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Preferential Trade Agreements and Financial Crises:
A Study on the Mechanics of Contagion

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Dedicatoria

Para Edmundo, Martha, y Camilo, que me mostraron que el amor de una familia siempre triunfa sobre todo.

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Resumen

La Crisis Financiera Global de 2009 mostró cómo sucesos económicos de este tipo tienen consecuencias negativas en múltiples aspectos de la sociedad moderna, así como la gravedad del fenómeno de contagio de dichas crisis. Considerando la creciente interconexión comercial generada por el aumento del uso de tratados de comercio preferenciales por parte de gobiernos en todo el mundo, este estudio cuantitativo analizará a través de un modelo de ecuaciones estructurales la relación entre la apertura comercial generada por tratados de comercio preferencial y la propensidad a crisis financieras en 70 países con diversas características geográficas, culturales, políticas y económicas desde 1960 hasta 2009.

Palabras clave: Crisis Financiera, Apertura Comercial, ACPs, SEM, Mediación.

Abstract

The 2009 Global Financial Crisis showed how economic events of this type have negative consequences in multiple aspects of modern society, in addition to the gravity of the contagion phenomenon of said crises. Considering the growing trade interconnection generated by the increase of preferential trade agreements usage by governments around the globe, this quantitative research will analyse through a structural equations model the relation between trade openness generated by preferential trade agreements and the financial crisis propensity in 70 countries with diverse geographical, cultural, political, and economical characteristics from 1960 to 2009.

Keywords: Financial Crisis, Trade Openness, PTAs, SEM, Mediation Analysis.

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Introduction

The 2009 Global Financial Crisis demonstrated just how vulnerable our modern economies are to these types of economic phenomena. Although this financial crisis had a gargantuan effect on economic growth (Vaitilingam 2009), unemployment (Zago 2015), and incomes (Kalleberg and Von Watcher 2017), its effects reverberated through areas not directly related to economic indicators such as public education (Evans, Schwab, and Wagner 2014), college enrolment (Long 2014), mental and physical health in adults (Margerison-Zilko, et al. 2016) and children (Reinhard, et al. 2018), and even migration (Massey 2012). Hence, this phenomenon served as a remained of how everyone, regardless of their socio-economic status, geographic location or political views, and being a citizen of developed or developing countries (Nissanke 2010), can be affected by events of this magnitude. Likewise, this event made economists around the world ponder how, in an ever globalized world, worldwide financial and trade interconnectedness serve as mechanisms for financial crises contagion.

Preferential trade agreements (PTAs) are the go-to economic tool for most governments to increase trade and seek for economic development. In addition to this, current research suggests that their effects stretch beyond trade creation into areas such as attracting foreign direct investment (Büthe and Milner 2008), boosting human rights' protection (Hafner-Burton 2009), and even reducing the incidence of international conflict (Haftel 2012). Since the end of the Second World War more than 700 PTAs have been signed (Dür, Baccini, and Elsig 2014). Moreover, the most recent PTAs have increased countries' financial and trade interconnectedness across continents (Dür and Elsig 2018), a feat that could not have been easily considered in the post Second World War, and immediate Cold War eras. However, these very links can increase countries' propensity for financial crisis. This reality is preoccupying considering PTAs' continuous growth in use and scope.

Although trade links and crises have been analysed in economics, notably through the Keynesian school argument for demand-side shocks, and trade openness itself has been recognized to be one of the economic fundamental causes for financial crises, the relationship between PTAs and financial crisis occurrence has not been studied yet. As such, this research analyses the relationship between PTAs and financial crises, considering the role that trade openness has in it. It argues that, although PTAs increase trade openness and trade links between countries, this very interconnection can cause financial crises and their contagion.

This study will be organized in the following way. Chapter 2 conducts a literary review on the key definitions to be used in the research, including PTAs, financial crisis occurrence and contagion, and trade openness. Chapter 3 outlines the methodology used to estimate, through a Structural Equations Model, the direct effect that PTAs and the indirect effect PTA-generated trade openness has on financial crisis occurrence. Chapter 4 will interprets the effects presented in chapter 3, and analyses them in practice using Brazil's propensity for financial crisis change as an example. Finally, concluding remarks are presented.

Chapter 2: Literature Review

This chapter describes the key definitions used in the research, specifically covering financial crises and their contagion, trade openness, and preferential trade agreements (PTAs). Furthermore, it introduces how trade openness is a mechanism for financial crisis contagion, and how PTAs promote said trade openness. Drawing from this literature, this chapter presents a hypothesis on how PTAs increase financial crisis contagion through trade openness.

Financial crises may be one of the most difficult incidents to define, as there is no consensus on what constitutes them or how they can be measured (Ishihara 2005). Many definitions for financial crises have been proposed throughout the years, and just as many have failed to be recognized consensually by the academia[1]. Still, considering the role that financial factors *and* trade have on generating them, this study uses Busuioc-Witowschi's (2010) definition. According to the author, financial crises are defined as "a sharp deterioration of a group of financial and economic indicators, an imbalance between the supply and demand of money, the fall of asset prices, *accompanied by the failures of financial institutions such as banks* [emphasis added]" (Busuioc-Witowschi 2010, 33). Recognizing this, and further building upon Reinhart and Rogoff (2009) and Lipscy's (2018) analyses, throughout this research financial crises are measured using banking crises as a proxy variable. The definition given by Reinhart and Rogoff when developing this variable in their dataset, and the one this analysis abides to, designates banking crises as "bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; or […] if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that

[1] For a detailed account on the debate concerning the establishment and evolution of financial crisis definition refer to Ishihara's 2005 research working paper *Quantitative Analysis of Crisis: Crisis Identification and Causality*.

marks the start of a string of similar outcomes for other financial institutions" (Reinhart and Rogoff 2011, 1680).[2]

Financial crises can be transmitted to other countries not yet affected by them. This transmission is presented in macroeconomic analysis through the term "contagion". As illustrated by Ahmadu-Bello (2014), the conceptual and operative definition of contagion varies largely on what each specific analysis is interested in obtaining from the data available; hence, there is also no commonly-agreed definition for the term (Caporale, Cipollini, and Spagnolo 2005). Acknowledging the international community's growing concern for these events, especially since the 2007-2008 Global Financial Crisis, the World Bank presented three proposals for a conceptual definition of contagion. The *Broad* definition, and the one this paper adheres to, maintains that "Contagion is the cross-country transmission of shocks or the general cross-country spill-over effects" (Porras 2016, 173).[3] This definition highlights how a country's exposure to another's condition (Claessens and Forbes 2004) results in a need to adjust for the shock.

Trade openness is defined as trade as a share of a country's GDP (Semančíková 2016).[4] This widely accepted definition reflects the degree upon which any domestic economy has become accessible and exposed to the global economy. Moreover, it is broad enough to encompass not only the results of trade policies, such as PTA adoption, but is also influenced by different factors related to the overall state of the international economy.

[2] Throughout the remaining of this research I will use the terms financial crisis and banking crisis interchangeably considering Lipscy's (2018) argument for adopting a broader definition of financial crisis.

