Trade Networks, Volatility, and Compensation

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Abstract

As international markets expand, both scholars and policymakers have expressed concern about the potential risks and domestic consequences of openness. For example, a significant group of scholars in international political economy have found that governments are responding to openness and the associated volatility by expanding the welfare state. But a favorable position in the global economy might actually lead to less risk and volatility — and the most common measures of globalization might not fully capture that dynamic. We argue that conventional shorthand for openness (trade as a share of overall income) fails to account for a crucial aspect of globalization; namely, a country’s relational position in the international network of trade. We employ social network analysis to create a new measure of openness. We demonstrate that centrality in the international system actually diminishes volatility and thereby allows governments to minimize compensation to domestic publics. The implication is that a country’s position in the world economy can moderate the risks of exposure to international markets.
1 Introduction

Many scholars and pundits have questioned whether globalization makes nations more vulnerable to swings in the global market and competitive pressures on domestic spending. The fear is both that market liberalization might strain welfare provision and thereby increase inequality within states, and that trade openness might leave countries overly exposed to global volatility and economic downturn.

Research on the domestic consequences of openness to international markets has not yet converged, in part because it is difficult to measure many of the facets of the broader relationship between globalization and economic outcomes. Scholars interested in estimating the effects of trade ties typically rely on a simple shorthand: a country’s imports and exports as a share of their overall income. But the implicit causal mechanism behind the notion that openness might have negative domestic consequences has little to do with the volume of traded goods per se. The increasingly dense ties of the global trade system mean that a country’s relational position in the network of the world economy could strongly influence economic outcomes. At issue is not only how much a country trades, but with whom it trades. Researchers interested in globalization have yet to focus on the number of trading partners that a country has, and, in turn, how deeply those partners are embedded in the international trading system.

In contrast to existing claims about the effects of “openness” on both the welfare state and volatility, we argue that centrality in the international trading network is a better indicator of a state’s likely experience of the consequences of globalization. Centrality, a core concept in social network analysis (SNA), is rapidly making headway in political science because it incorporates both the bilateral connection between states and the wider connection to the system into a single measure. This relational approach adheres closely to the realities of the international trading system, which is characterized by broad linkages within the community of nations rather than isolated bilateral ties. We stake new ground

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1See, for example, Leamer 1998, Dollar and Kray 2001. Birdsall & Hamoudi (2002) offer some skepticism, noting that countries that export commodities will have particularly high trade/GDP ratios but may not be open in other respects.
by arguing that economic volatility decreases when a country is more central to the global network of trade, which in turn leaves governments free to pursue the competitive benefits of trade in lieu of compensating domestic publics.

We demonstrate that a country’s relational position in the international trading system is associated with decreases in government spending in the developed and developing world alike. The link, though, is through stability: by being connected to a diverse set of countries that are themselves central to the international trading system, countries that are more central to the global trade network experience less volatility than those that are peripheral. Taken together, these results contribute to a deeper understanding of the dynamics of openness, and how openness without centrality leaves countries exposed to the volatility of the global marketplace.

The remainder of the paper proceeds as follows. The next section briefly reviews the relevant literature on the compensation hypothesis and volatility. The third section discusses the theoretical and empirical advantages of social network analysis as a tool for interpreting attributes of globalization that are not captured by the standard trade to GDP ratio. The fourth section describes the datasets and presents our models. We show that, in contrast to volume of trade, networked trade does indeed reduce government consumption across the world, and demonstrate a possible causal mechanism: that networked trade also decreasing a country’s vulnerability to shocks. The final section concludes.

2 Compensation, Volatility, and Vulnerability

The link between increased trade and economic growth has been exhaustively documented, both in theory and in practice. In classical Ricardian trade theory, open markets allow countries to specialize on goods in which they have comparative advantage, thereby increasing welfare for all participating countries. Empirically, many cross-national studies show a strong and positive relationship between a country’s levels of trade and its
economic growth, as well as between open markets and growth. However, at least in the classical model, economic growth through trade openness comes at a price. These models imply that the competitive pressures of free trade will crowd out the welfare function of the state because the movement of factors should, through factor price equalization, promote a “race to the bottom.” This apparent tension between optimal economic growth and the welfare function of the state is one of the central flashpoints of the debate on globalization.

Despite the intuitive appeal of this “race to the bottom” argument, empirical evidence demonstrates that government spending in the developed world in particular has actually increased with the rise of globalization and trade openness. This observation gives rise to the compensation hypothesis; that is, that governments who seek to maintain their hold on power will redistribute the gains from trade toward greater welfare spending. A significant body of empirical research grapples with this apparent contradiction, hoping to gain purchase with disaggregated measures of spending and of globalization alike (Dreher, Sturm & Ursprung 2008), or by introducing previously omitted variables, such as structural changes in a country’s economy, that might be driving the process (Iversen & Cusack 2000).

