Nijmegen School of Management
Department of Economics and Business Economics
Master's Thesis Economics (MAN-MTHEC)

The effect of (moderate) import tariffs on inflation and interest rates: A case about Protectionism.

Dionysios Stamos s1142712

Nijmegen, 30 June 2025

Program: Master's Program in Economics

Specialisation: Financial Economics

Supervisor: Dr. Bohn, F. (Frank)

Radboud Universiteit

Abstract

The aim of this paper is to analyze whether tariffs have a direct effect on interest rates, and if this direct effect is mediated through inflation. To facilitate this aim, a mediation analysis is employed to evaluate if inflation acts as a mediator between those two variables. The motivation of this empirical analysis lies at the 2018 - 2019 trade war between the US and the rest of the world, as well as the liberation day tariffs announced in 2025 by President Donald Trump. The analysis first evaluates the direct effect of tariffs on interest rates, then regresses tariffs on inflation to evaluate the mediator, and lastly regresses both tariffs and inflation on interest rates. The models include lags of some variables to account for time adjustments in policy. The results are evaluated with a robustness check that excludes outliers and influential variables to isolate the effect of moderate tariffs on the economy. The main findings show that there are both country and time differences. In cases of free trade, tariffs do not directly affect interest rates, whereas during projectionist times, there can be seen both a positive or negative direct effect depending on the country and a negative indirect effect through inflation.

Contents

1 Introduction

In recent years global trade dynamics have witnessed a resurgence of protectionist policies, with many countries turning to tariffs as a means to shield their domestic industries from foreign competition. The effect of tariffs on inflation has been extensively studied given their close relationship (Amiti, et al., 2019; Furceri et al., 2021; Alvarez & Yilmazkuday, 2025). Additionally, the effect of inflation on interest rates has also been widely studied and the responses of the central banks to inflationary pressures have been heavily documented (Berghe, 2024 ; Van den End & Pattipeilohy, 2017).

While trade interventions implemented without sufficient economic foresight are often associated with negative economic consequences such as higher inflation and distorted interest rates, moderate and strategic use of tariffs has historically been viewed more favorably (Batra, 2001). This viewpoint dates back to the formulation of the optimal tariff theory by Johnson in the 1950s, which argues that under certain conditions, particularly for large economies, tariffs can enhance national welfare.

This study aims to evaluate the effects of (moderate) tariffs on the nominal interest rates of the country imposing them. To do so, a mediation analysis is implemented, which evaluates if tariffs have a direct and significant effect on nominal interest rates and if so, how this effect is mediated through inflation. Therefore, the main research question of the paper is whether moderate tariffs from one country lead to changes in the nominal interest rate of the same country, and if this effect is mediated through inflation.

This paper contributes to current literature by providing a more holistic approach to evaluating protectionism through tariffs. More specifically, it analyses the effects of tariffs during trade wars and evaluates with a robustness check if those effects are similar in times of fewer trade tensions.

The outcomes of this research should not be interpreted without acknowledging the limitations of the analysis due to scarce public information about tariffs. If the publicly available tariff data can allow researchers to estimate correctly their effects, it is a topic that future literature should focus on. Having said that, the empirical analysis presents a different picture in cases of high protectionist policies, as opposed to cases of free trade. Additionally, the analysis has shown wide country related differences in the effect of tariffs. For example, tariffs seem to positively impact the interest rates for the United States when the time period includes the last part of the Trump presidency. The effect is partially mediated through inflation with small but significant downward pressure. When moderate tariffs are used, and outliers are excluded, tariffs remain insignificant for the central banks of all countries, suggesting that times of free trade are less disturbing for the central banks' policies.

This paper is structured as follows; Chapter 2 provides a literature review divided between the three components of the mediation. Firstly, protectionism thorough tariffs, secondly the effect of tariffs on inflation, and lastly the effect of both tariffs and inflation on interest rates. The chapter is concluded with the hypothesis derived from the review. Chapters 3 and 4 are dedicated to explaining the data collection as well as the methodology and the different models. They are followed by the empirical analysis and the results that explain the outcomes of the mediations alongside several empirical concerns. Ultimately, the paper will follow with a chapter dedicated to the conclusion and recommendations for further research.

2 Literature Review

The following chapter consists of a review of relevant literature for this thesis. In addition, this chapter is separated into three subcategories. Section 2.1 consists of theoretical and empirical framework of protectionism in the form of tariffs. Following, Section 2.2 explains the consequences that tariffs have on inflation, while Section 2.3 presents the outcome of inflation and tariffs on interest rates. Lastly, the research question and hypothesis are presented on section 2.4, and are raised organically from the gaps in the reviews.

2.1 Tariffs

Protectionism is defined as a policy involving the restriction of international trade, with the aim of preventing unemployment or capital losses in domestic industries threatened by imports (Hashimzade et al, 2017). Protectionism can take many forms. By instigating import quotas, a country can limit the number of foreign imports it receives. By enforcing subsidies, offering financial support to domestic industries, a country can increase the demand for domestic products. The most common and straightforward way to protect the domestic economy according to protectionism is tariffs. Tariffs, the main interest of this research, are taxes imposed by a government on imported and sometimes exported goods and services. Optimal market theory is the idea that a large country can improve its welfare by imposing moderate tariffs, even in the case of potential retaliatory tariffs from another country (Johnson, 1953). What arises when one country imposes a tariff, more often than not, is a retaliation. Additional research showed that tariffs pursued for revenue or lobbying reasons can sometimes yield net welfare gains, even in smaller economies and after anticipation of retaliation (Bhagwati & Srinivasan, 1976).

Regardless, during the last decades many countries have increased international cooperation and lower tariff rates. As a result, many countries, especially after the end of the Second World War and the fall of the Soviet Union, have increased their trade and

interconnectedness. After decades of supporting free trade, in 2018, the United States ignited a trade conflict that drags on until today. Economists expected that the election of President Joe Biden would revoke this practice. However, the inflation reduction act (Noll et al., 2024), and Biden's comments[1] made the rest of the world realize that he would largely adhere to the path of his predecessor. Modern economists largely agree that trade wars might offer some short-term benefits, but for long-term prosperity free trade is preferred. A useful comparison can be found in game theory (v. Neumann, 1928). If country A imposes tariffs on country B, country A can receive the expected benefits. On the contrary, if country B retaliates, both countries will receive a lower benefit from tariff implementation. Consequently, free trade is beneficial to both countries with minimal setbacks.

The results of the US trade wars with the rest of the world are highly debated. What is less divisive is the fact that the largest economy in the world has shifted its view on tariffs. Recent polling showed that in March 2025, 78% of Republican voters showed support for a flat 10% tariff in China (Lotz, 2025). The same voters expressed overwhelming support for imposing a 25% tariff on US military and trade allies as well, with 61% and 57% approval of tariffs in the European Union and Canada respectively. This indiscriminate tariff policy differs drastically from the idea of the optimal tariff theory. The "Liberation Day" tariff announcement of a universal 10% tariff as a basis for imports in the US is fundamentally different from the optimal tariff theory proposed by Robert Torrens and formalized by Johnson (The White House, 2025). This flat tariff is also aimed at tariffs with which the US has a trade surplus. Protectionism, and tariffs in particular, have kept the world in caution with talks about an all-out trade war being eminent. Other major economies have not sat idle with the European Union (EU) and China on talks about counter measures. The EU has stated that they are ready to answer both with diplomacy and negotiation, while also not excluding protectionist policies with tariffs and trade

[1] Joe Biden tweet (January 2021): "It's simple: When we spend taxpayer money, we should use it to buy products made in America and support jobs here at home. My Buy American Executive Order does just that.

barriers (European Commission, 2025). The Chinese government has also voiced its dissatisfaction with the announced tariffs and has vowed retaliation and counter measures (Ministry of Commerce of the People's Republic of China, 2025). The current trend towards protectionism raises the question of the actual effects tariffs had on the economy through time.

This research will try to examine how interest rates have been influenced by tariff policies. If a direct channel is observed, then a mediation analysis will be implemented to evaluate how the direct effect is passed through a mediator, in this case inflation, on the interest rate of the country imposing tariffs. The foundation of the research purpose is derived from the previous statement and can be summarized as follows: Did rising tariffs lead to higher (lower) interest rates only because they caused inflation (deflation)?

2.2 Inflation

Inflation is the rate at which the general level of prices for goods and services rise, causing the purchasing power of money to fall. Inflation is easily visible by consumers since it raises the prices of the products they use in their everyday life. Tariffs have a direct effect on prices for imported goods as when a country imposes tariffs, imported goods become more expensive. A question that arises from this statement is by how much. Some studies have shown that tariffs have historically increased border prices by a small, but significant, margin, however they have not always led to a comparable rise in consumer prices (Cavallo et al., 2021). A small increase in tariffs can often be absorbed by the importer, who may choose to cover the additional cost to avoid a drop in demand for their imported products. On the other hand, research after the 2019 United States (US) – China trade wars presented a different view. In the wake of this increase in trade protection, the US experienced substantial increases in the prices of intermediate and final goods. Additionally, the US undergone dramatic changes to its supply-chain network, reductions in availability of imported varieties, and the complete pass-through of the tariffs into domestic prices of imported goods (Amiti, et al., 2019; Furceri et al., 2021; Alvarez &

Yilmazkuday, 2025). Therefore, the full incidence of the tariffs has fallen on domestic consumers and importers, and estimates imply a reduction in aggregate US real income of $1.4 billion per month by the end of 2018 according to metrics stated by Amiti et al. (2019).

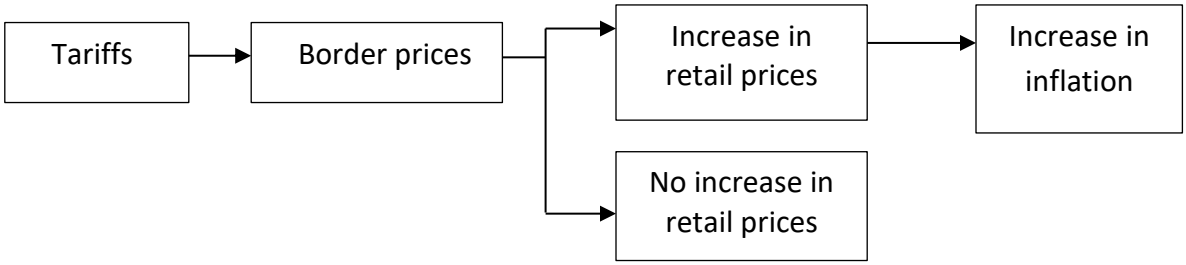
Many advanced economies, such as the US and the EU, have benefited from low tariffs since imports from low-wage countries are associated with strong downward pressure on inflation due to the cheap cost of labour and relaxed or non-existent working regulations, resulting in less expensive products (Anari & Kolari, 2016). On the contrary, high trade barriers are associated with higher prices and therefore higher inflation (Amiti, et al., 2019; Barattieri et al., 2021). Yet, tariffs seem to have different effects on inflation depending on the size and cycle of the economy. The effect of high tariffs on inflation is stronger during economic expansions, than in recessions (Furceri et al., 2021). The cycle of the economy is crucial to understanding the effects high tariffs may have on the economy. In good economic conditions, when purchasing power is high and the economy is close to overheating, tariffs have more severe consequences for output and inflation (Furceri et al., 2021). Additionally, tariffs do not only have a straightforward effect on inflation. They can trigger complex feedback loops which can have delayed impacts on critical economic indicators, including inflation (Pal, 2025).

Another important consideration about tariff induced inflation is the sector on which tariffs are imposed. Evidence from the steel industry finds that import tariff pass-through is complete for steel products, indicating an increase in prices beyond the borders (Ahmad & Ahmad, 2024). In other sectors, the effect is more mixed. While evidence from more research shows that the prices at the border increase even when the exporting country artificially lowers the value of its currency, whereas the pass-through to retail prices is mixed (Cavallo et al., 2021). This inconsistency in the way tariffs are incorporated in retail prices highlights sectoral differences making the effect on inflation more debated. This sectorial divergence is further examined and explained in a different exogenous shock.

After the COVID-19 pandemic, various sectors experienced price adjustments in different ways. Final and intermediate goods experience higher increases in prices, whereas services were far less affected, enhancing the idea of sectorial differences. (Ferrante et al., 2023).

A simple graph is included to visualize the effect of tariffs on inflation. Figure 2.2.1 illustrates the direction of the effect tariffs can have on inflation.

Figure 2.2.1 Visual representation of the effect tariffs have on inflation



Source: Own elaboration

The visual representation in Figure 2.2.1 captures the conditional pathway through which tariffs lead to higher inflation. Naturally it begins with tariff imposition which without doubt leads to higher border prices for goods (Cavallo et al., 2021). From that point on, the diagram splits in two different directions, either to higher retail prices for consumers or to tariffs falling in large part on firms that absorb the cost. It is important to point out the potential divergence of Consumer Price Index (CPI) and Producer Price Index (PPI). In the case of tariffs pass-through to consumer the CPI increases, whereas when the effect of tariffs falls on the producer/importer PPI is affected. This explains how tariffs affect different segments of the economy and mimic real-world variability in tariff pass-through, where some importers absorb the costs to maintain demand, while others pass the full burden onto consumers (Amiti et al., 2019; Furceri et al., 2021). Additionally, the economic context is crucial to evaluate the impact of tariffs on prices. A country that is a major importer will be affected significantly more than a country that is mainly self-

sufficient (European Central Bank, 2019). Overall, the diagram simplifies a complex and conditional process and, in the meantime, reflects current literature's understanding of tariff-induced inflation.