[3] Throughout the remainder of this research I will use the terms "contagion", "financial crisis contagion" and "financial crisis propensity" interchangeably, as they refer fundamentally to the same phenomenon described by the World Bank's *Broad* definition.

[4] Trade is defined as the annual sum of exports and imports of goods and services of a country (World Bank 2017).

Trade openness has consistently shown to have positive results on economic growth and performance through multiple channels[5], as reflected in several macroeconomic, financial and development indicators.[6] However, these same positive effects have led to largely overlook the disadvantageous outcomes brought about by trade openness, one being that it increases countries' exposure to adverse economic conditions of their trade partners. In fact, growing trade linkages have been proposed to be the paramount contagion channel in developed markets (Eichengreen and Rose 1999). In a similar vein, in their analysis of the emerging Thai, Russian, and Brazilian economies, and the crises they sustained during the end of the last century, Hernández and Valdés (2001) demonstrated that, when measured through stock market returns, trade links and geographical proximity seem to be the most important contagion channels, in addition to financial linkages. The causal mechanism for this is explained concisely by Ahmadu-Bello (2014) as "reduction in income as a consequence of financial crisis will also lead to a reduction in the demand for imports, off-setting the balance trade by also affecting exports and related economic fundamentals in other economies" (23).

Notably, there are many other mechanisms that increase countries' propensity for financial crises. Ahmadu-Bello (2014) identified two major theoretical branches explaining the existence of financial crises contagion: economic-fundamental causes and investor behaviour. Within the first branch, Kaminsky and Reinhart (1998) determined common shocks, financial linkages, and the previously revised trade openness as fundamental causes of contagion. Moreover, investor behaviour causes can be divided into liquidity problems, incentive problems, information asymmetries, market coordination problems, and investor

[5] For a detailed explanation on the channels though which trade openness increases economic growth refer to Semančíková's 2016 article *Trade, Trade Openness and Macroeconomic Performance.*

[6] For an in-depth discussion on the effects of trade openness on macroeconomic performance indicators refer to Balassa (1978), Frankel and Romer (1999), Irwin and Tervio (2000), and Dollar and Kray (2004).

reassessment. (Ahmadu-Bello 2014) In this regard, it is important to clarify that this research will only involve itself with trade openness as a fundamental cause for economic crisis propensity[7], as it is the most directly related to PTAs and their effects.

Preferential Trade Agreements are defined throughout this study as "agreements that liberalize trade between two or more countries but that do not extend this liberalization to all countries" (Dür and Elsig 2018, 1).[8] This definition was selected considering that this research uses these authors' Design of Treaty Agreements database (DESTA) to codify the predictor variable for its analysis (Dür, Baccini, and Elsig 2014).[9] PTAs remain one of the most used tools to generate trade openness by nearly all countries in the world (Dür, Baccini, and Elsig 2014). Moreover, other main economic welfare reasons for governments signing PTAs include increasing net aggregate economic gains (Baier and Bergstrand 2004; Mansfield and Milner 2018), decreasing tariffs without suffering from negative trade effects (Bagwell and Staiger 1998), and allowing firms to take advantage of economies of scale (Chase 2005). Nevertheless, it is important to understand that PTAs are not miraculous trade instruments and that they also possess their shortcomings. For instance, while they increase trade between already established partners, there is still debate on whether they can or cannot create trade where inexistent previously (Egger et al. 2011), and that their success may be a function of the products dealt between the parties involved (Shingal 2018).

Notably, while revising the literature available regarding PTAs' limitations and adverse effects, this research found no study concerning the relationship between PTAs and

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[7] For a detailed revision on the other two fundamental causes refer to Claessens and Forbes's 2004 research *International Financial Contagion: The Theory, Evidence and Policy Implications*. For a deeper analysis on the investor behaviour causes branch, as well as another source on fundamental causes, refer to Ahmadu-Bello's 2014 doctoral dissertation *The 2007-09 Global Financial Crisis and Financial Contagion Effects in African Stock Markets.*

[8] This definition excludes "open regionalism" in the sense of "a group of countries unconditionally extend[ing] trade liberalizing measures on a most-favoured-nation basis" and unilateral concessions through non-reciprocal agreements (Dür and Elsig 2018, 1).

[9] For a thorough discussion on the number of trade partners as a result of PTA membership as a predictor variable refer to Chapter 3: Methodology and Model Specification.

financial crisis propensity, much less by including the role of trade openness. Thus, considering that PTAs have positive effects that include increasing trade openness, but that this trade openness has been recognized as a fundamental cause for financial crisis contagion, I propose the following hypothesis: *Preferential trade agreements increase countries' propensity for financial crisis contagion because they augment their trade openness.*

Chapter 3: Methodology and Model Specification

To evaluate the validity of the hypothesis it is necessary to estimate the significance and direction of the effect that trade openness created by PTAs has on financial crisis occurrence. In other words, this chapter will estimate the *indirect* effect PTAs have on financial crisis occurrence when going through trade openness. This indirect effect is obtained by adding the effect PTAs have on trade openness to the effect this trade openness has on financial crisis occurrence.

A straightforward process to obtain and add these coefficients is a Structural Equations Model (SEM) where trade openness can be treated simultaneously as an outcome of PTAs, and a predictor of financial crisis occurrence. Hence, through a SEM it can estimated how PTAs generate trade openness, and then how this trade openness results in financial crisis occurrence. Moreover, using a SEM it is possible to compare this indirect effect with the *direct* effect PTAs have on financial crisis occurrence, as well as obtain the proportion of how much of the *total* effect that PTAs have on generating financial crisis occurrence is caused by trade openness.

In the remainder of this chapter the variables that operationalize the key concepts of the research are introduced, the inclusion of different mechanisms to account for temporal dependence and unobserved heterogeneity in the model are explained, different control variables that, on theoretical grounds, may be related to the hypothesis are analysed, and their addition into the model is evaluated using the Bayesian Information Criterion (BIC), as suggested by Raftery (1995).[10] Finally, considering the SEM proposed combines a linear and a logistic regression, to obtain the indirect, direct, and total effects PTAs have on financial crisis occurrence, the coefficients of the logistic component are transformed to make them

[10] Following Raftery (1995), the control variable evaluated is adopted if in the model that includes it maintains statistical significance but shows a BIC value smaller in at least 6 units when compared to the baseline.

comparable to the scale of the linear component, as suggested by MacKinnon and Dwyer (1993).

Bearing in mind the definitions adopted in the previous chapter, financial crises are measured through a dichotomous variable, *banking crisis occurrence,* which takes the value of 1 for all country years where banking crises have taken place, and 0 otherwise. The data for this variable was extracted from Reinhart and Rogoff's (2009) *This time is different dataset*, spanning 68 countries which possess a multitude of different geographical, economic, social, cultural, and political characteristics, for a time lapse of 1945 to 2010.[11] Moreover, financial crisis contagion is measured in the remainder of this research through the relationship exposed in the hypothesis between banking crises occurrence, trade openness and PTAs: if PTAs and trade openness increase banking crisis occurrence, then financial crisis contagion occurs.

