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Quantitative Economics

Bachelor Thesis

TESTING FOR NON-LINEAR TRADE AND FINANCIAL LINKAGES: EVIDENCE FROM PANEL DATA

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CONTENTS

INTRODUCTION

The past few decades have witnessed a significant boom in globalization, with the majority of the world's economies becoming increasingly intertwined. This phenomenon includes the globalization of trade and investment which uncover an increasing topic of interest in the scholarly world. Thus, the exploration of the dynamics of trade integration and financial linkages has risen drastically in recent years, to determine the relevance of this increase in trade openness and whether trade intensity fosters cross-border portfolio investment between countries.

Trade integration and financial linkages are highly relevant in today's interconnected world, bearing substantial implications for global economic integration. Research such as François and Schuknecht (2000) and Imbs (2003) emphasize the benefits of financial market integration, specifically mentioning the positive effect it has on economic growth and the synchronization of business cycles. This is further expanded by Edison et al. (2002) who uncover that such integration significantly enhances economic growth, especially in economies with robust legal and institutional systems in place. Moreover, Baxter and Crucini (1994) bring to the forefront the role of financial integration in facilitating the international transmission of business cycles. On the other hand, Kiendrebeogo (2012) introduces a nuanced perspective by illustrating a bi-directional influence between financial development and international trade, arguing that in developing economies, financial development plays a more significant role in shaping this relationship. Further research emphasizes the importance of market integration. Haddad (2023) conducts a review of the literature on global financial market integration emphasizing that well-integrated markets are better positioned to attract global investments and support economic liberalization, trade, and diversification. Additionally, Davis (2014) spotlights the different impacts of debt and equity market integration on business cycle co-movement, showing that debt market integration fosters synchronization of business cycles through balance sheet effects, while equity market integration can lead to divergence due to wealth effects.

The main body of literature exploring the effects of trade globalization, openness, or integration consistently finds that this phenomenon positively impacts cross-border financial flows, further advancing the global integration of financial markets. Most notably Coeurdacier and Rey (2013) provide significant evidence that trade integration fosters deeper financial integration by offering diversification opportunities. However, their study also highlights the existence of 'Equity Home Bias'—the dominant preference for domestic equity— which appears to be diminishing over time. Adding another layer, Heathcote and Perri (2013) expands on this by introducing insights into how domestic assets often provide a hedge against non-

diversifiable labor income risks, particularly when domestic productivity leads to favorable shifts in terms of trade. Overall, the main scholarly consensus so far is that trade integration fosters cross-border portfolio investment, in particular, equity both theoretically and empirically (Bergin and Pyun, 2016; Koren, 2003; Portes and Rey, 2005; Aviat and Coeurdacier, 2007; Davis and Van Wincoop, 2018; Obstfeld and Rogoff, 2000; Martin and Rey, 2004).

However, Khalil (2019) delves into the relationship between global trade and financial portfolio structures and finds significant evidence that an increase in bilateral trade correlates with a reduction in the share of equities in a country's financial portfolio. These findings contradict the expected increase in foreign equity holdings often supported by established aggregate data. Specifically, Khalil (2019) empirical analysis using bilateral data from 2001-2012 across numerous country pairs shows a consistent decrease in equity shares with increasing bilateral trade, which primarily strengthens the holdings of foreign debt instead of equities.

Khalil (2019) findings are interesting and thought-provoking, raising the question of why bilateral data findings juxtapose the aggregate data. Perhaps this relationship is more heterogeneous than previously thought, potentially indicating the presence of non-linear dynamics. Historically, many economic relationships were initially considered linear until further research proved them to be non-linear. For example, the relationship between economic growth and financial development was often modeled linearly (King and Levine, 1993). However, recent studies have demonstrated that this relationship is non-linear, indicating that financial development impacts growth differently at various stages of economic development (Benczúr et al., 2019). Thus, my contribution to the literature with this thesis is replicating Khalil (2019) with an extended period and allowing a non-linear relationship between trade integration and cross-border portfolio investment. By doing so, I aim to explore whether non-linearities could help resolve the mismatch between the aggregate and bilateral data.

I follow Khalil (2019) and employ both linear and Tobit fixed effects models on bilateral data for the 2001-2019 timeframe. The dependent variable is the share of equities a country holds with another country over the total investment, which includes both equity and long-term debt. The main independent variable, bilateral trade, is a 5-year backward-looking moving average of exports and imports normalized to GDP. In the footsteps of Khalil (2019) and similar studies, I utilize data from the Coordinated Portfolio Investment Survey (CPIS) dataset (Lane and Milesi-Ferretti, 2008; Pericoli et al., 2013). To capture non-linear effects, I introduce a new independent variable constructed by squaring the bilateral trade variable.

The structure of this thesis is as follows: The first section is the literature review, divided into two main parts: empirical studies and theoretical literature. In this section, I will review

existing research, connecting theoretical frameworks with empirical evidence. Additionally, I will identify current gaps in the literature on trade integration and cross-border portfolio investment. The second section is the methodology, which is further divided into subsections on research design, model specification, econometric approach, data and samples, and limitations of the study. In the following section, I will present the results of the data analysis and compare the findings with current research. Finally, the conclusion will summarize the findings, provide final comments, and offer recommendations for future research.

1. ANALYSIS OF SCIENTIFIC LITERATURE

The interplay between global trade and financial portfolio structures presents complex dynamics that often challenge traditional economic theories. This review examines seminal works that provide the empirical and theoretical foundation for understanding these relationships, particularly in light of contrasting findings such as those by Khalil (2019).

1.1 Empirical Studies

This thesis adds to a growing number of empirical literature analyzing the relationship between cross-border portfolio investment and trade integration distinguishing between asset classes. In the pioneering paper, Lane and Milesi-Ferretti (2008) utilizes the Coordinated Portfolio Investment Survey (CPIS) data analyzing factors driving portfolio equity holdings across a small subset of countries. They find an existing strong correlation between bilateral trade volumes and bilateral equity holdings, suggesting that enhanced trade relationships promote greater informational proximity and economic interdependence.

Similarly, Pericoli et al. (2013) expand the subset from the CPIS database, implementing the share of equity in a bilateral portfolio, just normalized to total cross-border equities of a source country. They find that less synchronized economies attract larger portfolio investment shares. Pericoli et al. (2013) is similar to my study in that they explore the relationship using a non-stationary dependent variable—equity share—albeit with a different normalization method. Building on this Khalil (2019) further enriches the examination of the share of equity in a bilateral portfolio by increasing the sample and period of the study from the CPIS database. By employing the Tobit fixed effects model he finds significant evidence that the relationship between trade integration and the share of equities in a bilateral portfolio is surprisingly negative.