Besides the main idea that is presented in Figure 2.2.1 some economists challenge the conventional view. Historical evidence from the US challenges the norm as decades with high levels of tariffs were followed by decline in the cost of living, while free trade periods did not consistently lower prices (Batra, 2001). A theoretical explanation can be attributed to the benefits of an advanced and competitive market economy. Batra (2001) creates a model which suggests that the demand is redirected from foreign to domestic goods. This increased demand can in turn lead to productivity gains and lower prices. In this model, deflationary forces outweigh the increase in the prices of imports leading to an overall negative effect on inflation (Batra, 2001). The only setback of this research is the emphasis on the historical eras in which the US was not the largest importer of goods in the world. Thus, it may be outdated in the case where the US before Covid had imports just shy of 3 trillion US dollars (iLAB, 2022)

2.3 Interest rates

Interest rates have many forms, the main one used for this study is the nominal interest rate that is the stated or posted rate set by a central bank, used to influence borrowing costs, credit conditions, and ultimately economic activity. Interest rates are not the only way that the central banks can intervene in the market with open market operations, reserve requirements, and overnight repurchase agreements in the central banks quiver (Federal Reserve System, 2021). Most central banks' inflation target in the long run is around 2% as measured by the annual change in the price index for personal consumption expenditures (Federal Reserve System, 2021). Naturally, in cases where inflation is on the rise or in decline policy makers can intervein. In the European Union, after the European debt crisis and the deflationary outcome, the European Central Bank (ECB) intervened with the implementation of unconventional monetary policy that included quantitative

easing[2] and forward guidance[3]. On the other hand, higher inflation is targeted by higher interest rates.

The outcome is different when it comes to tariffs. Originally, an important question arises: Are tariffs directly considered in central banks interest rate decisions or is only the tariff related effect on inflation that matters? There is evidence from Barattieri et al. (2018) who find that protectionism acts as a supply shock by decreasing output and increasing inflation in the short run. They also find that protectionism leads to higher inflation which, in turn, prompts central banks to respond with a contractionary impulse (Barattieri et al., 2021). Further research shows that central banks are confronted with two immediate tariff-related risks: i) First, tariffs exert inflationary pressure by directly raising the cost of imported goods, affecting both final consumer products and intermediate inputs used by domestic producers; ii) Second, by distorting consumption and production decisions, tariffs generate efficiency losses that lower the economy's potential output. Those two outcomes combined lead to a supply shock that leads to slower economic growth alongside rising inflation (Werning et al., 2025). This dual effect is what makes monetary responses uncertain, as high inflation is targeted by higher interest rates, while lesser efficiency and productivity with lower interest rates (Federal Reserve System, 2021).

On the other side, several economists argue that contractionary policy in the form of higher interest rates is not the right answer to tariffs (Bergin & Corsetti, 2023). The rationale behind this idea is that even though tariffs can create inflationary pressure, demand may fall due to lower trade and thus the inflationary pressure may be weaker than expected. In that environment firms would prefer to adjust prices downward in response to declining demand and output. Furthermore, tariffs can create unfavourable consequences on real income, leading to lower aggregate income and investment,

[2] Quantitative easing refers to the practice of the central bank purchasing predetermined amounts of government bonds or other financial assets in order to stimulate economic activity (Joyce et al., 2012)

[3] Forward guidance is a tool that central banks use to tell the public about the likely future course of monetary policy (The Federal Reserve System, n.d.)

pushing the economy into a recession (Barattieri et al., 2021). As a direct result central banks may lower interest rates to make borrowing cheaper, as to encourage spending and investment, which can help stimulate the economy.

An important consideration in policymaking is the significant time lag before its effects are felt and decisions are taken. In the case of trade wars, since multiple tariffs announcements happen almost one after another, the incorporation of information and policy decision making may adjust with delays (Hakamada & Walsh, 2024). Central banks operate under an environment of uncertainty and policymakers do not operate under a perfect forecasting model. Gnabo and Moccero (2015) explain that this uncertainty is partially created because economic data is not available. The same can be said about tariffs. Policy makers are unaware of every idea of their government; therefore, they might need both, time to evaluate the data they have, and time for their decisions to have a real effect on the economy, making it more challenging to determine the optimal results. This idea is also supported by Svensson (1999) who argues that when policy makers are uncertain, they should be more cautious in their decision making. In that way, even if their response to tariffs is overall negative, the effect will be partially mitigated by their measured response.

2.4 Research gap and hypothesis

Building on the literature, it can be concluded that there is a relationship between tariffs and interest rates that passes through inflation, with the magnitude still debated. One could argue that for the country that initiates tariffs, interest rate should increase to account for the inflationary pressures created by the trade policies. Similarly, one might expect that the same might happen for the countries that answer with retaliatory tariffs. Subsequently, the impact of tariffs in an open economy in not necessarily clear.

In times of trade wars, tariff induced inflation is discussed in central banks worldwide. The question that arises is whether this is the norm, or if during stable times central banks are

neutral to trade policies. The direct effect is the central focus of this thesis. Establishing a direct effect is a prerequisite for conducting mediation analysis. How this direct effect is mediated, if it really is mediated, is another key objective of this thesis. The two forms of mediation according to Baron & Kenny (1986) are partial and complete. In the first scenario, tariffs retain a part of their explanatory value directly. In a complete mediation tariffs influence interest rates solely through their effect on inflation, implying that the relationship exists only due to changes in inflation.

As a result, the hypotheses can be summarized as follows:

1. Moderate tariffs from one country led to changes in the nominal interest rate of the same country, and this effect is mediated through inflation.

2. Moderate tariffs have a direct impact on the nominal interest rates of the same country regardless of their indirect effect on inflation.

3 Data

This section aims to explain the data utilized employed for this thesis, the selection process, and the rationale behind choosing it. To start with, it is important to point out the difficulties and the considerations that should be noted in regard to the data acquired. Most importantly, data availability on tariff rates bellow the year mark were not accessible through online databases and the LSEG platform. Thus, the information used is derived from the end-of-year tariff rate data of the selected countries, afterwards being linearly interpolated to complete the missing values. Additionally, missing data in the control variables is treaded the same way, as can be seen in the following tables.

For the USA, the nominal interest rate used as dependent variable is the effective Federal Funds Reserve rate. This rate is utilized to capture monetary policy implementation of the

central bank, as it is widely used to direct the census of the economy at a given time (Federal Reserve System, 2021). Additionally, the control variables introduced in the literature review are used for all three stages of the mediation analysis. Furthermore, the collection of the independent variables, alongside the control variables, has been made from the United States National Bureau of Statistics Agencies, such as the U.S. Treasury, United States Census Bureau, and the Federal Reserve Bank of St. Louis. The only exception comes in the form of monthly observations for GDP that originates from the S&P Global database. A graph of the three variables of interest, with average yearly observation from 2007 till 2022, can be found in Appendix A.

The Eurozone requires more consideration, as additional countries have adopted the euro over time. Since the start of the period of interest (2007-2022), the following seven countries also joined the eurozone, each on January 1 of their respective year: Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009), Estonia (2011), Latvia (2014), and Lithuania (2015). Thus, the information is adjusted using harmonized data that includes all 20 current eurozone members across the time series, even before some of them used the euro. This is done to simplify the collection process, since tariffs are implemented on a eurozone level and not on a currency level, therefore the effect of tariffs would not be significantly affected. The collection is done through the Eurostat's and ECB's databases (Eurostat, n.d.; ECB, n.d.) uses monthly data starting from January 2008 due to limitations on the financial account observations. Additionally, due to limited accessibility to the inward FDI of all the aforementioned countries, especially before their accession into the European Union and the Eurozone, the financial account is used as a broader proxy. While not directly equivalent, the financial account includes FDI as a subcomponent and reflects overall the external capital engagement of the block. This substitution is noted as a limitation and considered in the robustness checks.

For Japan, data collection is relatively smooth and straightforward. All variables, except tariffs, are presented monthly, therefore there is no need for any additional analysis or

interpolation. All data are collected either from the Bank of Japan or e-Stat, the national online bureau of statistics for the country (Bank of Japan, n.d.; e-Stat, n.d.).

The case of China presents a range of complex issues and methodological considerations. Foremost among these, is the credibility of official statistical reporting, chiefly concerning key macroeconomic indicators such as Gross Domestic Product (GDP) (Chen et al., 2021). Due to established concerns over data transparency and potential political influence during the reporting process, many analysts view the data published by the National Bureau of Statistics of China with suspicion. As a consequence, alternative data sources, such as the World Bank and Federal Reserve Bank of St. Louis have been utilized for these empirical analyses to enhance reliability. Nevertheless, data limitations persist, especially in terms of time-based granularity. The limitation in data availability can be seen in the time frequency of the data as well. Most variables are available only at an annual frequency, requiring interpolation techniques to approximate higher-frequency trends. The drawback of this method is that it introduces potential distortions and increases the risk of misinterpretation, especially for variables that do not have a clear linear progression. Additionally, imports are employed as control variable replacing FDI to capture China's exposure due to data limitations. As such, the volume of imports serves as a proxy for international economic exposure, especially in capturing the intensity of China's trade-based links with the rest of the world. This approach aligns with prior empirical studies, demonstrating that imports have the ability to influence domestic economic variables, and thus serve as a proxy for foreign exposure, which is also the aim for FDI (Hong & Pyun, 2024). Therefore, and with all the above taken into consideration, the findings presented for China should be interpreted with caution, recognizing both the limitations of the data and the methodological issues inherent in their use.

The expectation for the control variables is similar for all the selected countries and is outlined below and in the literature review. Firstly, it is important to understand the change of the independent variable depending on the specific path of the mediation analysis. Thus, for step one and three, the independent variable is the interest rate of the

country of interest, while for step two the mediator assumes the role of the independent variable.

3.1 Step one. Tariffs on interest rates.

For the first step, a lag of inflation by one period is used to account for the time needed to adjust the nominal interest rate and the effect of inflation in monetary policy (Hakamada & Walsh, 2024). Additionally, GDP per capita growth is used, under the assumption that increased available income towards a household leads to increase consumption, and eventually overheats the economy, leading to state intervention. Furthermore, the relative effect of Foreign Direct Investment (FDI) or imports, compared to the total GDP of the country is used to account for the effect of the tariffs in different economies. More precisely, higher import-based countries are expected to feel the effects of tariffs on interest rates higher than countries that are either export-based, have current account surpluses, or/and lower FDI (European Central Bank, 2019). Nonetheless, FDI by itself as an explanatory variable does not automatically lead to higher interest rates. Instead, it implies that if tariffs rise their effect would be more visible on the interest of the country, than in other cases, making the specific effect of the variable more questionable. Moreover, the debt to GDP ratio is also used to control the different levels of public debt between countries and the effect they may have on the economy. Higher debt levels can lead to increased interest rates due to default risk, especially in emerging markets (Mendoza & Ostry, 2006). Additionally, higher public debt can lead to a decrease in interest, sensitive demand leading to further increases in the public debt ratio. This indicates a feedback loop, where higher debt levels can lead to higher interest rates, aggravating debt accumulation (Jacobs et al., 2020). On the other hand, developed countries that have high debt, also have notoriously low interest rates, as can be seen in the case of Japan (Tanaka, 2021). Thus, the overall effect remains ambiguous. Lastly, the unemployment rate is one of the main focuses of monetary policy. Higher levels of unemployment can result in negative economic growth, leading to expansionary monetary policy where the aim is to boost economic activity, create jobs, and reduce

unemployment (Federal Reserve System, 2021). The ideas presented above can be summarized in the following table:

Table 3.1.1 Expected relationship between dependent and control variables.

Variable		Interest rate
Control Variables	Lagged Inflation	+
	GDP per Capita Growth	+
	FDI/GDP	+/-
	Debt/GDP	+/-
	Unemployment	-

Source: Own elaboration

3.2 Step two. Tariffs on inflation.

In this step, the mediator (inflation) takes the role of the dependent variable to evaluate the effect of the independent variable (tariff) on the former and then lead to a conclusion about the validity of the mediator. Two additional control variables are incorporated in this model to account for consumption power of the country and the effect of monetary policy from the central bank. Those are the interest rate of the previous period and the GDP per capita. It is known that adjustments in the nominal interest rates are made in order to account for cases of inflation or deflation. It is also widely understood that inflation leads to contractionary monetary policy, which is then expected to have a negative effect on inflation, leading to its eventual fall. Additionally, GDP per capita is used as a control variable to account for the level of economic development and income per person. While higher income may increase inflation via greater demand, this effect is context dependent. In high-capacity or productivity-led economies, the inflationary impact may be muted or even negative. Therefore, the expected sign of the coefficient is ambiguous and likely varies across countries.

Appendix A contains additional information about the data. For every country a graph that includes the time progression of the three key variables is created. Furthermore, a correlation table can be found as well since high correlation of variables is a potential disturbance in the mediation. Lastly a table that contains the descriptive statistics is also available.

3.3 Data considerations

As can be seen in table 3.1.1 the variables show, at least in theory, a high degree of variability and heterogeneity between them. This is presumed, as the sample countries include different types of economies when it comes to size and level of dependence on imports. As seen in table 3.3.1 the missing values for inflation and interest rate, which are the mediator and the dependent variable, are non-existent whereas there is a clear issue with the data for the independent variable, that is tariffs. For the control variables it should be noted that most missing values are observed in the case of one country, China, for which data regarding Unemployment, Population, GDP and debt, were not accessible monthly, thus inflating the overall percentage of missing variables. For the purposes of this thesis, all missing variables are interpolated for missing values in order to complete the sample. From this point onward, all reported variables refer to the interpolated values, unless otherwise stated. As for the tariffs, during the data analysis both interpolated and uninterpolated variables were used. The results, even though not identical, were relatively close, both in the coefficients and in statistical significance. Thus, the variable for tariff for this empirical analysis is also interpolated, unless stated otherwise.

3.3.1 Missing Values Description

Variable	Missing	Total	Percentage missing
Unemployment	176	756	23.3
Population	341	756	45.1
Trade - links	128	756	16.9
GDP	296	756	39.2
Inflation	0	756	0
Interest Rate	0	756	0
Debt	296	756	39.2
Tariff	693	756	91.6

Source: Own elaboration.