Taking a somewhat different tack, Rodrik (1997, 1998) argues that the missing link in the research on globalization and government spending is the relationship between openness and increased volatility. Exposure to the global economy leaves countries more vulnerable to the ups and downs of the international marketplace. Thus, shocks in the global economy can throw countries with open markets into temporary disequilibrium, forcing governments to spend more abundantly in order to cushion the blow. Bolstering this argument, Kim (2007) demonstrates empirically that openness has less impact on

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government spending than external risk.

In short, the underlying assumption that openness leads to greater volatility is misguided theoretically and contestable empirically. Our goal is to revisit that relationship and explore how the network of interconnectedness with other countries might impact external risk. Policymakers and previous research have assumed that openness spurs volatility, but it is also possible that certain types of openness would actually stabilize an economy, by bringing the welfare gains from trade from diversified sources.\(^4\) Diversification of trading partners can be a key component in cushioning a country from shocks.

If a country is trading heavily with partners who are themselves important in the international trading system, that indicates a frequency of interactions with several strong economies and a central role in the trade network. That, in turn, might act to insulate an economy from the an economic shock originating in one particular country — which could be damaging if that country were chained to a relatively few number of trading partners. Centrality to the trade network, then, could be an important precondition for stability as countries integrate on the international level. Indeed, if countries open up to the global economy with asymmetrical relationships, relying too heavily on one trade partner, they can be more exposed to short-term fluctuations that may increase volatility in the short run. That, in turn, would lead governments to seek compensation for their destabilized voting publics. But if countries that are central to the trade network experience decreased volatility, their governments would be free from the obligation to compensate, and international competitive pressures might in turn lead to drops in welfare spending, as suggested in the literature.

Crucial to this argument is the idea of diversification of trading partners, a concept that is not fully captured by simply measuring trade as a share of GDP. Countries may open their borders to trade but, in the case of many island nations, import far more

\(^4\)Many economists have explored the consequences of asymmetry in trading relationships, postulating that developed countries are best poised to reap the gains from trade with less developed economies (Dornbusch, Fischer& Samuelson 1977; Baumol & Gomory 1998; Krugman 1986). While centrality to trade networks in practice means that countries trade with other developed economies, we are less concerned here with general welfare outcomes than exploring how asymmetrical trading relationships might affect economic stability, and the subsequent effects on government spending.
than they export; or they may export only a few goods, such as commodities, to a few
countries. Such countries would have relatively high trade as a share of GDP but would
be peripheral to the trade network. By contrast, a country that had trade in- as well as
outflows with several countries that themselves were active in the global trade network
would be more central to the trade network.

These are the possibilities that this paper will explore, through a different means of
operationalization than the standard measures of openness. While the relationship be-
tween trade openness and economic outcome is important in its own right, the underlying
concern with the rise of globalization makes it imperative that some attention be given to
growing links between countries that are not captured in terms of simple trade. Brooks
(2005) notes that globalization is an expansive concept that has come to describe such
diverse developments as the monetarization of the world economy, increased foreign direct
investment, the growth in the number and influence of multinational corporations, and
unique social and political interdependencies.

Building on this observation that globalization encompasses much more than simply
the deepening and diversification of trade ties, a number of scholars have begun to study
the influence of non-trade linkages between states in the international system (Fern-
andez 1997, Nayyar 2008). In addition to expanding beyond trade to other forms of
international exchange and interaction, there is increasing scholarly interest in conceiving
of these interactions in terms of networks rather than bilateral exchange. The strength of
a country’s position in this economic network likely impacts stability of the international
system, as well as the relations between countries, and many scholars in political science
have recently been exploring those outcomes.

There are numerous illustrations of this trend. Von Stein (2008) explores the rela-
tionship between social networks and treaty ratification. Working on an entirely different
subject, but with similar methods, Hafner-Burton and Montgomery (2006) explore the
relationship between the network of IGO membership and international conflict, finding
that conflict is increased by the presence of other states in similarly structured net-

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work clusters. Also concerned with the incidence of international violence, Potter (2008) empirically demonstrates a relationship between centrality in international transit and telecommunication networks and a decreased likelihood of international conflict.

Conceiving of international exchange beyond the strict confines of trade and in terms of networks offers several advantages. One might imagine a situation where a country has relatively limited exposure to trade, due to factor endowments in that country, but does experience other forms of contact with the global economies. Countries that have a relatively modest degree in cross-border trade in goods but enjoy high level of tourism, for example, will certainly be more exposed to internationalizing forces than those that do not. Conversely, we can imagine that countries such as China, which in recent years has liberalized trade at a far greater rate than it has allowed information to flow into its economy, might be undergoing a different process than if it were deeply networked into today’s economy. Reyes, Fagiolo, & Schiavo (2008) show how networked measures of trade highlight the difference between the economic integration strategies of East Asia and Latin America over the last 40 years; the former group has far higher centrality scores than the latter.

