volatility in financial markets (Engle 2001; Leblang and Mukherjee 2004; Hausmann,

Panizza, and Rigobon 2004). To our knowledge, it has not been used in studies of international

trade, although it is ideally suited to our purposes. We emphasize strongly, however, that our

version explicitly adapts to the panel data context by including directed-dyad-specific fixed

effects ($\mu_{i,j}$) in equation 5.[19]

Trade agreements have a positive *indirect* impact on export levels to the extent that,

simultaneously, $\alpha_2, \alpha_3 < 0$ in equation 3 and $\beta_3 < 0$ in equation 5. Trade agreements have a

positive *direct* effect on exports to the extent that $\beta_1, \beta_2 > 0$ in equation 5.[20]

Independent Variables: Trade Agreements

Our two primary explanatory variables are $PTA_{i,j,t\text{-}1}$ and $WTO_{i,j,t\text{-}1}$. These dummy variables

indicate, respectively, that the pair of countries, i and j, are members of the same PTA or of the

GATT/WTO, at some point in year t-1. For convenience, subsequent references to these

variables often omit subscripts, but note that they are always lagged by one year. *PTA* takes

account of partial scope accords, FTAs, customs unions, common markets, and economic unions,

but not general cooperation agreements unless they include a schedule of trade-liberalizing

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[19] To make estimation feasible, we have had to assume that the ARCH.1, AR.1, and ARCH.M terms are common across panels (though this is hardly an unusual assumption, given the conventional constraint, in such pooled analyses, that the other coefficients are constant across cross-sections as well).

[20] Further, one year's volatility spills over positively into the next to the extent that the ARCH.1 coefficient, α_4, is

commitments with specific products, amounts, and timetables. This variable is restricted to agreements that are reciprocal in nature; accordingly, the Generalized System of Preferences and the EC's Lome Convention are not included. For hub-and-spoke agreements (such as the EC's Arusha II accord with Kenya, Tanzania, and Uganda), *PTA* is coded as one only for those bilateral relationships covered by the agreement, not for the relations among the "spokes" (unless, of course, they were covered by a separate PTA).[21] This variable equals one in 9 percent of the sample's observations, reflecting about 250 distinct PTA treaties, depending on how one counts successor or extension treaties. *WTO* equals one in 47 percent of our sample.

Control Variables

To adequately assess the effects of these explanatory variables, it is important to control for various other factors that previous studies have identified as likely influences on bilateral trade flows and on membership in trade agreements (Eichengreen and Irwin 1995; Frankel 1997; Mansfield, Milner, and Rosendorff 2000, 2002; Glick and Rose 2002; Mansfield and Reinhardt 2003; Rose 2003, 2004, 2005; Gowa and Mansfield 2004; Goldstein, Rivers, and Tomz 2007). All of these variables are measured in year *t*-1. Gravity models emphasize that trade flows between states *i* and *j* are influenced by each state's GDP and per capita GDP (or equivalently, national population).[22] We also control for the existence of a currency union between states *i*

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greater than zero.

[21] To code *PTA*, we assembled a variety of lists of preferential trade arrangements, working chiefly from official World Trade Organization documents (see Mansfield and Reinhardt 2003). We also used extensive records maintained unofficially by WTO Secretariat staff to keep track of PTAs not formally notified to the WTO as well as those consisting of countries not belonging to the WTO (available upon request). Finally, we consulted the available Internet home pages of the relevant agreements. This variable incorporates information in these sources about dates of official termination or practical cessation of the agreement. Instances of a revised PTA succeeding a predecessor with no interruption, however, manifest themselves in this variable as a continuous stretch in which *PTA* = 1.

[22] GDP is expressed in trillions of constant 1995 US dollars. Per capita GDP is expressed in thousands of constant 1995 US dollars. Given that international trade is largely transacted in US dollars, correcting for purchasing power parity is undesirable for our current purposes. Data on these variables are from a hierarchy of sources, starting with

and j.[23] In addition, we include three dummy variables measuring political-military conflict.