4 Method

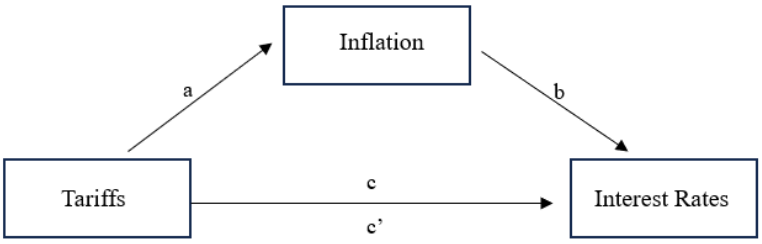
The research design employed for this thesis is outlined in this segment. The methodological approach predominantly involves the use of a dynamic model incorporating lagged variables of the mediator and dependent variable to account for temporal dynamics. In this framework, inflation serves as the mediator, while tariff and nominal interest rate function as the independent and dependent variable respectively. The mediation analysis follows a three-step process to evaluate if the conditions for the mediation are met. The statistical significance of the indirect effect is evaluated primarily with the bootstrap method for robustness, while a Sobel test is used as well when conditions are met.

4.1 Introduction of the steps and conditions

The mediation analysis is a common technique primarily used in social sciences, such as psychology or sociology, to study unobserved mechanisms between variables that are otherwise overlooked. Rather than a direct causal relationship between the independent variable and the dependent variable, a mediation model proposes that the predictor influences the mediator variable, which in turn influences the dependent variable (Baron & Kenny, 1986). In summary, path analysis, commonly known as mediation analysis, allows to study if the independent variable directly affects the dependent variable, as OLS

regressions do. Furthermore, it additionally allows us to examine if there is an indirect relationship between them which is made visible by the mediator. Hence, three steps are required to test the effect of the mediation/path analysis. First, the dependent variable is regressed on the independent one, to determine whether the independent variable is a significant predictor of the dependent variable (path c). If that is the case, then the mediator is regressed on the independent variable to test whether the independent variable is a significant predictor of the mediator (path a). Lastly, the dependent variable is regressed on both the mediator (path b) and independent variable (path c'). This step assesses whether the mediator is a significant predictor of the dependent variable, and evaluates the effect that the mediation has on the coefficient of the independent variable.

Figure 4.1: simple mediation analysis



Source: own elaboration using Baron & Kenny(1986)

The equations below follow the underling theory portrayed in Figure 4.1 and show the principal relationship in a simple mediation analysis:

(4.1) c: $Interest\ rate = \beta_1 + c\ Tariffs + \varepsilon_1$

(4.2) a: $Inflation = \beta_2 + a\ Tariffs + \varepsilon_2$

(4.3) c': $Interest\ Rate = \beta_3 + b\ Inflation + c'\ Tatiffs + \varepsilon_3$

Where Interest rate is the outcome variable, while inflation and tariffs are the mediator and the predictor variable respectively. For the mediation to be correct, there must be (i) substantial evidence that there is a significant linear relationship between the independent and the dependent variable, as seen by equation c, (ii) Indications that there is significant evidence of a linear relationship between the mediator (M) and the

independent variable (X), measured by α in the path diagram, (iii) there is a significant relationship between the mediator and the dependent variable, measured by b in equation (4.3) while also the coefficient of the independent variable for path c' becomes significantly smaller than path c from the equation (4.1) (Baron & Kenny, 1986). If relationship (iii) is not adhered to, there are two possible outcomes? Firstly, there is the phenomenon of suppression, which can occur in various third-variable effects, including mediation. This happens when the mediator actually suppresses the effect of the independent variable X , thereby increasing the direct effect when the mediator is included (MacKinnon & Lamp, 2021). Secondly, this result could simply be the outcome of modeling issues and data restrictions. Hence, during the layout of the results, careful considerations will be added to highlight the limitations and the considerations of the specific target country.

After the input of the control variables discussed above, the equations result in their final format, which is also used to derive the empirical results.

(4.4) c: $Interest\ Rate_t = \beta_0 + \ cTariff_t + \ \beta_1 infaltion_{t-1} + \beta_2 \frac{FDI_t}{GDP_t} + \beta_3 \frac{Debt_t}{GDP_t} + \beta_4 GDP\ per\ Captia\ Growth_t + \beta_5 Umemployment_{\ t}$

(4.5) a: $Inflation_t = \beta_0 + \ aTariff_t + \beta_1 infaltion_{t-1} + \beta_2 Interest\ Rate_{t-1} + \beta_3 \frac{Debt_t}{GDP_t} + \beta_4 GDP\ per\ Captia_t + \beta_5 GDP\ per\ Captia\ Growth_t + \beta_6 Umemployment_{\ t}$

(4.6) c': $Interest\ Rate_t = \beta_0 + \ cTariff_t + \ \beta_1 infaltion_t + \beta_2 \frac{FDI_t}{GDP_t} + \beta_3 \frac{Debt_t}{GDP_t} + \beta_4 GDP\ per\ Captia\ Growth_t + \beta_5 Umemployment_{\ t}$

4.2 Diagnostic test and mediation tests

This paragraph will delve into the statistical treatment and diagnostics made for the data analysis. This thesis uses a traditional Sobel test to determine if the relationship between tariffs and nominal interest rates has been significantly affected after the inclusion of the

mediator in the model, in order to do so, statistical testing will be required. In this case, if we denote path **a** of the mediation analysis on the coefficient, which measures the effect of tariffs on inflation, and path **b**, which represents the effect of inflation over the target on nominal interest rates, a Sobel test can be implemented (MacKinnon et al., 2004; Sobel, 1982; Beasley, 2012). The Sobel test is calculated as follows:

$$Z = \frac{a - b}{\sqrt{a^2 * SE_b + (b^2 * SE_a)}}$$

In addition, if the Sobel test shows significant results, the moderation effect is considered significant.

To arrive at the point of the mediation where the product of the coefficient is derived from path two and three, diagnostic checks will be performed to ensure that some of the assumptions of ordinary least squares (OLS) regression are satisfied. Multicollinearity will be examined using the Variance Inflation Factor (VIF)[4]. A VIF of 1.8 tells us that the variance of that predictor variable (i.e. its standard error) is 80% greater than would be the case with no collinearity effect: VIFs of 2.5 or greater are generally considered indicative of considerable collinearity suggesting that there will be difficulty in separating out the independent contribution of variables with such large VIFs. Overall, values below 5 indicate a slightly acceptable level of shared variance among predictors, while values below two or three are considered perfectly acceptable. (Hair et al., 2010; Adeboye et al., 2014; Alin, 2010). In order to address this critical issue, a Principal Component Analysis (PCA) is implemented. PCA is a technique used to reduce the dimensionality of a dataset while preserving as much variability as possible. It transforms the original correlated variables into a smaller set of uncorrelated variables called principal components. Each

[4] The variance inflation factor (VIF) is used as an index for multicollinearity as it measures increased variance due to multicollinearity and it is measured as VIF=1/(1-R_i^2) (Hancock & Mueller, 2013; Powell & Schafer, 2001).

component is a linear combination of the input variables and captures a proportion of the total variance of the data. Therefore, by focusing on the first few components, PCA simplifies complex correlated data and removes redundancy, without significant loss of information (Abdi & Williams, 2010).

Normality of residuals will be assessed through histograms, Q–Q plots and Shapiro Ratio, though this assumption is less critical when employing bootstrapping measures, which do not rely on the normality of the sampling distribution of the indirect effect (Preacher & Hayes, 2004). On the other hand, when using traditional approaches, such as the Sobel test, to evaluate the significance of the indirect effect that the mediator has, normality of the sampling distribution of the product of coefficients (from paths **a** and **b**) is assumed. However, research has shown that the distribution of the product of two normally distributed coefficients is often skewed, especially in small to moderate samples, violating the assumption of normality (MacKinnon et al., 2004). Thus, to complete the mediation, if the assumption of normality is questioned, and in order to avoid the change of the variables of interest by introducing logarithms and excluding influential variables, Bootstrapping is preferred. Bootstrapping does not require the assumption of normality, instead it generates an empirical sampling distribution of the indirect effect by repeatedly resampling the data with replacements (Preacher & Hayes, 2004). All the results from the diagnostics can be found in Appendix B.

For better, and more accurate representation of the results, especially due to aforementioned data limitations, a nonparametric bootstrapping procedure is also employed. Bootstrapping involves repeatedly resampling the dataset with replacements (in this case, 5000 times) to create an empirical distribution of the indirect effect (product of path coefficients **a** and **b**). This method does not rely on the assumption of normality of residuals or homoscedasticity, making it particularly suitable when these assumptions are violated. The benefit of the bootstrapped confidence intervals is that it provides an estimate of the accuracy of the indirect effect, and if the interval does not include zero,

the mediation effect is considered statistically significant. Thus, this approach offers a robust alternative to traditional methods such as the Sobel test, especially in samples where normality assumptions are questionable (Preacher & Hayes, 2004). Consequently, this technique samples from the given dataset to estimate a parameter when it would otherwise be impossible or impractical to do so. In this way, the dataset is treated as the population, and each random sample aims to replicate a potential score within the true population, giving a more comprehensive approach and solutions when dealing with smaller data.

All countries employ a consistent methodological approach and, based on the literature review, adhere to similar theoretical frameworks. Nonetheless, some minor adjustments are made in order to complete the mediation according to the restrictions of both Sobel test and Bootstrapping. The main assumption in both cases is that of no multicollinearity. In the literature review there have been comments on the effect of past observations of inflation on the inflation of the next period. Even if the theoretical background behind this assumption is sound, it tends to come in contrast with the assumption of multicollinearity. During VIF tests, it was visible for all countries that the multicollinearity and correlation between those two variables was far above the acceptable limit of 3. This is expected, since they are lags of the same variable that share similar characteristics. The usual treatment in that case is the aforementioned PCA analysis. But if that treatment is employed, the variable of the mediator is replaced by a component that has the attributes of both the lagged value and the current value, changing the target of this thesis and losing its theoretical background for the mediation in the process. Thus, to adjust for the high multicollinearity, the inflation of the previous period is not used as a control variable for the last path of the mediation.

5 Results

This chapter presents the empirical analysis and its corresponding results, organized on a country-by-country basis. Each section offers a detailed, country-specific examination,

following a logical sequence through all mediation pathways and checks. The results are subsequently accompanied by graphic illustrations that enhance the interpretation of the results. Lastly, each country's analysis concludes with a comprehensive discussion, addressing the robustness and statistical significance of the findings and ensuring a thorough understanding of the results' reliability and practical importance.

5.1 USA

To start with, a base model is implemented for every step and altered when the assumptions of normality and, especially multicollinearity, are bridged. The initial model of this step regresses the tariff rate on the interest rate after controlling for several economic factors. Before continuing to the analysis of the model, the assumptions listed above should be tested to see whether the Sobel test, that evaluates the statistical significance of the mediation, can be made. Initially, multicollinearity is tested with the use of the Variance Inflation Factor (VIF) as it measures increased variance due to multicollinearity. Multicollinearity can distort the specific characteristics of the variables used making it hard to distinguish their unique effects. The results show that no variable presents significant effects of multicollinearity, and, in fact, all variables are below the threshold of 3, with the highest being the one of unemployment and the lag of inflation at 1,31. The complete results for the rest of the variables can be found in Appendix B. The assumption of normality is also important for the specific variables of interest, such as the mediator. If the mediator, the dependent, and the independent variable are not normally distributed, then the Sobel test might produce unreliable results. Potential variable configuration may provide a solution for this issue, while altering the interpretation of the result at the same time. These transformations aim to explore alternative specifications that might improve the model fit and satisfy the assumptions.

The squared and cubed forms of the variable are generated to capture potential non-linear relationships, where the effects of the independent variable may increase or decrease at varying rates. In addition, inversed transformations (1 divided by the square

and cube of the variable) were used to examine whether diminishing marginal impacts could explain the variance more effectively. It is important to note that if this configuration holds the assumption of normality, the hypothesis of linearity, which is crucial for the mediation, would be bridged, making the mediation analysis suboptimal for the calculation of the indirect effect. Additional transformations, both with the natural logarithm and the base-10 logarithm, are implemented where the variable allows it. For each transformation, histograms overlaid with a normal distribution curve are plotted to visually assess the degree to which each transformed variable approximated normality. Additionally, for the variable at its initial form, the Shapiro-Wilk test shows that none of the three variables satisfied the p-value >5%, indicating that the Sobel test cannot be implemented leading to the more robust choice of the Non-Parametric Bootstrapping test. This method involves repeatedly resampling the dataset with replacements and does not rely on assumptions of normality. All the potential variable transformations can be found in Appendix B[5].

[5] Tables B.1 and B.2 for normality. Table B.3 for multicollinearity.

Table 5.1 Results path C (Tariff on Interest Rate).

Variable	Model 1 Interest Rate
Tariff	0.123***
	(0.027)
$inflation_{t-1}$	0.141***
	(0.032)
GDP per Capita Growth	4.661
	(5.216)
FDI/GDP	-175.656***
	(67.103)
Debt/GDP	-5.180***
	(0.385)
Unemployment	-0.312***
	(0.030)
Constant	7.518***
	(0.467)
Observations	190
R-squared	0.642

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

The model in Table 5.1 acts as an initial check to evaluate whether tariffs have a significant effect on the interest rate after controlling for additional economic variables. As an opening observation, all estimated coefficients align with theoretical expectations ,as discussed in the data section, in terms of direction. Inflation of the previous period, GDP per Capita growth, and the independent variable of interest (tariffs), exhibit a positive and statistically significant effect on the interest rate, in accordance with findings from the

existing literature. Additionally, FDI, Debt, and Unemployment exhibit a negative effect, as anticipated. It should be noted that all values are statistically significant with a p-value < 0.01, besides GDP per Capita growth. The model explains approximately 64.2% of the variation in the dependent variable, indicating a relatively strong fit and suggesting that the included macroeconomic variables meaningfully control for changes in tariff intensity.