Klein and Shambaugh (2006) find that fixed exchange rates significantly increase bilateral trade by reducing the risk arising from exchange rate volatility. Bergin and Pyun (2016) discuss how international diversification can reduce risks by investing in markets with low correlation to the home country, optimizing the risk-return trade-off for investors. Likewise, Koren (2003) explore the impacts of financial globalization on portfolio diversification, highlighting the benefits of international diversification in achieving a more balanced risk-return profile for investors.

Meanwhile Coeurdacier and Rey (2013) explore the mechanisms behind equity home bias, revealing that in the face of increasing financial integration, investors persistently prefer domestic over foreign equities, contrary to optimal portfolio diversification beliefs. Understanding the conditions that influence investors to deviate from the expected behavior is essential, whether it comes from non-tradable income risks or exchange rate volatilities. Heathcote and Perri (2013) investigate the macroeconomic implications of financial openness, focusing on how it affects consumption correlations and economic volatility across countries. They argue that while theoretical models predict enhanced international risk sharing through financial integration, actual outcomes can vary significantly due to structural and institutional differences. Meaning that financial openness can lead to diverse outcomes in equity and debt holdings, influenced by domestic economic conditions and risk factors (Heathcote and Perri, 2013). Hausmann-Guil (2024) extends the analysis to a two-country DSGE model with bonds and equities, highlighting the hedging motives behind equity home bias. The model depicts that while trade openness increases financial integration, the effect on equity home bias is complex. Higher trade openness leads to increased external debt positions, while changes in external equity positions are more modest and can even decrease for sufficiently high levels of trade openness.

Hausmann and Klinger (2007) introduce the concept of the 'product space' and its implications for economic complexity and growth. They discuss how structural economic dynamics influence trade and financial flows, offering a broader macroeconomic context for the portfolio adjustments observed in Khalil (2019). This concept provides a framework for understanding the interdependencies between trade integration and financial market behavior, highlighting the factors driving investment decisions at a macroeconomic level (Hausmann and Klinger, 2007). Diyarbakirlioglu (2011) examine domestic and foreign equity biases, providing a behavioral perspective on the financial decision-making processes discussed in Khalil (2019). They explore how investors' tendencies toward 'home bias'—preferring domestic over foreign equities—and 'foreign bias'—favoring specific foreign markets—impact international portfolio diversification. Diyarbakirlioglu (2011) suggests that despite global financial integration, psychological and informational barriers significantly shape investment choices, offering a nuanced view of the complexities influencing portfolio structures in an interconnected world.

Forbes and Chinn (2004) find that financial integration enhances cross-border equity holdings, suggesting that increased trade ties strengthen financial linkages and reduce home bias. Similarly, Paramati et al. (2016) observe that trade intensity positively impacts stock market linkages among countries, reinforcing the notion that greater trade integration fosters closer financial connections. Asgharian et al. (2013) highlight that bilateral trade encourages the synchronization of business activities and subsequently impacts stock markets, indicating that

enhanced trade relationships can lead to increased equity investments.

1.2 Theoretical literature

Regarding theoretical publications, there exist several studies that estimate a positive relationship between foreign goods trade growth and cross-border asset holdings. Gravity models introduced by Tinbergen (1962) explain bilateral trade flows based on the country's economy sizes and the distance between them. Such models have become foundational in trade theory, predicting that larger economies tend to trade more with each other, while the distance, which is a proxy for trade costs, reduces the trade volume. The extension of gravity models to asset trade is grounded in theories of financial diversification and capital allocation. These models predict that financial assets will flow between countries based on economic size, market development, and bilateral trade relationships. The core idea is that economic integration through trade fosters financial linkages, as investors seek to diversify their portfolios internationally (Bergin and Pyun, 2016; Koren, 2003).

Studies such as those by Portes and Rey (2005) and Aviat and Coeurdacier (2007) gravity framework aims to explain the foreign asset holdings in a bilateral setting, finding that an increase in bilateral trade raises bilateral asset holdings. Additionally, Davis and Van Wincoop (2018) introduce a theoretical model, supported by their empirical findings, which demonstrates that financial globalization—characterized by increased foreign asset holdings—generally raises the correlation between inflows and outflows. This supports the idea that as countries become more financially integrated, their capital markets become more interconnected.

Obstfeld and Rogoff (2000) highlight the idea that lower transportation costs reduce the friction to import which in turn increases demand for foreign equity. Additionally, they argue that such frictions can explain the frictions in the financial trade, implying that transport-cost-based bias towards domestic goods justifies the Equity Home Bias noted in many studies. Building on this Lane and Milesi-Ferretti (2008) generalize this model, supporting their aforementioned results. Martin and Rey (2004) demonstrate that financial integration lowers the cost of capital and boosts asset prices, with larger markets benefiting more from these effects. Suggesting that larger market sizes support more financial assets, leading to higher asset prices and increased international financial flows.

Khalil (2019) introduce a theoretical model illustrating that deeper trade integration increases a country's exposure to terms of trade risks. This leads risk-averse investors to favor foreign bonds over equities as a hedging mechanism, thus explaining the observed shift from equity to debt holdings with increasing trade integration.

Concluding the literature review, the current research examines the relationship between trade integration and foreign asset holdings via a linear approach. However, the discontinuity between aggregate data and bilateral data persists, indicating that existing methods may not fully capture the complexities of these relationships. Specifically, the findings from aggregate data often suggest different dynamics compared to those observed in bilateral data, highlighting a significant gap in the literature. Khalil (2019) indicates that higher-order effects may play a role in the choice between equity and debt, while Holland et al. (2021) recommends the future focusing on specialized datasets and granularity/asset demand systems should incorporate non-linearities inherent in cross-border barriers and investment.

2. METHODOLOGY

2.1 Research Design

This section covers the data sources, samples, and dataset structure used in this research, as well as the empirical model. The methodology employed closely follows Khalil (2019) study but has significant adjustments. This research utilizes the Coordinated Portfolio Investment Survey's panel structure. One of the differences with Khalil (2019) is that this study extends the dataset to 2019, stopping before the COVID-19 pandemic. The exclusion of the COVID-19 period is due to concerns about volatility and imbalances during the pandemic, which could introduce biases in the analysis of long-term trade and financial linkages (OECD, 2022; Barbero et al., 2021). The primary objective is to study the non-linear properties of the relationship between trade intensity and cross-border portfolio investment, focusing on the share of equities in bilateral portfolios. In hopes of linking the inconsistencies between bilateral and aggregate data.