The first indicates whether state i was the site of an armed conflict (either civil or international);

the second indicates whether state j was such a site; and the third indicates whether i and j were

antagonists in an armed conflict.[24] Finally, we include a 21-point measure of each state's regime

type that ranges from -10 for the most autocratic countries to 10 for the most democratic ones

(Jaggers and Gurr 1995). Table 1 provides descriptive statistics on all of our independent

variables, as well as our measures of trade volatility.[25]

   All five models incorporate fixed effects specific to each ordered pair of countries, i and j, as

well as year-specific fixed effects. The latter capture system-wide trade shocks felt by all pairs

of states. The former control for unobserved sources of pairwise heterogeneity. We include

such fixed effects because a number of recent studies of trade have argued that omitting them can

dramatically bias estimates (Anderson and van Wincoop 2003; Baltagi, Egger, and Pfaffermayr

2003).[26] As a consequence of using this method, however, we cannot estimate the impact of

factors that are constant over time within an ordered pair of countries. Some factors of this sort –

especially bilateral distance, border contiguity, and past colonial relationships – are often

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the World Bank's *World Development Indicators*, the OECD, UNCTAD's *Handbook of Statistics On-Line*, the International Monetary Fund's *World Economic Outlook*, Penn World Tables version 6.1, and the IMF's *International Financial Statistics*. The source for any given observation is available upon request.

[23] The source is Glick and Rose (2002), which we updated using their sources and definition (see their pages 1128-9). We discovered a small number of apparent discrepancies between their data and the material contained in the original IMF documents, which we corrected to fit their stated definition.

[24] These are from PRIO's Armed Conflict Dataset, version 2.1 (Gleditsch et al. 2002).

[25] These various measures of volatility are not highly correlated. In particular, the measure normalized by the partner's GDP exhibits virtually zero correlation with all the others, while the dummy variable measuring a large drop in exports, the absolute change in log exports, and the fitted estimate of the conditional variance, $\hat{\sigma}^2_{i,j,t}$, in Models 4 and 5, have bivariate correlations ranging from 0.08 to 0.15, 0.34, 0.38, and 0.40. Since these operational measures of volatility diverge widely in practice, we should infer support for our hypotheses only if the results from each variable's separate regression are largely in agreement.

[26] The debate over Rose's (2003) finding that the WTO does not increase trade flows has revolved in part around the issue of whether to include country- or pair-specific fixed effects in the estimation (e.g., Subramanian and Wei 2005; Goldstein, Rivers, and Tomz 2007). Yet the results we report below, on the negative impact of WTO and PTA membership on trade volatility, become much stronger, not weaker, if we exclude fixed effects from our estimation. Not surprisingly, tests of the collective significance of the sets of cross-sectional and year-specific fixed

included in gravity models that omit pairwise fixed effects. Similarly, such a tiny fraction of

country pairs change their alliance status over our sample period that we are not able to control

for that variable either. However, excluding these covariates does not introduce bias since their

effects are fully absorbed into the cross-sectional fixed effects.[27]

The Models

Models 1, 2, and 3 include $PTA_{i,j,t\text{-}1}$, $WTO_{i,j,t\text{-}1}$, the control variables described above, and the

lagged export level, $\ln X_{i,j,t-1}$. Models 4 and 5 – the heteroskedastic regression and ARCH-in-

mean model – both include $PTA_{i,j,t\text{-}1}$, $WTO_{i,j,t\text{-}1}$, all the control variables, and $\ln X_{i,j,t-1}$ in their

export levels equations (3 and 5, above).[28] Their variance equations (4 and 6, above) incorporate

$PTA_{i,j,t\text{-}1}$, $WTO_{i,j,t\text{-}1}$, $\ln X_{i,j,t-1}$, year-specific fixed effects, and *Currency Union*$_{i,j,t\text{-}1}$. We add the

latter variable because participation in a currency union is likely to stabilize prices.

<u>Results</u>

The regression estimates for Models 1-3 (the three different year-on-year change measures),

Model 4 (heteroskedastic regression), and Model 5 (ARCH-in-mean) are shown in Tables 2, 3,

and 4, respectively. All five models provide very strong and consistent support for our

hypotheses. Both PTAs and the GATT/WTO reduce the volatility of exports in a substantively

meaningful and statistically significant fashion. This finding does not depend on which measure

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effects validate their inclusion, with $p < 0.001$ in each model.

[27] Fortunately, 43 and 21 percent of the pairs in the sample experience at least one change in WTO or PTA status, respectively, such that there is considerable within-dyad as well as across-dyad variation in the independent variables of central interest for this paper.

[28] We incorporate the ordered pair-specific fixed effects in the levels equations of Models 4 and 5 through the technique of de-meaning. Doing so makes estimation of these already computationally-demanding models feasible, with no consequence for the estimates reported below.

of volatility is analyzed and it is quite robust statistically, as we describe below. Moreover, the

Model 5 results – which parse out the direct versus indirect effects of trade agreements on export

levels – show that some of the beneficial impact these agreements have on export levels stems

from their ability to reduce volatility rather than from increased market access alone.