After evaluating the effect of tariffs on interest rates, the nest step is the evaluation of the effect that tariffs have on the mediator, inflation. For this step, the control variables differ slightly, in order to account for a plurality of potential reasons for changes in the values of inflation. During the input of additional control variables, the Variance Inflation Factor (VIF) test showed increased values for a plethora of control variables. The VIF measures how much the variance of a regression coefficient is inflated due to multicollinearity with other independent variables (Hancock & Mueller, 2013; Powell & Schafer, 2001). According to the requirements of the mediation analysis, high multicollinearity between variables can lead to false results, and thus an adequate transformation is necessary. Using the Principal Components Analysis (PCA), multicollinearity is drastically reduced, reaching acceptable levels for the mediation[6]. The PCA transforms a large set of correlated variables into a smaller set of uncorrelated variables, called principal components, and in the meantime retains as much of the original data's variation as possible (Abdi & Williams, 2010). In Table 5.2 the effects of each variable can be seen, including both before and after the variable transformation. It is evident that the results presented in the initial model were unusual. Primarily, the majority of the variables present statistical insignificance. More precisely, the tariff rate, unemployment, and the inflation rate of the previous period are all statistically insignificant and do not reflect an effect on inflation, even if they have high theoretical importance (Federal Reserve System, 2021). Additionally, model 2 suggests a very strong fit that might be attributed to specific values and not the overall model itself, due to the

[6] The results can be seen in Table B.3.

insignificance of a plethora of variables. Passing over to model 3, where multicollinearity is no longer an issue, more meaningful results are noted.

Table 5.2 Results path A (Tariff on Inflation) U.S.A.

Variable	Model 2 Inflation	Model 3 (PCA) Inflation
Tariff	-0.020 (0.017)	-0.198*** (0.041)
$Interest\ Rate_{t-1}$	0.937*** (0.026)	
$Inflation_{t-1}$	-0.012 (0.046)	
GDP per Capita Growth	11.523*** (3.131)	0.787 (8.526)
Debt/GDP	0.00003* (0.00002)	
GDP per Capita	-0.827 (0.711)	
Unemployment	0.019 (0.027)	
Econ PC 1		-1.010*** (0.062)
Econ PC 2		-0.391*** (0.073)
Constant	-0.690 (0.514)	2.833*** (0.140)
Observations Adjusted R^2	190 0.952	190 0.619

Standard Errors in parentheses

*Note: *** p<0.01, ** p<0.05, *p<0.1*

Source: Own Elaboration

Most notably, the tariff rate exhibits a statistically significant negative effect on inflation. Although the coefficient is relatively modest (−0.198), it implies that a 1% monthly increase in the tariff rate is associated with a 0.198 % point decrease in monthly inflation. This finding challenges the conventional belief that tariffs create inflationary pressures regardless of other factors (Amiti et al., 2019). On the contrary, the finding supports the idea that carefully designed tariffs may not be inflationary, challenging the narrative that even carefully designed tariffs create inflationary pressures (Batra, 2001). It should be noted that there might also be the possibility that the effect witnessed can be artificially created due to interpolation of the independent variable, thus making the creation of final statements difficult. Furthermore, Model 3 shows that both Principal Components (PC) are statistically significant with a negative coefficient. Since the Principal Components Analysis (PCA) is an unsupervised method of treating multicollinearity, the meaning of the coefficients is hard to interpret (Chan et al., 2022).

What is easier and more useful to interpret is the percentage of the variance that remained from the variables used. For the PCA, the selected economic variables include inflation, lagged by one period, interest rate, lagged by one period, GDP per capita, debt to GDP ratio, and unemployment rate. The first two principal components account for approximately 82.5% of the total variance, retaining a significant variance of the five included variables, with the first component alone explaining 48.4%. Subsequent components contribute progressively less, with diminishing returns beyond the third component[7]. Those findings, if correct, suggest that inflation acts as a suppression variable for the overall positive effect of tariffs on interest rate seen in model one. Nonetheless, regardless of the interpretation of the results, their statistical significance and the absence of multicollinearity allows the mediation to progress toward the final stage where both the mediator and the independent variable are regressed on the interest rate.

[7] Results can be seen in Table B.4.

The combination of paths **b**[8] and **c'**[9] estimates the joint effect of tariffs and inflation on the interest rate of the USA. To retrieve meaningful results, it is essential to assess whether multicollinearity is present among the explanatory variables. Multicollinearity can distort the coefficients of variables making the identification of their unique characteristics challenging. To address this, a Variance Inflation Factor (VIF) test is conducted since it can detect increase variance between variables due to multicollinearity, and it shows no significant presence of multicollinearity in the model[10]. Furthermore, the **c'** pathway differs to that of **c** mainly due to the lack of a lagged variable of inflation. As can be seen in Appendix B.2., the inclusion of inflation lagged by one period substantially increases multicollinearity, potentially violating key assumptions of the path analysis. This issue is particularly problematic given that only two variables, one being the mediator, are involved in this high multicollinearity. Applying a Principal Components Analysis (PCA) would effectively combine the effects of inflation across time into a single component, breaking the temporal and causal structure that is necessary for the mediation, making it unsuitable. This would happen since PCA transforms a large set of correlated variables into a smaller set of uncorrelated variables, called principal components, maintain as much of the variance as possible (Abdi & Williams, 2010). The most effective way to deal with this issue, in this case, is to drop the variable that witnesses high multicollinearity with the mediator and continue the analysis (Kyriazos & Poga, 2023; Han & Lee, 2025; Leeuwenberg et al., 2021).

[8] Path **b** estimates the effect inflation has on interest rate and is part of the indirect effect.
[9] Path **c'** estimates the effect of tariffs on interest rate controlling for inflation.
[10] Results can be seen in Table B.2.

Table 5.3 Results path C' (Tariff and Inflation on Interest Rate) U.S.A.

Variable	Model 4 Interest Rate
Tariff	0.125*** (0.027)
Inflation	0.138*** (0.032)
GDP per Capita Growth	3.697 (5.283)
FDI/GDP	-174.098* (68.349)
Debt/GDP	-5.356*** (0.385)
Unemployment	-0.318*** (0.030)
Constant	7.735*** (0.467)
Observations	190
Adjusted R-squared	0.6489

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

Since model 4 satisfies the key assumptions of the non-parametric bootstrapping test, which is no multicollinearity in order to have unbiases coefficients, its implementation is considered valid. Before presenting the final step, a thorough examination of the last model is warranted. To start with, the model yields an R-squared of 0.6489, indicating that approximately 64.89% of the variation in interest rates is explained by the included explanatory variables of the model. This result suggests a reasonably strong model fit with enough explanatory power. Additionally, most variables are statistically significant and

exhibit the expected signs, consistent with economic theory. However, GDP per Capita growth remains insignificant. This might be due to reverse causality where changes in the interest rate influence GDP per Capita growth rather than the other way around (European Central Bank, 2020). To continue the analysis, both tariffs and inflation are significant on a p-value of less than 1%. This indicates a partial mediation, since the independent variable retains part of the explanatory value and does not pass all of it to the mediator. Furthermore, both have positive coefficients, indicating that they are key drivers in monetary response by central banks. On the contrary, higher unemployment and levels of public debt are related with lower interest rate. Overall, the findings fit neatly with economic theory and underscore the complexity of monetary policy by a plethora of external factors.

The final step of the analysis is the conclusion of the Nonparametric Bootstrap procedure, the outcomes of which are presented below in Table 5.3.

Table 5.3 Results and Mediation Relationships U.S.A.

Effect	**Estimate**	**95% CI Lower**	**95% CI Upper**	**p-value**
ACME (Indirect)	-0.0273	-0.0433	-0.0129	< 0.01 ***
ADE (Direct)	0.1238	0.0451	0.2178	< 0.01 ***
Total Effect	0.0965	0.0205	0.1880	< 0.05 **
Proportion Mediated	-0.2825	-1.2346	-0.1031	< 0.05 **

*Note: *** p<0.01, ** p<0.05, * p<0.1*

Source own Estimation

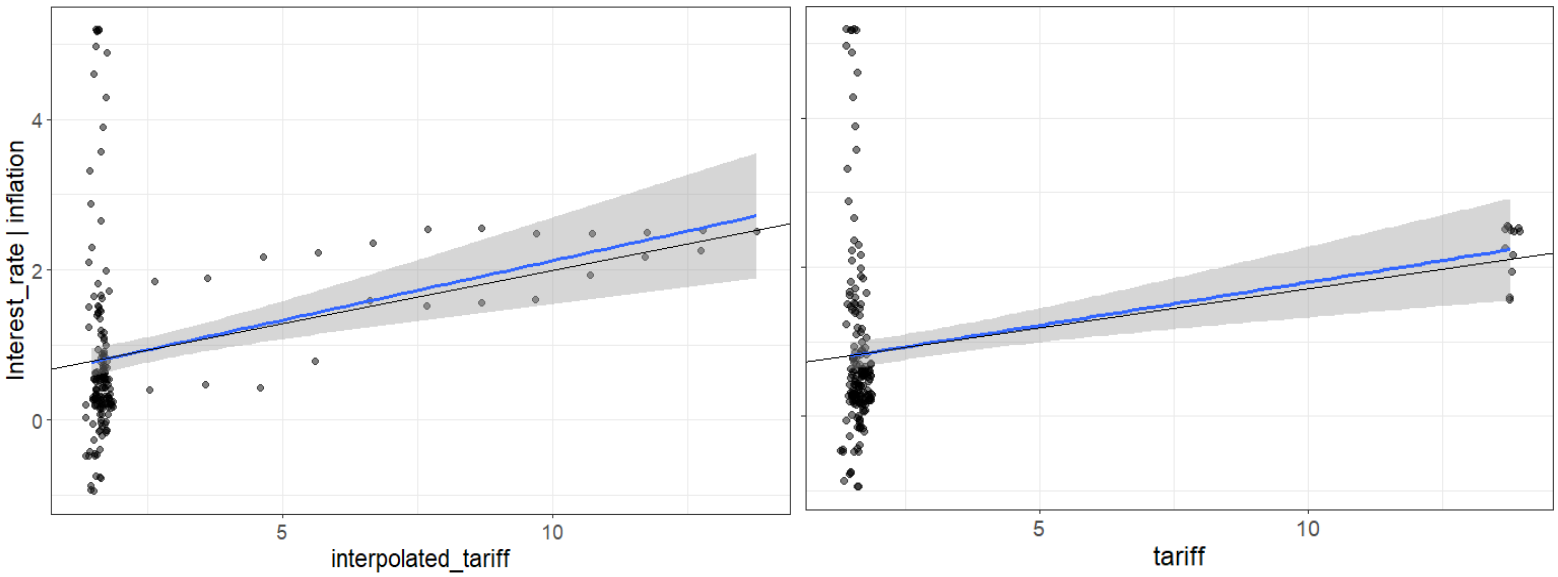
The process includes 5000 resamples of the data and creates values that help estimate static events such as the indirect effect. The results provide strong evidence of a statistically significant indirect relationship. More precisely, the Average Casual Mediation Effect (ACME) is estimated at -0.0273, with a 95% confidence interval ranging from -0.0433 to -0.0129 and a p-value of less than 1%, indicating a highly significant negative mediation effect. The confidence interval presents a range of plausible values, slightly higher and lower than the quoted value. Since zero is not included in the given

range, it can be said with 95% confidence that the indirect effect is real and significant, at least according to the restricted data.

The result suggests that inflation negatively mediates part of the relationship between tariffs and interest rates, meaning that an increase in tariffs might lead to a higher interest rate, but this effect is slightly lower due to the substitution effect of inflation. Nonetheless, the indirect effect does not imply that tariffs decrease inflation. It merely suggests that, if the data limitations and manipulation have not significantly altered the results, the attributes of the independent variable, calculated and planed tariffs, may not lead to inflationary pressures. This might explain the generally more favourable public attitude toward tariffs observed among U.S. citizens (Batra, 2001). In contrast, the Average Direct Effect (ADE) is positive and statistically significant, with a coefficient of 0.1238 and a 95% confidence interval between 0.0451 and 0.2178, indicating that tariffs also exert an upward influence on interest rates regardless of inflation. When both pathways are analysed together, the total effect remains positive and significant, but with a lower estimate of 0.0965. Notably, the proportion mediated is estimated at -0.2825, reinforcing the notion of a suppressor effect, where the indirect pathway through inflation partly counteracts the direct positive impact of tariffs on interest rates.

The overall finding of the mediation adds nuance to the relationship by showing that higher tariffs lead central banks to increase interest rates directly, while also having slightly deflationary attributes that lead to a more controlled and measured implementation of contractionary policy. The final interpretation should be approached with caution, as overly simplistic readings of results constrained by data limitations, risk overlooking the intertwined nature of economic channels. At the same time, it is essential to remain open to results that challenge conventional expectations as they may reveal important underlying dynamics. A final and useful visualization of the overall positive effect of tariffs and the substitutional effect can be seen in Figure 5.4:

Figure 5.4 Representation of the Mediation effect with and without interpolation, U.S.A.[11]



Source: Own estimation

Figure 5.4 provides a visual representation of the results of the mediation. The figure includes both the interpolated tariff, that is used up to that point (interpolated_tatiff), and the original yearly tariff values, plotted across the x-axis on the left and right figures respectively. The y-axis reflects the values of the dependent variable (interest rate). In both panels, the blue regression line illustrates the direct effect of tariffs on interest rate before the mediation, whereas the black line represents the total effect after considering the mediation through inflation. Additionally, the divergence between these two lines indicates the presence of a mediation effect. As can be seen from the graphs, the mediation effect maintains its substitutional attributes in both datasets, suggesting that the interpolation method did not distort the directional relationship of the variables. Moreover, the relatively small gap between the blue and black lines in both cases underscores either a limited indirect effect via inflation or a substantially stronger direct effect of tariffs on inflation. The graphs are in alignment with Table 5.3 and reinforce the

[11] While the two graphs illustrate the directional relationships suggested by the model coefficients, they do not account for control variables. This limitation arises because the mediate.plot function in R restricts the inclusion to only the three variables involved in the mediation analysis. As a result, the actual slopes of the full models may differ slightly.

notion that, while inflation acts as a partial mediator of the overall relationship, the dominant influence of tariffs on interest rates is passed mainly through the direct channel.