In sum, we argue that centrality in international trade and transit networks insulates states from the volatility of the international marketplace, thereby allowing such central states to minimize compensation to domestic publics in the form of welfare payments. This proposition immediately leads to two testable hypotheses:

$H_1$: Countries that are more central to global trade networks experience less economic volatility.

$H_{1a}$: The decreased volatility that “central” countries experience allows them to avoid compensating their domestic publics; thus, government spending decreases.

The following section goes into greater detail on the mechanics of centrality to a particular network.
3  Measuring Networked Trade and Transit

A network-theoretic test is particularly appropriate for the question of globalization because of the nature of the data. There are two sorts of data relevant to this discussion: attribute data and relational data. Attribute data describes the qualities of agents — age, income, and power, for example. Standard statistical techniques are designed to uncover relationships in such data. However, a great deal of data in political science, including most data with which we might operationalize aspects of globalization, is relational data — the contacts, ties, connections and transfers between agents that cannot be cleanly reduced to properties of the agents themselves because they are characterize their interactions (Scott 1991). Because globalization and interdependence are unambiguously relational phenomena, social network analysis can produce more accurate empirical measures of these ties between states as the second order links between states and the broader and more complexly connected international system.

To take one example, consider the trade data commonly used in measures economic openness. When researchers assign imports to states, they are effectively taking a flow, thought of graphically as a line (or “edge”) between two states (or “nodes”) and artificially reducing it to an attribute of a state. Not only does this limit the analysis to counting only imports or exports and discarding the other in order to avoid redundancy, it also fundamentally obscures the fact an import in one country is an export from another. It would be far better to consider a broader network of trade, which can map the flow of exchange through the entire international system.

Social network analysis, which has a relatively longer history of use in fields such as sociology and finance, began to make significant inroads into political science in the 1990s primarily through the study of policy networks (Marin & Mayntz, 1992; Marsh Rhodes, 1992), though there are earlier, pioneering examples (see Eulau & Siegel 1981; Tichy, Tushman, & Fombrun 1979). Network theory was immediately influential, in part, because it offered an array of developed and readily accessible tools with which to explore the broader structure of the relationships between actors. It has found use in
such disparate areas as the study of public opinion (Huckfeldt, Beck, Dalton, & Levine 1995), innovation diffusion (Mintrom & Vergari 1998), political theory (Robin 2000), and the study of legislatures and the judiciary (Fowler 2006).

Some scholars have already begun the process of adapting network analysis techniques to measure economic interdependence and the reach of globalization. For example, Kim and Shin (2002) use social network analysis to demonstrate that the international trade network has become denser since the mid-1950s, a result driven primarily by the development of nations at the middle of the spectrum. However, they also find evidence of regionalization in the globalization process, with greater density in intraregional trade networks than interregional ones. Along similar lines, Kali and Reyes combine data on international trade linkages with network methods to examine the global trading system as an interdependent complex network. They find that the network of international interdependence is hierarchical, that smaller countries have been integrated into this network with considerably more frequency over the 1990s, and that the network is ‘balkanized’ according to the geography of trading partners. From these findings, they argue that a country’s position in the network plays an important role in the trajectory of its economic growth (Kali & Reyes 2006).

Our task here is to discover whether such networked conceptions of interdependence have effects on economic growth that are independent of standard measures of openness. In order to employ network measures to study the relationships between globalization, volatility and economic growth we need data that can be analyzed in in yearly N x N matrices where N is the the states of the international system in a given year (Table One). This, however, is a reasonably straightforward task, as the required information is already present in dyadic datasets, albeit in truncated form.

Measures of network centrality provide a simple way characterize the relational importance of each state in these matrices, and therefore serve as a useful empirical approximation of the relative integration of a state into the globalized international system. Centrality measures evaluate the location and prominence of actors or nodes in the net-
Table 1: **Trade Matrix, 1990 (sample)**

<table>
<thead>
<tr>
<th></th>
<th>United States</th>
<th>United Kingdom</th>
<th>France</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>*</td>
<td>0.049</td>
<td>0.028</td>
<td>0.024</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.008</td>
<td>*</td>
<td>0.042</td>
<td>0.025</td>
</tr>
<tr>
<td>France</td>
<td>0.005</td>
<td>0.045</td>
<td>*</td>
<td>0.057</td>
</tr>
<tr>
<td>Italy</td>
<td>0.004</td>
<td>0.024</td>
<td>0.053</td>
<td>*</td>
</tr>
</tbody>
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work based on network position alone and can therefore be thought of as a structural attribute of the nodes in a network. This will prove advantageous because, as a statistic, centrality measures can infuse a relational understanding into a statistical model of economic growth. It is therefore possible to retain some measure of comparability with existing findings while capturing the deeper interrelationships between the node and the broader network. We use a measure of eigenvector centrality to capture the relational position of a state to the international system. This measure is described in Equation 1, which produces a system of equations (one for each state per year) from which we derive a measure of network centrality for each state in the international system for each year under investigation (Kali & Reyes, 2006; Salancik, 1986).