Models 1-4

Models 1-4 provide a good overall fit.[29] Moreover, in Models 1, 2, and 3, and in Model 4's

variance equation, the estimated coefficients of *PTA* and *WTO* are negative and statistically

significant, as we expected. Trade agreements reduce absolute changes in exports, whether

logged or as a share of the partner's market, and they reduce the chances of a collapse in bilateral

exports. They also reduce the instantaneous variance of export flows, as evidenced in Model 4's

variance function.

The volatility-reducing impact of PTA and GATT/WTO membership is substantively as well

as statistically significant. Table 5 compares the predicted values of the four different volatility

measures, based on the estimates of Models 1-4, given the absence and presence of PTA and

GATT/WTO membership, respectively, holding all other variables at their sample means. In

combination, these institutions reduce volatility by about a third, though that value ranges from

14 to 76 percent, depending on the measure used.[30] Whether membership in GATT/WTO or the

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[29] The fact that these models explain a relatively small proportion of the *sample* variance, however, is to be
expected. While there are identifiable institutional determinants of volatility, a large fraction of the variation in
volatility is due to chance. It is also important to note that our results are not threatened by some common regression
assumption violations. Multicollinearity is not sizable, with a maximum variance inflation factor (VIF) of 2.7.
While tests reveal the presence of heteroskedasticity in these models — not surprisingly, since this is the central
theoretical focus of Models 4 and 5 — we base tests of statistical significance on heteroskedastic-consistent standard
errors that address this problem. Further, we address potential serial correlation in the data by controlling for the
lagged value of exports in all models, including Model 4's variance equation. What is more, Maddala-Wu panel
unit root tests (with trend and constant) reject the null hypothesis of nonstationarity in any of the ordered pairs'
series, with $p < 0.001$, for the dependent variables in all five models. See Maddala and Wu (1999).
[30] Recall that the logarithmic scale of the dependent variable in Models 1 and 4 compresses these apparent

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average PTA has a greater effect in reducing the volatility of trade likewise varies across the models.[31] Note that this comparison is with the average PTA; the difference may be attenuated when comparing the GATT/WTO to, say, the EU, or the handful of other PTAs with comparably strong dispute settlement regimes.

What is the impact of PTAs and WTO membership on trade levels in Model 4? As shown in the first column of Table 3, both PTAs and the GATT/WTO strongly boost the level of bilateral exports, while simultaneously reducing the trade volatility (see the table's second column).

The volatility-reducing effects of PTAs and the GATT/WTO in Models 1-4 are robust to a wide variety of statistical challenges. First, they hold for all four measures of export volatility. Second, these effects persist even after dropping observations where the value of the dependent variable is extremely large.[32] Third, the results are unchanged if we add three variables indicating whether the exporter, the importer, or the pair are members of the EC; or if we add the GDP growth rate of each country to the models. Fourth, the coefficient estimates of *PTA* and *WTO* remain negative and statistically significant in Model 3 even if we reduce the threshold at which *Export Drop* equals one from 50 percent to 25 percent or 10 percent. Fifth, the results are also unchanged if we employ Newey-West standard errors, which are robust to first-order autocorrelation as well as heteroskedasticity. Sixth, the two trade institution variables retain their effects if we recode the conflict variables using a higher threshold of violence ("war") or if we add an additional variable indicating that either state in the dyad had a contiguous neighbor participating in a war in year *t*-1. Finally, the results are robust to the inclusion of a variable

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differences. In real dollar terms, the percentages would be higher.

[31] We can reject the null hypothesis that the estimated coefficients of $PTA_{i,j,t-1}$ and $WTO_{i,j,t-1}$ are equal in all cases but Model 2 ($p < 0.05$). The absolute value of the estimated coefficient of $PTA_{i,j,t-1}$ is greater than that of $WTO_{i,j,t-1}$ in Models 1 and 3; but the reverse is true in the variance equations for Models 4 and 5.

[32] Specifically, the findings apply if we drop cases where $Abs(\Delta\ Log\ Exports)_{i,j,t}$ exceeds 10.

measuring the past year's variability in the bilateral exchange rate.[33]

Model 5: ARCH-in-Mean

As shown in Table 4, Model 5 also provides a good fit to the data. Moreover, the parameters that distinguish it from Model 4 – the ARCH-in-mean (ARCH.M), ARCH.1, and AR.1 terms – are statistically significant, indicating that this is an appropriate generalization of heteroskedastic regression with which to analyze our data.[34] It is therefore particularly noteworthy that this model yields the same basic results as the earlier models: PTA membership and GATT/WTO membership both decrease the instantaneous variance in real exports. These findings are statistically and substantively significant. Table 5 shows the variance as estimated in Model 5, holding all other variables at their sample means, and including the average ARCH.1 component of the variance, for different combinations of PTA and GATT/WTO membership. Compared to a baseline predicted variance if no agreements were in place, a PTA reduces variability by 6.1 [3.6, 8.5] percent; the GATT/WTO reduces variability by 12.3 [11.2, 13.4] percent; and both agreements together reduce variability by 16.2 [14.3, 18.1] percent (where the figures in brackets form a 95 percent confidence interval around these point predictions). That this is the weakest substantive effect among our five models probably stems from the apparent ARCH.1 process at work. Volatility spills over from one year to the next, a dynamic which should not be attributed to the impact of trade institutions.