The *trade openness* definition used in this research is already operatized; thus, it presents the following measurement mechanism. The variable used to measure it was taken from the World Development Indicators database (World Bank 2017), where it is coded as the sum of exports and imports of goods and services measured annually as a share of the country's gross domestic product. This variable was recoded to cover the same list of 68 countries measured by the banking crisis occurrence dependent variable, but its observations only lapse from 1960 to 2010.

A variable that counts the accumulation of trade partners obtained through PTA membership was recoded to operationalize PTAs' definition, as this is a reflection of how

[11] These countries are: Algeria, Angola, Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Canada, Central African Republic, Chile, China, Colombia, Costa Rica, Cote D'Ivoire, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, Iceland, India, Indonesia, Ireland, Italy, Japan, Kenya, Korea, Malaysia, Mauritius, Mexico, Morocco, Myanmar, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela, Zambia, and Zimbabwe.

PTAs liberalize trade between countries. The 2018 version of the DESTA database (Dür, Baccini, and Elsig 2014) was used for this process, resulting in the variable "Number of trade partners as a result of PTA membership" (*PTA Partners*) that measures the total number of trade partners of any given country resulting from signing any given number of Preferential Trade Agreements. It can be argued that this is a *de facto* measure of PTAs as it uses a variable that represents the results of their implementation, the number of partners, and *not* a variable that, in principle, enables these results.

As a baseline this chapter presents a SEM combining a linear regression and a logistic regression consisting of the three principal variables described until now: banking crisis occurrence, trade openness, and PTA Partners. The results of the regression are presented in column 1 of table 1.[12] Recognizing that both regressions are Time-Series Cross Sectional analyses (TSCS) with the logistic component including a binary dependent variable (BTSCS), cubic splines to account for duration dependence are included, as well as a count variable for previous banking crisis occurrence (Beck, Katz, and Tucker 1998; Lipscy 2018).[13] Moreover, bearing in mind the diversity of the countries included in the dataset, and that time invariant factors not directly measured in the dataset, such as geographical and cultural characteristics, may affect banking crisis occurrence, country-fixed effects are added in the regression model.[14] [15] The results of these additions can be seen in column 2 of table 1,

[12] Table 1 only focuses on the inclusion of cubic splines, previous banking crisis occurrence variable, and country fixed effects, in addition to the purely economic control variables related to PTAs, trade openness, and banking crisis occurrence.

[13] Knots were placed at 1, 3, and 5 years, following the average time for PTA provisions to enter into force, the usual time to start to perceive PTA results in the short-medium and medium-long terms respectively Alternative knot placements were tested as seen in Appendix 1, but this configuration was adopted following the BIC evaluation results.

[14] Some authors argue that including fixed effects in a BTSCS can present problems if the observations' values of the dependent variable do not change. Here that is not an issue as all countries in the dataset have experienced multiple banking crises in the period analysed, and the key independent variables also vary in this time frame.

[15] To incorporate country-fixed effects in a structural equations model that includes a logistic regression I added the country-fixed effects estimator directly into the codification for the SEM by

which shows a much smaller BIC value compared to the baseline model; thus, will be incorporated in subsequent evaluations.

Banking and currency crises often come together, and for this reason are referred to as "twin crisis" (Kaminsky and Reinhart 1998). To account for this strong relationship, a dummy variable for *currency crisis occurrence* is included. This measurement takes the value of 1 for all country years where a currency crisis has taken place, and 0 otherwise.[16] The results of this variable's integration are shown in column 3 of table 1. Incorporating currency crises yields a smaller BIC in comparison to the previous model; however, because this variable is not statistically significant in the trade openness equation of the SEM, it will only be maintained for the financial crisis equation of following evaluations.

Lambrechts, McGrath and Rule (2012) have found that, not counting countries with marked social or political unrest, there is a strong correlation between a country's level of trade openness and its GDP per capita. In addition to this, Lipscy (2018), argues that "it is possible that wealthy countries have larger, more complex banking systems that are difficult to regulate effectively. Speculative mania may also take hold more frequently in wealthy countries where markets are reasonably well developed, and citizens have accumulated assets to invest" (14); hence, making wealthier countries more susceptible to financial crises. Thus, using the value of each country's GDP per capita constant at 2010 USD value, yearly *Economic Growth percentage* as a control variable has been recoded and included in the proposed model.[17] [18] The results for this are shown in column 4 of table 1. Including this

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beforehand establishing the country numeric code as the panel variable in the dataset and then including it as a country specific dummy variable into the regression.

[16] The data for this variable was taken from Reinhart and Rogoff's (2009) *This time is different* dataset.

[17] The data for GDP per capita constant at 2010 USD was taken from the World Bank's World Development Indicators (2017). It covers the lapse from 1960 to 2010.

[18] This variable reports the difference between a country's economic growth in percentages by subtracting the value of a country's GDP per capita from the value of the same country's GDP per capita in the previous year, dividing this value by the country's GDP per capita in said previous year, and then multiplying the result by 100.

variable results in a smaller BIC value, and is statistically significant in both equations of the SEM; hence, it will be maintained in the remaining analysis. This model will be the baseline to evaluate the rest of the proposed control variables.

Table 1: Model Specification and Economic Control Variables Evaluation

	SEM 1	SEM 2	SEM 3	SEM 4
	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis
Trade Openness	0.996*	1.012*	1.012*	1.014*
	(-2.39)	(2.12)	(2.13)	(2.55)
PTA Partners	1.008***	1.026***	1.027***	1.027***
	(6.28)	(5.78)	(5.83)	(5.79)
Currency Crisis			2.047***	1.547*
			(3.66)	(2.12)
Economic Growth (%)				0.852***
				(-7.84)
	Trade Openness	Trade Openness	Trade Openness	Trade Openness
PTA Partners	0.206***	0.189***	0.189***	0.188***
	(9.90)	(15.85)	(15.86)	(15.28)
Currency Crisis			-0.691	
			(-0.88)	
Economic Growth (%)				0.163*
				(2.36)
Country-Fixed Effects	-	Y	Y	Y
Splines	-	Y	Y	Y
BIC	33111.81	26426.51	26411.51	25538.24
Observations	2926	2926	2924	2832

Note: Coefficients for the first equation [Banking Crisis] are reported in odds ratios, the second equation [Trade Openness] is reported in unstandardized 'B' coefficients. The first equation in all models corresponds to a Bernoulli data distribution and uses a Logit link function, the second equation in all models corresponds to a Gaussian data distribution and uses an Identity link function. All equations include the following control variables that are omitted from the table for brevity: a country specific variable to include country fixed effects, cubic splines to account for duration dependence, and a count variable for previous banking crisis occurrence. The observations number has been kept constant at 2788 for the BIC calculation.
z statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

A dummy variable to mark the *independence* of a country[19] has been incorporated on the grounds that self-governing countries may decide to increase their trade openness in hopes of obtaining the economic welfare benefits that they were denied previously by their colonizers. The results for this model are shown in column 1 of table 2. Not only a country's independence is not statistically significant in any equation, but the resulting BIC value is reasonably higher to the baseline model; thus, it will not be included in following models.

[19] The data for this variable was taken from Reinhart and Rogoff's (2009) *This time is different* dataset.

