Cross-Border Trade Competition and International Stock Return Comovement*

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ABSTRACT

Stock markets of countries that actively engage in international trade may move together more or less depending on their international trade linkages. This paper demonstrates that the stock markets of two countries are less likely to move together if these countries compete intensely in their export product markets. This is in contrast to the higher stock co-movement of countries that share similar exposures to common demand shocks. The empirical patterns imply that stronger cross-border trade linkages may not result in higher cross-market return correlations.

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ABSTRACT

Stock markets of countries that actively engage in international trade may move together more or less depending on their international trade linkages. This paper demonstrates that the stock markets of two countries are less likely to move together if these countries compete intensely in their export product markets. This is in contrast to the higher stock co-movement of countries that share similar exposures to common demand shocks. The empirical patterns imply that stronger cross-border trade linkages may not result in higher cross-market return correlations.

The last several decades have seen a rise in globalization as a result of rapid technological developments and lower transportation costs. A particularly salient component of globalization is the cross-border flow of goods, which has grown substantially over this period. The proportion of cross-border trades to total global Gross Domestic Product (GDP) increased from 13% in 1970 to 29% in 2021 (World Bank). With cross-border trades connecting economies around the world, the increase in global trade is commonly perceived to positively impact the comovement of stock returns across markets, as local demand shocks reverberate through the global trade network.[1]

However, trade linkages may not necessarily imply a higher return correlation across markets. For example, for two countries that compete intensely in a common market, a positive production shock in one of the countries would result in lower product prices in the common market, potentially harming the competitor country, as highlighted by Krugman, Obstfeld, and Melitz (2015) in their classical international economics textbook. More generally, countries producing similar goods may observe a lower stock market correlation due to product market competition in common markets.

The potentially negative effect of this "competition" channel on return correlations may be muted as countries competing for market shares in common export markets are also exposed to common demand shocks in those markets. Two countries sharing common export markets would have increased shared exposures to the demand fluctuations in their common markets, with a demand shock in one of those markets affecting the stock returns of these two countries in the same direction, leading to a higher correlation between their stock markets.

This paper studies whether the stock markets of countries that compete fiercely in a common export market are characterized by lower or higher cross-market return correlations. After disentangling the product market "competition" channel from the shared exposure

[1] Bekaert and Harvey (2000), Griffin and Stulz (2001), Bekaert, Harvey, and Ng (2005) Forbes (2004), Baele (2005), and Eiling and Gerard (2015), among others, either assume or document a positive relationship between equity market correlations and globalization.

to "common demand" shocks, we demonstrate that more intense product market competition leads to a lower comovement of country-level stock market returns. Our novel finding provides a prospective explanation for the surprisingly limited evidence of increased cross-market correlations in recent years, as highlighted in Bekaert, Hodrick, and Zhang (2009) and Bekaert, Ehrmann, Fratzcher, and Mehl (2014).

We start with constructing two trade measures that capture (1) the extent of product market competition and (2) the shared exposure to common demand fluctuations, respectively, between a pair of countries. The first measure is based on the competition measure developed in Glick and Rose (1999), which measures the extent to which two focal countries compete in other countries, i.e., their shared export markets. We construct a measure of product market competition between a pair of countries at the granular product level and then aggregate them to the country-pair level. We develop the second measure to capture common demand exposure based on the similarity of export destinations between the two countries. Instead of focusing on shared exposure at the product level (as in the first measure), this "common demand" measure is estimated using country-level aggregate exports. For example, when firms in two countries export different goods to a common market, they would both be subject to common demand fluctuations arising from the common market.

Our results indicate that these two related but distinct dimensions of cross-border trade linkages affect the stock market return relationships in opposite directions. First, a more intense product market competition between a pair of countries is associated with a lower return comovement between the respective stock markets of those countries. Second, when a pair of countries have higher shared exposures to common export destinations at the aggregate level, their stock markets are more likely to move together. These results suggest that intensive cross-border trade linkages may imply a higher or a lower stock market return correlation, depending on the intensity of product market competition.

Our first set of analyses examines the comovement of country-level stock index returns with the US index returns, as measured by the slopes of simple regressions of daily country-level stock index returns on contemporaneous and lags of daily US index returns. We document a strong negative relationship between these comovement measures and cross-country product market competition. That is, the stock markets of countries that compete more with the US in the product market move together less with the US stock market. This pattern is robust after controlling for various other trade-based measures, such as exposures to common shocks in demand and supply, trade openness, proximity to the US, and the degree of economic development.

We further investigate whether this observed pattern is related to currency effects. Previous research investigating how crises spread from an international competition perspective (e.g., Forbes 2004, Pavlova and Rigobon 2007) has linked contagion to shifts in terms of trade. These studies posit that a negative shock in a focal country leads to its currency depreciation and relative currency appreciation of countries it competes with. As a result of this shift in terms of trade, firms in competing countries face a comparative disadvantage, ultimately resulting in a higher correlation between the stock returns of the focal and competing countries.

We find contradictory evidence to this "terms of trade" channel. First, we observe currency effects consistent with the existing literature: the *currency* returns of countries that compete more intensely in the export product market with a focal country have lower correlations with the focal country's stock index return. However, in contrast to the existing literature, we find a lower correlation between the *stock* returns of a pair of countries that compete more intensely in the product market. This pattern is observed even when the index returns are denominated in their respective local currencies.

Our working hypothesis is that the export product market competition between firms across a pair of countries is an important determinant of the stock market correlation between the two countries. Since competition occurs at the product market level, this hypothesis assumes that a supply shock in one country, rather than a demand shock, would have a more significant negative effect on the stock market of the competing country. To validate this assumption, following Gofman, Segal, and Wu (2020), we decompose US industries into upstream and downstream industries according to each industry's vertical position in the supply chain. We then calculate the upstream and downstream industry returns separately, with the notion that the returns of upstream industries are more likely to reflect supply shocks than downstream industries. Consistent with our working hypothesis, we document a lower comovement between the upstream industry returns in the US and the equity index returns of countries that compete more intensely with the US in the export product market. We observe no such relationship using the downstream industry returns.

As the trade competition measure between a pair of countries tends to be relatively static, we further examine whether *changes* in the competition dynamics lead to corresponding changes in the comovement of stock markets in the corresponding countries. We focus on free trade agreements (FTA) established with the US in the 1990s and 2000s since they seem to be ideal settings due to the potentially substantial effects of these agreements on the dynamics of trade linkages. We employ five FTAs that come into force during our sample period and measure how the FTA counterparty's competition level with other countries in the US market has evolved. We find that after an FTA comes into force, the stock prices of the FTA counterparty tend to move together less with countries with whom it competes more intensely in the US market.

With the US being the largest economy in the world, both in trading volume and the size of its stock market, it seems natural to develop our baseline analyses of the effects of trade linkages from the US perspective. Nevertheless, conceptually, the patterns we document are not necessarily limited to the US market and economy. Therefore, we complement our analysis with two additional tests. First, we expand our analysis to all country pairs and perform a global panel analysis. We find similar results to the US-centric analysis: countries that compete more intensely in their export product markets have lower stock market return correlations. Second, we study the comovement of *industry* stock returns across countries. Using a disaggregated product market competition measure at the industry level, we document that the stock returns of firms operating in the same industry across two different countries are less likely to move together if they compete more intensively in their common product markets. The specification of the last analysis allows us to control for country-pair fixed effects, which capture both country-level and country-pair-level omitted variables, e.g., cultural affinity and geographical proximity.

This article contributes to the growing literature that examines the relationship between international asset return correlations and cross-border trades. Previous studies have explored this link in various contexts, such as the foreign exchange market during currency crises (Glick and Rose 1999), the international stock return predictability during Asian and Russian debt crises in the late 1990's (Forbes 2004), and the relationship between direct trade and cross-country factor loadings (Forbes and Chinn 2004). We offer a distinct perspective by examining how product market competition in export markets affects stock market comovement. Our framework implies that a country can benefit from shifting consumer demands in export markets, particularly when its competitors suffer.

Recent research on cross-country return correlations has identified a number of factors that contribute to the comovement of stock markets across different countries. Bekaert and Harvey (2000), Bekaert, Harvey, and Lumsdaine (2002), Gelos and Wei (2005), and Hau and Rey (2006), among others, focus on the role of cross-border asset holdings, while Bekaert, Harvey, Lundblad, and Siegel (2013) highlights the impact of political risk and the degree of economic development. Morck, Yeung, and Yu (2000) attribute high stock return comovement of emerging market countries to property rights. Eun, Wang, and Xiao (2015) argue that cultural variables are important determinants of cross-country stock correlations. The current study documents the relevance of international trade dynamics on the comovement in international stock markets.

Other studies focus on the time-series dynamics of the correlations. Bekaert, Ehrmann, Fratzcher, and Mehl (2014) contend that local factors become more important than global factors during times of crises, leading to a disintegration of the global market. Eiling and Gerard (2015) study the time trend in the cross-country and cross-region correlations. They find that the positive trend in the correlations is closely related to the openness of the world. To enhance our contribution to this literature, we perform various robustness tests to show that the effect of product market competition on equity index comovement is separate from these previously documented variables. This study highlights the importance of a deeper dive into the dynamics of the growing international trade linkages.

While previous research has explored the link between product market competition and the cross-section of stock returns, the majority of this literature has focused on US domestic returns. Hoberg and Phillips (2010) find that comovement in equity returns is lower for concentrated industries. Lang and Stulz (1992) and Jorion and Zhang (2007) find that upon bankruptcy, a positive return is observed for firms that compete fiercely with the defaulted firm. Ahern (2014) argues that stocks of firms in less competitive industries are more elastic because they have closer substitutes than stocks in more competitive industries. The results of this paper support the notion that product market competition can result in lower comovement in stock prices, and provide a more general set of consistent empirical evidence across countries.

I. Trade Measures

Cross-border trade activities are commonly perceived to increase cross-country stock market comovement. Nevertheless, the net effect of international trade exposures on the correlation between the stock markets of countries exporting to the same markets could be ambiguous. The common export market exposures could increase stock market comovement for these countries, as they face similar demand shocks emanating from the shared export markets. However, cross-market stock correlations of countries with a common export market can be lower for countries competing in the product markets. A negative productivity shock in one of the exporting countries could hurt its competitiveness and benefit other countries competing in the same product market. The following example illustrates the importance of this conflicting effect:

Japan and Korea are two geographically proximate countries in Asia. Both countries focus on the electronics and automobile industries and share a similar industry structure. Given their high trade openness, their stock markets are affected by similar regional or industry-specific demand shocks. One would therefore imagine their stock returns would be highly positively correlated. However, at the same time, the products produced by these two countries often compete in common international product markets (e.g., the US or China). A negative productivity shock in one of the countries would lead to an increase in the competitiveness of the other country. For example, following the Tohoku earthquake in Japan in 2011, the costliest natural disaster in recent history, the Korean stock market index (KOSPI) increased by more than 12% two months after the earthquake, whereas the Japanese index (TOPIX) decreased by 10.6%.

In this section, we develop measures of trade linkages to distinguish these two shock transmission channels. The first measure captures product market competition, highlighting the negative effect of a productivity shock in one of the countries on the performance of the competing country. The second measure captures common demand exposure, the extent that a common demand shock in a particular market affects the stock prices of countries serving that market in the same direction. With the US equity market having the highest market capitalization, we begin with a US-centric analysis to alleviate the difficulty of isolating country-specific shocks empirically. We then generalize the analysis to pairs of stock markets around the world.

1. Competition measure

We develop several trade-based measures to capture the rich structure of trade linkages. Following Glick and Rose (1999), we first measure product market competition between countries a and b at the individual product level. This measure uses the product level import and export database provided by the United Nations, as described in detail in the Appendix. The competition for product p is defined as

$$C_p(a,b) = \sum_{d \in D^{a,b}} w_p(a,d) \left(1 - \frac{|X_p(a,d) - X_p(b,d)|}{X_p(a,d) + X_p(b,d)}\right), \quad (1)$$

where $D^{a,b}$ is the set of all countries in the world excluding a and b, $X_p(a,d)$ is the export of product p from country a to export destination d, and the weight, $w_p(a,d) = \frac{X_p(a,d)}{\sum_{d' \in D^a} X_p(a,d')}$, measures country a's export of product p to country d as a proportion of the export of the same product to the entire world.

There are two things to note from this product-level competition measure. First, the numerator inside the parentheses, $|X_p(a,d) - X_p(b,d)|$, is negatively related to how countries a and b compete in market d. If both a and b export an equal dollar value of product p to a third country, country d, this numerator would be zero, denoting an intense competition between the two exporting countries a and b with both countries having identical market shares of product p in country d. The value in the parentheses is 1 in this context. In contrast, if only one country exports product p to country d, the numerator equals the denominator, and the value in the parentheses is 0, denoting the absence of product market competition.