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[33] Specifically, the measure is the (absolute value of the) % drop from year *t*-1 to *t*, of the nominal bilateral exchange rate, expressed in terms of the side losing its value (from the International Monetary Fund's *International Financial Statistics*). Joint membership in either type of trade agreement has virtually zero association with bilateral exchange rate volatility across our sample: this variable has a bivariate correlation with *PTA* and *WTO* of less than |0.02|.

[34] However, even as simple an ARCH-in-mean model as that reflected in equations 5 and 6, applied to this large dataset, is exceptionally time-consuming to estimate and would be unlikely to converge if we extended it further. The estimates in Table 4 were generated in Stata 9.1 SE using arch …, noconstant arch(1/1) archm ar(1) het(…) robust difficult, which successfully converged at the default tolerance in 214 iterations.

However, as we mentioned earlier, the ARCH-in-mean model allows us to parse out the direct and indirect impact of trade agreements on the level of exports. The results are striking. First, the negative and statistically significant coefficient of the ARCH.M term in the export levels model indicates that heightened volatility itself reduces exports. This is consistent with the argument that private traders and investors respond rapidly to expected volatility by decreasing their commerce with the affected market.

Second, by reducing volatility, trade agreements indirectly boost export levels. Of course, since the coefficients of *WTO* and *PTA* are positive and significant in the export levels equation, both kinds of agreements *directly* increase the volume of bilateral trade. Compared to an otherwise-average reference point with no agreements in place, membership in GATT/WTO, a PTA, or both types of agreements boosts export levels by an *aggregate* of 19 [14, 24], 35 [27, 42], or 60 [48, 72] percent, respectively. But, respectively, 8.1 [6.3, 10.7], 2.5 [1.4, 3.7], and 4.5 [3.6, 5.6] percent of these gains in export levels are due to the variance-reducing effect of the trade agreements, as multiplied by the ARCH.M term in the levels equation. The direct effects of trade agreements on export levels are stronger; but their indirect effects, while smaller, are still substantively meaningful, especially for GATT/WTO. Another way to express this finding is that, absent a trade agreement, high volatility acts as a substantial "tax" on commerce, reducing the expected value of exports by an estimated 9.9 [8.6, 11.2] percent. With the GATT/WTO and a PTA in place, this volatility tax on the average pair's exports shrinks to 8.4 [7.3, 9.5] percent. Consequently, the gain in exports from the two agreements working together to reduce volatility is comparable to the gain achieved by cutting the average nominal tariff by 1.5 percent. Since the average nominal most favored nation (MFN) tariffs have been below 4-5 percent for many countries over the past two decades, this is a nontrivial effect.

Control Variables

Before concluding, we should also summarize the effects of the control variables. While these factors are not central to our analysis, little empirical work has been conducted on the political economy of trade volatility, so the results should be of interest. A few variables exert a strong and a fairly uniform influence, regardless of which measure of volatility is analyzed. Military conflict is associated with greater volatility in overseas commerce and exports to countries with large markets are less volatile. However, the remaining variables do not have a consistent impact on trade volatility.[35]

In addition, there is some evidence that currency unions increase export volatility (at least in Models 4 and 5). Very little research has accumulated on this issue, but Rose (2005) finds that monetary unions have no systemic effect on trade volatility. Like our Models 4 and 5, however, a number of related studies conclude that currency unions promote the flow of trade among members (Glick and Rose 2002; Klein and Shambaugh 2004).[36] How can these findings be reconciled? One insight with venerable roots is that countries in currency unions generally have higher output volatility; conversely, more flexible exchange rate arrangements help insulate a country against terms-of-trade shocks. Trade volatility is a likely byproduct of output volatility and macroeconomic fluctuations, which affect production and demand for traded goods. Consistent with this point, Broda (2004) and Edwards and Levy-Yeyati (2003) report that terms-

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[35] It should also be noted that most of the estimates in the models of export levels (the first columns of Tables 3 and 4) accord with our expectations. That GDP is positively related to trade is consistent with predictions based on the gravity model (Frankel 1997). Furthermore, like previous studies, we find that (1) democracy and currency unions promote the flow of trade; (2) military conflict inhibits commerce; and (3) the level of exports exhibits temporal dependence. If per capita GDP has an unexpected sign here, that is because of the inclusion of pair-specific fixed effects, which absorb the major contrasts in trade levels evident when comparing rich pairs with poor ones. See Eichengreen and Irwin 1995; Frankel 1997; Mansfield, Milner, and Rosendorff 2000; Glick and Rose 2002; Mansfield and Reinhardt 2003; Rose 2003, 2004; and Gowa and Mansfield 2004.