To account for the effect of "marked social or political unrest" that Lambrechts, McGrath and Rule (2012) refer to in their analysis, as well as considering that Reinhart and Rogoff's (2009) results show armed conflicts being possible triggers for banking crises, a dummy variable for *war* is integrated in the model.[20] This measurement takes the value of 1 when an interstate, intrastate, and extrastate war takes place in a given country year, and 0 otherwise. The results for this model are shown in column 2 of table 2. Including armed conflicts yields a significantly smaller BIC value; however, its effect is only statistically significant in the trade openness equation of the SEM. As a consequence, armed conflicts will only be maintained for this equation in subsequent models.

As shown by Lipscy (2018) through a wide time-range analysis from the 1800's to 2010, democracies tend to be more prone to suffer financial crises in comparison with autocratic governments because these possess some inherent characteristics that actively increase such propensity. Thus, it was deemed important to include a measurement of the *degree of democratization* of a country to consider the effect that said characteristics would have in the model. This measurement takes the form of the dichotomous variable used by Lipscy (2018) where a value of 1 corresponds to a democratic regime and a value of 0 otherwise in a given country year.[21] The results for including democracy in the model are shown in column 3 of table 2. Adding democracy in the model does not yield a significantly lower BIC value when compared to the previous model, nor it is statistically significant; hence, it will not be used in the analysis. The model specification that only includes the final control variables for the study is shown in column 4 of table 2.[22]

[20] The data for this variable was taken from Lipscy's (2018) dataset, and was recoded to cover the same time lapse and countries observed in the variable banking crisis occurrence.

[21] Ibid.

[22] Summary statistics for all variables used in the SEM specification process are presented in Appendix 2.

Table 2: Model Specification, Non-Economic Control Variables Evaluation, and Comparable Coefficients Transformation for Rescaled Outcome Variables

	SEM 5	SEM 6	SEM 7	SEM 8	SEM 9
	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis'
Trade Openness	1.014*	1.014*	1.014*	1.014*	1.345*
	(2.55)	(2.41)	(2.54)	(2.55)	(2.55)
PTA Partners	1.027***	1.027***	1.027***	1.027***	1.605***
	(5.73)	(5.70)	(5.67)	(5.79)	(5.79)
Currency Crisis	1.544*	1.568*	1.539*	1.547*	1.075*
	(2.11)	(2.18)	(2.09)	(2.12)	(2.12)
Economic Growth (%)	0.852***	0.855***	0.852***	0.852***	0.739***
	(-7.84)	(-7.62)	(-7.86)	(-7.84)	(-7.84)
Independence Year	1.124				
	(0.01)				
War		0.888			
		(-0.47)			
Democratic Regime			1.356		
			(1.05)		
	Trade Openness	Trade Openness	Trade Openness	Trade Openness	Trade Openness
PTA Partners	0.187***	0.181***	0.181***	0.181***	0.181***
	(15.19)	(14.96)	(14.89)	(14.96)	(14.96)
Economic Growth (%)	0.157*	0.139*	0.136*	0.139*	0.139*
	(2.26)	(2.02)	(1.98)	(2.02)	(2.02)
Independence Year	0.0657				
	(1.32)				
War		-4.507***	-4.522***	-4.507***	-4.507***
		(-5.47)	(-5.48)	(-5.47)	(-5.47)
Democratic Regime			-0.144		
			(-0.16)		
Country-Fixed Effects	Y	Y	Y	Y	Y
Splines	Y	Y	Y	Y	Y
Rescaled Outcome Variable	-	-	-	-	Y
BIC	25552.12	25035.88	25035.18	25044.11	25044.11
Observations	2832	2788	2825	2832	2832

Note: Coefficients for the first equation [Banking Crisis] are reported in odds ratios, the second equation [Trade Openness] is reported in unstandardized 'B' coefficients. Coefficients for SEM 9 are reported in comparable odd ratios for [Banking Crisis] and comparable unstandardized 'B' coefficients for [Trade Openness].The first equation in all models corresponds to a Bernoulli data distribution and uses a Logit link function, the second equation in all models corresponds to a Gaussian data distribution and uses an Identity link function. All equations include the following control variables that are omitted from the table for brevity: a country specific variable to include country fixed effects, cubic splines to account for duration dependence, and a count variable for previous banking crisis occurrence. The observations number has been kept constant at 2788 for the BIC calculation.
z statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Understanding this SEM consists of a linear regression (Banking Crisis) and a logistic regression (Trade Openness) that are linked, it is possible to make simultaneous inferences of both. However, to conduct a mediation analysis using these regressions it is necessary to first

rescale Y_{it} to make its coefficients comparable to Z_{it}, as suggested by MacKinnon and Dwyer (1993).[23] The results for this process are portrayed in the final column of table 2 where the coefficients for the logistic regression are presented as odds ratios.[24] The corresponding path analysis and matching comparable equivalent equations for this final model specification are presented below. Notice that in table 2, as well as in figure 1, a prime (') indicates the rescaling of Y_{it} and its resulting comparable coefficients. Moreover, to make the analysis of the direct, indirect and total coefficients more straightforward this diagram only includes the predictor, mediator, and outcome variables.[25]

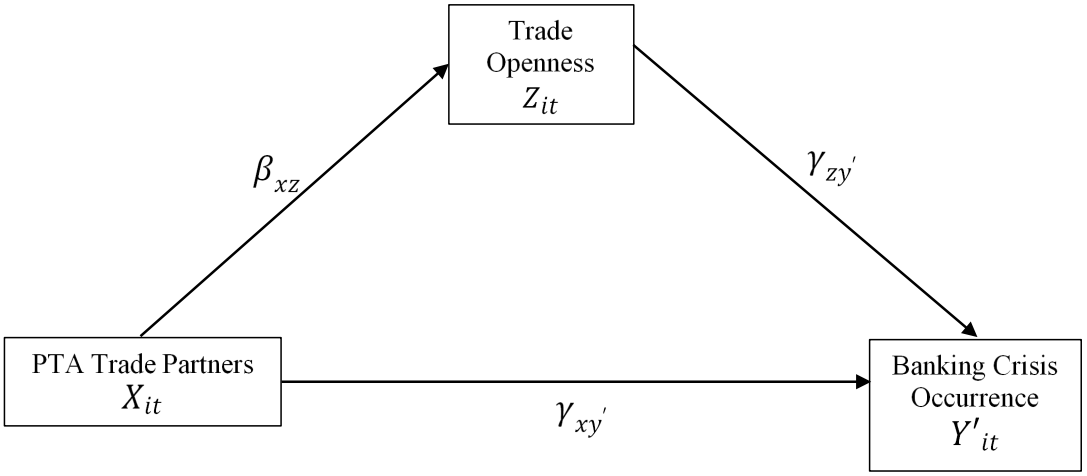

Figure 1: Simplified Comparable Coefficients Path Analysis for PTA Trade Partners – Rescaled Banking Crisis Occurrence, Mediated by Trade Openness (Structural Equations Model)

[23] This rescaling and comparison-enabling procedure is available in Appendix 4.