Second, this measure is asymmetric between each pair of countries a and b: $C_p(a, b)$ is conceptually different from $C_p(b, a)$. This is because the weight ($w_p(a, d)$) for each product market is defined from the perspective of the first country, i.e., country a for $C_p(a, b)$. The weights are determined by the relative importance of country d as an export destination for a only, completely ignoring the importance of country d to b. The measure is designed so that if countries a and d do not trade much with each other, competition in d's market would not affect country a's competitive position even if countries b and d trade intensively. This asymmetry is relevant if the two focal countries a and b substantially differ in their respective sizes.

Aggregating from the product level, we define the country-level competition between a and b as the weighted average of the product-level competition:

$$Comp_{(a,b)} = \sum_{\forall p} \frac{X_p(a)}{X(a)} C_p(a, b), \tag{2}$$

where $X_p(a)$ is a's total export of product p ($= \sum_{\forall d \neq a} X_p(a, d)$) and $X(a)$ is the total export of country a of all products ($= \sum_{\forall p} X_p(a)$).

2. Common demand measure

Our second measure is the common demand (CD) measure. This measure is conceptually connected to the product market competition measure as two countries with a high degree of competition would export to similar markets and should be exposed to common demand risk emanating from those markets. The key difference is that the competition measure is constructed using disaggregated information at the product level, whereas the CD measure is calculated using the aggregated trade flows.

To compute the CD measure, we obtain country-level total exports and imports data from the IMF Direction of Trade Statistics (DOTS), which provides a breakdown of the annual total of merchandise imports and exports by each counter-party country. Then, the CD of country a with respect to country b is defined as

$$CD(a,b) = \sum_{d \neq b} f(a,d) \left(1 - \frac{|f(a,d) - f(b,d)|}{f(a,d) + f(b,d)} \right), \tag{3}$$

where $f(a,d)$ is the fraction of country's a's total export that is exported to country d, which is calculated as the amount of export from country a to d $(X(a,d))$ divided by the total export of country a to the entire world $(X(a) = \sum_{\forall d \neq a} X(a,d))$.

The CD measure resembles the competition measure in Equation (2), with two crucial differences. First, as also emphasized above, the competition measure is calculated from individual product-level data, which is then aggregated to the country level, whereas the CD measure is computed from the aggregated trade data. If two countries export different products (e.g., Australia exports iron ores and France exports luxury products) to the US, their CD measure will reflect their shared exposure to US demand shocks, but the competition measure would underline the lack of product market competition between the two countries.

Second, instead of calculating the dollar amount of export difference as in the competition measure $(|X_p(a,d) - X_p(b,d)|)$, the CD measure uses the difference between the respective *fraction* of the amount exported to the common market by each of the two countries $(|f(a,d) - f(b,d)|)$. Therefore, the CD measure will be higher when two countries have similar compositions of export destinations.

The motivation for using the dollar amount of export for the competition measure and the fraction of export for the CD measure is easier to illustrate for two countries with differing sizes. A small country (S) and a large country (L) will compete intensely in a product market (d) only if these two countries have similar market shares in that market

($X_p(S,d) \approx X_p(L,d)$) despite their different sizes. These market shares are reflected in the dollar amount of export from each country.

However, a common demand shock could affect the two countries regardless of the different sizes of their economies (or their total exports). Countries that rely heavily on a single export destination, e.g., the US for Mexico and Costa Rica, would have a large fraction of their exports tied to the US and would be substantially affected by demand shocks in that destination country (i.e., the US) despite the substantial difference in the economy sizes of Mexico vs. Costa Rica. This means that the fraction of export to the US is the relevant input to the measure of exposure to common US demand shock.

3. Additional trade measures

The previous two measures consider two countries' linkages with a third country as a common export destination. Stock market correlations could also be affected by the direct trade relationship between the two countries and the characteristics of each country.

We define an export share ($ExpShare$) measure to capture the extent of one country's reliance on a second country as an export destination in cross-border trade. Using the DOTS data, we define direct trade, $ExpShare_{(a,b)}$ of country a to b as the log difference between the export of country a to b ($X(a,b)$) and the total export of country a to the entire world ($X(a) = \sum_{\forall d} X(a,d)$). We expect this measure to have a positive influence on stock return correlation. If a significant fraction of country a's exports flow to country b, then any demand shock that originates from country b should affect country a. As such, this measure is also useful for capturing the economic proximity between the two countries.

We also measure the share of exports ($FracExp$) of a country's aggregate economic activities. We measure this by taking the log difference between a country's total export ($X(a)$) and its total GDP. All else equal, we expect countries with a higher export share of GDP to be influenced more by the global economy compared to countries that have a relatively larger domestic market and export less to the rest of the world.

We also develop a common supply measure to capture the potential shared exposures to supply shocks. Similar to the common demand measure, the common supply measure ($CS_{(a,b)}$) is defined as

$$CS_{(a,b)} = \sum_{s \neq b} g(s,a) \left(1 - \frac{|g(s,a) - g(s,b)|}{g(s,a) + g(s,b)} \right), \tag{4}$$

where $g(s,a)$ is the fraction of country a's total import from country s, calculated as the amount of import of country a from country s divided by the total import of country a.

Finally, we measure the import share of country a with respect to country b ($ImpShare_{(a,b)}$) as the log difference between the country a's import from b ($X(b,a)$) and the total import of country a from the entire world ($\sum_{\forall d} X(d,a)$).

4. Relationship between trade measures

In Figure 1, we chart a scatterplot, along with their corresponding correlation coefficients, of the trade measures of various countries with respect to the US. Since our main analyses investigate the relevance of trade linkages from the US perspective, in the scatterplot, we focus on trade measures constructed from the US perspective. Each of the corresponding trade measures is averaged over time.

The figure displays two important features of the trade measures that are worth mentioning. First, the competition and the common demand (CD) measures are negatively correlated with each other. However, the negative correlation is largely driven by two countries (Canada and Mexico), which belong to the same trade union (NAFTA) as the US. The broadly negative relationship is remarkable given a potential mechanical correlation between these two measures as they take similar forms except for the crucial difference of product-level vs. aggregate measure in their respective constructions. The competition measure is aggregated from individual product level similarities, whereas the CD measure is computed directly from aggregated trade flow data. The observed negative relationship between these measures helps to alleviate the potential concern that they are mechanically related, underlines the distinct features of trade linkages captured by each of these two measures, and allows us to perform empirical analyses to identify the distinct effect of each measure.

Second, many trade measures are highly correlated with geographical distance, measured as the distance from the capital city of the country to Washington DC (Dist). This is partially driven by the geographical proximity of Canada and Mexico to the US, with many of their firms being vertically integrated due to NAFTA. It is natural to share a common demand or supply shock for firms belonging to the same supply chain. In the Appendix, we report the robustness analysis of our empirical results below after removing Canada and Mexico from our sample.

II. Empirical Results

In this section, we analyze how the two aspects of international trade linkages – common demand exposure and product market competition – relate to the comovement of international stock returns. First, countries that export similar amounts of the same set of products to the same destination markets as the US would have a higher product market competition measure with the US. We predict that these countries' stock indices would display a *lower* correlation with the US stock index. Second, countries whose aggregate export destinations are similar to those of the US would have a higher CD measure with the US. We predict that their stock indices would be more likely to move in the same direction as the US index.

We take the US as the focal country and begin the analysis by using daily return data. We compare how the stock markets of different countries react to shocks to the US stock prices as a function of those countries' trade linkages vis-a-vis the US. We employ the trade linkage measures calculated in year t as a potential explanatory variable for the cross-country return dynamics in the following year $t + 1$.

1. Daily contemporaneous/predictive relations

Analyzing international stock returns at a daily frequency requires extra caution. For instance, when the US stock market opens at 9:30 AM Eastern Standard Time (EST), the London Stock Exchange is in the middle of its trading hours of the same day (1:30 PM), whereas the market in the Tokyo Stock Exchange is already closed (10:30 PM). Likewise, when the US stock market closes at 4 PM, most of the stock markets, including Australia and New Zealand, are closed. Hence, a shock during the US trading hours is likely incorporated into stock prices in other markets globally during the following trading day.

We take these asynchronous trading hours into account in our analysis of the cross-market daily stock return dynamics. We refer to the first day the stock market closes after our focal market – i.e., the US market for the first part of our analyses – closes as 'contemporaneous,' the following trading day as 'one-day predictive,' and so forth. The exception is for markets in the rest of the North and South American continents, where 'contemporaneous' is defined as the same trading day, given the almost complete overlap in trading hours with the US market. For example, a Monday in the US is contemporaneous with the same Monday in the rest of the Americas and Tuesday in markets of Asia-Pacific, Europe, and Africa. Similarly, Tuesday for stock markets in the Americas and Wednesday for the rest of the world are treated as one-day predictive.

The literature on cross-market return dynamics suggests that the global equity market is relatively integrated, and stock prices across countries tend to move together. The literature has also observed some predictive relationships at a higher frequency, such as at the daily level, especially if some markets are less efficient, less liquid, or if the flow of information is slower in some markets.[2] In the rest of our discussion, we refer to the combined pattern of contemporaneous movement and short-term predictability of returns as "comovement" and make specific reference to "predictability" only when we exclude the contemporaneous pattern.

Before performing our main analysis, we examine how prevalent these comovement patterns are. We do this by examining how international equity index returns correlate with each other both contemporaneously and with short lags. We consider the regression model of

$$R_{i,t+k} = \alpha_i + \beta_i R_{US,t} + \epsilon_{i,t+k}, \tag{5}$$

where $R_{i,t+k}$ is the stock index return of country i on day $t+k$ denominated in USD. As discussed above, we refer to the regression of $k=1$ as contemporaneous and $k=2$ as one-day predictive for all countries except for countries in the American continents, where $k=0$ is treated as contemporaneous and $k=1$ and $k=2$ as one-day predictive, respectively.

Table 1 summarizes the contemporaneous and predictive slopes of daily international index returns regressed on US index returns. The slopes and standard errors of the contemporaneous, one-day predictive, and one-week (i.e., two to five days) predictive regressions are provided in the table. As has been previously documented, there is a strong positive comovement observed between the US and each country's index returns. One potential reason for this contemporaneous pattern is a global macro factor shared among different countries.

[2]See, for example, Karolyi and Stulz (1996), Griffin and Karolyi (1998), Griffin and Stulz (2001) Forbes and Rigobon (2002), among others, that study the comovement and predictability of international stock returns at the daily frequency. See also, Chordia and Swaminathan (2000), Hou and Moskowitz (2005), Hou (2007), among others, that suggest the lead-lag relation among US stock returns can appear due to slow diffusion of information.

Ferson and Harvey (1993), for example, report that international stock returns are partially predictable using global factors such as the world market index.

In addition to the contemporaneous comovement, we also observe some directional predictability. The predictability seems plausible in this setting if the US market is relatively more efficient or liquid than other markets. In this context, the US market would respond first to a global shock before the rest of the global markets react (e.g., Rapach, Strauss, and Zhou 2013). To illustrate this possibility, we examine the predictability of country-level index returns using past US index returns by reporting the predictive slopes for different horizons in the subsequent three columns: one-day and one-week returns, respectively. As anticipated, some indices are predictable by US market returns with a day of lag. For some countries, the predictability persists up to the weekly horizon.

It is important to note that there is a considerable variation in both contemporaneous and predictive βs. While the contemporaneous slopes are all positive, some index returns (mostly western and northern European countries, e.g., Belgium, Finland, France, Germany, Italy, Netherlands, Sweden, Switzerland, and the UK) are *negatively* predicted by the US returns at longer horizons such as a week. This paper focuses on this heterogeneous response to US returns, highlighting the role of the trade-based linkages of common demand exposures and product market competitions. The averages of each country's measures of competition and CD with the US are reported in the last two columns of Table 1.

We next perform formal statistical analyses of these patterns using different lags of returns. We are particularly interested in examining whether common demand and product market competition have distinct effects on the cross-country equity return dynamics. We hypothesize that the cross-country patterns of equity market dynamics are related to how countries are connected through trade linkages.

To formally test this hypothesis, we implement the two-step estimation procedure of Fama and MacBeth (1973). As a first step, for each country i, we capture how international equity prices react to contemporaneous and lagged US market returns. That is, we estimate the following daily time-series regressions:

$$R_{i,t+k} = \alpha_i + \beta_{i,0} R_{US,t} + \beta_{i,1} R_{US,t-1} + \beta_{i,w} \sum_{\tau=2}^{5} R_{US,t-\tau} + \epsilon_{i,t+k}, \tag{6}$$

where $k = 1$ for countries outside of the American continents and $k = 0$ for countries in South or North America. We estimate this regression annually without any overlapping observations. These annual regressions generate four series of annual estimates of the slopes for each country i ($\hat{\beta}_{i,0}$, $\hat{\beta}_{i,1}$, and $\hat{\beta}_{i,w}$), each representing a different horizon of US returns' predictive pattern.