As illustrated in Figure 5.4, tariff values remain relatively low throughout the sample period, with most years hovering around 1.5%. However, this pattern changed in 2019 under the first presidency of Donald Trump. During a short time window, his presidency led to an overall trade-weighted average tariff of around 13.78% being applied across all products, while in most years before and after it was around 1.5% (World Bank, 2019). This event arouses suspicion over the effect that those outliers or influential values have on the model. The presence of outliers and influential cases can dramatically change the magnitude of regression coefficients and even alter the direction of coefficient signs (Choi, 2009). As a robustness check, the outliers are excluded from the data and the steps for the bootstrapping are evaluated again. The rationale for this exclusion is supported by prior literature that emphasizes the sensitivity of regression models to influential observations (Lee et al., 2022). Specifically, 23 monthly observations are omitted from the data due to the abrupt rise and subsequent fall in tariffs during this short time window. After those values are excluded, the steps to perform a mediation analysis are repeated, firstly to evaluate the direct effect of tariffs on the interest rate and then proceed to the mediation.

As in the previous steps, the effect of multicollinearity needs to be addressed. Multicollinearity makes it difficult to distinguish the unique effects of the predictor and the mediator since it inflates standard errors (Can et al., 2015; Tarka, 2018). If not addressed properly, the results of the Bootstrapping test might be misleading and difficult to interpret. The Variance Inflation Factor (VIF) is used again as an index since it can capture increased variance due to multicollinearity (Hancock & Mueller, 2013; Powell & Schafer, 2001). VIF produces results from 1 and above, with a lower variable indicating less multicollinearity. Model 1, which regresses the tariff rate on interest rate, is repeated

after confirming that all variables have a VIF less than 3[12]. The results of the Ordinary Least Squares (OLS) can be seen in table 5.5, alongside the result from the completed dataset established before the robustness check.

Table 5.5 Results path C as Robustness check (Tariff on Interest Rate) U.S.A.

Variable	Model 1 Robustness check Interest Rate	Model 1 Interest Rate
Tariff	0.974 (0.655)	0.123*** (0.027)
$inflation_{t-1}$	0.152*** (0.034)	0.141*** (0.032)
GDP per Capita Growth	12.112 (9.823)	4.661 (5.216)
FDI/GDP	-169.298*** (61.213)	-175.656*** (67.103)
Debt/GDP	-6.254*** (0.385)	-5.180*** (0.385)
Unemployment	-0.423*** (0.032)	-0.312*** (0.030)
Constant	7.741*** (1.206)	7.518*** (0.467)
Observations	168	190
R-squared	0.723	0.642

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

Overall, the results in both models are largely consistent, particularly for the control variables, with only minor differences in the estimated coefficients. However, the main

[12] Full results on Appendix B table B.13

finding is that the tariff rate is not a significant predictor of interest rate, casting doubt on the validity of the initial results. The robustness check suggests that small changes in tariff regimes are unlikely to significantly shape U.S. policy on interest rates. Those results are in line with recent post-Trump empirical evidence, suggesting that moderate tariff shocks have minimal and, mainly, no meaningful impact on U.S. interest rates, supporting the findings of the robustness check (Bergin & Corsetti 2023). Additional studies suggest that a high degree of tariff pass-through at border prices may correspond to a very low degree of pass-through at consumer prices. This may be because the bulk of tariff costs are absorbed at the border and do not translate into higher consumer prices (Cavallo et al., 2021). Therefore, a change in the existing monetary policy may be deemed unnecessary by the Central Bank.

The robustness check reveals that the initially observed effect does not hold under the alternative hypothesis and model specifications. After excluding the influential variables of the last part of President's Donald Trump term in the White House, the effect of tariffs on inflation becomes insignificant, casting doubt on the validity of the original results. To conclude, recent literature on mediation has determined that the indirect effect passing through the mediator (inflation) can exist without a direct effect of the independent variable (tariff) on the dependent (interest rate)(Hayes, 2009; Zhao et al., 2010). In contrast, this study follows a different, more conservative, approach, mainly because of an alternative stated purpose. Since the main objective indicated in the literature review is to determine whether and how a direct effect is mediated, the analysis will end when the direct effect is not significant.

5.2 Japan

Japan has always had a special place in economists' research. Its economy has been characterized as unique many times due to extremely low inflation and persistent oligopoly practices (Asano & Tyers, 2019). Additionally, Japan exports a plethora of high-tech products worldwide with companies like Toyota, Panasonic, and Sony to name a few.

Being also dependent on imports of natural resources, Japan needed export revenues to finance its imports. Japan has been exploiting its comparative advantages based on its manufacturing industry. At the start of this decade, foreign trade had become an essential element of the Japanese economy, and the country had maintained foreign merchandise trade surplus for more than 30 years, which undoubtedly demonstrates the export orientation of its economic model (Padoba et al., 2021). It can be said that high tariffs from its trade partners would not benefit the Japanese economy. However, the present study focuses on inward tariffs imposed by the government to protect domestic production and industries, raising the question of how such measures influence the broader economy in the form of inflation and interest rates.

Firstly, this section aims to investigate if there is a relationship between the tariff rate of Japan and its monetary policy. If evidence shows that this effect is significant, then the path analysis will investigate if this effect passes on interest rates only directly or also indirectly through inflation that acts as a mediator. The mediation through OLS and Sobel test needs to meet the assumptions of normality and no multicollinearity, while bootstrapping needs only the latter (Baron & Kenny 1986; MacKinnon et al., 2004). When the normality assumption is violated then the test statistics such as confidence intervals (CI) and p-values become unreliable and can indicate false positives or false negatives. Additionally, multicollinearity makes it hard to distinguish the unique effects of the predictor and the mediator since it inflates standard errors (Can et al., 2015). If the residuals for the values of interest are not normally distributed, Bootstrapping is employed because treating multicollinearity does not require data transformation (Log, square rote etc.). As seen in the method section, normality is detected with the Shapiro-Wilk test since it checks if residuals are normally distributed. Multicollinearity is detected with the variance Inflation Factor (VIF) since it can capture increased variance created by multicollinearity. The results can be found in Appendix B[13].

[13] Results can be seen in Tables B.5 and B.6.

Since the residuals of inflation, interest rate, and tariffs are not normally distributed, whereas no variable witnesses severe multicollinearity (highest is Debt/GDP at 2,34) and is below the threshold of 2,5, the analysis is conducted with the first step being the regression of tariffs on interest rate and final goal the bootstrapping. Table 5.6 contains the results of the regression.

Table 5.6 Results path C (Tariff on Interest Rate) Japan.

Variable	Model 1 Interest Rate
Tariff	-0.027 (0.022)
$inflation_{t-1}$	0.028 (0.027)
GDP per Capita Growth	-0.046*** (0.016)
Financial Account /GDP	0.619 (3.736)
Debt/GDP	-0.438*** (0.041)
Unemployment	-0.025* (0.014)
Constant	1.124 *** (0.151)
Observations	185
R-squared	0.555

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

Most notably, tariffs do not seem to have a significant direct effect on interest rates after controlling for additional variables. There are several reasons as to why the results present the effect of tariffs as insignificant. Firstly, it can be due to the fact that the bulk of tariff costs are absorbed at the border and do not translate into higher consumer prices (Cavallo et al., 2021). Therefore, the central bank may not find necessary a change in the existing monetary policy. Another reason, more tailored made for Japan, is that the effect of tariffs is mitigated through fiscal and not monetary means (Fujimoto & Watanabe, 2022). This idea is based on evidence which shows that subsidy programs and tariffs often work in tandem. The program imposes a modest tariff on imported goods and uses this revenue to subsidize domestic production, thus ensuring the prices of domestic and imported goods match. Last but not least, Japan as a global exporter depends on exports more than countries like the U.S. This means that economic growth and monetary policy are more sensitive to foreign demand, and thus the relatively small changes in the tariff rate might have a limited effect on them. Overall, the results create challenges to the mediation analysis this paper employs. Since the primary objective is to assess how a direct effect is mediated, rather than merely identifying the presence of an indirect effect, tariff rate must be a significant predictor of interest rate for the analysis to proceed. In this case, since tariff rate is not a good predictor, the country specific analysis is concluded without yielding significant results.

5.3 China

China's case shares many similarities with that of Japan's. As an export-driven economy it is reasonable to assume that tariffs imposed by other countries, particularly by China's key trading partners, can negatively impact the Chinese economy. Research from the Federal Reserve Bank has suggested that the 2019 trade war with the U.S. has caused a reduction of the Chinese GDP by a moderate 0.25% (Ferraro & Van Leemput, 2019). Reductions in GDP can entice the Chinese state to intervein either fiscally or monetarily in order to protect its economic model. On the other hand, there are enough evidence to suggest that the Chinese domestic consumption section is far lower than the ideal one

for the second largest economy in the world. Consumption growth in urban centers is lower than its peer economies with demographic issues and low GDP per capita as drivers of domestic consumptions inefficiencies (Wright et al., 2024). That weak domestic consumption should concern the Chinese government, especially if they intended to implement higher tariffs. If tariffs manage to pass from border prices and lead to rises in the prices of final products, then the already weak domestic market might find it difficult to purchase the same amount of goods and services. Consequently, that would lead to a central bank intervention or state intervention with fiscal means to contain the negative effects of price hikes.

The model aims to evaluate if this theory can be observed in practice. As the first step of the mediation analysis (path **c**), model one regresses tariffs on interest rate to evaluate if a direct effect can be observed. The results can be seen in Table 5.6. Before explaining them, it is crucial to evaluate if the conditions of the mediation are met. For the Sobel test the assumption of normality is crucial since non-normal residuals can affect the p-values and Confidence Intervals leading to false positive and false negative indications of statistical significance. Since the variables are not normally distributed,[14] a Sobel Test cannot be used, and Bootstrapping is preferred. For the Bootstrapping test, the condition of no multicollinearity is required. The evaluation is done with the VIF test variance Inflation Factor (VIF) since it can capture increased variance due to high multicollinearity. Multicollinearity must be delt so that the values of the coefficients are based on the unique characteristics of each variable and are not distorted. The results can be found in Appendix B[15]. The VIF test reveals moderate to relatively high levels of multicollinearity between the variables of tariff rate, imports, and debt. Values above 2,5 indicate moderate levels of multicollinearity while values above 5 indicate severe multicollinearity (Can et al., 2015). In order to address this problem, a Principal Components Analysis (PCA) is employed to combine the highly correlated variables into fewer uncorrelated

[14] Table b. 10 Shapiro-Wilk normality test for China
[15] Table B.11 VIF Results on the left side

components. The tariff rate is not added to the PCA since it is crucial to distinguish its effects from that of the control variables. The results of the PCA reveal that the merged variables in the form of Principal Component one (PC1) manage to preserve 88.2% of the total variance of the imports and debt to GDP[16] while reducing multicollinearity for tariffs by more than 1 point from above 5 to 3,9[17]. This value, while still relatively high, is below the value of 5, and with caution allows the process towards bootstrapping to continue.

[16] Table B.12 Principal Components Analysis (PCA) path c results, China.
[17] Table B.11 VIF Results on the right side

Table 5.6 Results path C (Tariff on Interest Rate) China.

Variable	Model 1 Interest Rate	Model 2 (PCA) Interest Rate
Tariff	0.013 (0.035)	-0.038 (0.032)
$inflation_{t-1}$	-0.036 (0.034)	-0.008 (0.033)
GDP per Capita Growth	-0.092** (0.04)	-0.057 (0.039)
Net Imports/GDP	5816*** (926.924)	
Debt/GDP	-0.145 (0.309)	
Unemployment	0.85 (0.143)	0.139 (0.145)
Econ PC 1		-0.199*** (0.032)
Constant	1.899 *** (0.719)	2.663*** (0.706)
Observations	186	186
R-squared	0.428	0.400

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

The results of model one and model two both lead to the conclusion that, empirically, there is no direct effect of tariffs on interest rate to be mediated through inflation. Model 1 has high multicollinearity and cannot be used for the mediation analysis. On the contrary, Model 2 manages to decrease it in moderate and fairly acceptable levels but still

tariffs are not statistically significant in this model. The People's Bank of China (PBoC) does not operate under the same independent regime as that of its European and American counterparts. On the contrary, the PBoC is legally structured under the State Council, and major decisions are ultimately made at the government level (Das & Song, 2022). This lack of instrumental autonomy can explain why tariffs are not significant for Chinese monetary policy. Relatively stable interest rates are set in coordination with fiscal policy while tariff changes (a state policy) are already accounted for. Furthermore, the way that the PBoC operates leaves it vulnerable to political pressures. The Chinese government prioritizes stability and political cohesion, leading to stable and slightly decreasing tariff regime and monetary policy. Since both models, and primarily model two, show that there is no statistical significance of the effect of tariffs on interest rate, there is no effect to be mediated, finalizing the analysis for China[18].

5.4 Eurozone

The Eurozone presents a unique case in this study, as it operates under a single monetary policy set by the European Central Bank (ECB), while fiscal policies remain decentralized and are managed individually by each member state. Additionally, tariff rates are set at the European level, which includes non-Eurozone countries such as Bulgaria and Sweden. In essence, tariff policy falls under the European Union's (EU) common trade policy, while monetary policy is the ECB's responsibility. Thus, whether it is the case of Germany or Bulgaria importing goods from a third country, the same EU's common tariff is implemented. This unique form of union can lead to tensions when the ECB wants to implement specific policies that do not align with fiscal preferences of certain member states.