[24] Odds ratios are a representation of the association between the probability of an event "A" happening over the probability of this same event "A" not happening, when an event "B" is involved. If the probability of "A" happening if "B" is involved is 0.75 and its probability of *not* happening if "B" is involved is 0.25, then the odds ratio of "A" happening is the result of dividing both probabilities (0.75/0.25=3). Hence, if the odds ratio of "A" happening when "B" is involved is 3, it can be interpreted as "All other variables fixed, for a change of one unit in "B", the odds of "A" happening are expected to increase by a factor of 3", or in other words, "for every unit change in "B", "A" is 3 times more likely to happen."

[25] A complete path analysis for the final control variables specification that includes the effects of said control variables, as well as the cubic splines and fixed effects is available in Appendix 3.

The equivalent equations for this path analysis, including the control variables, fixed effects, and cubic splines, are:

$$Z_{it} = \beta_0 + \beta_{xz}X_{it} + \beta_{ez}E_{it} + \beta_{wz}W_{it} + \beta_{kz}K_t + \beta_{cz}C_i \quad [1]$$

$$Y'_{it} = \gamma_0 + \gamma_{zy'}Z_{it} + \gamma_{xy'}X_{it} + \gamma_{ey'}E_{it} + \gamma_{uy'}U_{it} + \gamma_{ky'}K_t + \gamma_{cy'}C_i \quad [2]$$

Where in [1]:

Z_{it} = outcome variable trade openness, for country-year

β_0 = constant

$\beta_{xz}X_{it}$ = effect of predictor variable PTA Partners on outcome variable

$\beta_{ez}E_{it}$ = effect of control variable economic growth percentage on outcome variable

$\beta_{wz}W_{it}$ = effect of control variable war on dependent variable

$\beta_{kz}K_t$ = grouped effect of cubic splines at 1, 3, and 5 years, on outcome variable to account for temporal dependence

$\beta_{cz}C_i$ = grouped effect for each country specific dummy variable on outcome variable, to serve as a fixed effects estimator to account for unobserved heterogeneity

And in [2]:

Y'_{it} = rescaled outcome variable banking crisis occurrence, for country-year

γ_0 = constant

$\gamma_{zy'}Z_{it}$ = effect of mediator variable trade openness on rescaled outcome variable

$\gamma_{xy'}X_{it}$ = effect of predictor variable PTA Partners on rescaled outcome variable

$\gamma_{ey'}E_{it}$ = effect of control variable economic growth percentage on rescaled outcome variable

$\gamma_{uy'}U_{it}$ = effect of control variable currency crisis occurrence on rescaled outcome variable

$\gamma_{ky'}K_t$ = grouped effect of cubic splines at 1, 3, and 5 years, on rescaled outcome variable to account for temporal dependence

$\gamma_{cy'}C_i$ = grouped effect for each country specific dummy variable on rescaled outcome variable, to serve as a fixed effects estimator to account for unobserved heterogeneity

Having obtained these comparable coefficients, to continue the mediation analysis it is necessary to estimate the direct, indirect and total effects of the relationship between the

number of trade partners as a result of PTA membership (X_{it}), financial crisis occurrence rescaled (Y'_{it}), and trade openness (Z_{it}).[26] Formally, the direct effect of PTA Partners on financial crisis occurrence is understood as the effect that X_{it} has on Y'_{it} *controlling* for Z_{it}, the indirect effect represents the effect X_{it} has on Y'_{it} when *going through* Z_{it}, and the total effect represents the effect X_{it} has on Y'_{it} when *including* the indirect effect. These coefficients are shown in table 3 column 1, and have been exponentiated in column 2 to present them as odds ratios. Finally, the last rows of table 3 correspond to the comparison between the size of the direct and indirect effect, and the percentage of the total effect mediated by the indirect effect.

Table 3: Mediation Analysis Effects, Size Comparison, and Mediation Proportion

	Mediation Effects - log odds -	Mediation Effects - odds ratios -
	Banking Crisis'	Banking Crisis'
Direct Effect - PTA Trade Partners	0.473***	1.605***
	(5.79)	(5.79)
Indirect Effect - PTA Trade Partners	0.0537*	1.055*
	(2.52)	(2.52)
Total Effect - PTA Trade Partners	0.527***	1.693***
	(6.60)	(6.60)
Observations	2832	2832
Indirect and Direct Effect Size Comparison	8.81	
Total Effect Mediated (%)	10.12%	

Note: Prime (') next to outcome variable Banking Crisis denotes rescaling in comparison to outcome variable presented in table 2, column 4. Indirect and Direct Effect Size Comparison, and Percentage of Total Effect Mediated have been obtained using log odds of column 1 as reference.
z statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[26] For the process to obtain these coefficients, as well as a path analysis diagram that includes each effect refer to Appendix 5.

Chapter 4: Analysis

In the previous chapter I outlined the methodology to obtain the Direct, Indirect and Total effect of PTAs on financial crisis occurrence rescaled, as portrayed in table 4. This methodology consists of a SEM where trade openness acts as a mediator in the PTA – Financial Crisis relationship, and economic growth, currency crises, and war, are control variables in the model, as presented in table 3. In this chapter I will interpret the coefficients presented in table 4, in addition to the difference between the indirect and direct effects' sizes, and the percentage of the total effect mediated. I also interpret briefly the effects of the control variables in table 3. Moreover, I will analyse these coefficients' implications on Brazil's actual propensity for financial crisis as measured by the database used to obtain the relationships previously interpreted in this research.

The Direct Effect row of table 4 shows that PTA Trade Partners has a highly statistically significant effect on financial crisis occurrence. This effect, as portrayed in the odds ratio column of the table, can be interpreted as, *in any given year and maintaining all other variables fixed, for every trade partner resulting from PTA membership a country is 1.605 times more likely to suffer a financial crisis [rescaled] than a country with no new trade partners in the same year.*

But, what does this coefficient actually mean? To answer this question I will use the case of Brazil's change on probability of suffering financial crises. According to the database used to obtain the coefficients previously interpreted in this research, in 1970 Brazil had a 0.04348% probability of suffering a financial crisis. This will be the baseline probability to compare the direct, indirect and total effects of PTAs on financial crisis occurrence. Taking into account that from 1970 to 2009 Brazil gained 49 new trade partners resulting from PTA membership, according to the direct effect obtained, then Brazil's propensity for financial crisis could increase by a factor of 78.65 from 0.04348% to 3.42%.

The Indirect Effect row of table 4 reflects that trade openness as a result of PTA Trade Partners also has a statistically significant effect on financial crisis occurrence. This shows that the effect PTAs have on financial crisis occurrence is, in fact, partially mediated by trade openness. This coefficient, as portrayed by the odds ratio column of the table, can be interpreted as follows. *In any given year and when mediated through trade openness, for every new trade partner resulting from PTA membership, a country is 1.055 times more likely to suffer a financial crisis [rescaled] than a country with no new trade partners in said year.* I will now analyse this coefficient, using again the Brazilian case. Bearing in mind Brazil's 49 new trade partners resulting from PTA membership gained from 1970 to 2009, which resulted in an increase of 34.51% in trade openness during this time frame, Brazil's propensity for financial crisis could increase by a factor of 51.70 from 0.04348% to 2.25%.