2.2 Model specification

Following the framework of Khalil (2019), this study examines the link between trade and financial integration, particularly focusing on external assets. The focus is on the perspective of a source country (country A) that holds equity and debt securities issued by a certain host country (country B). Each observation captures the relationship between one source country and one host country from the source country's point of view. Equity refers to ownership stakes in companies, representing riskier but potentially higher-reward investments, while debt encompasses safer, interest-bearing securities like bonds. Bilateral trade, defined as the sum of imports and exports between two countries, is a key variable in examining these financial linkages.

There are two main models used in this thesis. Both models are closely based on Khalil (2019) model specifications. The first fixed effects model is specified as follows:

$$\text{equityshare}_{AB,t} = \alpha + \beta_{\text{trade}}\text{trade}_{AB,t} + \beta_{\text{controls}}x_{AB,t} + \delta_t + \gamma_{AB} + u_{AB,t} \tag{1}$$

In this model, the term α denotes the constant term, $\text{trade}_{AB,t}$, which measures the bilateral trade between country (A) and country (B) at time t. While the $x_{AB,t}$ represents the vector of the control variables. Time-fixed effects are indicated by δ_t, and country-pair fixed effects are denoted by γ_{AB} and $u_{AB,t}$ represents the error term in the model.

The second, augmented, model is specified similarly:

$$\text{equityshare}_{AB,t} = \alpha + \beta_{\text{trade}}\text{trade}_{AB,t} + \beta_{\text{trade}^2}\text{trade}^2_{AB,t} + \beta_{\text{controls}}x_{AB,t} + \delta_t + \gamma_{AB} + u_{AB,t} \quad (2)$$

In this model, the only difference from the model above lies in the newly introduced trade squared variable. Specifically, $\text{trade}^2_{AB,t}$ represents the squared term of the bilateral trade variable.

The variable $\text{equityshare}_{AB,t}$ or just "share of equities" in a bilateral portfolio refers to the proportion of equity investments in the total financial assets held by the source country (A) that were issued by the host country (B). This metric is useful because it provides insight into the risk preference and investment strategy of a country's investors in their cross-border financial activities.

The dependent variable is represented as follows:

$$\text{equityshare}_{AB,t} = \frac{\text{equity}_{AB,t}}{\text{equity}_{AB,t} + \text{debt}_{AB,t}} \quad (3)$$

Where $\text{equity}_{AB,t}$ ($\text{debt}_{AB,t}$) represents the equity (long-term debt) holdings by source country (A) issued by host country (B) at time t.

Focusing on the share of equity in a bilateral portfolio offers several advantages. First, the unitless measure facilitates straightforward comparisons across different countries. Second, it eliminates the need to adjust for inflation and the potential non-stationarity of the variable. Third, employing this measure enables us to discern whether changes in the volume of foreign assets related to trade are driven by movements in equity or debt (Khalil, 2019).

The control variables included in the vector $x_{AB,t}$ may consist of the real GDP per capita ratio between host and source countries, and third country equity share. While the main independent variable $\text{trade}_{AB,t}$ (also referred to as bilateral trade) is constructed as a sum of imports and exports from a source country to the host country and is normalized to the source country's nominal GDP or total trade. As in Khalil (2019) I also calculate the bilateral trade variable as a 5-year backward-looking moving average. This approach offers substantial analytical benefits, it smooths out year-to-year fluctuations, providing a more stable and consistent measure that better reflects the sustained economic interaction rather than short-term anomalies. It mitigates the impact of transient economic shocks or policy changes that might skew the analysis if only single-year data were considered.

The control variable *third_country_equity_share* is constructed similarly to the dependent variable. Specifically, it represents the number of equities a source country holds in other host countries ('rest of the world'), over the total equities and long-term debt it holds in the 'rest of the world':

$$\text{third\_country\_equity\_share}_{AB,t} = \frac{\text{equity}_{A,\text{rest\_of\_world},t}}{\text{equity}_{A,\text{rest\_of\_world},t} + \text{debt}_{A,\text{rest\_of\_world},t}} \tag{4}$$

Moreover, Khalil (2019) utilizes the log of the source and host countries' nominal GDP as a control measure to represent wealth at home and abroad, which act as determinants of cross-border portfolio composition. However, the use of GDP as a control introduces complications due to its non-stationary properties. To circumvent this issue, the measure of wealth was substituted with a ratio of real GDP per capita between the host and source countries.

2.3 Econometric approach

This section briefly discusses the employed econometric approach. As noted in Khalil (2019), the dependent variable is observed to lie between 0 and 1. Thus, the linear model (1) suffers from non-normally distributed errors[1]. This could impact the robustness of the fixed effects regression results, to control for this I follow Papke and Wooldridge (2008) and employ the Tobit fixed effects model, thereby serving as a robustness check[2]. An additional check involved running a regression of logged variables similar to Khalil (2019), as well as incorporating the growth rates of equity and long-term debt, which is an extension of the original analysis.

The choice of the fixed effects model is essential in this study as it eliminates certain biases and improves the accuracy of the results. First, it allows for control of unobserved heterogeneity—factors that could influence the dependent variable and are correlated with the independent variables. For instance, country-specific factors, such as institutional quality, economic policies, or cultural attitudes toward investment. Additionally, it accounts for time-invariant characteristics, such as historical ties and geographical location, and emphasizes the within-country-pair variation over time. Lastly, to supplement the fixed effects model I include the time dummy variables, which take a value of 1 if it's a certain year, and 0 otherwise for all years. This allows me to control the time-varying effects, such as technological advancements or international policy changes that impact trade and financial markets.

[1] See Appendix Figure A.1 for the distribution of the dependent variable.

[2] Greene (2004) demonstrates that the Tobit model estimates are more reliable when dealing with censored data.