[18] While an indirect effect from tariffs to inflation and subsequently to interest rates may exist, it is not examined in this paper, as the analysis prioritizes the presence of a significant direct effect as a necessary prerequisite for mediation (Baron & Kenny, 1986).

As for tariff rates, according to the World Trade Organization (WTO), the EU has generally low to average tariff rates compared to other countries. The only exception is in the form of agricultural products, in order to protect European farmers from being replaced with cheaper alternatives from third countries. Low tariffs that are strategically drafted to account for small trade imbalances can enhance economic growth and lead to insignificant or slightly negative pressures on interest rates (Bergin & Corsetti 2023). Furthermore, after the European financial and debt crisis, the Eurozone had been plagued with very low inflation that persisted for years. As a result, the ECB used nonstandard tools and unconventional monetary policies in the forms of Quantitative Easing (QE), and negative interest rates to influence upward pressures on inflation. It is hard to anticipate how tariffs impacted monetary policy and inflation in a timespan that includes that period. This paper will try to evaluate the direct effect tariffs have on interest rates and, if a direct effect is detected, how it is mediated.

Table 5.7 presents the results for all the models of the mediation. **Model 1** regresses the tariff rate on interest rates to detect if a direct effect is present. **Model 2** examines the impact of the tariff rate on the proposed mediator (inflation) to determine whether changes in tariff regimes influence inflation. **Model 3** serves as an amended version of model two since it accounts for multicollinearity and treats it to ensure more reliable coefficients. Lastly, **Model 4** regresses both the mediator and the tariff rate on interest rates and allows to evaluate if the direct effect is mediated through inflation partially or completely. Models 3 and 4 are used for the final bootstrapping since they comply with the assumption of the mediation analysis.

Before running the regressions, it is important to assess if the models comply with the assumptions of either the Sobel test or the Bootstrapping test. Assumptions for the Sobel test include normality and no multicollinearity, while assumptions for Bootstrapping include only the latter. However, the former assumption usually fails, especially in smaller samples, because the product of the coefficient of two paths tends to be skewed and not

normal, therefore, bootstrapping is preferred (Preacher & Hayes, 2004). Given that in the data the variables are non-normal,[19] Bootstrapping is chosen. Multicollinearity is evaluated with the Variance Inflation Factor (VIF) since it can detect excess multicollinearity due to high correlation of the independent variables (Adeboye et al., 2014). Multicollinearity is problematic as it can confuse the separate characteristics and effects of each variable disturbing the results of the mediation.

In paths **c** and **c'**, corresponding to models 1 and 4, where interest rate is the dependent variable, no severe multicollinearity is detected. On the contrary, path **a**, corresponding to model 2, where inflation is the dependent variable, witnesses sings of moderate to severe multicollinearity[20]. To solve this, a Principal Component Analysis (PCA) is implemented that includes the variables that have high multicollinearity. By transforming variables into smaller components, it clears multicollinearity and also preserves a big part of the original information[21] (Abdi & Williams, 2010). The first two components preserve around 85% of the variation, while also reduce multicollinearity, making model 4 ideal for the mediation.

[19] Table B.7 Results for Shapiro - Wink normality test
[20] Table B.8 Results for VIF test for all the paths.
[21] Table B.9 Results for PCA for model 3 / path a.

Table 5.7 Results for OLS models included in the mediation, Eurozone.

Variable	Model 1 Interest Rate	Model 2 Inflation	Model 3 PCA Inflation	Model 4 Interest Rate
Tariff	-0.649***	0.049	-2.641***	-0.689***
	(0.192)	(0.145)	(0.393)	(0.191)
$inflation_{t-1}$	0.146***	1.052***		0.138***
	(0.023)	(0.022)		(0.023)
GDP per Capita Growth	-0.04	0.085**	0.359***	-0.0046
	(0.04)	(0.042)	(0.142)	(0.059)
Financial Account/GDP	-262.385			-234.290
	(337.150)			(340.006)
Debt/GDP	- 12.367***	2.559***		-12.608***
	(0.602)	(0.965)		(0.597)
Unemployment	0.1761***	-0.186***		0.180***
	(0.027)	(0.049)		(0.028)
$Interest\ Rate_{t-1}$		-0.125*		
		(0.066)		
GDP per Capita		-0.0001***		
		(0.00003)		
PC 1			0.035	
			(0.063)	
PC 2			-1.032***	
			(0.062)	
Constant	10.927***	2.365*	6.504***	11.184***
	(0.770)	(1.303)	(0.701)	(0.757)
Observations	180	180	180	180
R-squared	0.788	0.976	0.718	0.792

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

In hindsight, the results support the idea that tariff rates have negatively impacted nominal interest rates, and this direct effect is partially mediated through inflation. As seen in model one, tariffs significantly lower interest rates (-0.649) after controlling for other economic variables. Furthermore, tariffs seem to also put negative pressures on inflation, as seen in model 3 (-2.641). Lastly model 4 which presents the last pathway (**c'**) shows that even with the inclusion of inflation as a mediator, the effect remains significant and negative. The bootstrapping test is implemented after assessing the statistical significance of the variables included in all model. The results on Table 5.8 were created by repeatedly resampling the data 5000 times. The results present the direct and indirect effect of tariffs on inflation, alongside their statistical significance, and the proportion that is mediated.

Table 5.8 Results and Mediation Relationships Eurozone.

Effect	**Estimate**	**95% CI Lower**	**95% CI Upper**	**p-value**
ACME (Indirect)	-0.36357	-0.60779	-0.18850	< 0.01 ***
ADE (Direct)	-0.68875	-0.99856	-0.33498	< 0.01 ***
Total Effect	-1.05232	-1.29130	-0.81066	< 0.01 ***
Proportion Mediated	0.34549	0.16994	0.63050	< 0.01 ***

*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Estimation

The results of the Bootstrapping test confirm the findings of the OLS models. Specifically, the negative direct effect of tariffs on interest rates is smaller in magnitude than the total effect, indicating that tariffs reduce both inflation and interest rates. Additionally, the proportion mediated is positive. This suggests that inflation has a positive effect on interest rates. Therefore, when tariffs lower inflation, this indirectly contributes to a further reduction in interest rates, reinforcing the total negative impact. The results are not in line with mainstream beliefs about the inflationary pressures of inflation and interest rates. On the contrary, they are in line with views of more nuanced opinions from

economists that contradict mainstream beliefs. Some indications from representatives of the ECB also back the idea that tariffs may not behave in the predictable way[22].

Before arriving to the final conclusions, a robustness check is employed to evaluate if the results persist in a different setting. The beginning of the Russian invasion of Ukraine led to increased inflation with a maximum of around 10% based on monthly estimations from Eurostat. Those values may have altered the results due to their influence. As a robustness check, the outliers are excluded from the data and the steps for the bootstrapping are evaluated again. The rationale for this exclusion is supported by prior literature that emphasizes the sensitivity of regression models to influential observations (Lee et al. 2022). Specifically, observations after January 2022 are omitted from the data due to the abrupt rise of externally induced inflation. After those values are excluded, the steps to perform a mediation analysis are repeated to evaluate, firstly the direct effect of tariffs on the interest rate, and then proceed to the additional steps.

Table 5.9 contains both the initial model 1 and the same model after performing the robustness check.

[22] "Tariffs may be disinflationary in the short run but pose upside risks over the medium term," ECB board member Isabel Schnabel

Table 5.9 Results path C as Robustness check (Tariff on Interest Rate) Eurozone.

Variable	Model 1 Interest Rate	Model 1 Robustness check Interest Rate
Tariff	-0.649***	0.053
	(0.192)	(0.218)
$inflation_{t-1}$	0.146***	0.236***
	(0.023)	(0.045)
GDP per Capita Growth	-0.04	-0.082
	(0.04)	(0.085)
Financial Account/GDP	-262.385	-173.798
	(337.150)	(422.911)
Debt/GDP	- 12.367***	-14.108***
	(0.602)	(0.728)
Unemployment	0.1761***	0.217***
	(0.027)	(0.035)
Constant	10.927***	10.712***
	(0.770)	(0.874)
Observations	180	167
R-squared	0.788	0.866

Standard Errors in parentheses
*Note: *** p<0.01, ** p<0.05, * p<0.1*
Source: Own Elaboration

The robustness check creates a different picture in the analysis. There are some explanations as to why tariffs might be insignificant in the new model. Low tariffs that are strategically drafted to account for small trade imbalances can enhance economic growth and lead to insignificant or even slightly negative pressures on interest rates (Bergin & Corsetti 2023). Additionally, other research suggests that tariffs can have delayed effects that are not immediately visible, creating a longer timeframe which is not examined in this thesis (Pal, 2025). Ultimately, the results of the robustness check suggest that

moderate tariff rates are not a significant predictor of interest rates. As a result, there is no direct effect to be mediated, and the analysis is completed.

6 Conclusion and Discussion

This chapter aims to draw conclusions and address the central research question: Is there an effect of tariff rates on interest rates, and if so, how is this effect mediated through inflation? The discussion includes the key findings as well as the limitations and restrictions of the research. Additionally, some recommendations are made, which nonetheless should be interpreted with caution and in light of the methodological and contextual limitations of the analysis.

Trade is a major aspect of the world economy. According to the World Trade Statistics (WTS), in 2024 world trade in goods and commercial services, on a balance of payments basis, expanded by 4% to US $31.5 trillion (World Trade Organization, n.d.). This massive amount highlights the potential benefits and setbacks of protectionism and tariff wars. Major importers such as the United States may believe they can benefit from high import tariffs in various ways, including encouraging the domestic market and raising more capital through high tariff rates. Important setbacks of high tariffs might include increased prices, alongside retaliation in the form of tariffs from other countries. In this highly complicated environment, it seems that the choice and the effect of tariffs, either positive or negative, depend on the context of their implementation.

The main purpose of this research does not depend on the effect tariffs have on inflation but on the direct effect they have on interest rates. Recent literature on mediation has concluded that the indirect effect passing through the mediator (inflation) can exist without a direct effect of the independent variable (tariff) on the dependent (interest rate) (Hayes, 2009; Zhao et al., 2010). This phenomenon has been studied greatly, and many economists suggest there is an effect that passes from inflation and leads to interest rates. Empirical research has shown that the imposition of U.S. tariffs resulted in

substantial short-term price increases for both intermediate and final goods. These tariffs also caused major disruptions in supply chains, reduced the availability of imported product varieties, and were almost fully passed through to domestic prices (Amiti et al., 2019; Furceri et al., 2021; Alvarez & Yilmazkuday, 2025). On the other hand, some economists claim the moderate level of tariffs can be beneficial and even lead to expansionary monetary policy (Bergin & Corsetti, 2023). What those papers have in common is that most of them agree that tariffs affect inflation. It is logical then to assume that central banks, since they show interest in inflation, will intervene. The alternative approach of this research posits that a significant direct effect must be established for the mediation analysis to proceed. Additionally, the mediation analysis examines if there is a partial or a complete mediation and towards what direction.

It is important to differentiate between the time periods and external events during tariff imposition. For example, the results for the United States suggest that the effect of tariff imposition on interest rates has been positive, leading to higher rates. On the contrary, and quite unpredictably, the effect of tariffs on inflation was small but negative. This result may have several potential explanations: i) Either the characteristics of tariffs have been altered due to data manipulation and interpolation, ii) or the Fed considers alternative variables such as economic output and potential GDP for evaluating economic conditions. iii) Lastly, the Federal Reserve may adopt either a reactive or proactive approach to tariff policy, resulting in time lags or miscalculated decisions that are difficult to capture accurately in the analysis and may lead to misinterpretations.

Countries such as Japan and China witness different results than those of the US. The aforementioned countries are major exporters of goods and have low or decreasing tariff policies. In those cases, the results presented a different picture. The tariff policies of those countries have an insignificant effect on monetary policy, suggesting that there is no direct effect to be mediated. Literature that supports this idea suggests that the effects of tariffs are mitigated through fiscal and not monetary means (Fujimoto & Watanabe,

2022). Additionally, the limited central bank independence in the case of China can also explain the limited significance that tariffs have on monetary policy.

The Eurozone represents a distinctive case, characterized by the blend of independent national fiscal policies and a centralized monetary policy governed by the European Central Bank. Low and strategically planned tariff policies have led to a significant and negative effect on inflation and interest rates. The mediation analysis suggests that the effect of tariffs on interest rates is partially mediated through inflation. These results stand in contrast to popular assumptions about tariffs that suggest a reverse economic impact (Amiti et al., 2019). When the influential values on inflation caused by the Russian invasion of Ukraine are excluded, the results present a different picture. Once again, it seems that low and moderate tariffs without significant variations have no direct effect on inflation.

Overall, there are two main takeaways that can be derived from this paper. Firstly, in times of free trade without exogenous shocks on inflation or on tariffs, central banks remain unfazed by small changes in tariff rates. Even if small increases or decreases in tariffs have an indirect effect that is mediated through inflation, the direct effect remains insignificant, supporting the hypothesis that moderate tariffs lead to higher (lower) interest rates only because they may cause inflation (deflation). Secondly, conclusions about protectionism are limited. The results regarding the United States show that, in the case of protectionist policies, tariffs become an important component in central bank cycles. In the US, the analysis showed that the outcomes of protectionist policies through tariffs can be hard to accurately predict. The central bank operating in an environment of uncertainty may raise interest rates anticipating higher inflation, while the actual effect of tariffs on inflation might be moderate, insignificant or even negative.

To conclude, this paper adds to the literature of tariffs and interest rates by using inflation as a mediator. Inflation is a key component for every central bank policy (Federal Reserve

System, 2021). Understanding the effects of tariffs on interest rates and inflation will be the key in navigating Donald Trump's second term in the White House. Additionally, the attention that policy makers pay to trade policies can provide a better understanding of the direction in which the economy is headed. If policy makers start mentioning trade policies more often, protectionism may be on the rise. On the other hand, if the central banks remain unaffected by trade policies, tariffs are moderate, and free trade is still prevailing.