The Total Effect row of table 4 reflects how the Direct Effect PTAs have on financial crisis occurrence, when keeping all other variables fixed, added to the Indirect Effect PTAs have on financial crisis occurrence, when mediated through trade openness, is highly statistically significant. The odds ratio column of the table for this effect can be interpreted as follows. *In any given year and when including the effect trade openness has, a country is 1.693 times more likely to suffer a financial crisis [rescaled] in comparison to a country with no new trade partners.* Going back to Brazil's illustrative example, if from 1970 to 2009 this country gained 49 trade partners resulting from PTA membership, then according to the total effect odds ratio, Brazil's propensity for financial crisis could increase 82.96 times from 0.04348% to 3.61%.

These coefficients seem to support the hypothesis that PTAs have an effect on financial crisis occurrence, and that trade openness has a role in this relation. The final row of table 4 shows that the total effect that PTAs have on financial crisis occurrence is mediated in 10.12% by trade openness; thus, supporting the hypothesis presented in Chapter 2. Still,

considering that the Indirect and Direct Effect size comparison row in table 4 shows that the effect PTAs have on financial crisis occurrence is 8.81 times larger than the effect trade openness generated by PTAs has on financial crisis occurrence, I conclude that, although there is evidence in support for my hypothesis concerning the role of trade linkages in the relationship between PTAs and financial crisis occurrence, there are other unknown factors at play that have an important say in this relation.

I will now briefly present the coefficients of the control variables of the SEM. All the control variables presented in table 3, column 2, are statistically significant. The trade openness equation shows that economic growth in percentages has a moderate and positive effect in trade openness creation. In comparison, war has a much stronger negative effect in trade openness creation. In fact, maintaining all other variables fixed, for an increase in one percent of economic growth, we can expect trade openness to increase in 0.139 units. In contrast, maintaining all other variables fixed, as expected, an armed conflict's occurrence will reduce trade openness in 4.507 units.

Moving on to the banking crisis rescaled equation of the SEM, all variables are statistically significant[27]. Keeping all the other variables fixed, for every new unit of trade openness, the odds of having a financial crisis will increase by a factor of 1.345, or in other words, a country that increases its trade openness by one unit is 1.345 times more likely to have a financial crisis than a country that does not; hence, reinforcing trade openness' role as an economic-fundamental cause for financial crisis contagion.

The rescaled banking crisis equation shows that currency crisis does have a positive effect on financial crises occurrence, confirming the "twin crisis" phenomenon. Maintaining all other variables fixed, a country with an ongoing currency crisis is 1.075 times more likely to have a financial crisis than one that is not going through a currency crisis. On the other

[27] The path coefficients of the banking crisis equation are reported in odds ratios.

hand, economic growth in percentages shows a moderate negative effect on financial crisis occurrence that can be presented more accurately by calculating the inverse of its odds ratios. Thus, we can state that country that does not increase its economic growth percentage is 1.353 times more likely to experience a financial crisis in comparison to one that does increase its economic growth percentage, meaning that countries that are growing may be healthier and less prone to financial crises.

Conclusion

This research sought to ponder how preferential trade agreements, one of the most used tools to generate global interconnectedness through trade links, could affect the propensity for financial crisis contagion. As such, it claimed that because preferential trade agreements increase trade linkages between countries, these then become more exposed to adverse economic conditions of each other; thus, increasing financial crisis occurrence and contagion.

To analyse the validity of this argument, the key concepts were defined and the theoretical foundation of their relationship was presented through a literature review. Once this was achieved, a Structural Equations Model was specified with the purpose of estimating the effects PTAs have on financial crisis occurrence, but also the effect trade openness generated by said PTAs has on financial crisis occurrence. To appropriately model this relation it was necessary to account for factors that could affect its resulting effects, such as armed conflicts, currency crises occurrence, and economic growth, as well as include mechanisms to consider unobserved heterogeneity and temporal dependence.

The model results showed that trade openness generated by preferential trade agreements does have an effect on generating financial crisis occurrence, by increasing countries' propensity to it by 1.605 times for each trade partner gained though PTAs. The model also revealed that 10.12% of the effect preferential trade agreements have on financial crisis occurrence is mediated by trade openness; thus, supporting this research's argument for the role of trade linkages. However, the complete results of the analysis suggest this is not the whole story. Considering that the effect PTAs have on financial crisis occurrence when controlling for all the other variables selected is 8.81 times larger than the mediated effect, it is necessary to recognize that although the proposed hypothesis has found support, there may

be other explanations for the strength of the direct relation preferential trade agreements seem to have with financial crisis occurrence.

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Appendix 1: Alternative Knot Placement Comparison

	Knot Pl. 1 -1, 4, 6-	Knot Pl. 2 -1, 4, 7-	Knot Pl. 3 -1, 3, 5-	Knot Pl. 4 -1, 3, 7-	Knot Pl. 5 -1, 3, 10-	Knot Pl. 6 -1, 5, 10-
	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis	Banking Crisis
Trade Openness	1.011*	1.011*	1.012*	1.011*	1.011*	1.011*
	(2.09)	(2.08)	(2.12)	(2.10)	(2.10)	(2.05)
PTA Trade Partners	1.026***	1.026***	1.026***	1.026***	1.027***	1.026***
	(5.80)	(5.80)	(5.78)	(5.82)	(5.80)	(5.68)
	Trade Openness	Trade Openness	Trade Openness	Trade Openness	Trade Openness	Trade Openness
PTA Trade Partners	0.188***	0.188***	0.189***	0.188***	0.188***	0.188***
	(15.68)	(15.61)	(15.85)	(15.67)	(15.53)	(15.49)
Country-Fixed Effects	Y	Y	Y	Y	Y	Y
Splines	Y	Y	Y	Y	Y	Y
BIC	26455.68	26465.39	26426.51	26446.83	26468	26501.94
Observations	2926	2926	2926	2926	2926	2926

Note: All models include the following control variables that are omitted from the table for brevity: a country specific variable to include country fixed effects, cubic splines to account for duration dependence, and count variable for previous banking crisis occurrence. The observations number has been kept constant at 2788 for the BIC calculation.

z statistics in parentheses.