The second-stage regression is a cross-sectional regression of each of these $\hat{\beta}_{i,y}$s estimated in year y on the lagged common demand and competition measures derived in year $y-1$. The regression model is given as follows:

$$\hat{\beta}_{i,y} = \delta_{i,0} + \delta_{i,1} Comp_{(i,US,y-1)} + \delta_{i,2} CD_{(i,US,y-1)} + e_{i,y}, \tag{7}$$

for $j = 0, 1, w$. In Table 2, we report the time-series average of the second-stage regression parameter estimates, the associated t-statistics calculated using Newey and West (1987) adjustments, and the average of the R^2 of the second-stage regressions.

Panel A shows the result for analyses in which each of the two trade measures is included separately as an explanatory variable. Panel B reports the parameter estimates when both trade measures are included simultaneously in the second-stage regression. For both specifications, we first consider only the contemporaneous variable $\beta_{i,0}$ in Equation (6) by letting $\beta_{i,1} = \beta_{i,w} = 0$ for all countries. Columns (1) and (4) in Panel A show how the contemporaneous relationship between equity index returns depends on each of our trade measures. Column (1) in Panel B includes both measures in the same second-stage regression predicting contemporaneous return betas, $\hat{\beta}_{i,0}$.

Next, we focus only on the predictive variables ($\beta_{i,1}, \beta_{i,w}$) in the first-stage regression (i.e., setting $\beta_{i,0} = 0$ in Equation (6)). Columns (2) and (5) in Panel A as well as Column (2) in Panel B report the parameter estimates from this alternative specification. Finally, Columns (3) and (6) in Panel A and Column (3) in Panel B summarize the results of the full specification in Equation (6).

Three observations are worth noting from the two panels of this table. First, the relationship between the international and US index returns is weaker when a country competes more with the US. However, a country's stock returns move together with the US when the country shares a common export market with the US. Therefore, these two dimensions of trade linkages have opposite roles in cross-country equity return dynamics. Second, the two trade measures explain 36% of the cross-sectional variation in contemporaneous return betas. The power decreases for the one-day predictive relationship, with more than 21% of the variation explained by the two trade measures. For the one-week predictive relationship, the two measures still explain 15% of the cross-sectional variation of the predictive βs. Third, we observe some delays in reaction to US returns. US market shocks take at least two full days (three calendar days) to be transmitted through these trade channels.[3]

2. Exploring the terms-of-trade channel

The fluctuation of the foreign exchange rate is an important consideration in any analysis of cross-country stock correlations. In the current context, the patterns that we document

[3]Our results are robust to excluding countries that belong to NAFTA (Mexico and Canada). We also document similar results after standardizing returns using the standard deviation calculated over a rolling window. We report these robustness results in the Appendix.

regarding the effects of the two trade channels on cross-country comovement of stock returns could be driven by changes in the relative value of currencies rather than the value of equities. This alternative channel is particularly important in this context because all stock returns in the main analysis are converted to a common currency.

In this subsection, we examine how changes in the terms of trade due to fluctuations in exchange rates could affect the comovement of stock prices. The main result reported in the previous section could be consistent with the terms of trade being an important driver of cross-country stock returns and consequently cross-country comovement under two distinct scenarios.

The first scenario is that a positive productivity shock in the US leads to the *depreciation* of currencies of countries competing with the US, relative to USD. The currency depreciation would result in a "terms-of-trade" effect that increases the equity value in those countries, at least in domestic terms, as predicted by Pavlova and Rigobon (2007). Reconciling this effect with the empirical findings we document in the previous section would require the "currency translation" effect (i.e., currency depreciation reducing competing countries' USD-denominated returns) to dominate the terms-of-trade effect. Empirically, this means that we should be able to observe the terms-of-trade effect once we control for the translation effect.

The second scenario is that a positive US productivity shock leads to a currency *appreciation* of competing countries. The "terms-of-trade" effect in this scenario would predict lower stock returns, in domestic currency terms, for competing countries as their terms-of-trade worsen, which would be consistent with the lower comovement for competing countries observed in the previous section. If this is indeed the key mechanism driving the competition effect, the empirical result in the previous version would be driven by the domestic currency denominated stock returns, with the currency translation component working in the opposite direction to offset the lower comovement partially. In other words, we should observe that currency returns (vs USD) of competing countries have a higher comovement with US stock returns.

To investigate these potential terms-of-trade-driven scenarios, we perform two related analyses. First, we attempt to remove the effect of currency translations by controlling for each country's corresponding currency returns (relative to USD) in our analysis of the USD-denominated stock returns of each country. Specifically, we include the currency returns as one of the control variables in the first-stage regression. This approach is akin to subtracting the country's corresponding currency returns, but it allows for a more flexible parameterization. This allows us to examine whether the first scenario (i.e., depreciation) is plausible. Second, we directly examine the link between currency returns (relative to USD) and the US stock market. In this analysis, we assign the currency returns as the dependent variable in the first-stage regression. This allows us to examine whether the second scenario (i.e., appreciation) is plausible. The results of both analyses are reported in Table 3.

Panel A shows the estimates from the second-stage regressions when changes in the currency value are included as a control variable in the first-stage regression. We find that the sensitivity of a country's stock returns to US stock returns positively correlates with product market competition even after controlling for currency returns. In other words, positive US stock returns tend to be followed by a relative decrease, not an increase as implied by the terms-of-trade mechanism, in stock prices in countries that compete more intensely with the US in the product markets, even after controlling for the currency translation effect. Hence, we can conclude that the first scenario through which the terms-of-trade channel may be relevant does not seem plausible.

Panel B presents the estimates from the second-stage regressions when currency returns are used as the dependent variable in the first-stage regression. The results in Panel A indicate that the product market competition measure has a negative correlation with the sensitivity of non-US currency returns to US stock returns. This implies a relative currency depreciation for countries that compete more intensely with the US following positive US stock returns, inconsistent with the second scenario in which the terms-of-trade mechanism is relevant.

In aggregate, the patterns we observe using this return decomposition are not fully consistent with the standard terms-of-trade mechanism. We, therefore, conclude that the negative effect of product market competition on international stock return correlations does not operate through this currency-driven mechanism.

3. Controlling for additional trade measures

We also consider several additional trade-based measures described in the data appendix. We first focus on demand shocks and consider two additional measures beyond competition and common demand: a bilateral direct trade measure ($ExpShare$) and the share of exports in the country's economy ($FracExp$). These two measures capture the relative importance of the US for the corresponding country in their export markets. If domestic US demand shocks drive US stock returns, it is natural to expect that the stock returns of countries that export heavily to the US would be positively correlated with US stock returns. A country's exposure to the US as its export destination is a product of two factors: the country's reliance on exports as a fraction of its economy and its reliance on the US as a fraction of its total exports. We measure the former using the country's export share, i.e., its total export amount as a fraction of its total GDP. We measure the latter using the export share of the US, i.e., the country's export to the US as a fraction of its total export amount.

The first three columns of Table 4 (under Model 1) report the results of the cross-sectional regressions after adding export share to the US and the fraction of export as additional explanatory variables. As hypothesized, stock market returns tend to move together with the US for countries that export more to the US. However, we do not observe any evidence that the stock returns of countries that rely more on exports tend to move together with the US market; if anything, we observe the opposite. Nevertheless, the two primary trade measures in this study – CD and competition – continue to be important determinants of stock return comovement in a manner consistent with Table 2.

Among US firms, previous studies show that there is a cross-industry return predictability in the short term along the supply chain. While the subject of this paper is at the aggregate level, the export share channel resembles the customer-supplier link studied by Cohen and Frazzini (2008) or Menzly and Ozbas (2010). Consistent with these studies, we find positive contemporaneous and predictive relationships within the same supply chain. However, the predictability becomes substantially weaker after a day and somewhat reverses within a week.

We next consider several additional trade-based measures that are intended to capture the relative importance of supply shocks to each country in our sample. Stock markets of two countries may be correlated because they share a common set of supply shocks. For example, the 2022 Russia-Ukraine war has had a global impact, through increased natural gas prices. During this period, countries that import natural gas should experience a negative effect on stock prices. Common supply share (CS) is intended to capture the extent a country shares a common supply shock with the US. Similar to common demand, this measure is estimated using trade flows data aggregated at the country level. Finally, import share ($ImpShare$) measures the degree to which a country relies on the US as its import market.

The next three columns of Table 4 (under Model 2) summarize the results of the second-stage cross-sectional regressions. As hypothesized, higher levels of US import share and common supply measures generally imply a higher comovement to the US stock index. US import share has a more direct and immediate impact on the return correlation, whereas the effect tends to be observed with a lag for the common supply measure. Our competition measure remains negative and statistically significant after controlling for these supply-related measures.

Finally, we consider a specification where we jointly control for the additional trade measures that capture the importance of the US as the export market as well as measures of potential supply-side linkages. The last columns of the table (under Model 3) summarize the results. Overall, the relevance of the competition measure is robust to adding these additional trade measures in the regression; if anything, its parameter estimates become stronger, i.e., more negative, with these additional controls.

4. Weekly dynamics of country stock markets

We have established that the returns of stock markets of countries that compete more with the US move less with US stock market returns. Our analysis also highlights some predictive relationships on a daily frequency. The competition and common demand effects seem to last more than a day and often for two subsequent trading days.

The daily analysis is imperfect for two possible reasons. First, analyzing daily returns in an international setting is challenging due to asynchronous trading hours, with only a few countries observing trading hours similar to the US. Second, the asynchronous trading hours also result in difficulties in controlling global stock market returns. In this section, we deviate from the previous analysis across these two dimensions. First, we use weekly instead of daily returns. Second, we further investigate whether the terms-of-trade channel is a key determinant of the cross-country stock correlations. Specifically, we consider two additional specifications, where we control for the global and currency returns in the first stage regression and study the effect on currency returns directly.

As the baseline, we consider the first-stage regression specification:

$$R_{i,t} = \alpha_i + \beta_{i,US} R_{US,t} + \beta_{i,g} R_t^* + \epsilon_{1,i,t}, \tag{8}$$

where $R_{i,t}$ is the stock return of country i for week t denominated in USD, $R_{US,t}$ is the value-weighted CRSP returns, R_t^* is the MSCI world index returns denominated in USD. Weekly returns are computed by taking the sum of log daily returns over five days. The control for the global market and currency returns follows the international capital asset pricing model of Adler and Dumas (1983). The first-stage regression is estimated every year using weekly data that belongs to that particular year. We call this baseline specification as "no currency control."

Additionally, to study the significance of the terms-of-trade channel, which we refer to as the "currency control", we consider an additional specification where we control for the currency effect. The specification considered is:

$$R_{i,t} = \alpha_i + \beta_{i,US} R_{US,t} + \beta_{i,g} R_t^* + \beta_{i,q} \Delta q_{i,t} + \epsilon_{2,i,t}, \tag{9}$$

where $\Delta q_{i,t}$ is the weekly return of currency i relative to the USD, where a higher $q_{i,t}$ implies a currency appreciation for country i.

Similar to the daily analysis, the second-stage regression is the panel regression of the US return beta $\hat{\beta}_{i,US,y}$s estimated for each year y on the lagged common demand and competition measures of year $y-1$. We choose to lag the trade measures to be consistent with our earlier analyses. However, the results are qualitatively similar if we use contemporaneous trade-based measures instead. The regression is given as

$$\hat{\beta}_{i,US,y} = \delta_0 + \delta_1 Comp_{(i,US),y-1} + \delta_2 CD_{(i,US),y-1} + \mathbf{c}'\mathbf{Control}_{i,y-1} + \text{Year FE}_y + e_{i,y}, \tag{10}$$

where **Control** is a vector of variables including $ExpShare_{(i,US)}$, $FracExp_i$, $CS_{(i,US)}$, and $ImpShare_{(i,US)}$. In this panel regression setting that includes all country i and year y, we employ year-fixed effects as our primary objective in this section is to investigate the cross-sectional relationship.

The results of the panel regressions using betas estimated using weekly return data are reported in Table 5. Overall, we continue to observe a strong negative relationship between stock market comovement and the competition measure in these panel regressions. The coefficients are strongly negative and statistically significant even after controlling for export share to the US and the country's overall reliance on exports. For currency returns, the signs for the competition and common demand measure are generally consistent with our daily analysis, although they are not always statistically significant.

Notably, we fail to document statistical significance for the common demand measure in Model 1. Moreover, when we add the export share to the US as a control variable in the second stage regression, the sign of the common demand coefficient becomes negative in Models 2–3 and 5–6. The inconsistency of the common demand channel in the second-stage regression is likely to be related to the inclusion of the value-weighted global stock market returns in the first-stage regression, which captures aggregate global demand shocks. The patterns are similar regardless of whether we control for currency returns in the first-stage regression.