\[ imp_i = \sum dep_{ij} imp_j + iv_i \text{ for all } j \neq i \]  

(1)

where \( dep_{ij} \) = the degree to which \( i \) is depended upon by \( j \)

\( imp_j \) = the importance of \( j \)

and \( iv_i \) = the intrinsic value of \( i \)

This measure differs from simpler measures of centrality (e.g. degree, closeness, or betweenness) in ways that adhere closely to the mechanics of globalization. It simultaneously accounts for the overall volume or magnitude of the international interaction, as well as the number and importance of partners. The insight of the measure is that if no one depends on a country then that country is not central to the network. Furthermore,
if only unimportant countries depend upon a country, then it is also relatively isolated from the system. However, if a state is widely depended on, or is depended upon by central states in the international system, then that state will also rate highly in centrality. Thus, the relative importance of a state in the international system is determined by a reciprocal set of equations, which in turn describe the relative importance of the states to which it is connected.

To illustrate, Figure One depicts a network graph of the trade flows among the members of the South African Development Community (SADC) for the year 1996. The countries that are most central to the network in that year — Mozambique, Zambia, and Zimbabwe — were those that had not only the largest number of trading partners, but also higher volume of trade with those partners, who in turn traded relatively heavily with other important countries in the network. That is, the aforementioned countries form the core of the system and are central to it, while states like Swaziland, Lesotho and Namibia constitute the periphery. This distinction is the essential insight that we capture with the measure of eigenvector centrality.

FIGURE ONE ABOUT HERE

As Lazer (2003) notes, a state that is more central to a network of countries is in turn embedded in a complex web of existing as well as potential relationships, meaning that this measure is capturing something very different from the bilateral ties explored in most models that link trade to economic growth.

To illustrate this point, Figure Two shows the discrepancy between the conventional measure of openness (trade as a share of gross domestic product) and the eigenvector centrality measures of networked trade as described above, for Latin American countries, with values averaged from 1960 to 2000.

FIGURE TWO ABOUT HERE

Note that in this developing part of the world, a systematic disconnect exists between the correlations at the low- and high- end of this graphic. Many countries that are low on
trade/gdp are also low on networked trade. But unlike in the OECD countries — which trade frequently and have many central trading partners — in Latin America there is not a single instance where a country is high in both. The countries that are most central to the global trade network are not necessarily the countries that have a high trade to GDP ratio; Panama and Guyana both trade extensively, but mostly with countries that are themselves less central to the global trade work. Guyana’s main trading partners are the USA, the UK, Trinidad and Tobago, Japan, Canada and Jamaica. The United States accounts for only one-third of Panama’s trade, with other trading partners including Venezuela, Japan and Germany. By contrast, Argentina’s main trading partners in 2000 were Brazil, Chile, and the U.S., China, Spain, Germany; Brazil’s were USA, Germany, Japan, the Netherlands, Argentina, the former USSR and Italy. The difference in those countries’ scores lies in the combination of the number of connections and the fact that connections to high-scoring nodes carry more weight in an individual score than equal connections to low-scoring nodes.

For further comparison, Table Two shows that this measure goes beyond even complicated measures of globalization. We contrast our measures of centrality to the trade network with a disaggregated index of globalization across several dimensions — including political, economic, and cultural.\footnote{We are grateful to Axel Dreher for these data.}

TABLE TWO ABOUT HERE

Interestingly, the component that is most highly correlated with trade centrality is the measure of political globalization (correlation of 0.72), which might indicate that centrality to the trade network implies ideological convergence. But none of the component measures scores particularly high; their average correlation with networked trade is .34. This demonstrates that though there is some overlap with concepts of globalization, centrality to international trade and transit networks has distinct properties that generate distinct expectations. The following sections examine those expectations more closely.
4 Empirical Tests

This section outlines the operationalization of the theories we have outlined above and offers empirical tests of the hypotheses derived from those theories. We begin by demonstrating that centrality in the international trade and transit networks have a substantial negative impact on government expenditure, across developed and developing countries alike. We then demonstrate that centrality in the international trade and transit networks is associated with lower economic volatility across a variety of dimensions. We argue that this second finding indicates the mechanism through which trade moderates government spending.

4.1 Operationalizing of Key Variables

In order to test our expectation that depth of linkages beyond trade independently contribute to the volatility experienced by an economy, we require some operationalization of these linkages. We take eigenvector centralities through the method outlined above, using Gleditsch’s (2002) expanded measure of dyadic trade. Perhaps unsurprisingly, those countries that rank relatively low in trade centrality are in Africa and Central Asia. Also unsurprisingly, the OECD countries are at the top of the list for centrality. The surprises occur at the margins; for example, even though a significant share of the United Arab Emirates’ GDP goes toward trade, it scores lower on trade centrality than other countries that trade considerably less than it does. This illustrates not only the deceptive weight that trade in commodities can introduce in examining trade alone, but also the importance of a country’s trading partners; the UAE’s are Japan, South Korea, India, Thailand, China, who themselves do not rank in the very top in terms of trade centrality. In a further illustration, many of the islands in the South Pacific have high levels of trade, but do not rank high in terms of trade centrality — indicating that although those island states rely disproportionately on trade, their high level of imports mean that they are not themselves deeply embedded in the reciprocal trade network.
In all specifications, we also include the standard measure of openness as described above: trade as a share of GDP (trade). We include those in the models to highlight the contrast between the traditional measure of openness and our networked measures. To avoid the problem of endogeneity — that is, the possibility that positive economic outcomes are driving our measures of centrality in the network — we lag all network variables by one year. Additional control variables are discussed as we present our various models.