2.4 Data and samples

This section discusses the data used for this research, including the initial data sources and the choice of samples. The main data source is the International Monetary Fund (IMF), with supplementary data for the GDP control variable provided by the World Bank. Two key databases from the IMF are utilized. First, the CPIS (Coordinated Portfolio Investment Survey) dataset contains information on cross-border investments, including equities and long-term debt, which is classified as debt securities with a maturity longer than one year. The CPIS dataset covers portfolio investments and excludes Foreign Direct Investment (FDI), reserves, and other similar investments. It is a survey-based annual dataset reporting the international portfolio investments of residents issued by non-residents. Additionally, data on bilateral trade, including exports and imports between source and host countries, was obtained from the IMF's Direction of Trade Statistics (DOTS) database. Imports are reported on a cost, insurance, and freight (CIF) basis while exports are recorded on a free-on-board (FOB) basis.

The sample for this research is constructed using the same source and host countries as in Khalil (2019). This sample includes countries based on specific criteria and is subsequently adjusted. First, some countries are excluded from the CPIS dataset due to non-participation or classification as tax havens or offshore financial centers. Additionally, observations containing negative values in bilateral equities or long-term debt are removed from the sample. Furthermore, country pairs that do not have continuous observations throughout the sample period are excluded, with the exception of country pairs that lost observations due to negative equity or long-term debt values. To maintain consistency with Khalil (2019) methodology, a 1% significance threshold is employed, meaning that the source-country portfolio investment in the host country must account for at least 1% of the total source country's cross-border portfolio investment, as explained in more detail in (5).

$$\text{Threshold}AB,t = \frac{\text{Investment}AB,t}{\sum_{j \neq B} \text{Investment}_{Aj,t}} \geq 0.01 \tag{5}$$

Where $\text{Threshold}_{AB,t}$ is the proportion of the source country A's investment in host country B at time t. $\text{Investment}_{AB,t}$ is the amount of portfolio investment from source country A to host country B at time t. $\sum_{j \neq B} \text{Investment}_{Aj,t}$ represents the total portfolio investment from source country A to all other countries j (excluding B) at time t. By ensuring that $\text{Threshold}_{AB,t} \geq 0.01$, we only include those country pairs where the host country B receives a significant share (at least 1%) of the source country A's total portfolio investment, thereby focusing on meaningful economic relationships.

The main sample is divided into two periods: 2001-2012, matching Khalil (2019) time-frame, and an extended period from 2001-2019. This division allows for an analysis of the consistency and evolution of findings over time. The total number of country pairs in both samples is identical at 348, with the broader period sample comprising 6,227 observations and the smaller time-frame sample containing 3,874. The detailed list of these countries is provided in the appendix[3]. Tables 1 and 2, display the summary statistics of both samples used in the research.

Table 1
Descriptive statistics of full sample, spanning the years of 2001-2019. Bilateral trade variables are expressed as 5-year backward-looking moving averages.

Variable	Mean	Std. dev.	Median	Min	Max
Share of equity in bilateral portfolio	0.34	0.29	0.26	0.00	1.00
Total cross-border equity to GDP	0.17	0.22	0.10	0.00	1.79
Total cross-border debt to GDP	0.28	0.24	0.23	0.00	0.99
Bilateral trade to GDP	0.04	0.06	0.02	0.00	0.52
Bilateral trade to total trade	0.07	0.08	0.04	0.00	0.84
Total trade to GDP	0.61	0.37	0.50	0.08	1.51
Observations	6227				

Table 2
Descriptive statistics of the shorter sample, spanning the years of 2001-2012. Bilateral trade variables are expressed as 5-year backward-looking moving averages.

Variable	Mean	Std. dev.	Median	Min	Max
Share of equity in bilateral portfolio	0.33	0.29	0.25	0.00	1.00
Total cross-border equity to GDP	0.14	0.15	0.09	0.00	0.75
Total cross-border debt to GDP	0.27	0.24	0.22	0.00	0.95
Bilateral trade to GDP	0.04	0.06	0.02	0.00	0.52
Bilateral trade to total trade	0.07	0.08	0.04	0.00	0.84
Total trade to GDP	0.59	0.35	0.49	0.08	1.51
Observations	3874				

2.5 Limitations

In this section, I will briefly go over the limitations of the research. First of all, the main database used, CPIS (Coordinated Portfolio Investment Survey), has some inherent limita-

[3]See Appendix A for the list of host and source countries.

tions as this is a voluntary survey, although, of very high quality, some countries have chosen to participate in it after the year 2001 or may choose not to participate in it for a certain year, potentially leaving gaps in the observations. Additionally, the data is collected annually, which means we might miss important short-term variations and dynamics in trade and financial linkages that could be beneficial for a complete understanding. Moreover, the generalizability of the results is somewhat limited by the sample composition. Although the dataset includes a wide range of countries, many are highly developed nations, which could make it challenging to apply the findings to less developed or emerging economies. These highly developed countries' economic structures and financial systems might differ significantly from those of developing countries. In addition, this research does not consider recent times, including the COVID-19 pandemic, various conflicts, and geoeconomic fragmentation that could impact the long-term relationship of bilateral trade and cross-border portfolio investment.

There arise additional limitations from the primary study that affect this analysis. Specifically, certain control variables used in Khalil (2019) were excluded from this analysis due to data availability issues. Variables such as domestic portfolio equity holdings, domestic portfolio debt holdings, partner portfolio equity holdings, and partner portfolio debt holdings were constructed using the BIS Quarterly Review, which no longer offers easy access to its database. Additionally, the Standard and Poor's review was discontinued in 2014. These data constraints limit my ability to replicate the exact specifications used in Khalil (2019), potentially impacting the comparability of the findings. However, it is important to note that these control variables were found to be insignificant in the original study, suggesting that their exclusion does not materially affect the analysis.

Furthermore, the sample selection guidelines provided by Khalil (2019) result in a somewhat different sample composition in my analysis. Although both studies utilize the same data for the same period and employ the same 1% threshold for relevant-country pair filtering, my analysis yields a sample with more observations but fewer country pairs. This discrepancy arises because I opted to keep the country-pair observations continuous, ensuring a more consistent and reliable dataset. Despite these differences, the overall methodology and analytical framework remain closely aligned with Khalil (2019), allowing for meaningful comparisons and insights.