5. Upstream vs. downstream returns

A positive demand shock in the US should affect both the US stock returns as well as the stock returns of countries that export to the US. It may also positively influence the stock markets of countries that share export destinations with the US if global demand shocks are correlated with US demand shocks. However, this positive demand shock should not have any perceptible effect on countries that compete in specific product markets with the US.

In contrast, a supply shock – such as disruption of the supply chain or technological innovation – within the US could directly affect countries competing with the US. A positive supply shock should decrease the stock prices of non-US firms in competing supply chains. For example, a positive productivity shock in the US aircraft industry will decrease the stock prices of European firms operating in a competing supply chain. Therefore, stock prices of countries dominated by firms that compete with the US in the product market are likely to be negatively affected by a US supply shock. A US demand shock, in contrast, should increase the stock price of all countries involved, as an increase in US demand for aircraft will increase the global demand for similar products.

The above example suggests that supply shocks should propagate through the competition channel, whereas demand shocks (of the common market) should propagate through the common demand channel. In this section, we examine whether demand and supply shocks affect the comovement in international stock returns differently.

To facilitate this analysis, we proxy demand and supply shocks using stock returns of firms based on their distance to the consumers (See, for example, Gofman, Segal, and Wu (2020), among others.) Downstream firms are located lower in the supply chain and produce goods directly consumed by end customers, whereas upstream firms are located higher in the supply chain. They process raw materials and supply parts and materials used for further processing by downstream firms in the supply chain. Hence, a positive shock to upstream firms would benefit firms within the same supply chain and hurt firms operating in other supply chains. As a result, countries that compete with the US should move less with the stock prices of US upstream firms.

We first sort industries by their vertical position in the supply chain (Antràs, Chor, Fally, and Hillberry 2012) and assign firms based on the industries they operate into three groups: upstream, midstream, and downstream firms. The details of the construction of this measure are provided in Appendix A. We then repeat the previous analysis after replacing the US returns with the respective returns of upstream and downstream industry portfolios in the first-stage regression. Table 6 summarizes the results of the second-stage regression, where US return betas are regressed on the trade measures. In columns denoted by Models 1–3, the betas in the first-stage regression are estimated using upstream industry returns. In the remaining columns (Models 4–6), the betas are estimated using downstream industry returns.

The patterns obtained using upstream US returns in Models 1-3 are consistent with our weekly baseline results in Table 5 and particularly the negative coefficients for the competition measure. We do not observe a similar pattern using downstream US returns in Models 4-6. The results are consistent with the hypothesis that countries that compete with the US have lower returns upon a positive supply shock in the US (as reflected in upstream US returns), but the effect is muted for a positive demand shock in the US (as reflected in downstream US returns). These results are consistent with the intuition that US supply shocks are propagated through the competition channel. We do not observe any significant difference in currency returns between the two groups of regressions.

6. Competition and US FTA

The above analysis shows that stock returns of countries that highly compete with the US tend to move less with the US stock market, and markets that share exposures to demand shocks with the US tend to move together with the US market. This section aims to provide more direct evidence that confirms the link between trade linkages and international stock price comovement.

In this section, we focus on how the establishment of an FTA with the US affects the dynamics of international trade linkages. Our goal is to test whether such changes in the trade dynamics affect the stock market comovement across countries in a way that is consistent with the results of our main analysis. The FTA with the US provides an ideal setting to address this question because the US has established FTAs with other countries throughout our sample period, and these agreements have influenced the dynamics of trade linkages substantially.

We consider five FTA that came into force during our sample period: Australia (signed 2004; effective January 2005, Chile and Singapore (signed 2003; effective January 2004), South Korea (signed 2007; effective March 2012), and Colombia (signed 2011; effective May 2012).

The influence of an FTA on the degree of competition is ambiguous because it may either increase or decrease the degree of competition with another country in the US market. The direction of this effect would depend on several factors, which include the country's relative competitiveness in each product market before the FTA come into force, the geographic distance to the US, and the degree of economic development.

For example, consider three countries exporting beef to the US market: Canada, Australia, and Japan, listed in descending order of the amount of beef exported to the US market. The establishment of an FTA between Australia and the US may increase the degree of competition between Australia and Canada in the US beef market. However, this is likely to reduce the competition between Australia and Japan in the US market as the agreement will make Australia an even more dominant player in the beef market in the US.

To test our hypothesis, we investigate how an FTA of a country with the US changes the competition dynamics between the country and another non-US country. Since an FTA with the US is likely to generate the most immediate and dramatic effect on the composition of exports to the US market, we focus on how the FTA affected competition and demand in the US. Therefore, we re-construct the competition and common demand measures focusing only on the US as a common export destination.

We compute the competition measure at the product level for each country pair (similar to Equations (1)- (2), but focus on how the pair compete in the US market. That is, we define product-level competition between an FTA counter-party country a and another non-US country b in the US product p market as

$$Comp^{US}(a,b) = \sum_{\forall p} \frac{X_p(a,US)}{X(a,US)} \left(1 - \frac{|X_p(a,US) - X_p(b,US)|}{X_p(a,US) + X_p(b,US)}\right), \tag{11}$$

where $X_p(a, US)$ is the export of product p from country a to the US and $X(a, US)$ is the total export of country a of all products to the US.

The common demand measure is also reconstructed in this context by computing the common exposure to US demand shocks between an FTA counter-party country a and another non-US country b, which is defined as

$$CD^{US}(a,b) = 1 - \frac{|f(a,US) - f(b,US)|}{f(a,US) + f(b,US)}, \tag{12}$$

where $f(a, US) = \dfrac{X(a,US)}{\sum_{\forall d} X(a,d)}$ is the fraction of country a's total export that is exported to the US. As we may introduce more estimation errors by focusing solely on the US as the export destination market, we take the average of these US-centric trade measures three years before and after the FTA effective dates.[4] For agreements that become effective in the middle of the year, we drop that particular year from the analysis.

We compare the changes in the degree of comovement between the stock markets of an FTA counter-party and another country with the changes in the trade measures as defined above. If our hypothesis is accurate, we expect the stock returns of a country pair to comove more if the US FTA with one of the countries reduces the product market competition

[4]The results are robust to the horizon selected for this averaging.

between the country pair in the US. If the FTA intensifies competition between the country pair, their stock markets should comove less.

We test the hypothesis by adopting a two-stage regression framework similar to our main analysis. We estimate the following first-stage regression for $i = \{AUS, COL, CHL, KOR, SGP\}$, $\forall j \neq i$ and $j \neq US$:

$$R_{i,t} = \alpha_{i,j} + \beta_{i,j,S} R_{j,t} + \beta_{i,j,US} R_t^{US} + \beta_{i,j,G} R_t^{*} + \beta_{i,j,iq} \Delta q_{i,t} + \beta_{i,j,jq} \Delta q_{j,t} + \epsilon_{i,j,t},$$

where $R_{i,t}$ is the stock return of country i at time t, R^* and R^{US} are the value-weighted global and US index returns, respectively, and $\Delta q_{i,t}$ is the currency returns of country i relative to the US. This regression is estimated yearly the year before and after an FTA agreement of country i with the US is into force. We note that we control US returns to capture the common exposure that countries have with respect to US returns.

The second-stage estimation is a panel regression, where the betas ($\hat{\beta}_{i,j,S,y}$) of year y are regressed on several indicator variables: $1_{After,i,y}$ takes a value of 1 if year y is the immediately subsequent year after country i establishes an FTA with the US and 0 if it is the year before the FTA establishment. $1_{Comp^{US},i,j}$ ($1_{CD^{US},i,j}$) is a dummy that takes a value of 1 if competition (common demand) between country i and j has increased after the establishment of FTA between country i and the US. Finally, we interact the after-FTA dummy with the two trade-based dummies: $1_{After,i,y} \times 1_{Comp^{US},i,j}$ and $1_{After,i,y} \times 1_{CD^{US},i,j}$, respectively. In the regression, we also include the time-series averages of other trade variables as described earlier as control variables.

Our objective here is to test whether the interactive dummy variables have statistically significant parameter estimates with signs that are consistent with our premise. In particular, if a more intensive competition after the FTA leads to a lower comovement of stock prices, we would expect a negative sign on the interactive dummy variable $1_{After,i,y} \times 1_{Comp^{US},i,j}$.

Table 7 summarizes the results of the second-stage panel regression. Across several different regression specifications with different types of country-fixed effects, the interactive coefficient $1_{After,i,y} \times 1_{Comp^{US},i,j}$ have negative slopes across all specifications that we consider. This implies that the comovement of a country that establishes an FTA with the US and another (non-US) country will be lower only when the FTA intensifies the FTA counterparty's competition with that country in the US market. If the FTA weakens the degree of competition, their stock markets will comove more.

7. International industry competition and return comovement

The analysis in previous sections provides corroborating evidence that a higher degree of competition among countries is associated with a lower comovement in their stock prices. While our analyses so far examine this relationship using the US as the focal country, the logic should extend more generally to all pairs of countries. In this section, we extend the empirical analysis to the stock returns aggregated at the country-industry level. We study whether an industry's stock returns in one country comove less with the stock returns of the *same* industry in another country if they compete more heavily in their common product markets.

There are two purposes of this industry-level analysis. First, this analysis allows us to incorporate more stringent controls for the aggregate country-level stock returns and various fixed effects, which should alleviate concerns regarding potential biases due to omitted variables. Second, this analysis offers a robustness check as well as a generalization of our initial analysis from country-level stock returns to cross-country industry-level returns. The result from this analysis would highlight the relevance of product market competition for the relationship between country stock returns.

To operationalize this analysis, we compute the value-weighted weekly industry returns for each country at the 2-digit SIC level using the Compustat Global database. We exclude country-industry observations for which there are fewer than 10 firms in the country operating in the industry. We also develop an industry-level competition measure analogous to the main competition measure employed in our main analysis. We measure the degree of competition between countries i and j at the industry ind level as

$$IndComp_{(i,j,ind)} = \sum_{\forall p \in ind} \frac{X_p(i)}{X_{ind}(i)} C_p(i,j), \tag{13}$$

where $C_p(i,j)$ is defined as in Equation (1), $X_p(i)$ is the amount of export of product p of country i, and $X_{ind}(i)$ is the amount of export of all products that belong to industry ind for country i, where the HS product codes are matched to SIC industry codes using the table provided by Pierce and Schott (2012).

We then implement a two-stage estimation process analogous to our main analysis. The first-stage regression is

$$\begin{aligned} R_{i,ind,t} &= \alpha_{i,j,ind} + \beta_{i,j,ind} R_{j,ind,t} + \beta_{i,j,ind,iM} R_{i,M,t} + \beta_{i,j,ind,jM} R_{j,M,t} \\ &\quad \beta_{i,j,ind,iq} \Delta q_{i,t} + \beta_{i,j,ind,jq} \Delta q_{j,t} + \epsilon_{i,j,ind,t}, \end{aligned} \tag{14}$$

where $R_{i,ind,t}$ is the stock return of industry ind in country i, $R_{i,M,t}$ is the market return of country i, and $\Delta q_{i,t}$ is the currency return of country i relative to USD. All stock returns are denominated in USD.

The second-stage panel regression is

$$\hat{\beta}_{i,j,ind,y} = a + b\, IndComp_{(i,j,ind,y-1)} + FE_{i,j} + FE_y + e_{i,j,ind,y}, \tag{15}$$

where $IndComp_{(i,j,ind,y-1)}$ is industry competition measure for industry ind computed between countries i and j in year $y-1$. We also include various combinations of the following fixed effects: year, country i, country j, and country pair (i,j).

Table 8 summarizes the results of this panel regression with several specifications, where they differ by the types of country-fixed effects used. For all combinations of fixed effects considered, we find support for our working premise that cross-country competition in product markets has a negative effect on stock market correlations. The stock prices of an industry are less likely to move together with the stock prices of the same industry in a different country if the two countries compete more heavily in the common product markets.

8. Global competition and stock market returns

In this section, we further expand the return dynamic analysis formalized in (10) and reported in Table 5 to the entire global market. The objective is to examine whether the trade measures explain the comovement of stock returns in the cross-section of country-pairs.

In this global analysis, we implement a similar testing strategy as the industry-level analysis in the previous section but examine the relationship using returns aggregated at the country level. We consider the following first-stage regression:

$$R_{i,t}^{j\$} = \alpha_{i,j} + \beta_{i,j,S} R_{j,t} + \beta_{i,j,G} R_t^{*,j\$} + \beta_{i,j,q} \Delta q_{i,j,t} + \epsilon_{i,j,t}, \tag{16}$$

where $R_{i,t}^{j\$}$ is the weekly stock returns of country i denominated in currency of country j, $R_{j,t}$ is the weekly stock returns of country j in currency j, $R_t^{*,j\$}$ is the weekly global value-weighted index denominated in currency j, $\Delta q_{i,j,t}$ is the currency returns of country i relative to country j. Similar to previous analyses, a higher $q_{i,j,t}$ implies a currency appreciation for country i relative to country j. This regression is estimated annually for each pair of countries using the weekly data that belongs to that particular year. We also consider a specification that does not control for currency returns, where $\beta_{i,j,q}$ is constrained to be zero.