We calculate volatility measures for all relevant variables (output, income, final consumption, household final consumption, and investment) using the standard technique in use among economists, which is to take the natural log of the difference of the variable in question, and then the square root of the five-year moving average, multiplying that quantity by the square root of the number of years in the sample (25 years, for our primary specifications).

Pooled time series datasets such as this one violate the Gauss-Markov assumptions for linear estimation. The presence of relationships within countries and in particular time periods means that there will be serial correlation among observations, as well as structure in the error terms. Though there are many fixes, no one method will work for all types of data (Beck and Katz 1995, Wilson and Butler 2004). To correct for serial correlation while avoiding the downward bias caused by including lagged dependent variables (Achen 2004), our main specifications employ Prais-Winsten transformations, which assume an autoregressive moving-average process. We also include panel-corrected standard errors to correct for unit effects.

Another complication is the presence of a high degree of missingness across observations. Many studies simply drop all observations with missing variables. However, as has been well documented, listwise deletion can lead to biased coefficients as well as inefficient estimations (King et al 2001). Since the missing data across those countries and years did not appear to be missing at random — the poorer countries tend to have more missing observations, as did all countries in the earlier part of the sample — we used Amelia (Honaker, King, and Blackwell 2007) to impute values for the missing observations. The
estimations below reflect estimations across five imputed datasets. Because our central-ity measure is based on dyadic trade measures that only extend until 2000, and because many developing countries had extreme missingness on variables in the 1960s and early 1970s, we limited the imputations from 1976 to 2001.

4.2 Findings

The first task is to determine the relationship between the above described measures of trade centrality and government spending ($H_1$). Table Three shows the results of a model that includes parameters from several well-known specifications of the determinants of welfare spending (Iverson and Cusak 2000, Rudra 2002), including the age dependency ratio (that is, the ratio of the combined population of children (0-14 years) and the elderly population (65 years and over) — persons in the “dependent” ages — to every 100 people); the level of output (GDP in constant US dollars); the level of democracy (Polity scores), the percent of the population that lives urban areas; and value added in manufacturing as well as in agriculture. We also include our measure of networked trade, taking the square root to normalize the distribution.

TABLE THREE ABOUT HERE

Note that our measure of centrality in the international trade network is associated with statistically significant decreases in government spending. This shows that operationalizing globalization as a country’s centrality to international networks produces different results than simply measuring trade as a share of GDP; the effects of the latter measure are actually positive. Figure Three, which graphs the expected values for both indicators, provides a sense of the magnitude of these effects, as well as the degree to which the relative effects of trade and trade centrality diverge.

FIGURE THREE ABOUT HERE

Although trade openness does track increases in spending, those changes are nearly

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6Missingness for the variables in question was at around 30 percent. The final estimations represent average coefficients across all five datasets, with the standard errors reflecting the within- as well as the between-dataset variation.
matched in magnitude by decreases in spending associated with networked trade. Thus, for every dollar spent as compensation for an increase in trade as a share of output, a proportional increase in networked trade means a drop in spending of 88 cents. Thus, even though the net gain is an increase in spending, those increases are offset by trading heavily among more networked partners. This indicates that countries hoping to maintain their competitive edge in the international system might consider not only the volume of trade, but diversification of their trading partners to include countries who are themselves central to the network.

Our next task is to show the mechanism through which trade decreases spending. We argued above that centrality to the network implies greater volumes of trade with countries that are themselves diversified and active players in the international trade network. Thus, with revenue from trade not hinging on the health of any one trading partner, a country will be more insulated from shocks.

To test this supposition, we estimate the effects of centrality to the network on volatility, using key independent variables from the literature on volatility in economics (IMF 2007) as well as political science (Kim 2007). Volatility has shown to be a function of output (GDP); the size of a country (population); a government’s ability to make decisions without constraint (constraints, operationalized here as Henisz’s (2007) political constraints index); the level of democracy in a country, which further shows how insulated politicians are from the electorate (democracy, expressed through Polity scores); the level of inflation, the stock of money in the economy (M2 as a share of GDP), the volatility of terms of trade; and capital openness (Reinhart and Rogoff’s twelve-point scale). We also include the standard measure of trade as a share of GDP, as well as our measure of networked trade.