3. RESULTS

In this section, I present the results of the regression analysis. First, Table 3 contains the results of the replication of the shorter sample, ranging from 2001-2012 using both linear fixed effects and Tobit fixed effects models. All of the regressions include time dummies and country pair fixed effects. Columns (1) and (4) contain a single independent variable, bilateral trade, normalized to the nominal GDP of a source country. Columns (1), (2), and (4), (5) replicate the specifications from Khalil (2019). The results in magnitude are comparatively similar, ranging from -1.16 to -1.72, with light deviations, potentially due to a larger sample or the use of a non-stationary GDP control measure - real GDP per capita ratio of the host and source country. Introducing the third country's equity share and GDP control in the regression reveals that the third country's equity share is significant and positively associated with the equity share in bilateral portfolios. On the other hand, the GDP control exhibits a negative relationship ranging from -0.04 to -0.06.

Columns (2) and (4) also include the newly introduced variable—bilateral trade squared, constructed by squaring the main independent variable, bilateral trade. The inclusion of this non-linear variable increases the magnitude effect of bilateral trade on the equity share, with coefficients ranging from -2.34 to -2.46 for this sample. Additionally, the bilateral trade squared variable is statistically significant and positively affects the dependent variable, with magnitudes ranging from 2.59 to 2.87. It is worth noting that the non-linear variable is more statistically significant in the Tobit fixed effect model, which is used mainly as a robustness check for the fixed effects model. The larger magnitude of the non-linear variable indicates that the marginal effect on the dependent variable, i.e., the derivative, could vary depending on the initial value of bilateral trade. This means that all of the sample countries are affected by this non-linearity, however, for sufficiently trade-integrated countries the effect reverses from negative to positive. Consequently, I examine for what percentage of the shorter sample this effect reverses, finding that for 1% of this sample, the effect of bilateral trade is positive rather than negative [4].

[4] See Appendix Table A.1 for the formal representation of marginal effects for 2001-2012

Table 3
Dependent variable: share of equity in the bilateral portfolio. Panel regression results, 2001–2012

	(1) Linear FE	(2) Linear FE	(3) Linear FE +non-linear	(4) Tobit FE	(5) Tobit FE	(6) Tobit FE +non-linear
Bilateral trade	-1.65***	-1.17***	-2.34***	-1.72***	-1.16***	-2.46***
	(0.27)	(0.26)	(0.53)	(0.27)	(0.26)	(0.52)
Bilateral trade squared			2.59**			2.87***
			(1.01)			(0.99)
Third country equity share		0.44***	0.44***		0.45***	0.45***
		(0.03)	(0.03)		(0.03)	(0.03)
GDP per capita ratio		-0.04***	-0.04***		-0.06***	-0.06***
		(0.01)	(0.01)		(0.01)	(0.01)
# Observations	3,856	3,856	3,856	3,856	3,856	3,856
# Country pairs	348	348	348			

Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Extending the analysis, Table 4 presents the results for the extended sample period from 2001 to 2019. This longer timeframe allows for the examination of the temporal stability and evolution of the observed relationships. As with the previous analysis, columns (1) and (4) include only the single independent variable—bilateral trade. Columns (2) and (5) follow Khalil (2019) specifications. Notably, the magnitude of the negative effects of bilateral trade on equity share appears to have reduced in the extended period, with coefficients now ranging between -0.91 and -1.36. Additionally, the inclusion of the third country's equity share and GDP control in the regression continues to show significant and positive associations with the equity share in bilateral portfolios, while the GDP control maintains a negative relationship.

Table 4
Dependent variable: share of equity in the bilateral portfolio. Panel regression results, 2001–2019

	(1) Linear FE	(2) Linear FE	(3) Linear FE +non-linear	(4) Tobit FE	(5) Tobit FE	(6) Tobit FE +non-linear
Bilateral trade	-1.33***	-0.93***	-3.40***	-1.36***	-0.91***	-3.43***
	(0.17)	(0.17)	(0.34)	(0.17)	(0.16)	(0.34)
Bilateral trade squared			5.59***			5.69***
			(0.67)			(0.67)
Third country equity share		0.38***	0.38***		0.40***	0.39***
		(0.02)	(0.02)		(0.02)	(0.02)
GDP per capita ratio		-0.05***	-0.05***		-0.06***	-0.06***
		(0.01)	(0.01)		(0.01)	(0.01)
# Observations	6,209					
# Country pairs	348					

Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Columns (2) and (4) in Table 4 also include the non-linear variable of bilateral trade, represented by bilateral trade squared. Consistent with the previous timeframe, the inclusion of this non-linear variable increases the negative effect of bilateral trade on equity share, with coefficients now ranging between -3.4 and -3.43, and bilateral trade squared coefficients between 5.59 and 5.69. In this extended sample, bilateral trade squared is even more statistically significant than in the previous period, suggesting that non-linear effects have evolved and intensified over time. Consequently, I re-examine the proportion of the sample that has an inverse, positive effect, of trade integration by this non-linear relationship and find it to be 5%, indicating a significant increase from the earlier 1% [5]. Comparing these results with the findings of Khalil (2019), we observe that the negative relationship between bilateral trade and the share of equity in a bilateral portfolio is consistent across both timeframes. The introduction of the bilateral trade squared term suggests a non-linear relationship, indicating that the negative impact on equity share diminishes over time and depends on the initial value of bilateral trade.

Khalil (2019) examines what drives the decrease in equity share by utilizing log levels of variables. There are two ways the share of equities in a bilateral portfolio can decrease. First, the absolute value of equities and the absolute value of long-term debt are increasing, but the amount of long-term debt increases faster. Second, because the absolute amount of equity reduces in a bilateral portfolio. My approach differs from Khalil (2019) as I do not take the log of bilateral trade; it is already normalized to the GDP of the source country and is measured as a moving average. In Table 5, columns (1) and (2) display the results of the fixed effect regression on the log of equity, while columns (3) and (4) focus on log levels of debt. The results indicate that bilateral trade has a positive effect on the log levels of both equity and long-term debt. Extending the timeframe in Table 6, the positive effect of bilateral trade on equity log levels shows a decreasing magnitude over time. Conversely, the negative effect of bilateral trade squared is increasing for debt. These findings of a positive effect of linear bilateral trade and a negative effect of non-linear bilateral trade align with the aggregate data, reinforcing the consistency of these relationships across different data levels. Specifically, the 2001-2012 sample shows that 2.9% of the sample has the marginal effect of trade integration reversed to negative for equity in log levels, and 10% for the log of long-term debt. In the 2001-2019 sample, this changes to 3.3% and 19.9%, respectively, further implying that these non-linear effects are intensifying over time. This non-linear effect was not accounted for in Khalil (2019) initial analysis, leading to a misinterpretation of the negative coefficient he observed. The more integrated the markets, the stronger these effects become, particularly in the case of debt.