Our primary interest is how shocks to country j reflected in its stock index returns are related to country i's index returns. Hence, we study whether $\hat{\beta}_{i,j,S}$ can be predicted by the two trade measures we consider. In particular, the second-stage panel regression that we implement is as follows:

$$
\begin{aligned}
\hat{\beta}_{i,j,S,y} =& \delta_1 Comp_{i,j,y-1} + \delta_2 CD_{i,j,y-1} \\
& + \delta_3 ExpShare_{i,j,y-1} + \delta_4 FracExp_{i,y-1} + \delta_5 CS_{i,j,y-1} + \delta_6 ImpShare_{i,j,y-1} \\
& + \text{Time FE}_y + \text{Country FE}_{i,j} + e_{i,j,y},
\end{aligned} \tag{17}
$$

where we control for time-fixed effects and country-fixed effects.

Since this analysis is an expansion of the US-based panel regression, our initial specifications in the first two columns of Table 9 control for country j fixed effect as well as for two countries being located on the same continent to account for geographical proximity. The results are consistent with our hypothesis developed earlier (i.e., $\delta_1 < 0$ and $\delta_2 > 0$), similar to the US-based result. The stock returns of two countries that compete more in a common market have a lower correlation with each other. It is important to note that the negative effect of competition on return correlation remains even after controlling for global market returns in the first-stage regression.

Just like the industry-level analysis, the global setting also allows us to include country-pair fixed effects in the second-stage panel regression. The country-pair fixed effects should absorb any (time-invariant) cross-sectional variation in stock market comovement, leaving only the time-series component to be explained by the trade measures. That is, the hypothesis we test is whether a higher competition in one year between two countries i and j is followed by a lower comovement of stock prices between these two countries the following year. The last column of Table 9 summarizes the result of this regression specification. We continue to observe a significant negative effect of competition on stock market comovement, consistent with our US-based results.

Notably, we find the opposite sign for our CD measure. There are several possibilities for these conflicting results. One may be that the global stock market returns R_t^* in the first-stage regression of the current analysis captures the common global demand shock exposure of the two countries. With the global beta ($\beta_{i,j,G}$) estimated annually using non-overlapping observations, it may be more efficient in capturing the time-series dynamic than the (lagged) CD measure. Another potential reason is that the CD measure may reflect geographical proximity, cultural proximity, or other country-pair characteristics. Indeed, in an earlier analysis, we demonstrated that the CD measure is correlated with geographical proximity. The country-pair fixed effects are likely to capture these time-invariant characteristics.

III. Conclusion

This paper examines the potentially ambiguous effect of trade competition on equity market comovement. We develop an empirical framework to distinguish the product market competition aspect of trade linkages from the common demand exposures as well as the direct trade channel between two countries. We quantify the product market competition between two countries in their common export markets and examine its effect on international equity return dynamics. While the direction of this effect is a priori ambiguous, we find that the product market competition channel has a negative effect on cross-market return correlation: equity markets of countries that compete more with the US in the product market tend to have a lower correlation with the US stock market. This lower correlation is in contrast to the more widely documented positive effect for common demand linkages, i.e., the stock returns of countries that share common export markets with the US tend to have a higher stock return correlation with the US.

Our finding that product market competition has a negative effect on cross-country stock comovement is novel to the literature. The conflicting effects of common demand exposure and product market competition dimensions of trade linkages that we document indicate that the increasingly integrated global trade network may not necessarily lead to increasingly high cross-market correlations among asset returns. Similarly, our findings indicate that the specter of trade wars and the ongoing pandemic-stricken supply chains do not necessarily herald lower equity market comovement. Understanding how these correlations vary with the contours of the global trade network is crucial for investors seeking diversification in foreign equity markets.

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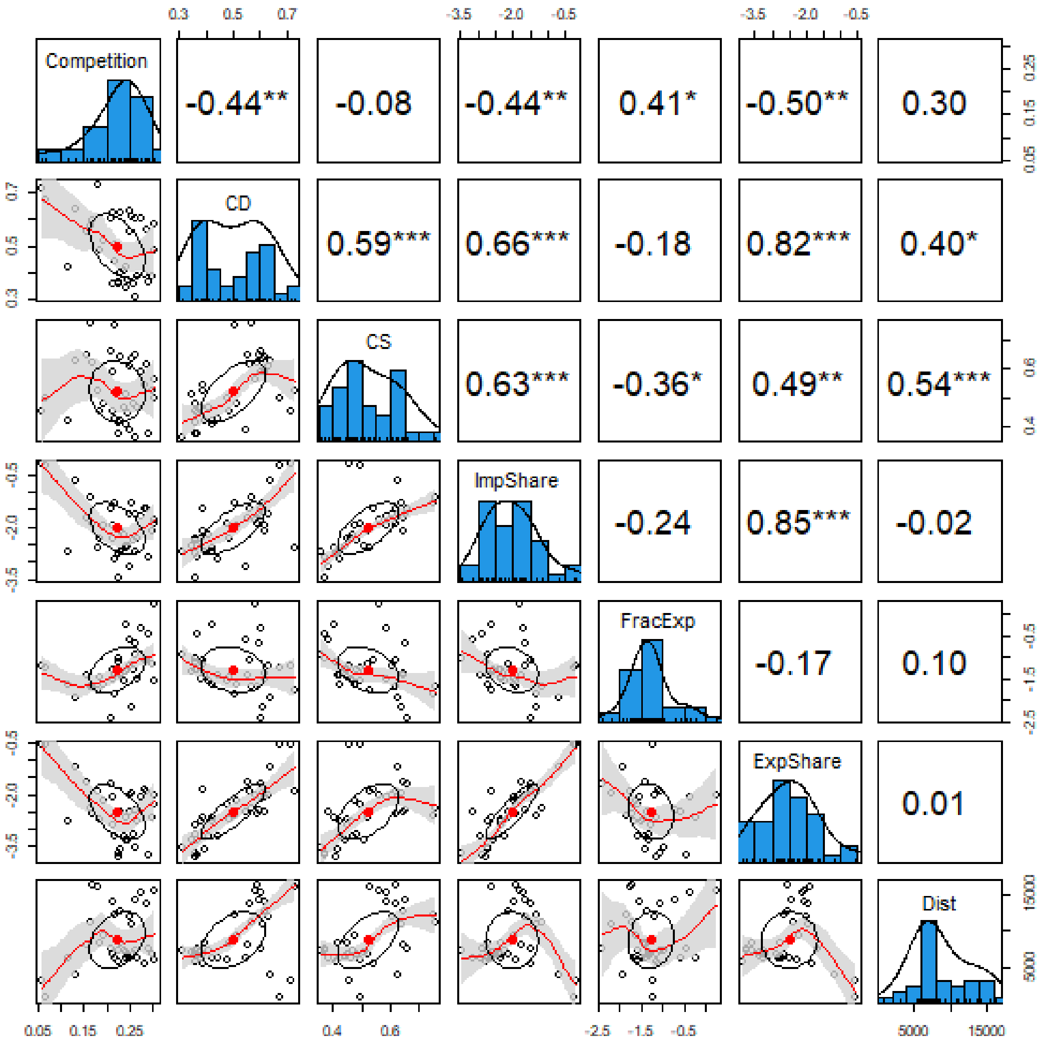

Figure 1: Correlation across trade measures

This figure plots the cross-country correlation of the trade measures considered in this paper. All trade measures are averaged by country using the entire time series. We include the following variables: competition with the US, common demand (CD) and common supply (CS) exposures with the US, percentage of import to the US as a fraction of total import ($ImpShare$), percentage of export to the US as a fraction of total export ($ExpShare$), amount of total export of a country as a fraction of total GDP ($FracExp$), and the distance between the capital city and Washington DC ($Dist$) in kilometers.

Table 1
Daily Return Regressions

This table summarizes the time-series averages of the slopes and the Newey-West standard errors of annual regressions of each country's daily stock returns on US stock returns, both contemporaneous and lagged:

$$R_{i,t+k} = \alpha_i + \beta_i R_{US,t} + \epsilon_{i,t+k},$$

where $R_{i,t+k}$ is the stock return of country i on day $t+k$ denominated in USD. The regression with $k = 0$ is defined as contemporaneous, $k = 1$ as one-day predictive, and the sum of $k = 2$ to $k = 5$ as one-week predictive for all countries on the Americas continents. For countries outside of the Americas, the above is lagged by a day: $k = 1$ is contemporaneous, $k = 2$ is one-day predictive, and the sum of $k = 3$ to $k = 6$ is one-week predictive. Common demand (CD) and Competition ($Comp$) with the US are defined in the main text.

		Dependent variables: Country Stock Returns						Trade Measures	
		Contemporaneous		Predictive					
	Sample			One-day		One-week		$CD_{(i,US)}$	$Comp_{(i,US)}$
Country	begins	Slope	SE	Slope	SE	Slope	SE		
Australia	1995	0.53***	0.04	0.01	0.03	−0.01	0.06	0.73	0.18
Austria	1999	0.29***	0.04	0.01	0.04	−0.04	0.08	0.31	0.26
Belgium	1999	0.29***	0.03	−0.02	0.03	−0.10*	0.06	0.42	0.24
Brazil	1995	1.00***	0.04	0.18***	0.05	0.21***	0.08	0.60	0.21
Canada	1995	0.89***	0.02	0.12***	0.03	0.12*	0.06	0.67	0.07
Chile	2002	0.50***	0.03	0.16***	0.04	0.20***	0.06	0.55	0.15
China	1995	0.16***	0.03	0.01	0.02	0.12***	0.04	0.57	0.17
Colombia	2005	0.58***	0.04	0.28***	0.04	0.31***	0.10	0.64	0.13
Denmark	1995	0.30***	0.02	0.00	0.03	−0.06	0.05	0.37	0.25
Egypt	2000	0.19***	0.03	−0.02	0.03	0.17**	0.08	0.51	0.20
Finland	1995	0.39***	0.03	−0.04	0.04	−0.21***	0.07	0.35	0.24
France	1999	0.29***	0.03	−0.03	0.03	−0.18***	0.06	0.38	0.27
Germany	1999	0.25***	0.03	−0.01	0.03	−0.12**	0.06	0.36	0.21
Greece	1999	0.30***	0.04	−0.01	0.04	0.02	0.07	0.40	0.23
Hungary	2001	0.39***	0.04	−0.06	0.05	−0.09	0.09	0.36	0.29
India	1996	0.27***	0.03	0.06**	0.03	0.17**	0.07	0.50	0.22
Indonesia	1995	0.49***	0.04	0.00	0.03	0.08	0.08	0.59	0.17
Ireland	1995	0.32***	0.03	−0.02	0.04	−0.07	0.07	0.39	0.28
Italy	1999	0.24***	0.03	−0.02	0.03	−0.11*	0.06	0.41	0.24
Japan	1999	0.45***	0.02	0.02	0.02	−0.02	0.05	0.61	0.25
Malaysia	1995	0.31***	0.02	0.03	0.02	0.05	0.05	0.60	0.28
Mexico	1995	0.88***	0.03	0.18***	0.03	0.07	0.07	0.72	0.06
Netherlands	1995	0.32***	0.03	0.00	0.03	−0.12**	0.06	0.55	0.25
Norway	1999	0.36***	0.04	−0.01	0.04	−0.06	0.07	0.42	0.12
New Zealand	1995	0.41***	0.02	0.00	0.02	0.03	0.05	0.62	0.21
Philippines	1995	0.45***	0.02	0.02	0.02	0.08	0.06	0.56	0.29
Poland	1995	0.41***	0.04	−0.03	0.03	−0.09	0.07	0.36	0.23
Portugal	1995	0.24***	0.03	−0.01	0.03	−0.10*	0.05	0.36	0.23
Singapore	1995	0.36***	0.02	0.03	0.03	0.06	0.06	0.58	0.31
South Africa	2002	0.39***	0.05	−0.04	0.05	−0.20**	0.09	0.62	0.23
South Korea	1995	0.53***	0.04	0.04	0.05	0.03	0.08	0.63	0.25
Spain	1999	0.25***	0.04	−0.04	0.03	−0.13**	0.06	0.44	0.22
Sweden	1995	0.36***	0.03	−0.01	0.03	−0.16**	0.06	0.36	0.26
Switzerland	1995	0.26***	0.02	−0.01	0.03	−0.12***	0.04	0.39	0.30
Thailand	1995	0.31***	0.03	0.09***	0.03	0.18***	0.06	0.60	0.26
Turkey	2006	0.33***	0.05	−0.01	0.05	−0.09	0.11	0.48	0.18
United Kingdom	1995	0.29***	0.03	−0.03	0.03	−0.15***	0.06	0.48	0.30

Table 2
Return Slopes and Cross-Border Trade:
Cross-sectional Regressions

This table summarizes the average of the slope coefficients, Newey-West adjusted t-statistics, and the average R^2s of the second stage of a two-stage cross-sectional regression model. The first-stage regression is an annual regression using daily data of country stock returns on US index returns, both contemporaneous and lagged:

$$R_{i,t+k} = \alpha_i + \beta_{i,0} R_{US,t} + \beta_{i,1} R_{US,t-1} + \beta_{i,w} \sum_{\tau=2}^{5} R_{US,t-\tau} + \epsilon_{i,t+k},$$

where $R_{i,t+k}$ is the stock returns of country i in USD on day $t+k$, $R_{US,t}$ is the value-weighted daily US stock market return on day t, and $k=1$ for countries outside of the Americas and $k=0$ for countries in the Americas. In Model (1), we let $\beta_{i,1} = \beta_{i,w} = 0$. In Model (2), we let $\beta_{i,0} = 0$. Model (3) does not impose any restrictions. The reported estimates are from the second-stage cross-sectional regressions of

$$\hat{\beta}_{i,j,y} = \delta_{0,j} + \delta_{1,j} Comp_{(i,US,y-1)} + \delta_{2,j} CD_{(i,US,y-1)} + e_{i,j,y},$$

for $j = 0, 1, w$ and y represent different years. The adjusted R^2 of each second-stage regression is reported beneath the corresponding parameter estimate and the Newey-West adjusted t-statistics (in parentheses). Panel A shows the result when only one trade measure is added at a time in the second-stage regression, with $Comp_{(i,US)}$ estimates reported in columns (1)-(3) and the corresponding $CD_{(i,US)}$ estimates reported in columns (4)-(6). Panel B reports the results when both trade measures are added simultaneously.