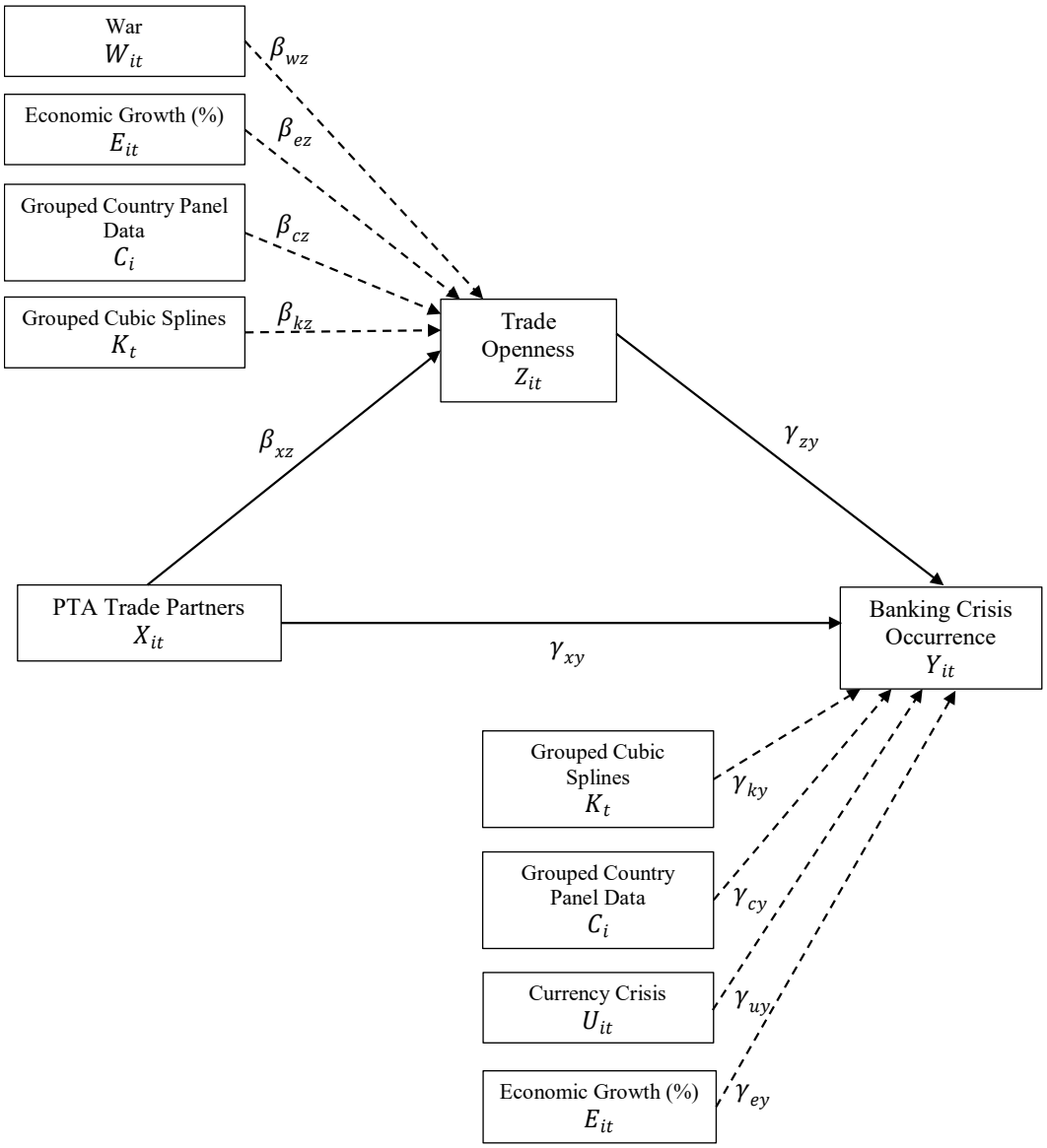
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix 2: Summary Statistics - Variables used in SEM Specification Process

Variable	Observations	Mean	Std. Dev.	Min	Max
Banking Crisis	4,154	0.102311	0.3030934	0	1
Trade Openness	2,926	6.018.102	4.693.878	0.17	411.6
PTA Trade Partners	4,154	3.080.067	3.970.213	0	153
Currency Crisis	4,152	0.1738921	0.3790623	0	1
Economic Growth (%)	2,962	2.254.278	4.297.574	-2.862.642	3.100.793
Independence Year	4,154	0.9386134	0.240067	0	1
War	3,933	0.2257818	.04181493	0	1
Democratic Regime	3,993	0.5857751	0.4926494	0	1

Appendix 3: Complete Structural Equations Model Final Specification Path Analysis

The totality of the final specification for the SEM portrayed in column 4 of table 2 can be displayed in the following path analysis diagram:



Appendix 4: Rescaling and Comparable Coefficient Transformation Process

Given a Structural Equations Model (SEM) consisting of two linear regression equations:

$$Z_{it} = \beta_0 + \beta_{xz} X_{it} \quad \text{[Linear]}$$

$$Y_{it} = \beta_0 + \beta_{zy} Z_{it} + \beta_{xy} X_{it} \quad \text{[Linear]}$$

Where Z_{it} is the mediator variable, and Y_{it} is the outcome variable, a mediation is defined as the product of two regression coefficients: $\beta_{xz}\beta_{zy}$.

The first coefficient, β_{xz}, represents the effect of the predictor variable X_{it} on the mediator variable. The second coefficient, β_{zy}, represents the effect of the mediator variable on the outcome variable. This mediation is referred to as "indirect effect", because, when combined, these coefficients signify the effect that the predictor variable has on the outcome variable when going through the mediator.

As both equations represent linear regression models, the residual variance changes in the two of them with the addition of other co-variables. Thus, it is possible to obtain the product of β_{xz} and β_{zy}.

However, if either the mediator variable Z_{it} or the outcome variable Y_{it} are dichotomous, then the model used to estimate them is no longer a linear regression but a logistic one. For instance, if the outcome variable is dichotomous, then the SEM can be represented by the following equations:

$$Z_{it} = \beta_0 + \beta_{xz} X_{it} \quad \text{[Linear]}$$

$$Y_{it} = \gamma_0 + \gamma_{zy} Z_{it} + \gamma_{xy} X_{it} \quad \text{[Logit]}$$

Here, the residual variance in the logistic model remains fixed, in contrast to the linear model. This results in the mediator and the outcome variables being in different scales; thus, obtaining the product of coefficients β_{xz} and γ_{zy} is not possible as these are not comparable.

To solve this, MacKinnon and Dwyer (1993) propose multiplying the coefficients of the logistic equation by the standard deviation (SD) of the predictor variable and then divide the result by the standard deviation of the rescaled outcome variable, denoted by adding a prime (') next to it: Y'_{it}

The standard deviation of the rescaled outcome variable can be obtained through the following formula derived from MacKinnon and Dwyer's (1993) work.

$$SD(Y'_{it}) = \sqrt{{\gamma_{xy}}^2 * Var(X_{it}) + {\gamma_{zy}}^2 * Var(Z_{it}) + 2(\gamma_{zy})(\gamma_{xy}) * Cov(X_{it}; Z_{it}) + \frac{\pi^2}{3}}$$

Where:

$Var(X_{it})$ = variance of X_{it}

$Var(Z_{it})$ = variance of Z_{it}

$Cov(X_{it}; Z_{it})$ = covariance of $X_{it}$and Z_{it}

$\frac{\pi^2}{3}$ = variance of the standard logistic distribution

As a result, the SEM with a rescaled outcome variable and comparable coefficients is:

$$Z_{it} = \beta_0 + \beta_{xz} X_{it} \qquad \text{[Linear]}$$

$$Y'_{it} = \gamma_0 + \gamma_{zy'} Z_{it} + \gamma_{xy'} X_{it} \qquad \text{[Logit comparable]}$$