[5] See Appendix Table A.2 for the formal representation of marginal effects for 2001-2019

Table 5
Panel regression results with different dependent variables, 2001-2012

	Equity log-level		Debt log-level	
	(1) Linear FE	(2) Linear FE + non-linear	(3) Linear FE	(4) Linear FE + non-linear
Bilateral trade	4.10**	12.81***	7.36***	26.61***
	(1.86)	(3.32)	(1.51)	(3.077)
Bilateral trade squared		-27.74***		-41.58***
		(6.30)		(5.81)
GDP per capita ratio	-1.72***	-1.00***	-0.80***	-0.83***
	(0.08)	(0.07)	(0.06)	(0.06)
# Observations	3,770	3,770	3,793	3,793
# Country pairs	348			

The dependent variables are expressed as the logged values of either debt or equity. The independent variables of bilateral trade and bilateral trade squared are normalized to GDP. The reduced observation count is due to log transformation, as the sample contains values of 0. Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 6
Panel regression results with different dependent variables, 2001-2019

	Equity log-level		Debt log-level	
	(1) Linear FE	(2) Linear FE + non-linear	(3) Linear FE	(4) Linear FE + non-linear
Bilateral trade	2.90***	5.69***	4.34***	25.66***
	(1.12)	(2.05)	(1.05)	(2.16)
Bilateral trade squared		-13.59***		-47.55***
		(4.03)		(4.23)
GDP per capita ratio	-1.72***	-1.14***	-0.40***	-0.44***
	(0.05)	(0.05)	(0.05)	(0.05)
# Observations	6,067	6,067	6,136	6,136
# Country pairs	348	348	348	348

The dependent variables are expressed as the logged values of either debt or equity. The independent variables of bilateral trade and bilateral trade squared are normalized to GDP. The reduced observation count is due to log transformation, as the sample contains values of 0. Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

To gain a deeper understanding of the factors contributing to the decrease in equity share, I use the growth rates of equity and debt as the dependent variables in my regressions [6]. Tables 7 and 8 contain the results of the fixed effects regressions for the 2001-2012 and 2001-2019 periods, respectively. Initially, we see that in columns (1) and (4) bilateral trade has a statistically significant relationship with the growth rate of equity and debt in a bilateral portfolio. The relationship is negative for the equity growth rate and positive for the debt growth rate. However, over time, this significance diminishes. While bilateral trade squared shows some significance in column (4) in the 2001-2012 sample, indicating that non-linearity exists in the growth of debt, in the 2001-2019 sample, bilateral trade has a negative effect, contrary to the positive effect observed in the earlier sample. While the GDP control has a statistically significant effect on both, the growth rate of equity and long-term debt.

[6]The dependent variables are constructed as a difference of logged values of either equity or long-term debt.

Table 7
Panel regression results with different dependent variables, 2001-2012

	Equity Growth Rate		Debt Growth Rate	
	(1) Linear FE	(2) Linear FE + non-linear	(3) Linear FE	(4) Linear FE + non-linear
Bilateral trade	-4.02**	-3.80	1.56	7.04**
	(1.67)	(3.13)	(1.67)	(3.47)
Bilateral trade squared		4.05		-11.74*
		(5.94)		(6.51)
GDP per capita ratio	0.39***	0.10	0.2***	0.19**
	(0.08)	(0.08)	(0.08)	(0.08)
# Observations	3,378	3,378	3,397	3,397
# Country pairs	345	345	346	346

The dependent variables are expressed as the differences in the logged values of either debt or equity. The independent variables of bilateral trade and bilateral trade squared are normalized to GDP. The reduced observation count is due to log transformation, as the sample contains values of 0. Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 8
Panel regression results with different dependent variables, 2001-2019

	Equity Growth Rate		Debt Growth Rate	
	(1) Linear FE	(2) Linear FE + non-linear	(3) Linear FE	(4) Linear FE + non-linear
Bilateral trade	-1.25	-2.79*	-0.88	-1.66
	(0.80)	(1.67)	(0.87)	(1.83)
Bilateral trade squared		3.45		1.73
		(3.28)		(3.56)
GDP per capita ratio	0.14***	0.14***	0.10**	0.10**
	(0.04)	(0.04)	(0.04)	(0.04)
# Observations	5,617	5,617	5,687	5,687
# Country pairs	348			

The dependent variables are expressed as the differences in the logged values of either debt or equity. While the independent variables of bilateral trade and bilateral trade squared are normalized to GDP. The reduced observation count is due to log transformation, as the sample contains values of 0. Standard errors are reported in parentheses. ***, **, * indicate statistical significance at the 10%, 5% and 1% levels, respectively.

The main results from 3 and 4 confirm the initial negative effect of bilateral trade on the share of equity found in Khalil (2019). However, the inclusion of the non-linear term (bilateral trade squared) in the regression models reveals crucial insights. The significant positive coefficient for the bilateral trade squared variable suggests that as bilateral trade increases beyond a certain threshold, its impact on the share of equity in a bilateral portfolio becomes positive. This implies that for country pairs that are sufficiently trade integrated, increased trade fosters greater cross-border equity investments. This could be due to several reasons. First, higher trade volumes might reduce information asymmetry between countries, making foreign equity investments less risky and more attractive to investors. Second, deep trade relationships often lead to closer economic and financial integration, providing a more stable and predictable environment for equity investments. Third, investors might seek to diversify their portfolios internationally to mitigate domestic risks, and higher trade integration provides more opportunities and confidence in foreign equity markets.

Moreover, the results from Tables 5 and 6 align with established beliefs. Specifically, Lane and Milesi-Ferretti (2008) and Pericoli et al. (2013) have both explored the CPIS database with similar aims, but with different normalization approaches, and found that trade integration positively affects foreign equity investment. The difference between shorter and longer period samples reveals that the effect of an increase in bilateral trade diminishes over time

for equity, while it remains relatively stable for long-term debt. This observation is consistent with the 7-year time gap, during which globalization could have played a role, as well as the recovery period following the 2007-2008 financial crisis when investors were more cautious and preferred to hedge their risk, thus maintaining a preference for debt. Furthermore, the negative significant non-linear variable in both timeframes signals the diminishing marginal effect of trade integration, indicating that there may exist a threshold beyond which higher trade integration no longer fosters the growth of the log of equity and the log of debt.