[36] In no case do our results regarding *Currency Union* change if we use Glick and Rose's exact coding, with the

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of-trade shocks have a significantly greater impact on real GDP in countries with a nominally fixed exchange rate regime. Levy-Yeyati and Sturzenegger (2003) and Edwards and Magendzo (2003) also find that countries with fixed currencies experience more volatility in the rate of economic growth. Glick and Rose's (2002) measure of currency unions focuses only on the nominal currency regime, and only on the most extreme form of regime. More recent work on exchange rates has emphasized *de facto* exchange rate regime classifications, with a wider range of types represented (Levy-Yeyati and Sturzenegger 2003; Klein and Shambaugh 2004). Perhaps this distinction between *de jure* and *de facto* currency regimes is empirically significant for trade. Future studies might address this puzzle by examining the relationships among the exchange rate regime, trade volatility, and trade levels with these richer data on currency policies.

Discussion

Our results offer very strong evidence that PTAs and the GATT/WTO reduce the volatility of exports. Moreover, there is ample reason to be confident in this finding. We have analyzed the largest possible sample of cases, indeed, the entire population of independent countries since World War II. We have measured trade volatility using a number of different indices and techniques. Our findings are robust with respect to a range of statistical challenges and estimation methods.

Not only do trade agreements reduce the volatility of exports, lower export volatility itself increases the level of exports. By addressing this issue, we have been able to identify the direct and the indirect influence of such agreements on export levels. Our findings indicate that the indirect effects are especially important: the boost in export levels associated with PTA and

attendant restrictions that are placed on the sample.

GATT/WTO membership stems largely from the tendency for these institutions to reduce trade

volatility, rather than from their ability to increase market access. These results accord with the

conventional wisdom that private traders and investors prefer stability in (cross-border) relative

prices. Moreover, private market actors seem to respond to the assurance of such stability, which

is promoted by trade agreements, by increasing their overseas commerce and investment.

Nevertheless, another possibility is that our results reflect a tendency to form commercial

agreements on the part of states that, for whatever reason, already have very stable trade

relations. If so, then the effect of PTAs would be spurious to a pre-existing harmony of interests

(Downs, Rocke, and Barsoom 1996). However, further analysis, based on Mansfield and

Reinhardt's (2003) study of PTA formation among GATT/WTO members, allows us to refute

this possibility. Starting with Mansfield and Reinhardt's data and sample, we add (one at a time)

each of this paper's four volatility measures (the last one being $\hat{\sigma}^2_{i,j,t}$ from Model 5) to the three

models of PTA formation reported in their Table 2 (Mansfield and Reinhardt 2003, 849). In no

case does trade volatility influence the establishment of PTAs: each estimated coefficient of

volatility is virtually zero and is far from statistically significant. These results indicate that the

trade volatility of pairs of states entering into PTAs is no different than that of other country-

pairs. Preferential arrangements do not select out pairs predisposed to low trade volatility;

rather, they independently reduce variability in trade after the agreement is in place.

Consider the example of Germany's exports to Finland, Sweden, and Austria in the wake of

their accession to the EU in 1995. Not surprisingly, the level of German exports to those three

countries increased after accession. The volatility of its exports to them decreased considerably

at the same time. Specifically, the average absolute percentage change in the real value of

exports to these three countries dropped from 12.1 to 5.7, comparing the five years before and

after 1995. Alternatively, Germany's comparable figure averaged over all other developed GATT/WTO member-states actually rose from 15.5 to 17.4 over the same two periods. This case illustrates the independent role that PTAs play in reducing trade volatility.

Our results also bear on an interesting and important debate over whether the GATT/WTO promotes international trade. This debate was stimulated in large measure by a series of studies in which Rose (2003, 2004) found that GATT/WTO membership does not increase the volume of trade conducted by country-pairs. As shown in the first column of Tables 3 and 4, our results point in the opposite direction since the GATT/WTO directly increases bilateral trade flows. Of greater importance for present purposes, however, is the divergence between Rose's (2005) conclusion that the GATT/WTO does not dampen trade volatility and our finding that this institution markedly reduces such volatility.