Panel A. Univariate regressions

	$Comp_{(i,US)}$			$CD_{(i,US)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}_{i,0}$	-1.700^{***}		-1.708^{***}	0.853^{***}		0.875^{***}
	(-9.07)		(-9.38)	(7.71)		(7.83)
	0.119		0.118	0.255		0.260
$\hat{\beta}_{i,1}$		-0.489^{***}	-0.471^{***}		0.314^{***}	0.362^{***}
		(-5.10)	(-5.03)		(5.65)	(6.48)
		0.198	0.065		0.123	0.152
$\hat{\beta}_{i,w}$		0.031	-0.017		(0.05)	0.071^{**}
		(0.67)	(-0.41)		(1.60)	(2.27)
		0.124	0.027		0.116	0.116

Panel B. Bivariate regressions

	(1)		(2)		(3)	
	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$
$\hat{\beta}_{i,0}$	-1.567^{***}	0.875^{***}			-1.570^{***}	0.896^{***}
	(-7.62)	(9.06)			(-7.88)	(9.21)
	0.359				0.362	
$\hat{\beta}_{i,1}$			-0.473^{***}	0.315^{***}	-0.445^{***}	0.357^{***}
			(-4.73)	(5.56)	(-4.82)	(6.35)
			0.182		0.212	
$\hat{\beta}_{i,w}$			0.045	0.054^{*}	-0.001	0.074^{**}
			(1.12)	(1.75)	(-0.02)	(2.46)
			0.146		0.152	

Table 3
Stock Returns and Currency Returns

This table summarizes the results of two-stage regression models of international stock and currency returns. The first-stage regression in Panel A is the model of country i's stock returns:

$$R_{i,t+k} = \alpha_i + \beta_{i,0} R_{US,t} + \beta_{i,1} R_{US,t-1} + \beta_{i,w} \sum_{\tau=2}^{5} R_{US,t-\tau} + \gamma \Delta q_{i,t+k} + \eta_{i,t+k},$$

where $R_{i,t+k}$ is the stock returns of country i in USD, and $\Delta q_{i,t+k}$ is the currency returns of country i relative to USD. We set $k = 1$ for countries outside of the Americas and $k = 0$ for countries in the Americas. The first-stage in Panel B is the model of country i's currency returns:

$$\Delta q_{i,t+k} = \alpha_i + \beta_{i,0} R_{US,t} + \beta_{i,1} R_{US,t-1} + \beta_{i,w} \sum_{\tau=2}^{5} R_{US,t-\tau} + \epsilon_{i,t+k}.$$

These time-series regression models are estimated annually for each country using daily data. Model (1) imposes the restriction of $\beta_{i,1} = \beta_{i,w} = 0$. In Model (2), the restriction is $\beta_{i,0} = 0$, and in Model (3), there are no restrictions. Reported are the time-series average of parameter estimates, the Newey-West adjusted t-statistics, and the average adjusted-R^2s from the second-stage cross-sectional regression model with the following specification:

$$\hat{\beta}_{i,j,y} = \delta_{0,j} + \delta_{1,j} Comp_{(i,US,y-1)} + \delta_{2,j} CD_{(i,US,y-1)} + e_{i,j,y},$$

for $j = 0, 1, w$ and y represent different years.

Panel A. Stock returns, controlling for currency returns

	(1)		(2)		(3)	
	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$
$\hat{\beta}_{i,0}$	-1.162^{***}	1.338^{***}			-1.163^{***}	1.349^{***}
	(-6.52)	(6.69)			(-6.56)	(6.64)
	0.170				0.171	
$\hat{\beta}_{i,1}$			-0.173^{**}	0.464^{***}	-0.140^{**}	0.530^{***}
			(-2.37)	(3.50)	(-1.97)	(4.40)
			0.093		0.095	
$\hat{\beta}_{i,w}$			-0.005	0.099^{*}	-0.041	0.139^{**}
			(-0.15)	(1.73)	(-1.20)	(2.54)
			0.079		0.089	

Panel B. Currency returns

	(1)		(2)		(3)	
	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$
$\hat{\beta}_{i,0}$	-0.566^{***}	0.771^{***}			-0.574^{***}	0.794^{***}
	(-9.27)	(7.12)			(-8.92)	(7.23)
	0.254				0.258	
$\hat{\beta}_{i,1}$			-0.326^{***}	0.295^{***}	-0.347^{***}	0.301^{***}
			(-8.08)	(3.55)	(-8.09)	(3.32)
			0.151		0.157	
$\hat{\beta}_{i,w}$			0.033^{**}	-0.002	0.02	0.015
			(2.06)	(-0.07)	(1.41)	(0.50)
			0.082		0.084	

Table 4
Cross-sectional Regressions Controlling for Trade Measures

This table summarizes the slope coefficients, Newey-West adjusted t-statistics, and the average adjusted-R^2s of the two-stage regressions controlling for additional trade measures. The first stage is an annual time-series regression of

$$R_{i,t+k} = \alpha_i + \beta_{i,0} R_{US,t} + \beta_{i,1} R_{US,t-1} + \beta_{i,w} \sum_{\tau=2}^{5} R_{US,t-\tau} + \epsilon_{i,t+k},$$

where $k = 1$ for countries outside of the continent of America and $k = 0$ for countries in America. The reported estimates are from the second-stage cross-sectional regressions of

$$\hat{\beta}_{i,j,y} = \delta_{0,j} + \delta_{1,j} CD_{(i,US,y-1)} + \delta_{2,j} Comp_{(i,US,y-1)} + \delta'_j Control_{i,US,y-1} + e_{i,j,y},$$

where $Control_{i,US,y-1}$ includes country i's fraction of export to the US ($ExpShare$), the fraction of export to the total GDP of country i ($FracExp_{i,y-1}$), common supply share (CS) as defined in the main text, and country i's import to the US (ImpShare) as a fraction of total import of country i. All trade measures are lagged.

	Model 1			Model 2			Model 3		
	$\hat{\beta}_{i,0}$	$\hat{\beta}_{i,1}$	$\hat{\beta}_{i,w}$	$\hat{\beta}_{i,0}$	$\hat{\beta}_{i,1}$	$\hat{\beta}_{i,w}$	$\hat{\beta}_{i,0}$	$\hat{\beta}_{i,1}$	$\hat{\beta}_{i,w}$
$Comp_{(i,US)}$	-1.483^{***}	-0.333^{***}	0.003	-1.299^{***}	-0.567^{***}	-0.186^{***}	-1.330^{***}	-0.618^{***}	-0.223^{***}
	(−8.26)	(−3.18)	(0.08)	(−5.93)	(−3.99)	(−3.83)	(−5.21)	(−4.07)	(−4.24)
$CD_{(i,US)}$	0.349^{***}	0.005	0.109^{**}	0.693^{***}	0.050	0.014	0.375^{***}	−0.090	0.038
	(3.00)	(0.11)	(2.57)	(9.75)	(0.83)	(0.40)	(2.83)	(−1.25)	(0.73)
$ExpShare_{(i,US)}$	0.098^{***}	0.067^{***}	−0.006				0.098^{***}	0.041^{***}	−0.004
	(6.54)	(7.21)	(−1.45)				(4.02)	(3.28)	(−1.15)
$FracExp_{(i)}$	-0.089^{***}	-0.051^{***}	0.002				-0.050^{***}	-0.018^{***}	−0.009
	(−3.07)	(−4.18)	(0.08)				(−3.03)	(−2.13)	(0.97)
$ImpShare_{(i,US)}$				0.072^{***}	0.060^{***}	−0.002	0.000	0.029^{**}	0.003
				(5.86)	(7.29)	(−0.99)	(0.01)	(2.28)	(0.59)
$CS(i,US)$				−0.159	0.142^{*}	0.141^{***}	−0.063	0.176^{*}	0.142^{***}
				(−1.63)	(1.92)	(6.09)	(−0.45)	(1.89)	(4.02)
R^2	0.444	0.325	0.193	0.460	0.386	0.269	0.460	0.386	0.269

Table 5
Trade Competition and Stock Market Correlations at the Weekly Frequency

This table summarizes the results of the two-stage panel regression model with country cluster-robust standard errors. The first stage is the regression

$$R_{i,t} = \alpha_i + \beta_{i,US} R_{US,t} + \beta_{i,G} R_t^* + \beta_{i,q} \Delta q_{i,t} + \epsilon_{i,t},$$

where $R_{i,t}$ is the weekly stock returns of country i, $R_{US,t}$ is the weekly US stock returns, R_t^* is the weekly global value-weighted index, all of which is denominated in USD, $\Delta q_{i,t+1}$ is the currency returns of country i relative to USD. *"No currency control"* refers to the case where $\beta_{i,q}$ is set to zero. The first-stage regression estimates are included in the second-stage panel regression with the following specification:

$$\hat{\beta}_{i,US,y} = \delta_1 Comp_{i,US,y-1} + \delta_2 CD_{i,US,y-1} + \delta' Control_{i,US,y-1} + \text{Year FE}_y + e_{i,y},$$

where $\hat{\beta}_{i,US,y}$ is the estimate from each first-stage regression, $CD_{i,US,y-1}$ and $Comp_{i,US,y-1}$ are common demand share and competition measures of year $y-1$ as defined in the main text. Control includes country i's fraction of export to the US ($ExpShare$), the fraction of export to the total GDP of country i ($FracExp_i$), common supply share (CS) as defined in the main text, and country i's import to the US ($ImpShare$) as a fraction of total import of country i. There are a total of 853 observations in each of the second-stage panel regressions.

	Currency control			No currency control		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$Comp_{(i,US)}$	−2.474	−2.436	−2.180	−2.472	−2.356	−2.17
	(−2.88)	(−3.61)	(−2.27)	(−2.46)	(−3.29)	(−2.10)
$CD_{(i,US)}$	0.298	−0.385	−0.789	0.711	−1.002	−0.909
	(1.30)	(−3.88)	(−2.02)	(2.25)	(−4.95)	(−2.34)
$ExpShare_{(i,US)}$		0.222	0.239		0.325	0.307
		(4.51)	(2.78)		(7.10)	(3.58)
$FracExp_i$		0.074	0.044		0.017	0.007
		(0.58)	(0.33)		(0.14)	(0.05)
$CS_{(i,US)}$			−0.084			−0.181
			(−0.29)			(−0.34)
$ImpShare_{(i,US)}$			−0.024			0.024
			(−0.36)			(0.33)
Year FE	Y	Y	Y	Y	Y	Y
R^2	0.441	0.462	0.462	0.568	0.595	0.596

Table 6
Supply vs Demand Shock

This table summarizes the results of the two-stage panel regression with country cluster-robust standard errors, where top upstream and bottom downstream US returns are used instead of the US value-weighted portfolio returns in the first stage regression. Upstream industries are US industries classified as suppliers in the supply chain, whereas downstream industries are classified as close to the end users of the product in the supply chain. The first-stage regression is

$$R_{i,t} = \alpha_i + \beta_{i,u} R^u_{US,t} + \beta_{i,d} R^d_{US,t} + \beta_{i,G} R^*_t + \beta_{i,q} \Delta q_{i,t} + \epsilon_{i,t},$$

where $R^u_{US,t}$ and $R^d_{US,t}$ are the US upstream and downstream industry returns. The second-stage regression is identical to Table 5, but the dependent variable is $\hat{\beta}_{i,u}$ in Panel A, and $\hat{\beta}_{i,d}$ in Panel B, respectively. There are 853 observations in each of the second-stage panel regressions.