7 References

Abdi, H., & Williams, L. J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, *2*(4), 433–459.

Adeboye, N. O., Fagoyinbo, I. S., & Olatayo, T. O. (2014). Estimation of the effect of multicollinearity on the standard error for regression coefficients. *IOSR Journal of Mathematics*, *10*(4), 16-20.

Ahmad, M., & Ahmad, I. (2024). Tariff pass-through and implications for domestic markets: Evidence from U.S. steel imports. *The Journal of International Trade & Economic Development*, *33*(3), 482-496.

Alin, A. (2010). Multicollinearity. *Wiley Interdisciplinary Reviews: Computational Statistics*, *2*(3), 370–374.

Amiti, M., Redding, S. J., & Weinstein, D. E. (2019). The impact of the 2018 tariffs on prices and welfare. Journal of Economic Perspectives, 33 (4), 187-210.

Anari, A., & Kolari, J. (2016). Dynamics of interest and inflation rates. *Journal of Empirical Finance*, *39*, 129-144.

Asano, A., & Tyers, R. (2019). Japan's oligopolies: Potential economy wide gains from structural reforms. *Economic Modelling*, *82*, 361-375.

Auer, R., & Fischer, A. M. (2010). The effect of low-wage import competition on U.S. inflationary pressure. *Journal of Monetary Economics*. *57*(4), 491-503.

Bai, L., & Stumpner, S. (2019). Estimating US consumer gains from Chinese imports. *American Economic Review: Insights*, *1*(2), 209-224.

Bank of Japan. (n.d.). Statistics (Web page). Retrieved June 27, 2025.

Barattieri, A., Cacciatore, M., & Ghironi, F. (2021). Protectionism and the business cycle. *Journal of International Economics*, *129*.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182.

Barsky, R. B. (1987). The Fisher hypothesis and the forecastability and persistence of inflation. *Journal of Monetary Economics*, *19*(1), 3-24.

Batra, R. (2001). Are tariffs inflationary? *Review of International Economics*, *9*(3), 373-382.

Beasley, T. M. (2012). Power of product tests of mediation as a function of mediator collinearity. *Multiple Linear Regression Viewpoints*, *38*(2), 17-23.

Berghe, S. (2024). Monetary policy and inflation: Analyzing Central Bank strategies. *Journal of Economics and Economic Education Research*, *25*(3).

Bergin, P. R., & Corsetti, G. (2023). The macroeconomic stabilization of tariff shocks: What is the optimal monetary response? *Journal of International Economics*, *143*.

Bhagwati, J. N., & Srinivasan, T. N. (1976). Optimal trade policy and compensation under endogenous uncertainty: The phenomenon of market disruption. *Journal of International Economics*, *6*, 317-336.

Bohannon, M. (2025). Trump lashes out at Jerome Powell after Fed doesn't cut interest rates. *Forbes*.

Bown, C. P., & Kolb, M. (2025). Trump's trade war timeline: An up-to-date guide. *PIIE*.

Cavallo, A., Gopinath, G., Neiman, B., & Tang, J. (2021). Tariff pass-through at the border and at the store: Evidence from US trade policy. *AER: Insights*, *3*(1), 19-34.

Chan, J. Y.-L., Leow, S. M. H., Bea, K. T., Cheng, W. K., Phoong, S. W., Hong, Z., & Chen, Y.-L. (2022). Mitigating the multicollinearity problem and its machine learning approach: A review. *Mathematics*, *10*(8).

Chen, N., Imbs, J., & Scott, A. (2004). Competition, globalization, and the decline in inflation. *Centre for Economic Policy Research*.

Chen, S., Qiao, X., & Zhu, Z. (2021). Chasing or cheating? Theory and evidence on China's GDP manipulation. *Journal of Economic Behavior & Organization*, *189*, 657-671.

Choi, S.-W. (2009). The effect of outliers on regression analysis: Regime type and foreign direct investment. *Quarterly Journal of Political Science*, *4*(2), 153-165.

Cox, J. (2025). Trump says he'll 'demand that interest rates drop immediately'. *CNBC*.

Das, M. S., & Song, W. (2022). Monetary policy transmission and policy coordination in China. *International Monetary Fund*. (Working paper).

Dormois, J.-P. (2006). Classical Trade Protectionism 1815-1914, *Routledge*, 160-193.

e-Stat. (n.d.). Portal Site of Official Statistics of Japan, Retrieved June 27, 2025.

European Central Bank. (2019). The effects of tariff hikes in a world of global value chains. *ECB Economic Bulletin*, *8*.

European Central Bank. (2020). Interest rate-growth differentials on government debt: an empirical investigation for the euro area. *Working Paper Series*, *2486*.

European Commission. (2025, April 3). Statement by President von der Leyen on the announcement of universal tariffs by the US. (Press Release).

Federal Reserve System (2021). The Fed Explained: What the Central Bank Does. Federal Reserve System Publication.

Ferrante, F., Graves, S., & Iacoviello, M. (2023). The inflationary effects of sectoral reallocation. *Journal of Monetary Economics*, *140*, 64-81.

Ferraro, J. K., & Van Leemput, E. (2019). Long-run effects on Chinese GDP from U.S.-China tariff hikes. *FEDS Notes*.

Fujimoto, T., & Watanabe, M. (2022). Comparison of the price adjustment program and subsidy scheme in Japan: Evaluation of domestic sugar support policy to internalize positive externalities. *Japan and the World Economy*, *61*.

Furceri, D., Hannan, S. A., Ostry, J. D., & Rose, A. K. (2018). Macroeconomic consequences of tariffs. *National Bureau of Economic Research*.

Furceri, D., Hannan, S. A., Ostry, J. D., & Rose, A. K. (2018). The macroeconomy after tariffs. *The World Bank Economic Review*, *36*(2), 361-381.

Gnabo, J. Y., & Moccero, D.N. (2015). Risk management, nonlinearity and aggressiveness in monetary policy: The case of the US Fed. *Journal of Banking & Finance*, *55*, 281-294.

Granville, B., Zeng, N. (2019). Time variation in inflation persistence: New evidence from modelling US inflation. *Economic Modelling*, *81*, 30-39.

Hakamada, M., & Walsh, C. E. (2024). The consequences of falling behind the curve: Inflation shocks and policy delays under rational and behavioral expectations. *International Monetary Fund*, *24*(42).

Hakamada, M., & Walsh, C. E. (2024). The Consequences of Falling Behind the Curve: Inflation.

Han, Y., & Lee, W. (2025). How do manipulation checks interfere with the inference of causal relationships? *Behavior Research Methods*, *57*(33).

Hashimzade, N., Gareth, M., & Black, J. (2017). A Dictionary of Economics. *Oxford University Press*, *5*.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, *76*(4), 408–420.

Hong, T., & Pyun, J. H. (2024). FDI and import competition and domestic firm's capital structure: Evidence from Chinese firm-level data. *Emerging Markets Reviews*, *61*.

Hottman, C. J., & Monarch, R. (2020). A matter of taste: Estimating import price inflation across U.S. income groups. *Journal of International Economics*, 127.

iLAB. (2022). At a Glance: U.S. World Imports 2016 – 2021 (Data Visualization).

Jacobs, J., Ogawa, K., Sterken, E., & Tokutsu, I. (2020). Public debt, economic growth and the real interest rate: A panel VAR approach to EU and OECD countries. *Applied Economics*, *52*(12).

Johnson, H. G. (1953). Optimum Tariffs and Retaliation. *The Review of Economic Studies*, *21*, 142-153.

Joyce, M., Miles, D., Scott, A., & Vayanos, D. (2012). Quantitative easing and unconventional monetary policy – An introduction. *The Economic Journal*. *122*(564), 271-288

Kyriazos, T., & Poga, M. (2023). Dealing with Multicollinearity in Factor Analysis: The Problem, Detections, and Solutions. *Journal of Statistics*, *13*(3), 404-424.

Leeuwenberg, A. M., van Smeden, M., Langendijk, J. A., van der Schaaf, A., Mauer, M. E., Moons, K. G. M., Reitsma, J. B., & Schuit, E. (2021). Comparing methods addressing multi-collinearity when developing prediction models. *Cornell University*.

Lotz, A. (2025, March 6). Republicans favor Trump tariffs despite anticipated price hikes: poll. *Axios*.

MacKinnon, D. P., & Lamp, S. J. (2021). A unification of mediator, confounder, and collider effects. *Prevention Science*, *22*(8), 1185-1193.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research*, *39*(1), 99–128.

Mendoza, E. G., & Ostry, J. D. (2006). Defaultable debt, interest rates and the current account. *Journal of International Economic*, *69*(1).

Ministry of Commerce of the People's Republic of China. (2025, April 11). MOFCOM Regular Press Conference. (Press Conference Transcript).

Noll, B., Steffen, B., & Schmidt, T. S. (2024). Domestic-first, climate second? Global consequences of the Inflation Reduction Act. *Joule*, *8*, 1869-1877.

Padoba, Z. S., Gorshkov, V. A., & Ozerova, A. A. (2021). Japan's export specialization in 2000–2020. *Asia and the Global Economy*, *1*(2).

Pal, H. (2025). Modeling the dynamic effects of tariffs on economic variables and trade policies. *Future Business Journal*, *11*(83).

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, *36*(4), 717–731.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879-891.

Shocks and Policy Delays Under Rational and Behavioral Expectations. *International Monetary Fund*, *24*(42).

Svensson, L. E. O. (1999). Inflation targeting: some extensions. *Scandinavian Journal of Economics*, *10*, 337-361.

Tanaka, K. (2021). Why do interest rates remain low despite the accumulation of government debt in Japan? *Public Policy Review*, *17*(2)..

The White House. (2025, April 2). Regulating imports with a reciprocal tariff to rectify trade practices that contribute to large and persistent annual United States goods trade deficits. (Presidential Action).

The Federal Reserve System. (n.d.). What is forward guidance, and how is it used in the Federal Reserve's monetary policy? (Web page).

v. Neumann, N. (1928). Zur Theorie der Gesellschaftsspiele. *Mathematische Annalen*, *100*, 295-320.

Van den End, J., & Pattipeilolhy, C. (2017). Central Bank balance sheet policies and inflation expectations. *Open Economies Review*, *28*, 499-522.

Werning, I., Lorenzoni, G., & Guerrieri, V. (2025). Tariffs as cost-push shocks: Implications for optimal monetary policy. *NBER Working Paper Series*. World Trade Organization. (n.d.). *World Trade Statistics*. (Web page).

Wright, L., Boullenois, C., Jordan, C. A., Tian, E., & Quinn R. (2024). No quick fixes: China's long-term consumption growth. *Rhodium Group*.

Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206.

8 Appendix

8.1 Appendix A: data description

Figure A.1: Annual Tariff, Interest Rate and Inflation for the US over time.

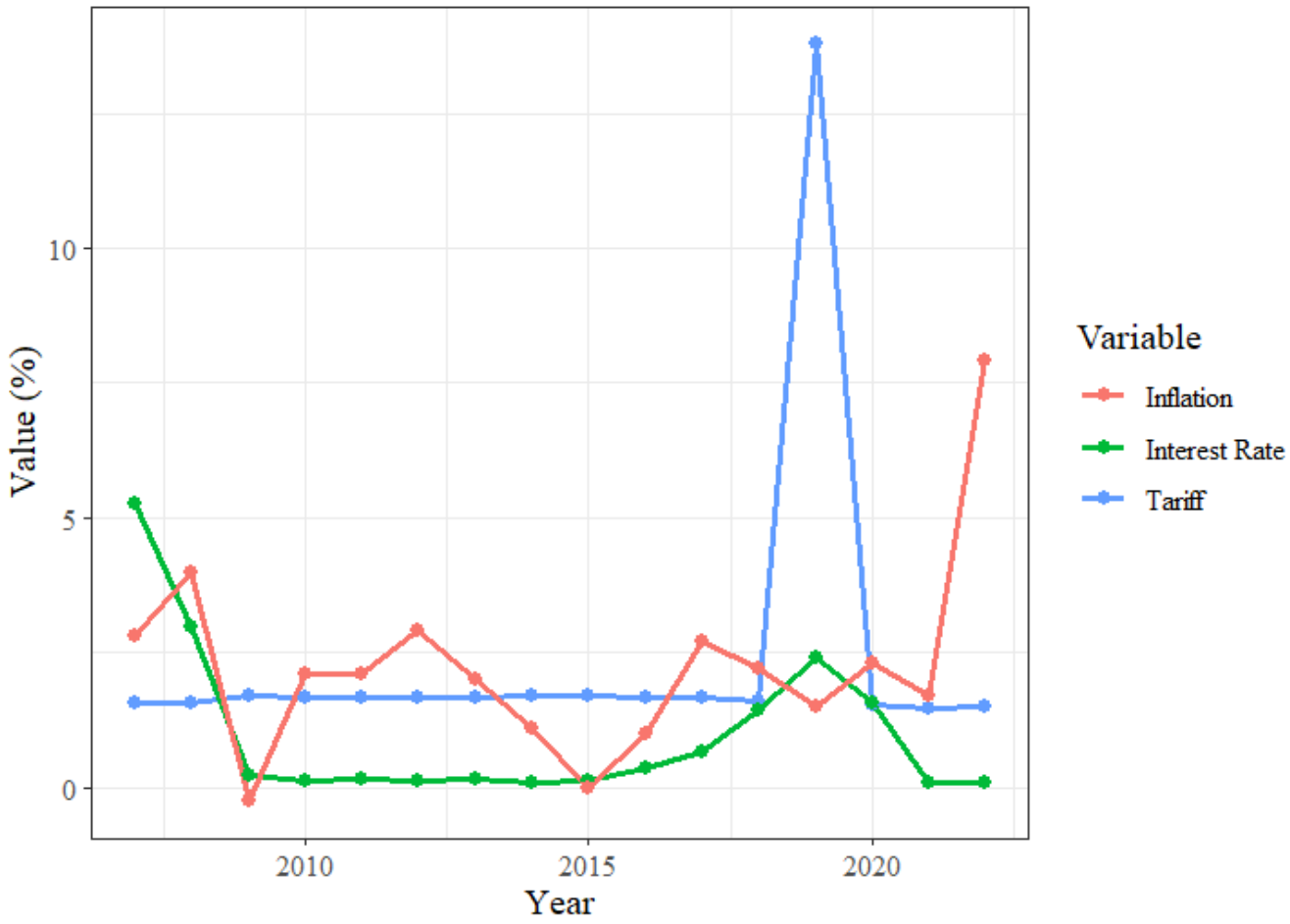


Table A.2: Descriptive statistics for the USA.