In part, this divergence stems from how trade volatility is measured. In contrast to our dependent variables, Rose measures volatility as the variation within a time series (of observations of $X_{i,j,t}$) for a given country measured over 25-year periods. However, as we have argued, his approach ignores period-to-period variation and conflates *predictable* changes in trade with *unexpected* fluctuations. Our measures of volatility, though rough in some ways, do not suffer from these limitations.

Furthermore, our results cast doubt on his conclusion that the multilateral trade regime has little overall bearing on international trade. Rose does not account for the effect of trade volatility on trade flows. We do so and find that the GATT/WTO regime indeed boosts trade levels indirectly, by reducing volatility. This could be the case even if it did not do so directly by expanding market access.

As Rose (2004; see also Milner with Kubota 2005) argues, the GATT/WTO has not done as

much as might be expected to reduce trade barriers. After all, the Generalized System of Preferences and other nonreciprocal schemes undermine the multilateral regime's applicability (Özden and Reinhardt 2005b). Likewise, many countries have far higher Uruguay Round bindings than applied tariffs (Finger, Ingco, and Reincke 1996), suggesting that the GATT/WTO does not universally operate to reduce trade barriers reciprocally. Nonetheless, the GATT/WTO's impact on exports is not trivial. Apart from reducing trade barriers, this institution secures and binds policies, locking them in place at their status quo level, whatever that may be. Such stability and security reduces the "volatility tax" that otherwise dampens international commerce, thereby promoting trade among the contracting parties to the multilateral trade regime.

The issues addressed in this paper raise various questions for future research. For instance, we have argued that trade institutions reduce volatility in relative international prices and, consequently, variability in trade flows. Whereas we have focused attention on the volatility of trade, it would be useful to analyze more directly whether participation in such institutions reduces terms-of-trade volatility. Similarly, we have argued that trade institutions deter members from introducing new protectionist barriers on the products of other participants. Like most of the literature, however, we do not measure trade policy directly since reliable data of this sort are in very short supply. There is a pressing need for more and better data on trade policy, as well as for samples that include new instances of trade protection and "non-cases" where protection is merely contemplated but not imposed (e.g., Busch, Raciborski, and Reinhardt 2005). Furthermore, not all trade agreements are alike. Do differences across agreements in the breadth and depth of market access concessions, dispute settlement institutions, heterogeneity of membership, and organizational development condition how much they reduce trade volatility?

There is reason to think so, based on the argument presented here, and future research could usefully explore this issue. Finally, we have argued that trade institutions reduce volatility by stabilizing the expectations of private traders and investors. It would be useful to analyze this micro-causal mechanism more directly in a study cast at the level of individual firms' responses to trade agreement formation.

Conclusion

In this paper, we have presented some of the first systemic evidence that international institutions stabilize and reduce the volatility in international outcomes. Despite the voluminous literature that has been generated on international institutions, remarkably little emphasis has been placed on exactly how they operate to affect state behavior and what sorts of behavior they influence (Martin and Simmons 1998). The studies that have addressed this issue place virtually no emphasis on the ability of such institutions to reduce the volatility of outcomes, focusing instead on whether the level of a given outcome rises in the presence of an international institution (Braumoeller 2006). We have shown, however, that ignoring the volatility-reducing effects of international institutions and regimes risks both significantly underestimating their impact on global outcomes and presenting a distorted picture of how these institutions affect international relations.

Our analysis also helps to clarify why recent empirical research has been characterized by such heated debate about the effect of the GATT/WTO on trade. These debates stem partly from the emphasis that existing studies place on the level of trade without also considering its volatility. Once we take trade volatility into account, the beneficial impact of trade agreements becomes particularly apparent. Finally, our results show that international institutions can

benefit members as much by locking in the status quo as by improving it. Such institutions have

an important effect on the international economy, but for reasons quite different than those

advanced in most of the existing literature on this topic.

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Table 1: Descriptive Statistics

Variable	Mean	SD	Min	Max
Log Exports$_{i,j,t}$	-0.63	4.73	-9.33	12.27
Abs(Δ Log Exports)$_{i,j,t}$	1.15	2.06	0	17.92
Abs(Δ Export Share)$_{i,j,t}$	0.14	4.39	0	1310.0
Export Drop$_{i,j,t}$ †	0.17	0.38	0	1
Log Exports$_{i,j,t-1}$	-0.74	4.77	-9.33	12.27
Democracy$_{i,t-1}$	0.91	7.73	-10	10
Democracy$_{j,t-1}$	0.86	7.73	-10	10
Conflict$_{i,j,t-1}$	0.001	0.033	0	1
Conflict$_{i,t-1}$	0.25	0.43	0	1
Conflict$_{j,t-1}$	0.24	0.43	0	1
Log GDP$_{i,t-1}$	23.98	2.03	17.73	29.79
Log GDP$_{j,t-1}$	23.91	2.05	17.73	29.79
Log Income$_{i,t-1}$	7.79	1.43	3.90	11.05
Log Income$_{j,t-1}$	7.78	1.44	3.90	11.05
Currency Union$_{i,j,t-1}$	0.02	0.13	0	1
WTO$_{i,j,t-1}$	0.47	0.50	0	1
PTA$_{i,j,t-1}$	0.09	0.28	0	1