Returning to the growth rates of equity and debt from Tables 7 and 8, one can gain insights into why the share of equity decreases as trade openness increases. The 2001-2012 sample shows that trade integration reduces the growth rate of cross-border equity and fosters the growth rate of long-term debt, mathematically explaining the reduction in the share of equity in a bilateral portfolio. The longer 2001-2019 sample also supports this negative effect. Although both growth rates are negative, the growth rate of equity decreases faster than that of debt, leading to a decrease in the proportion of equity in a bilateral portfolio. It is worth noting that the inverse effect of the non-linear variable reduces the impact of initial trade integration, and for some sample countries, it even reverses it.

CONCLUSIONS

In this study, I extend the timeframe of Khalil (2019) and investigate the non-linearities in the relationship between trade intensity and cross-border portfolio investment. By analyzing data from 2001 to 2019, I observe how this relationship is evolving and identify the impact of increased trade integration on the dynamics of financial linkages. This thesis shows that the relationship is very nuanced and that there is enough evidence to call the relationship non-linear. Aggregate data analysis suggests that as trade intensity increases, the amount of cross-border equity investment generally increases. In contrast, the bilateral data reveals an inverse relationship. My findings suggest that the inclusion of non-linear effects helps bridge the gap between the aggregate and bilateral views.

The negative effect of increased trade intensity on the share of equity in a bilateral portfolio, as identified by Khalil (2019), holds over an extended period but diminishes over time. Specifically, the coefficients for the negative effect of bilateral trade on equity share range from -0.91 to -1.36 for the 2001-2019 period, compared to -1.16 to -1.72 for the 2001-2012 period. However, I also identify a highly significant positive relationship with the non-linear bilateral trade variable, which positively affects the share of equities and is increasing over time. The coefficients for the non-linear bilateral trade variable range from 2.59 to 2.87 for the shorter period and 5.59 to 5.69 for the extended period. Thus, while the overall effect of increased trade intensity on equity share is mostly negative, it can turn positive based on the initial bilateral trade value. In short, for country pairs that are sufficiently highly trade integrated, the effect reverses. This is observed in the increase of the percentage of the sample where the non-linear positive bilateral trade coefficient turns the initial negative effect of trade intensity positive, which rises from 1% in the 2001-2012 period to 5% in the 2001-2019 period. The robustness of these results is reinforced by the Tobit fixed effects model, which controls for the non-normal distribution of the dependent variable, yielding even more statistically significant results.

The findings indicate that the relationship between trade intensity and cross-border portfolio investment is heterogeneous and more complex than previously suggested by Khalil (2019). According to the data, there is a growing need for a theoretical model that can explain this non-linear relationship, accounting for the varying effects of trade intensity on equity shares in different contexts and over time.

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TESTING FOR NON-LINEAR TRADE AND FINANCIAL LINKAGES: EVIDENCE FROM PANEL DATA

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Bachelor thesis

Quantitative Economics

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Summary

34 pages, 1 figure, 10 tables, 34 references.

This thesis explores the relationship between trade intensity and cross-border portfolio investment by replicating and extending the analysis framework established by Khalil (2019) to the period from 2001 to 2019 and allowing for non-linearities. The motivation for this study stems from the heterogeneous results observed in aggregate and bilateral data findings, which potentially indicate the presence of non-linear dynamics.

The literature exploring trade openness and financial market integration can be divided into two main perspectives. The first is the aggregate view, based on theories like 'Equity Home Bias' (EHB), which implies that as trade integration increases, EHB decreases, leading to an increase in cross-border equity investment. In contrast, a study by Khalil (2019), examining bilateral-level data, found significant evidence that increasing trade integration results in a lower share of equities in a bilateral portfolio.

Incorporating bilateral data on foreign equity and long-term debt investments, as well as trade and export data, this study examines how trade impacts the share of equities in bilateral portfolios. Utilizing both linear and Tobit fixed effects models, the analysis explores the non-linear dynamics of these relationships. Additionally, this research explores the log levels and growth rates of both equity and long-term debt to investigate the underlying drivers of the results.

The findings indicate that while increased trade intensity generally leads to a reduction in the share of equities, this negative effect diminishes or even reverses for highly trade-integrated country pairs due to the non-linear effect of trade integration. The data suggests a growing need for a theoretical model that can adequately explain this non-linear relationship.

NELINIJINĖS PREKYBOS IR FINANSINIŲ SĄSAJŲ TIKRINIMAS: PANELINIŲ DUOMENŲ ĮRODYMAI

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Vilnius, May 21, 2024

Santrauka

34 puslapiai, 1 figūra, 10 lentelių, 34 citatos.

Šiame rašto darbe nagrinėjamas ryšys tarp prekybos intensyvumo ir tarpvalstybinių portfelinių investicijų, atkartojant ir išplečiant Khalil (2019) darbą 2001-2019 m. laikotarpiui ir įtraukiant netiesiškumus. Šio tyrimo motyvacija kyla iš nevienodų rezultatų, pastebėtų apibendrintuose ir dvišaliuose duomenyse, kurie galimai rodo netiesinės dinamikos buvimą.

Prekybos atvirumą ir finansų rinkų integraciją nagrinėjančią literatūrą galima suskirstyti į dvi pagrindines perspektyvas. Pirmoji - apibendrintas požiūris, pagrįstas tokiomis teorijomis kaip "nuosavo kapitalo prielaida" (angl. Equity Home Bias, EHB), kuri reiškia, kad didėjant prekybos integracijai, EHB mažėja, todėl didėja tarpvalstybinės investicijos į nuosavą kapitalą. Priešingai, Khalil (2019) tyrime, kuriame nagrinėjami dvišalio lygmens duomenys, rasta reikšmingų įrodymų, kad didėjanti prekybos integracija lemia mažesnę akcijų dalį dvišaliame portfelyje.

Šiame tyrime, įtraukiant dvišalius duomenis apie užsienio investicijas į nuosavą kapitalą ir ilgalaikę skolą, taip pat prekybos ir eksporto duomenis, nagrinėjama, kaip prekyba veikia akcijų dalį dvišaliuose portfeliuose. Naudojant tiesinį ir Tobit fiksuotų efektų modelius, analizuojama netiesinė šių ryšių dinamika. Be to, siekiant ištirti pagrindinius rezultatus lemiančius veiksnius, šiame tyrime nagrinėjami nuosavo kapitalo ir ilgalaikės skolos logaritminiai lygiai ir augimo tempai.