Table Four shows the results of these specifications for volatility (calculated as described above) for five critical components of a country’s economy: income (GNI), output (GDP), final consumption, household final consumption, and investment as a share of GDP.
The coefficients for the control variables in the models are generally in line with the inherited wisdom on the mechanics of economic volatility, though findings for these variables are largely statistically insignificant. Increased GDP has a constantly negative impact on volatility, suggesting that wealth helps to protect states from the swings of global markets. Inflation and volatility in the terms of trade show consistently positive coefficients, suggesting that, as expected, these factors make states more vulnerable. Findings for the other control variables are mixed.

Consistent with our hypothesized expectation, we find that trade centrality has statistically significant and negative effects on volatility in all five models, indicating support for Hypothesis 2. By contrast, the effects of open trade tend to be statistically insignificant and positive. This is consistent with Kim’s 2007 finding of the irrelevance of trade as a share of GDP in determining volatility. However, our results indicate that the way in which one measures trade is important. Though trade’s importance to a particular economy does not affect volatility, a country’s position in the global trading network can actually serve to decrease volatility and a substantively important way.

To give a sense of the substantive magnitude of the results, we calculated predicted for the key independent variables, holding other independent variables at their mean values. Table Five shows the substantive impact of an increase of one standard deviation for trade as a share of GDP, contrasted with our measure of networked trade, for all of our dependent variables of interest.

As a further illustration, Figure Four plots these predicted values for changes in trade as a share of GDP as well as networked trade, across changes varying from two standard deviations away from the mean in both directions.

From these graphs, it is easy to see that networked trade has persistent negative and statistically significant effects on all the types of economic volatility listed here. By
contrast, trade as a share of GDP has effects that are at times positive. Where the effects substantively match those of networked trade, they often run in the opposite direction, as we can see for the graphs on final consumption, household consumption, and spending. Not only do the signs of the coefficients on open trade flip, but in many cases they are not significantly different from zero. Similarly, fluctuations in final and household consumption that rise as a function of open trade are ameliorated by networked trade.

We performed several robustness checks to test the durability of the findings. First, we ran the models for the original dataset, prior to using multiple imputation. Despite the smaller number of observations and somewhat larger standard errors, the results were consistent with those presented here. Second, we ran Amelia to extend to a broader time span — from 1960 to 2007. The coefficients of interest remained unaffected, though the standard errors increased somewhat – a testament to the larger degree of missingness in those years, since the imputation algorithms produce noise in the presence of too few observations. Additionally, we ran the specifications using fixed effects for region, as well as individual fixed effects for country and year, which achieved largely similar results. We also adapted the specification set out by Mansfield and Reinhardt (2007), which examines the effects of WTO and PTA membership on volatility. However, central to that adaptation was the transformation of their dyadic dataset to a monadic one, including creating dummy variables for whether a country was in a conflict or in a currency union. This process removed a large part of the original argument made here, and, as such, the specifications had mixed results, with our network variables having the expected sign and significance for exchange-rate shocks, but not in the rest of the models. We view this as a function of the impossibility of cleanly converting many of the key variables under consideration here to a monadic format rather than a weakness of the original model.
5 Conclusion

We hope to have expanded on the ongoing debate on the effects of globalization in two ways. First, we have empirically demonstrated plausible causal mechanism that links globalization and the welfare state. By showing that centrality to the trade network decreases volatility, which in turn decreases government spending, we have delineated an important step in the process by which openness impacts national governments and the public. If countries with diversified trade links with important partners are more insulated from volatility, their governments can forego compensation, and welfare states face the erosion of competitive pressures.

Broad connections to the international system, or deep connections with particularly important states in the international system, appear to be a key indicator of the degree of volatility that a national economy will likely suffer. Thought of differently, this finding suggests that the core of the international economic system is considerably more insulated from volatility than is the periphery. If centrality to the trade network is shown to decrease volatility, this illuminates the findings in Table Three, that a country’s position in the trade network can lead to drops in welfare spending. When countries are open but are not forced to shield their citizens from the ill effects of volatility, international competitive pressures may in turn promote decreases in welfare spending.

Additionally, we hope to have shown the added leverage of using network measures as a way of approximating the ties among countries. We have also shown that networked trade is theoretically as well as empirically distinct from simple trade openness. This is further evidence that social network analysis has much to offer international political economy, in terms of providing accurate ways of measuring relational links among states.

In future research, we hope to examine more closely the dynamics within specific trade agreements. Regional trade agreements proliferate across the globe, but certainly some of those are more “networked” than others. Employing both social network analysis as well as our other dimensions of globalization to measure the depth of those agreements in practice would be a useful descriptive exercise in of itself, which would doubtless then
shed light on the dynamics of regionalization in the process of globalization.

Additionally, social network analysis could allow us to revisit and test further hypotheses about the potential pitfalls of globalization. Early dependency theory made much of the notions of “core” versus “peripheral” countries in the international system. Centrality could be an empirical stand-in for these concepts. Network analysis could help examine whether peripheral countries remained locked in development traps, or whether gains in the center came at the expense of gains in the periphery.