N = 527,883 (Models 1, 2, 4, and 5 sample)
† N = 473,797 (Model 3 sample) for this variable only
Number of countries = 162
Number of country-pairs (dyads) = 11,194
Number of ordered country-pairs (directed dyads) = 21,167
Average number of years per directed dyad = 24.9
SD = standard deviation

Table 2: Trade Volatility Models

	Model 1		Model 2		Model 3	
Estimation:	OLS		OLS		Conditional Logit	
Dependent Var:	Abs(Δ Log Exports)$_{i,j,t}$		Abs(Δ Export Share)$_{i,j,t}$		Export Drop$_{i,j,t}$	
Units:	Log 1995 $ millions		% of Partner's GDP		Cutoff: > 50 % Drop	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Constant	2.760**	(1.009)	11.125**	(2.993)	—	—
Log Exports$_{i,j,t-1}$	-0.038**	(0.003)	0.028**	(0.008)	0.495**	(0.004)
Democracy$_{i,t-1}$	0.000	(0.001)	0.001	(0.003)	-0.001	(0.002)
Democracy$_{j,t-1}$	0.000	(0.001)	0.003*	(0.002)	-0.005**	(0.002)
Conflict$_{i,j,t-1}$	0.113	(0.178)	-0.101	(0.088)	1.608**	(0.235)
Conflict$_{i,t-1}$	0.032**	(0.011)	0.078**	(0.019)	0.059**	(0.018)
Conflict$_{j,t-1}$	0.055**	(0.011)	0.149**	(0.046)	0.138**	(0.018)
Log GDP$_{i,t-1}$	0.032	(0.039)	-0.191*	(0.095)	-0.062	(0.070)
Log GDP$_{j,t-1}$	-0.091**	(0.034)	-0.358**	(0.090)	-0.768**	(0.068)
Log Income$_{i,t-1}$	-0.114**	(0.035)	0.283**	(0.089)	-0.334**	(0.067)
Log Income$_{j,t-1}$	0.055	(0.031)	0.008	(0.037)	0.451**	(0.066)
Currency Union$_{i,j,t-1}$	-0.014	(0.060)	0.025	(0.027)	-0.368**	(0.105)
WTO$_{i,j,t-1}$	-0.060**	(0.016)	-0.066**	(0.020)	-0.166**	(0.028)
PTA$_{i,j,t-1}$	-0.111**	(0.019)	-0.068*	(0.028)	-0.379**	(0.037)
N	527,883		527,883		473,797	
Model Test	$F = 43.1$**		$F = 8.1$**		$\chi^2 = 15005.9$**	
Fit to Sample	Adj. $R^2 = 0.149$		Adj. $R^2 = 0.160$		Pseudo-$R^2 = 0.195$	

* $p < 0.05$; **, $p < 0.01$. All tests of statistical significance are two tailed. Robust standard errors clustered by dyad are in parentheses. All models include year-specific as well as directed-dyad-specific fixed effects.

Table 3: Heteroskedastic Regression Model of Trade Levels and Volatility

	Model 4			
Estimation:	Heteroskedastic Regression			
Dependent Var:	Log Exports$_{i,j,t}$		Log Variance$_{i,j,t}$	
Units:	Log 1995 $ millions			
	Coeff.	SE	Coeff.	SE
Constant	—	—	1.741**	(0.014)
Log Exports$_{i,j,t-1}$	—	—	-0.098**	(0.001)
Democracy$_{i,t-1}$	0.018**	(0.001)	—	—
Democracy$_{j,t-1}$	0.016**	(0.001)	—	—
Conflict$_{i,j,t-1}$	-2.606**	(0.211)	—	—
Conflict$_{i,t-1}$	-0.180**	(0.011)	—	—
Conflict$_{j,t-1}$	-0.129**	(0.010)	—	—
Log GDP$_{i,t-1}$	1.394**	(0.026)	—	—
Log GDP$_{j,t-1}$	1.723**	(0.022)	—	—
Log Income$_{i,t-1}$	-0.835**	(0.024)	—	—
Log Income$_{j,t-1}$	-1.165**	(0.020)	—	—
Currency Union$_{i,j,t-1}$	0.806**	(0.044)	0.421**	(0.022)
WTO$_{i,j,t-1}$	0.217**	(0.012)	-0.284**	(0.006)
PTA$_{i,j,t-1}$	0.417**	(0.014)	-0.128**	(0.013)
N	527,883			
Model Test	$\chi^2 \to p<0.001$		$\chi^2 \to p<0.001$	

* $p < 0.05$; **, $p < 0.01$. All tests of statistical significance are two tailed. Robust standard errors are in parentheses. Both equations include year-specific fixed effects, and the export levels equation includes directed-dyad-specific fixed effects.