	Using upstream returns			Using downstream returns		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$Comp_{(i,US)}$	−1.423	−1.414	−1.998	−0.007	0.002	−0.090
	(−3.76)	(−3.78)	(−4.10)	(−0.03)	(0.01)	(−0.17)
$CD_{(i,US)}$	0.553	0.431	0.202	0.320	−0.013	−0.037
	(3.37)	(2.06)	(0.92)	(2.56)	(−0.01)	(−0.21)
$ExpShare_{(i,US)}$		0.023	0.015		0.068	0.079
		(0.82)	(0.37)		(3.25)	(2.34)
$FracExp_i$		−0.001	0.015		0.374	0.038
		(−0.02)	(0.66)		(1.50)	(1.36)
$CS_{(i,US)}$			0.543			0.025
			(2.44)			(0.11)
$ImpShare_{(i,US)}$			0.019			−0.063
			(0.11)			(−0.36)
Year FE	Y	Y	Y	Y	Y	Y
R^2	0.219	0.221	0.232	0.131	0.131	0.146
# of Obs	853	853	853	853	853	853

Table 7
Evidence from US Free Trade Agreements

This table shows the result of the two-stage panel regression with the following first-stage regression:

$$R_{i,t} = \alpha_{i,j} + \beta_{i,j,S}R_{j,t} + \beta_{i,j,US}R_{US,t} + \beta_{i,j,G}R_t^* + \beta_{i,j,iq}\Delta q_{i,t} + \beta_{i,j,jq}\Delta q_{j,t} + \epsilon_{i,j,t},$$

where $R_{i,t}$ is the stock return of country i at time t, $R_{j,t}$ is the contemporaneous stock return of country j, R_t^* is the value-weighted global index returns, and $\Delta q_{i,t}$ is the currency returns of country i relative to the US. The set of country i includes all countries that established an FTA with the US in the 1999-2017 period. The set of country j includes all other non-US countries in our sample. The betas are estimated for each country i and all country j for the year before and after the effective date of country i's FTA with the US. The estimated betas $\hat{\beta}_{i,j,S,y}$ measures the co-movement of the stock returns of country i and country j in year y. In the second-stage panel regression, these estimated betas are regressed on several indicator variables and their interactions. The first indicator variable $1_{After,y}$ takes a value of 1 for the year y following the effective date and 0 for the year preceding the effective date. The second indicator variable, $1_{Comp^{US},i,j}$, takes a value of 1 if the competition measure between countries i and j increases after country i's FTA with the US. The third indicator variable, $1_{CD^{US},i,j}$, is defined analogously using CD between i and j. $\overline{M}$ denotes the time-series mean of each trade measure M computed over the entire sample; the trade measures are defined in Figure 1. There are 357 observations used in each second-stage panel regression reported below.

	Dependent variable: $\beta_{i,j,S,y}$			
	Model 1	Model 2	Model 3	Model 4
$1_{After,i,y} \times 1_{Comp^{US},i,j}$	−0.080	0.081	−0.079	−0.091
	(−2.24)	(−2.15)	(−2.00)	(−2.06)
$1_{After,i,y} \times 1_{CD^{US},i,j}$		−0.015		0.067
		(−0.36)		(1.27)
$1_{Comp^{US},i,j}$	0.328	−0.095	0.087	0.090
	(2.17)	(−0.69)	(2.83)	(2.66)
$1_{CD^{US},i,j}$		−0.412		−0.036
		(−2.33)		(−0.92)
$1_{After,i,y}$	0.329	0.058	0.107	0.064
	(2.17)	(1.61)	(2.59)	(1.02)
$\overline{Comp^{US}_{(i,j)}}$			−0.235	−0.256
			(−1.10)	(−0.89)
$\overline{CD^{US}_{(i,j)}}$			0.123	0.046
			(2.58)	(0.19)
$\overline{ExpShare_{(i,j)}}$			0.013	0.002
			(1.63)	(0.30)
$\overline{FracExp_i}$			0.031	0.028
			(1.63)	(1.16)
$\overline{ImpShare_{(i,j)}}$			−0.144	0.916
			(−0.59)	(1.46)
$\overline{CS_{(i,j)}}$			0.000	−0.001
			(−0.01)	(0.00)
Year FE	Y	Y	Y	Y
County-pair FE	Y	Y	N	N
R^2	0.629	0.629	0.144	0.148

Table 8
International Industry Competition and Return Comovement

This table summarizes the results of the regression

$$R_{i,ind,t} = \alpha_{i,j,ind} + \beta_{i,j,ind}R_{j,ind,t} + \beta_{i,j,ind,iM}R_{i,M,t} + \beta_{i,j,ind,jM}R_{j,M,t} + \beta_{i,j,ind,iq}\Delta q_{i,t} + \beta_{i,j,ind,jq}\Delta q_{j,t} + \epsilon_{i,j,ind,t},$$

where $R_{i,ind,t}$ is the stock return of industry *ind* in country i, $R_{i,M,t}$ is the market return of country i, and $\Delta q_{i,t+1}$ is the currency return of country i relative to USD. All stock returns are converted in terms of USD. The second stage is a panel regression

$$\hat{\beta}_{i,j,ind,y} = a + bIndComp_{(i,j,ind,y-1)} + e_{i,j,ind,y},$$

where $IndComp_{(i,j,ind,y-1)}$ is industry competition measure for industry *ind* computed between countries i and j in year $y-1$. A total of 58,842 industry-country-year observations are used in each second-stage regression reported below.

	Model 1	Model 2	Model 3	Model 4	Model 5
$IndComp_{(i,j,ind)}$	-0.545	-0.568	-0.478	-0.513	-0.747
	(-2.59)	(-2.70)	(-1.80)	(-1.94)	(-2.44)
Country i FE	N	Y	N	Y	N
Country j FE	N	N	Y	Y	N
County-pair	N	N	N	N	Y
Year FE	Y	Y	Y	Y	Y
R^2	0.0001	0.0011	0.0012	0.0018	0.0129

Table 9
Global Competition and Stock Market Comovement

This table summarizes the results of two-stage panel regressions. The first stage is the annual regression of weekly returns:

$$R_{i,t} = \alpha_{i,j} + \beta_{i,j,S} R_{j,t} + \beta_{i,j,G} R_t^* + \beta_{i,j,q} \Delta q_{i,j,t} + \epsilon_{i,j,t},$$

where $R_{i,t}$ is the weekly stock returns of country i, $R_{j,t}$ is the returns of country j, R_t^* is the global value-weighted index return in USD terms, and $\Delta q_{i,t}$ is the currency returns of country i relative to country j. The second stage is the panel regression:

$$\hat{\beta}_{i,j,y} = \delta_1 Comp_{i,j,y-1} + \delta_2 CD_{i,j,y-1} + \delta' Control_{i,j,y-1} + \text{FE}_{i,j,y} + e_{i,j,y},$$

where $\hat{\beta}_{i,j,S,y}$ is the beta estimated in the first-stage regression in year y, $CD_{i,j,y-1}$, $Comp_{i,j,y-1}$ are lagged common demand and competition measures measured for country i with respect to country j, $ExpShare$, CS, and $ImpShare$ are also defined as above for country i with respect to country j, and $FracExp$ is the fraction of export to the total GDP of country i. There are a total of 29,698 observations in each second-stage panel regression reported below.

	Model 1	Model 2	Model 3
$Comp_{(i,j)}$	−0.149	−0.153	−0.168
	(−4.62)	(−4.14)	(−2.53)
$CD_{(i,j)}$	0.156	0.141	−0.167
	(7.93)	(6.56)	(−1.95)
$ExpShare_{(i,j)}$	−0.004	−0.006	0.031
	(−1.83)	(−2.66)	(−0.46)
$FracExp_i$	0.074	0.072	0.031
	(11.96)	(1.54)	(1.39)
$CS_{(i,j)}$	0.169	0.246	−0.079
	(9.17)	(12.60)	(−2.04)
$ImpShare_{(i,j)}$	0.006	−0.002	0.007
	(0.29)	(−1.27)	(1.37)
Year FE	Y	Y	Y
Country j FE	Y	Y	N
$1_{\text{Cont}_i=\text{Cont}_j}$	N	Y	N
$1_{\text{Cont}_i=\text{Cont}_j} \times$ Ctr j FE	N	Y	N
County-pair FE	N	N	Y
R^2	0.162	0.196	0.396

A. Data

1. Data sources

We collect our data from several different sources. The international stock index returns are obtained from the Daily World Indices provided by Wharton Research Data Services (WRDS). The database contains index returns from 36 countries from 1986 onward. Both developed and emerging economies are well covered in this database. From the dataset, we take four indices from North and South America (Brazil, Mexico, Chile, and Colombia), two indices from Oceania (Australia and New Zealand), 10 indices from Asia (China, India, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Thailand, and Turkey), two indices from Africa (Egypt and South Africa), and 18 indices from Europe (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and United Kingdom).

In addition to the data from Daily World Indices, we obtain additional index returns. For the US, we take the CRSP daily value-weighted index including dividends (US), and for Canada, which is excluded from the WRDS dataset, we take the S&P/TSX Composite Index (Canada). We employ the US as the focal country for the main analyses and consider the global panel as our supplementary analysis. Also, among indices covered by the WRDS, we note that we remove Hong Kong from the analysis because firms listed in the Hong Kong stock exchange have a strong correlation with China's trade activities, probably even stronger than with Hong Kong's own trade activities. We also remove Taiwan since some of the Trade database detailed below is missing.

These country-level stock index returns are converted to USD terms, using daily exchange rates compiled by the International Monetary Fund (IMF) from reports provided by each central bank at the end of the day. For currencies not reported on the IMF website, we obtain them directly from the corresponding central bank websites.

The trade measures are constructed from two sources. Our first measure captures the product market competition between two countries, constructed using the product-level trade dataset in the BACI database from the Centre d'Etudes Prospectives et d'Informations Internationales (CDPII). This dataset originates from the United Nations (UN) Comtrade dataset provided by the UN Statistics Division. The dataset covers international import and export for more than 200 countries and 5,000 products between 1994 and 2020, at the 6-digit level of the Harmonized Commodity Description and Coding System (HS). The methodology used to compile and clean the data is provided in Gaulier and Zignago (2010). Other trade measures are constructed from the aggregate trade volume. We obtain country-level total exports and imports data from IMF's Direction of Trade Statistics (DOTS) dataset, which provides a breakdown of the annual total of merchandise imports and exports by each counter-party country.

For robustness, we employ several additional variables from existing literature. We follow Johnson and Noguera (2012) and compute a measure of value-added trade. Specifically, we compute two measures of the fraction of US value-added traded. First, we compute the relative importance of value-added export to the US (VA%US) as the total amount of value-added export to the US as a fraction of total amount of value-added export to the entire world. Second, we compute the fraction of value-added as a relative value of total export value to the US ($\%VA_{(i,US)}$). For country i, it is defined as the amount of value-added export to the US divided by the total amount from country i's export to the US. The data is provided by the authors.

We also consider measures of financial integration. Motivated by Bekaert, Harvey, Kiguel, and Wang (2016), we measure the relative importance of a country's debt and equity holdings of the US as well as held by the US. $Equity_{(i,US)}$ is defined as the fraction of US equity in country i's global portfolio of equity. Similarly, $Debt_{(i,US)}$ is the fraction of US debt in country i's global portfolio of debt. $Equity_i^{US}$ ($Debt_i^{US}$) is defined as the fraction of country i's equity (debt) that is held by US investors.

GDP data is from IMF. We use the Total GDP based on PPP and construct GDP per capita by dividing the total GDP by the total population. $|\Delta \text{GDP}_{(i,j)}|$ is defined as the absolute difference between GDP of countries i and j. $|\Delta \text{GDPC}_{(i,j)}|$ is defined as the absolute difference between GDP per capita of countries i and j. GDP gap is defined as in Bekaert, Harvey, Kiguel, and Wang (2016) and is constructed by subtracting the five-year lagged average GDP from GDP per capita for each country. Several geographical and cultural variables are used as control and are from the CEPII-GeoDist database.

2. Vertical positions of industries

We use the Input-Output table of the Bureau of Economic Analysis (BEA) to quantify the vertical position of industries.