Additionally, network analysis could be useful in operationalizing the secondary determinants of the gains of trade. Thinkers in classical economics first conceived of internationalization as encompassing not just the movement of goods but also the flow of ideas. The classical models of production focus only on three factors — land, labor, and capital. Factor flows have typically been modeled as trade in goods and services, as well as migration. But the initial theories also placed a heavy emphasis on other conduits as well. Even as he was espousing protection of goods, John Maynard Keynes (1933) stated “ideas, knowledge, science, hospitality, travel – these are things that of their nature should be international.” More recently, evidence has shown that transfer of ideas and techniques to poor countries has played a significant role in the global evolution of health status (Deaton 2004). We are working to establish a link between the flow of ideas and a country’s position in the international network.

As it stands, we hope to have demonstrated the power of social network analysis to refine our understanding of integration into the global economy. The terms on which a country integrates, and the frequency of relations with its partners, can have important effects on a country’s stability and its need to cushion its constituents from international pressures.


Faber, Jan and Anneloes Barbara Hesen. 2001. Innovation capabilities of European nations Cross-national analyses of patents and sales of product innovations.


7 Appendix
Table 2: Correlation Matrix of Centrality Measures and Globalization

<table>
<thead>
<tr>
<th></th>
<th>Economic globalization</th>
<th>Actual flows</th>
<th>Restrictions</th>
<th>Social globalization</th>
<th>Personal contact</th>
<th>Information flows</th>
<th>Cultural proximity</th>
<th>Political globalization</th>
<th>Overall globalization</th>
<th>Centrality to trade network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic globalization</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual flows</td>
<td>0.86</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrictions</td>
<td>0.88</td>
<td>0.51</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social globalization</td>
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<td>0.60</td>
<td>0.87</td>
<td>1.00</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal contact</td>
<td>0.71</td>
<td>0.57</td>
<td>0.67</td>
<td>0.79</td>
<td>1.00</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Information flows</td>
<td>0.76</td>
<td>0.49</td>
<td>0.83</td>
<td>0.88</td>
<td>0.55</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural proximity</td>
<td>0.77</td>
<td>0.54</td>
<td>0.78</td>
<td>0.93</td>
<td>0.61</td>
<td>0.74</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Political globalization</td>
<td>0.21</td>
<td>0.10</td>
<td>0.26</td>
<td>0.29</td>
<td>0.01</td>
<td>0.29</td>
<td>0.39</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall globalization</td>
<td>0.88</td>
<td>0.66</td>
<td>0.86</td>
<td>0.92</td>
<td>0.66</td>
<td>0.83</td>
<td>0.89</td>
<td>0.58</td>
<td>1.00</td>
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<tr>
<td>Centrality to trade network</td>
<td>0.35</td>
<td>0.21</td>
<td>0.40</td>
<td>0.41</td>
<td>0.19</td>
<td>0.35</td>
<td>0.46</td>
<td>0.72</td>
<td>0.59</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Figure 1: Network Graph for the South African Development Community, 1996

Figure 2: Differences between trade measures for Latin American countries, 1960-2000 (average)
Figure 3: Effects of Trade vs Networked Trade on Spending
Figure 4: Effects of Trade vs Networked Trade on Volatility
Table 3: **Government Spending** *

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>19.76</td>
<td>(1.83)</td>
</tr>
<tr>
<td>Age</td>
<td>1.48</td>
<td>(1.50)</td>
</tr>
<tr>
<td>Dependency</td>
<td>5.26E-13</td>
<td>(3.44E-13)</td>
</tr>
<tr>
<td>Democracy</td>
<td>-0.004</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Urban</td>
<td>0.04</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Population</td>
<td>-8.93E-10</td>
<td>(1.72E-09)</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>-0.12</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>-0.09</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Trade</td>
<td>0.03</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Networked Trade</td>
<td>-1.43</td>
<td>(0.27)</td>
</tr>
</tbody>
</table>

| ρ                 | .69         |
| N                 | 4880        |
| R²                | .18         |
| Wald χ²           | 326.79      |
| Prob > χ²         | 0           |

* Dependent variable is government consumption as a share of GDP. Prais-Winsten regressions with panel-corrected standard errors in parentheses. Estimation coefficients and statistics are averaged across five datasets; panel-corrected standard errors are a function of the variance within and across datasets.
Table 4: Specifications for Volatility *