Table 4: ARCH-in-Mean Model of Trade Levels and Volatility

	Model 5			
Estimation:	ARCH-in-Mean			
Dependent Var:	Log Exports$_{i,j,t}$		Log Variance$_{i,j,t}$	
Units:	Log 1995 \$ millions			
	Coeff.	SE	Coeff.	SE
Constant	—	—	0.959**	(0.035)
Log Exports$_{i,j,t-1}$	—	—	-0.178**	(0.003)
Democracy$_{i,t-1}$	0.012**	(0.002)	—	—
Democracy$_{j,t-1}$	0.006**	(0.002)	—	—
Conflict$_{i,j,t-1}$	-0.723*	(0.320)	—	—
Conflict$_{i,t-1}$	-0.049**	(0.013)	—	—
Conflict$_{j,t-1}$	-0.051**	(0.012)	—	—
Log GDP$_{i,t-1}$	1.319**	(0.078)	—	—
Log GDP$_{j,t-1}$	1.526**	(0.055)	—	—
Log Income$_{i,t-1}$	-0.914**	(0.076)	—	—
Log Income$_{j,t-1}$	-1.064**	(0.052)	—	—
Currency Union$_{i,j,t-1}$	0.434**	(0.067)	0.601**	(0.078)
WTO$_{i,j,t-1}$	0.161**	(0.021)	-0.439**	(0.020)
PTA$_{i,j,t-1}$	0.290**	(0.030)	-0.195**	(0.044)
$\sigma^2_{i,j,t}$ (ARCH.M)	-0.020**	(0.001)	—	—
ρ (AR.1)	0.484**	(0.005)		
$\varepsilon^2_{i,j,t-1}$ (ARCH.1)	—	—	0.799**	(0.010)
N		527,883		
Model Test	$\chi^2 \rightarrow p{<}0.001$		$\chi^2 \rightarrow p{<}0.001$	

* $p < 0.05$; **, $p < 0.01$. All tests of statistical significance are two tailed. Robust standard errors are in parentheses. Both equations include year-specific fixed effects, and the export levels equation includes directed-dyad-specific fixed effects.

Table 5: Estimated Substantive Impact of Trade Institutions on Trade Volatility

Volatility Measure	Model 1 Abs(Δ Log Exports)$_{i,j,t}$	Model 2 Abs(Δ Export Share)$_{i,j,t}$	Model 3 Export Drop$_{i,j,t}$	Model 4 $\hat{\sigma}^2_{i,j,t}$	Model 5 $\hat{\sigma}^2_{i,j,t}$
Units	Log 1995 $ millions	% of Partner's GDP	Probability	Variance	Variance
No Agreements	1.19 [1.18,1.20]	0.17 [0.15,0.20]	0.185	6.07 [6.02,6.12]	5.36 [5.28,5.43]
WTO	1.13 [1.11,1.15]	0.11 [0.09,0.12]	0.162	4.57 [4.52,4.61]	4.70 [4.62,4.77]
PTA	1.08 [1.04,1.12]	0.11 [0.07,0.14]	0.135	5.34 [5.20,5.48]	5.03 [4.89,5.17]
Both WTO & PTA	1.02 [0.98,1.06]	0.04 [-0.03,0.11]	0.117	4.02 [3.92,4.12]	4.49 [4.38,4.59]

NOTE: This table displays estimated volatility figures given the presence and absence of each type and combination of trade institutions, holding all other variables at their respective sample means, using the estimates for Models 1 through 5 shown in Tables 2-4. The unit of analysis, just as in the regressions, is the directed-dyad-year. Figures in brackets form a 95 percent confidence interval around these point predictions. The Model 5 values include the average observation's ARCH.1 component of volatility. Because of the way the conditional logit technique treats the ordered-pair-specific fixed effects, the confidence intervals for Model 3's point prediction — as opposed to those for the effects of the trade agreement variables in that model's $\mathbf{x\beta}$ — cover nearly the entire probability range and are not reported.