Išvados rodo, kad, nors padidėjęs prekybos intensyvumas paprastai lemia akcijų dalies sumažėjimą, šis neigiamas poveikis dėl netiesinio prekybos integracijos poveikio sumažėja arba net pasikeičia labai integruotų šalių porų atveju. Duomenys rodo, kad vis labiau reikia teorinio modelio, kuris galėtų tinkamai paaiškinti šį netiesinį ryšį.

A SUPPLEMENTARY MATERIAL

The list of host and source countries used in the final sample (Khalil, 2019):

Source countries: Argentina, Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Japan, Malaysia, Netherlands, Norway, Poland, Portugal, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Thailand, Turkey, United Kingdom, United States.

Host countries: Argentina, Australia, Austria, Belgium, Canada, China, P.R.: Mainland, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Japan, Malaysia, Netherlands, Norway, Poland, Portugal, Russian Federation, Saudi Arabia, Slovak Republic, Slovenia, Spain, Sweden, Thailand, Turkey, United Kingdom, United States.

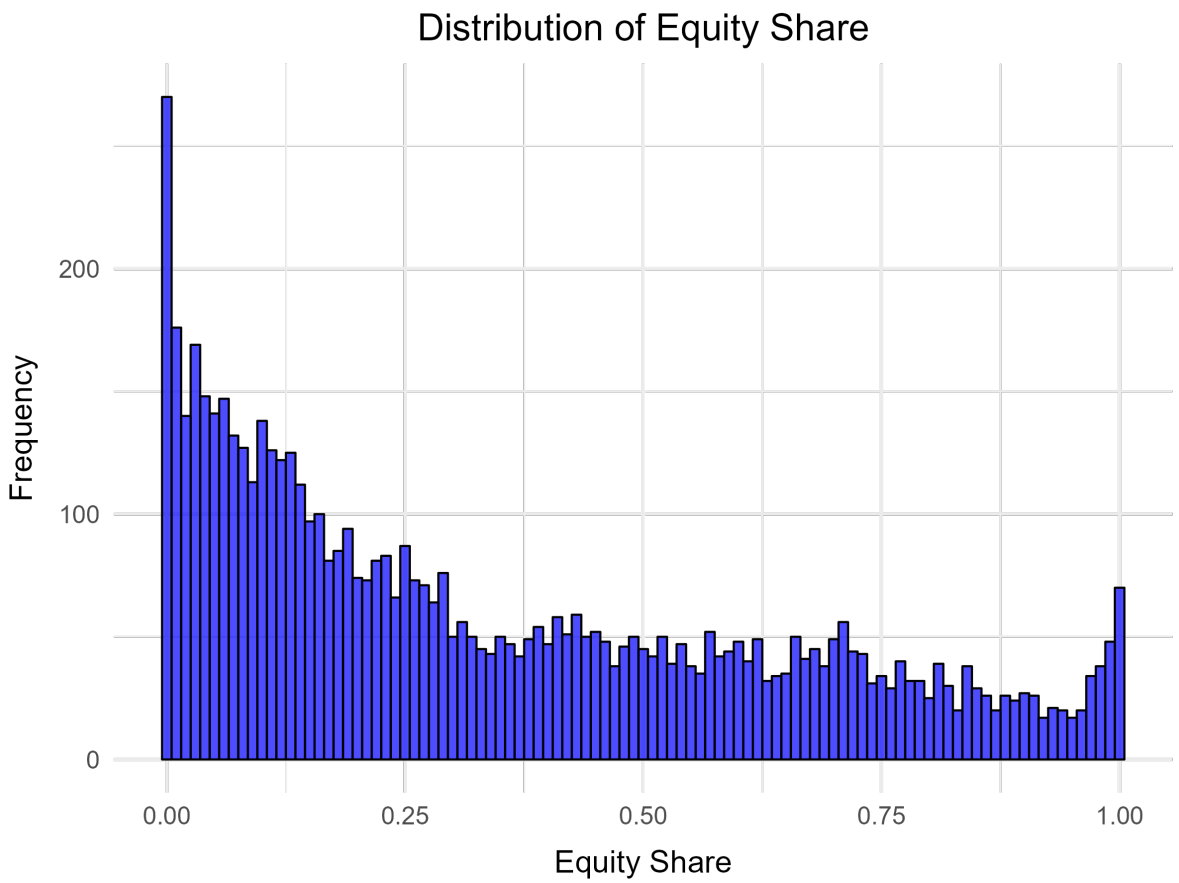

Figure A.1
Histogram of the dependent variable - equity share.

Table A.1
Marginal Effects of Bilateral Trade on Equity Share, 2001-2012

Regression Model	**Partial Derivative Expression**
Panel regression	$\frac{\partial \text{equity\_share}}{\partial \text{Bilateral\_trade}} = -2.34 + 2 \cdot 2.59 \cdot \text{Bilateral trade}$
Tobit regression	$\frac{\partial \text{equity\_share}}{\partial \text{Bilateral\_trade}} = -2.46 + 2 \cdot 2.87 \cdot \text{Bilateral trade}$
Log of debt panel regression	$\frac{\partial \log(\text{debt})}{\partial \text{Bilateral\_trade}} = 26.61 + 2 \cdot (-41.58) \cdot \text{Bilateral trade}$
Log of equity panel regression	$\frac{\partial \log(\text{equity})}{\partial \text{Bilateral\_trade}} = 12.81 + 2 \cdot (-27.74) \cdot \text{Bilateral trade}$

Table A.2
Marginal Effects of Bilateral Trade on Equity Share, 2001-2019

Regression Model	**Partial Derivative Expression**
Panel regression	$\frac{\partial \text{equity\_share}}{\partial \text{Bilateral\_trade}} = -3.4 + 2 \cdot 5.59 \cdot \text{Bilateral trade}$
Tobit regression	$\frac{\partial \text{equity\_share}}{\partial \text{Bilateral\_trade}} = -3.43 + 2 \cdot 5.69 \cdot \text{Bilateral trade}$
Log of debt panel regression	$\frac{\partial \log(\text{debt})}{\partial \text{Bilateral\_trade}} = 25.66 + 2 \cdot (-47.55) \cdot \text{Bilateral trade}$
Log of equity panel regression	$\frac{\partial \log(\text{equity})}{\partial \text{Bilateral\_trade}} = 5.69 + 2 \cdot (-13.59) \cdot \text{Bilateral trade}$