<table>
<thead>
<tr>
<th>Variable</th>
<th>Income Volatility</th>
<th>Output Volatility</th>
<th>Consumption Volatility</th>
<th>Consumption Volatility</th>
<th>Investment Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.43 (0.61)</td>
<td>2.53 (0.60)</td>
<td>1.23 (0.61)</td>
<td>2.38 (0.49)</td>
<td>2.91 (0.28)</td>
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<tr>
<td>GDP</td>
<td>-5.10E-13 (2.88E-13)</td>
<td>2.28E-13 (2.05E-13)</td>
<td>-3.13E-13 (1.21E-13)</td>
<td>-3.40E-13 (2.94E-13)</td>
<td>-1.82E-13 (9.76E-14)</td>
</tr>
<tr>
<td>Population</td>
<td>-1.73E-10 (1.69E-09)</td>
<td>1.88E-09 (1.32E-09)</td>
<td>8.06E-11 (2.73E-10)</td>
<td>-1.74E-09 (9.41E-10)</td>
<td>-6.24E-10 (5.82E-10)</td>
</tr>
<tr>
<td>Constraints</td>
<td>-0.15 (0.11)</td>
<td>0.08 (0.06)</td>
<td>-0.09099568 (0.05)</td>
<td>-0.003 (0.06)</td>
<td>-0.12 (0.06)</td>
</tr>
<tr>
<td>Democracy</td>
<td>0.0026 (0.0020)</td>
<td>-0.0006 (0.0013)</td>
<td>-0.0005 (1.23E-03)</td>
<td>1.79E-05 (0.0008)</td>
<td>-0.0012 (0.0011)</td>
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<tr>
<td>Inflation</td>
<td>0.00002 (1.87E-05)</td>
<td>0.00006 (1.78E-05)</td>
<td>(2.03E-05) (1.63E-05)</td>
<td>(5.26E-05)</td>
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</tr>
<tr>
<td>M2/GDP</td>
<td>0.003 (0.002)</td>
<td>0.0002 (0.002)</td>
<td>0.0004 (1.03E-03)</td>
<td>-0.002 (0.0009)</td>
<td>-0.0004 (0.0008)</td>
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<tr>
<td>Terms of trade</td>
<td>0.13 (0.05)</td>
<td>0.13 (0.04)</td>
<td>0.15 (0.03)</td>
<td>0.05 (0.03)</td>
<td>0.04 (0.02)</td>
</tr>
<tr>
<td>Capital</td>
<td>0.03 (0.03)</td>
<td>0.03 (0.02)</td>
<td>0.02 (0.02)</td>
<td>0.02 (0.02)</td>
<td>0.00 (0.02)</td>
</tr>
<tr>
<td>openness</td>
<td>0.04 (0.04)</td>
<td>0.02 (0.02)</td>
<td>0.02 (0.02)</td>
<td>0.02 (0.02)</td>
<td>0.00 (0.02)</td>
</tr>
<tr>
<td>Trade/GDP</td>
<td>-0.00007 (2.17E-03)</td>
<td>0.0001 (2.18E-03)</td>
<td>0.006 (2.51E-03)</td>
<td>-0.005 (2.58E-03)</td>
<td>-0.0002 (9.75E-04)</td>
</tr>
<tr>
<td>Networked trade</td>
<td>-0.40***</td>
<td>-0.47***</td>
<td>-0.28*</td>
<td>-0.51***</td>
<td>-0.15***</td>
</tr>
<tr>
<td>ρ</td>
<td>.80 (0.16)</td>
<td>.78 (0.19)</td>
<td>.78 (0.15)</td>
<td>.79 (0.16)</td>
<td>.89 (0.07)</td>
</tr>
<tr>
<td>N</td>
<td>3986</td>
<td>3627</td>
<td>3427</td>
<td>3367</td>
<td>4368</td>
</tr>
<tr>
<td>R²</td>
<td>.04 (.04)</td>
<td>.08 (.02)</td>
<td>.08 (.02)</td>
<td>.08 (.02)</td>
<td>.07 (.02)</td>
</tr>
<tr>
<td>Wald χ²</td>
<td>20.01</td>
<td>32.38</td>
<td>32.34</td>
<td>28.97</td>
<td>20.01</td>
</tr>
<tr>
<td>Prob &gt; χ²</td>
<td>.04 (.04)</td>
<td>.001 (.001)</td>
<td>.003 (.001)</td>
<td>.001 (.001)</td>
<td>.10 (.07)</td>
</tr>
</tbody>
</table>

* Prais-Winsten regressions with panel-corrected standard errors in parentheses. Estimation coefficients and statistics are averaged across five datasets; panel-corrected standard errors are a function of the variance within and across datasets.
Table 5: **Change in Predicted Probabilities (1 SD)**

<table>
<thead>
<tr>
<th>DV</th>
<th>Trade</th>
<th>Networked Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spending</td>
<td>1.21</td>
<td>-1.07</td>
</tr>
<tr>
<td>Income</td>
<td>-0.003</td>
<td>-0.30</td>
</tr>
<tr>
<td>Output</td>
<td>0.005</td>
<td>-0.35</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.29</td>
<td>-0.21</td>
</tr>
<tr>
<td>Household</td>
<td>0.25</td>
<td>-0.38</td>
</tr>
<tr>
<td>Consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment</td>
<td>-0.01</td>
<td>-0.11</td>
</tr>
</tbody>
</table>