The BEA produces supply and use tables separately. Supply tables show the goods and services produced by each industry, while use tables show who uses these goods and services. The supply and use tables can be combined to produce a matrix of the flows of commodities to the final customer. We follow Antràs, Chor, Fally, and Hillberry (2012) to construct a measure of vertical position for each industry. The supply table ($M \times N$ matrix) shows how N different goods and services produced in each of the M industries. The use table ($N \times M + 1$ matrix) contains how these M industries, in addition to the end customer, use the N different produced products. To calculate the proportion of products produced in one industry that flows into another, we can combine the supply and use tables. The steps are detailed, e.g., in Ahern and Harford (2014).

The first step is to normalize these two matrices by dividing each element by its row mean such that each row has a sum of one. The next step is to multiply the normalized supply table (S) by the use table (U) to generate a M by $M+1$ matrix. The last column of this matrix contains information about the proportion of industry output that is consumed by the end customer. If this proportion is high, the industry is more likely to be a downstream industry. If this is low, the industry is more likely to be an upstream industry.

The vertical position (VP) is defined as in Antràs, Chor, Fally, and Hillberry (2012). That is,

$$VP_{M\times 1} = (I_{M\times M} - S_{M\times N} \times U_{N\times M})^{-1} 1_{M\times 1}, \tag{18}$$

where $I_{M\times M}$ is a M-dimensional identity matrix and $1_{M\times 1}$ is a vector of ones. Note that the last column of the user matrix is removed from the computation but is redundant after the normalization. The M-vector VP is the vertical position of each industry. If this is high the industry is more likely to be downstream and vice versa.

B. Additional empirical analysis

1. Excluding NAFTA from the analysis

There are two countries that rely heavily on the US domestic market as a trade destination: Canada and Mexico. Given their unique characteristic, a concern with our baseline result is that it is driven by how these two countries trade with the US and how these stock markets comove with the US. We address this concern by excluding both countries from the analysis in autoreftab:NAFTA. Overall, the results are qualitatively similar to the main regressions. Even after removing these two countries, those competing with the US move less following

US market movements. Stock returns of countries that share a common demand with the US move together with the US.

2. Regression using standardized returns

The baseline analysis of this paper uses the beta on the US returns as the explanatory variable. Therefore, the variation in the cross-country betas may either be driven by the heterogeneity of the correlations of foreign stock markets with the US or by the correlation across various markets' return volatility. To understand the role of volatility transmission, we perform an analysis of standardized returns. In this analysis, returns are standardized by dividing both US and country stock returns by their respective standard deviations of that year. The results are summarized in Table A2. We observe similar results when returns are standardized, suggesting that the relationship between cross-country betas and trade measures shown in the paper is driven by the correlation of returns rather than return volatility.

3. Additional control variables

The main analysis uses various measures of trade linkages as control variables. In this analysis, we control for several other variables. Table A3 describes the results.

In Panel A of the table, we control for the degree of economic development as well as for the business cycle. We use the absolute value of the difference between a country's total GDP and GDP per capita with the US as control variables. We also control for the GDP gap, as defined in Bekaert, Harvey, Kiguel, and Wang (2016), which is the GDP growth rate in excess of its five-year historical rolling-window average.

The three columns show that difference in country size (i.e. larger difference in total GDP) has a positive, the difference in the degree of economic development (i.e., the difference between GDP per capita) has ambiguous, and the business cycle has no effect on stock market comovement. Our competition measure has a negative, and our common demand measure has a positive effect on stock market comovement even after adding these control variables.

In Panel B, instead of the fraction of US export and export as a fraction of GDP, we control for the relative importance of US value-added trade and for the relative value-added trade. These measures are defined in the data appendix. US returns no longer negatively predicts future returns of countries that fiercely compete with the US, but these country comove less with US stock returns.

Panel C shows the result where we control for US equity and debt holdings, which are proxies for financial integration (Bekaert, Harvey, Kiguel, and Wang 2016). Overall, the results are similar to our main analysis, suggesting that the lower comovement of countries that heavily compete with the US is not driven by the lower degree of financial integration.

Finally, in Panel D, we control for the geographical distance of countries as well as a common language. English-speaking countries comove less with US stock returns, but many English-speaking countries such as UK and Ireland heavily compete with the US.

4. Subsample analysis

In this subsection, we perform several subsample analyses. First, we take the weekly regression results reported in Table 5 and divide the sample periods in half. The first half contains sample periods between 1996 and 20008. The second half contains periods between 2009 and 2020. Second, we take the analysis of Table 9 and divide the sample periods in half, similar to the previous analysis. We also show robustness to excluding the US and countries that are located in Europe from the analysis.

Table A4 summarizes the results of these analyses. Overall, focusing on Panel A, the results indicate that the importance of the competition channel is neither stronger nor weaker in one of the sub-periods. The coefficients for the pre-2008 period are more negative but have lower t-statistics compared to the post-2009 period. The results in Panel B are similar. However, the common demand channel seems to be entirely driven by the post-2009 sample.

The regional analysis reported in Panel B suggests that our results are not driven by a particular region.

Table A1
Regressions excluding countries that belongs to NAFTA

This table summarizes the slope coefficients, Newey-West adjusted t-statistics, and the average R^2s of the two-stage regressions similar to Table 2 but excluding Canada and Mexico from the sample.

	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$
$\hat{\beta}_{i,0}$	-0.791^{***}	0.712^{***}			-0.824^{***}	0.734^{***}
	(-2.75)	(6.68)			(-2.88)	(6.99)
	0.220				0.222	
$\hat{\beta}_{i,1}$			-0.153	0.256^{***}	-0.122	0.295^{***}
			(-1.03)	(4.25)	(-0.82)	(5.03)
			0.134		0.152	
$\hat{\beta}_{i,w}$			-0.074	0.083^{**}	-0.086^{*}	0.097^{***}
			(-1.63)	(2.48)	(-1.90)	(2.97)
			0.153		0.163	

Table A2
Regressions using standardized returns

This table summarizes the slope coefficients, Newey-West adjusted t-statistics and the average R^2s of the two-stage regressions similar to Table 2 but dividing country stock returns by their 12-month rolling window standard deviations. The first stage regression is therefore as follows:

$$\tilde{R}_{i,t+k} = \alpha_i + \beta_{i,0}\tilde{R}_{US,t} + \beta_{i,1}\tilde{R}_{US,t-1} + \beta_{i,w}\sum_{\tau=2}^{5}\tilde{R}_{US,t-\tau} + \epsilon_{i,t+k},$$

where $\tilde{R}_{i,t}$ is the standardized return of country i denominated in USD.

	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$	$Comp_{(i,US)}$	$CD_{(i,US)}$
$\hat{\beta}_{i,0}$	-79.05^{***}	66.08^{***}			-78.31^{***}	67.39^{***}
	(-4.68)	(7.12)			(-4.63)	(7.23)
	0.369				0.372	
$\hat{\beta}_{i,1}$			-29.14^{***}	22.80^{***}	-27.27^{***}	25.43^{***}
			(-3.77)	(5.06)	(-3.51)	(5.75)
			0.176		0.203	
$\hat{\beta}_{i,w}$			2.47	4.78^{**}	-0.88	6.41^{***}
			(0.85)	(2.41)	(-0.32)	(3.31)
			0.135		0.152	

Table A3
Other Robustness Tests

This table summarizes the slope coefficients, Newey-West adjusted t-statistics and the average R^2s of the two-stage regressions similar to Table 2 but controlling for additional variables in the second-stage regression. The control variables include: the absolute value of the difference in GDP ($|\Delta$ GDP$_{(i,US)}|$) or GDP per capita ($|\Delta$GDPC$_{(i,US)}|$) between country i and the US, and GDP gap, defined as in the appendix in Panel A; the amount of value-added export to the US as a fraction of total value-added export of the country (VA%US) and the total amount of value-added export to the US as a fraction of total US export of a country (%VA) in Panel B; the fraction of US equity in the country's global portfolio of equity ($Equity_{(i,US)}$), the fraction of US debt in the country's global portfolio of debt ($Debt_{(i,US)}$), the fraction of the country's equity that is held by US investors ($Equity_i^{US}$), and the fraction of the country's debt that is held by US investors ($Debt_i^{US}$) in Panel C; and the log of geographical distance between capital cities between two countries and a dummy variable that takes a value of 1 if the country is an English-speaking country as a primary language in Panel D.

Panel A. Control for GDP Variables

	$Comp_{(i,US)}$	$CD_{(i,US)}$	$\|\Delta$GDPC$_{(i,US)}\|$	$\|\Delta$GDP$_{(i,US)}\|$	GDP Gap$_i$
$\hat{\beta}_{i,0}$	-1.593^{***}	0.795^{***}	-0.009	-0.007	-0.048
	(-7.88)	(7.42)	(-0.93)	(-1.24)	(-0.29)
$\hat{\beta}_{i,1}$	-0.478^{***}	0.277^{***}	0.013^{***}	-0.009^{**}	0.101
	(-3.91)	(4.57)	(2.68)	(-2.03)	(1.00)
$\hat{\beta}_{i,w}$	0.025	0.025	0.010^{***}	0.004^{*}	0.021
	(0.77)	(4.92)	(4.92)	(1.81)	(0.52)

Panel B. Control for value-added

	$Comp_{(i,US)}$	$CD_{(i,US)}$	$VA\%US_i$	$\%VA_{(i,US)}$
$\hat{\beta}_{i,0}$	-1.486^{***}	0.787^{***}	1.673^{***}	0.637^{*}
	(-4.05)	(4.42)	(9.50)	(1.65)
$\hat{\beta}_{i,1}$	0.204	0.225^{***}	0.689^{***}	1.266^{***}
	(1.25)	(3.72)	(4.32)	(4.49)
$\hat{\beta}_{i,w}$	-0.044	0.07	-0.094^{*}	0.05
	(-0.59)	(1.58)	(-1.70)	(0.47)

Panel C. Control for Asset Liability Holdings

	$Comp_{(i,US)}$	$CD_{(i,US)}$	Equity$_{(i,US)}$	Debt$_{(i,US)}$	Lib/Equity$_{(i,US)}$	Lib/Debt$_{(i,US)}$
$\hat{\beta}_{i,0}$	-1.003^{***}	0.484^{***}	-0.296	0.585	0.617^{***}	-0.114
	(-9.58)	(5.40)	(-0.63)	(1.64)	(7.23)	(-1.29)
$\hat{\beta}_{i,1}$	-0.419^{***}	-0.024	-0.618^{**}	0.234	0.236^{***}	0.173^{***}
	(-5.55)	(-0.35)	(-2.08)	(0.90)	(5.84)	(4.11)
$\hat{\beta}_{i,w}$	0.003	0.128^{***}	-0.187^{***}	0.035	-0.028	0.007
	(0.13)	(5.20)	(-2.88)	(0.40)	(-0.95)	(0.21)

Panel D. Control for geography and language

	$Comp_{(i,US)}$	$CD_{(i,US)}$	Distance$_{(i,US)}$	$1_{English}$
$\hat{\beta}_{i,0}$	-1.097^{***}	1.122^{***}	-0.089^{***}	-0.111^{***}
	(-3.62)	(9.54)	(-3.72)	(-4.29)
$\hat{\beta}_{i,1}$	-0.079	0.529^{***}	-0.069^{***}	-0.102^{***}
	(-0.64)	(7.01)	(-6.30)	(-4.84)
$\hat{\beta}_{i,w}$	-0.054	0.098^{***}	0.012^{***}	-0.019^{***}
	(-1.08)	(2.99)	(3.21)	(-3.41)

Table A4
Subsample Analysis

This table summarizes the slope coefficients, Newey-West adjusted t-statistics, and the average R^2s of the two-stage regressions similar to Table 9 but for several subsamples. We first divide the sample of Table 9 into two half subperiods, reported in the first two columns. We remove country-pair observations that involve the United States in the third column and remove country-pair observations that involve any European countries in the last column.

	Sub-period Analysis		Sub-region Analysis	
	1996-2008	2009-2020	Exclude US	Exclude Europe
$Comp_{(i,j)}$	−0.182	−0.260	−0.160	−0.220
	(−1.60)	(−1.70)	(−2.33)	(−1.85)
$CD_{(i,j)}$	0.107	−0.300	−0.202	0.092
	(1.23)	(−3.08)	(−4.66)	(0.96)
$ExpShare_{(i,j)}$	0.008	−0.232	−0.006	0.011
	(1.22)	(−2.63)	(−1.69)	(1.44)
$FracExp_i$	−0.136	−0.001	0.026	0.000
	(−3.12)	(−0.13)	(1.14)	(0.00)
$CS_{(i,j)}$	0.182	−0.232	−0.083	−0.050
	(2.70)	(−2.63)	(−2.12)	(−0.79)
$ImpShare_{(i,j)}$	−0.001	0.000	0.009	0.003
	(−0.20)	(0.07)	(2.63)	(0.49)
Year FE	Y	Y	Y	Y
County-pair FE	Y	Y	Y	Y
R^2	0.497	0.402	0.332	0.435
# of Observations	15372	14250	27948	7508