Where the coefficients equal:

$$\gamma_{zy'} = \gamma_{zy} \frac{SD(Z_{it})}{SD(Y'_{it})}$$

$$\gamma_{xy'} = \gamma_{xy} \frac{SD(X_{it})}{SD(Y'_{it})}$$

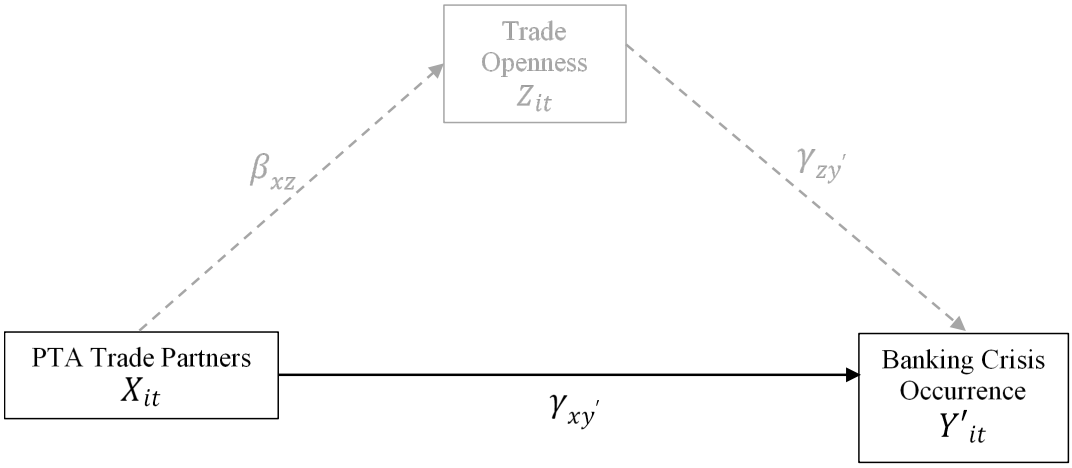
Using the prior formula, the standard deviation for banking crisis occurrence rescaled, Y'_{it}, is 2.273155704. Considering the summary statistics for all the variables used in the SEM specification process available in Appendix 2, table 3, column 2, shows the final SEM specification of table 2, column 4, with a rescaled outcome variable (Banking Crisis') and

comparable coefficients obtained using the previous method. Moreover, because Banking Crisis' coefficients of table 3, column 1, are still log odds, albeit comparable to the Trade Openness equation coefficients, they can be exponentiated to obtain their odds ratios to simplify their interpretation, as shown in table 3, column 2.

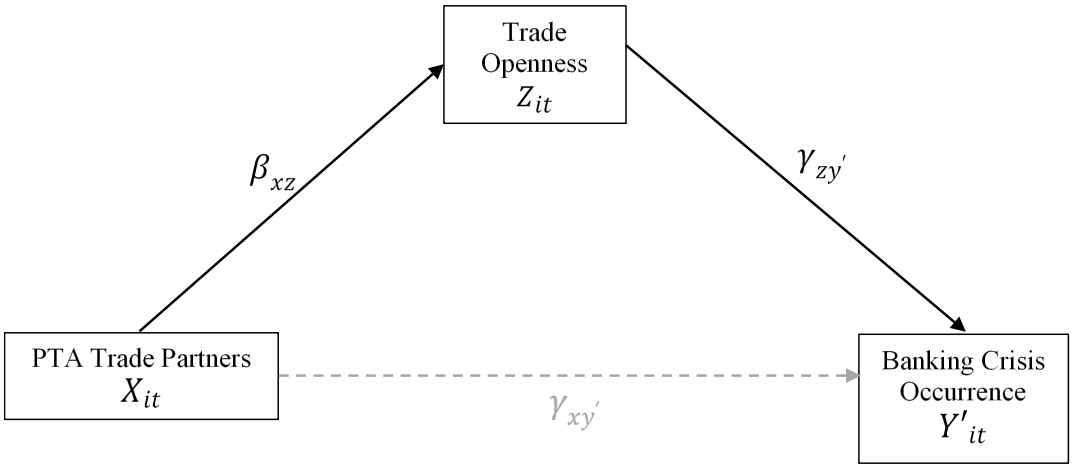
Appendix 5: Direct, Indirect, and Total Effect Calculation and Path Analysis

The coefficients of column 1 in table 3 represent the direct effect that X_{it} has on Y'_{it}, *controlling* for Z_{it}. This is denoted in the path analysis diagram of figure 1 and its equivalent equations [1] and [2] with the expression $\gamma_{xy'}$, and in a clearer form in the Direct Effect portion of figure 2. The indirect effect represents the effect X_{it} has on Y'_{it}, when *going through* Z_{it}. Hence, it is represented by the product of $\beta_{xz}\gamma_{zy'}$, and in figure 2 in its Indirect Effect portion. Finally, the total effect represents the effect X_{it} has on Y'_{it}, when *including* the indirect effect. Thus it is represented by the product of $\gamma_{xy'} + (\beta_{xz}\gamma_{zy'})$, and in the Total Effect portion of figure 2 . These effects have been exponentiated in table 3, column 2, to present them in odds ratios. In order, the last two rows of table 3 correspond to the comparison between the size of the direct and indirect effect, and the percentage of the total effect mediated by the indirect effect. To obtain the comparison between sizes the direct effect was divided by the indirect effect as follows: $(\gamma_{xy'})/(\beta_{xz}\gamma_{zy'})$. Finally, the percentage of the total effect mediated is the product of the indirect effect divided by the total effect, multiplied by 100: $((\beta_{xz}\gamma_{zy'})/(\gamma_{xy'} + (\beta_{xz}\gamma_{zy'}))\,100$

Direct Effect = $\gamma_{xy'}$



Indirect Effect = $\beta_{xz}\gamma_{zy'}$



Total Effect = $\gamma_{xy'} + (\beta_{xz}\gamma_{zy'})$

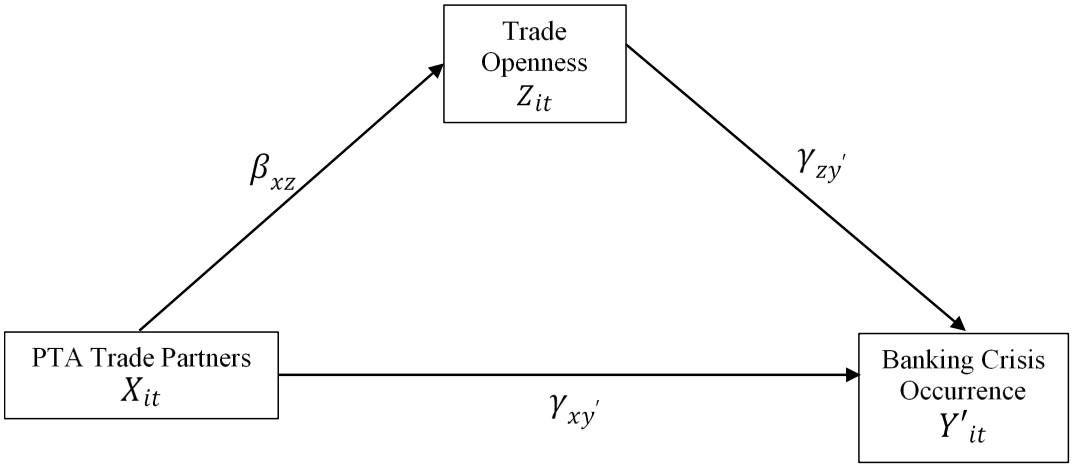


Figure 2: Direct, Indirect, and Total Effects Path Analysis Illustration