Variable	Mean	SD	Min	Max	Q1	Median	Q3
Tariff Rate	2.3888	2.3716	1.4700	13.7800	1.6125	1.6683	1.6858
GDP per Capita Growth	0.0028	0.0113	-0.0963	0.0588	-0.0003	0.0034	0.0064
Unemployment	6.1963	2.2297	3.5000	14.8000	4.4000	5.6000	8.0500
Inflation	2.3620	2.1008	-2.1400	9.1000	1.2000	2.0000	2.9000
FDI/GDP	0.0015	0.0009	-0.0017	0.0053	0.0011	0.0015	0.0019
Debt/ GDP	0.9698	0.1645	0.6086	1.2573	0.9131	0.9999	1.0343
$\mathbf{Inflation_{t-1}}$	2.3402	2.0846	-2.1400	9.1000	1.2000	2.0000	2.8750
$\mathbf{Interest\ Rate}_{t-1}$	0.9228	1.3253	0.0500	5.2700	0.1000	0.1750	1.5400
Interest Rate	0.9394	1.3415	0.0500	5.2700	0.1000	0.1800	1.5500

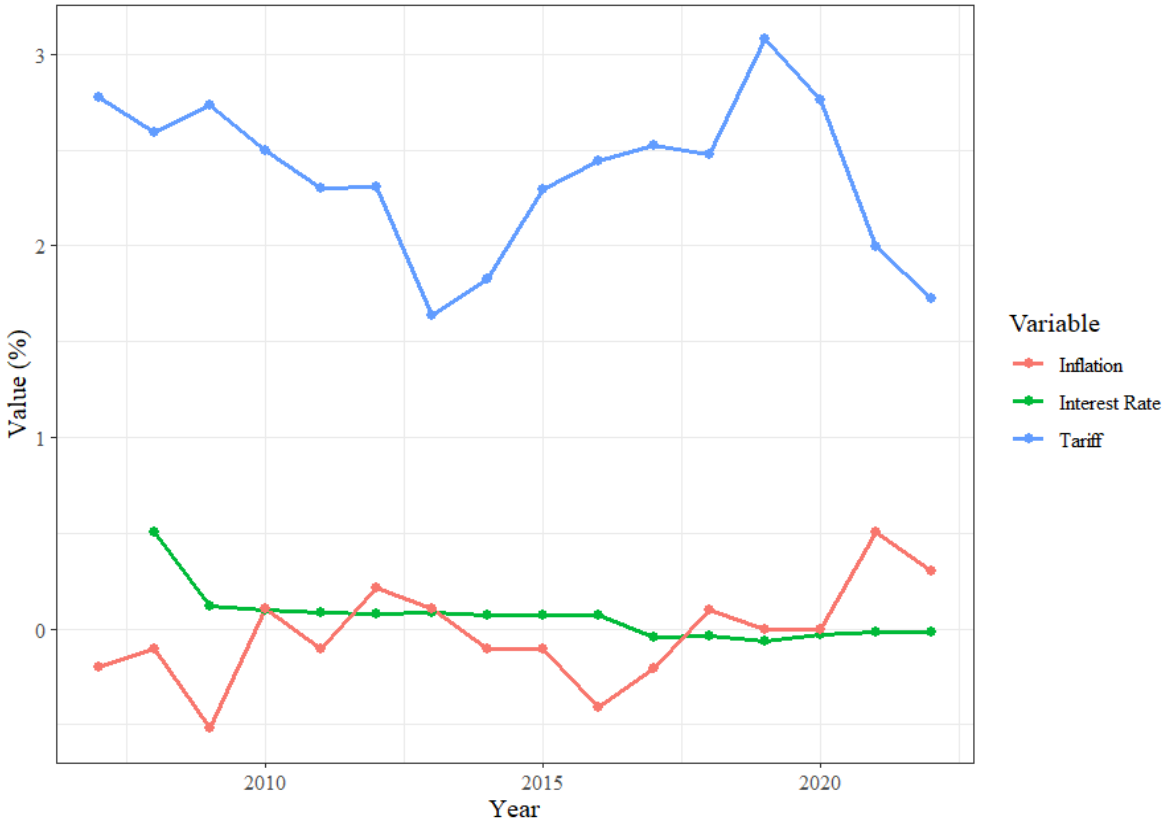
Source: Own estimation

Table A.3: Correlation table for USA.

Variable	Tariff Rate	GDP per Capita Growth	Unemployment	Inflation	FDI/GDP	Debt/GDP	$\mathbf{Inflation_{t-1}}$	$\mathbf{Interest\ Rate}_{t-1}$	Interest Rate
Tariff Rate	1.0000	-0.0994	-0.0292	-0.1383	-0.2500	0.2596	-0.1287	0.1035	0.0692
GDP per Capita Growth	-0.0994	1.0000	-0.0714	0.1003	0.0053	0.1372	0.0278	-0.0806	-0.0266
Unemployment	-0.0292	-0.0714	1.0000	-0.4358	-0.1678	-0.1624	-0.4312	-0.4845	-0.5145
Inflation	-0.1383	0.1003	-0.4358	1.0000	-0.0085	0.1998	0.9730	0.2567	0.2979
FDI/GDP	-0.2500	0.0053	-0.1678	-0.0085	1.0000	-0.1223	0.0138	0.0031	-0.0068
Debt /GDP	0.2596	0.1372	-0.1624	0.1998	-0.1223	1.0000	0.1824	-0.4868	-0.4388
$\mathbf{Inflation_{t-1}}$	-0.1287	0.0278	-0.4312	0.9730	0.0138	0.1824	1.0000	0.2722	0.3081
$\mathbf{Interest\ Rate}_{t-1}$	0.1035	-0.0806	-0.4845	0.2567	0.0031	-0.4868	0.2722	1.0000	0.9902
Interest Rate	0.0692	-0.0266	-0.5145	0.2979	-0.0068	-0.4388	0.3081	0.9902	1.0000

Source: Own estimation

Figure A.4: Annual Tariff, Interest Rate and Inflation for Japan over time.



Source: Own estimation

Table A.5: Descriptive statistics for Japan.

Variable	Mean	SD	Min	Max	Q1	Median	Q3
Tariff Rate	2.3634	0.4304	1.1800	3.5300	2.1981	2.3804	2.5890
GDP per Capita Growth	0.0378	0.5353	-2.5968	1.7361	-0.1371	0.0842	0.3231
Unemployment	3.5616	0.8966	2.1000	5.5000	2.8000	3.5000	4.2000
Inflation	0.0458	0.3095	-0.9212	2.0899	-0.1048	0.0000	0.2112
FDI/GDP	0.0021	0.0023	-0.0035	0.0096	0.0004	0.0017	0.0035
Debt/ GDP	2.0406	0.3108	1.4794	2.5837	1.8495	1.9689	2.3238
$\mathbf{Inflation_{t-1}}$	0.0413	0.3039	-0.9212	2.0899	-0.1048	0.0000	0.2107
Interest Rate $_{t-1}$	0.0782	0.1624	-0.0710	0.5210	-0.0380	0.0695	0.0880
Interest Rate	0.0775	0.1623	-0.0710	0.5210	-0.0380	0.0690	0.0870

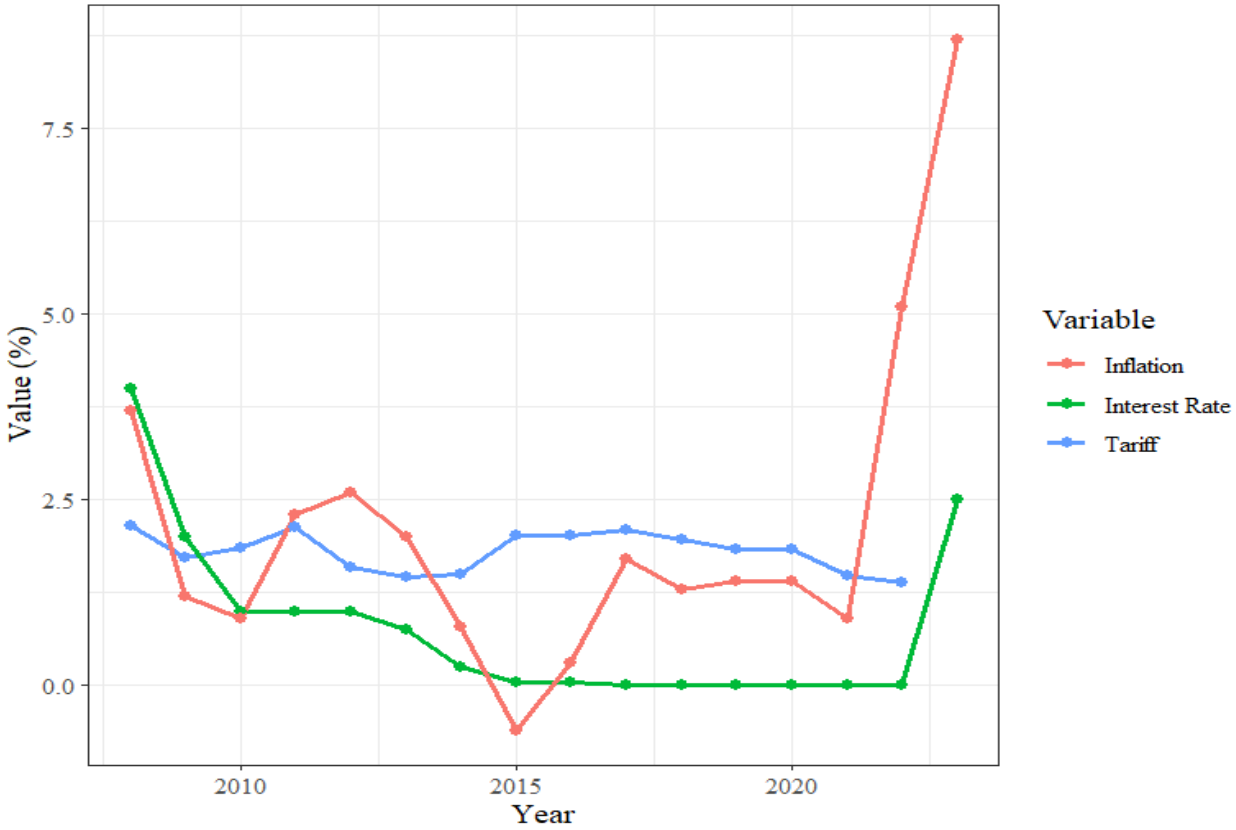
Source: Own estimation

Table A.6: Correlation table for Japan.

Variable	Tariff Rate	GDP per Capita Growth	Unemployment	Inflation	FDI/GDP	Debt/GDP	Inflation_{t-1}	$\text{Interest Rate}_{t-1}$	Interest Rate
Tariff Rate	1.0000	-0.2162	-0.1297	-0.1168	0.3094	-0.1699	-0.1099	0.1156	0.1122
GDP per Capita Growth	-0.2162	1.0000	-0.0244	0.0278	-0.1144	0.0869	0.0092	-0.2428	-0.2040
Unemployment	-0.1297	-0.0244	1.0000	-0.0652	-0.0093	-0.6995	-0.1015	0.4412	0.4392
Inflation	-0.1168	0.0278	-0.0652	1.0000	-0.0168	0.0047	0.2275	0.0244	0.0582
FDI/GDP	0.3094	-0.1144	-0.0093	-0.0168	1.0000	-0.1566	-0.0883	0.1329	0.1266
Debt /GDP	-0.1699	0.0869	-0.6995	0.0047	-0.1566	1.0000	0.0316	-0.7162	-0.7173
Inflation_{t-1}	-0.1099	0.0092	-0.1015	0.2275	-0.0883	0.0316	1.0000	0.0396	0.0489
$\text{Interest Rate}_{t-1}$	0.1156	-0.2428	0.4412	0.0244	0.1329	-0.7162	0.0396	1.0000	0.9904
Interest Rate	0.1122	-0.2040	0.4392	0.0582	0.1266	-0.7173	0.0489	0.9904	1.000

Source: Own estimation

Figure A.7: Annual Tariff, Interest Rate and Inflation for the Eurozone over time.



Source: Own estimation

Table A.8: Descriptive statistics for the Eurozone.

Variable	Mean	SD	Min	Max	Q1	Median	Q3
Tariff Rate	1.7753	0.2380	1.3350	2.1533	1.5352	1.8329	2.0012
GDP per Capita Growth	0.1973	0.6317	-2.8675	3.6797	-0.0218	-0.0161	0.2591
Unemployment	8.3322	1.5244	5.8000	10.9000	7.0000	8.5000	9.5000
Inflation	1.9556	2.2204	-0.6000	10.6000	0.5000	1.4000	2.4000
FDI/GDP	0.0001	0.0001	-0.0003	0.0006	0.0000	0.0000	0.0001
Debt/ GDP	0.8805	0.0697	0.6680	0.9880	0.8570	0.8975	0.9290
$\mathbf{Inflation_{t-1}}$	1.9267	2.1680	-0.6000	10.6000	0.5000	1.4000	2.4000
$\mathbf{Interest\ Rate}_{t-1}$	0.6256	0.9738	0.0000	4.2500	0.0000	0.0500	1.0000
Interest Rate	0.6339	0.9961	0.0000	4.2500	0.0000	0.0500	1.0000

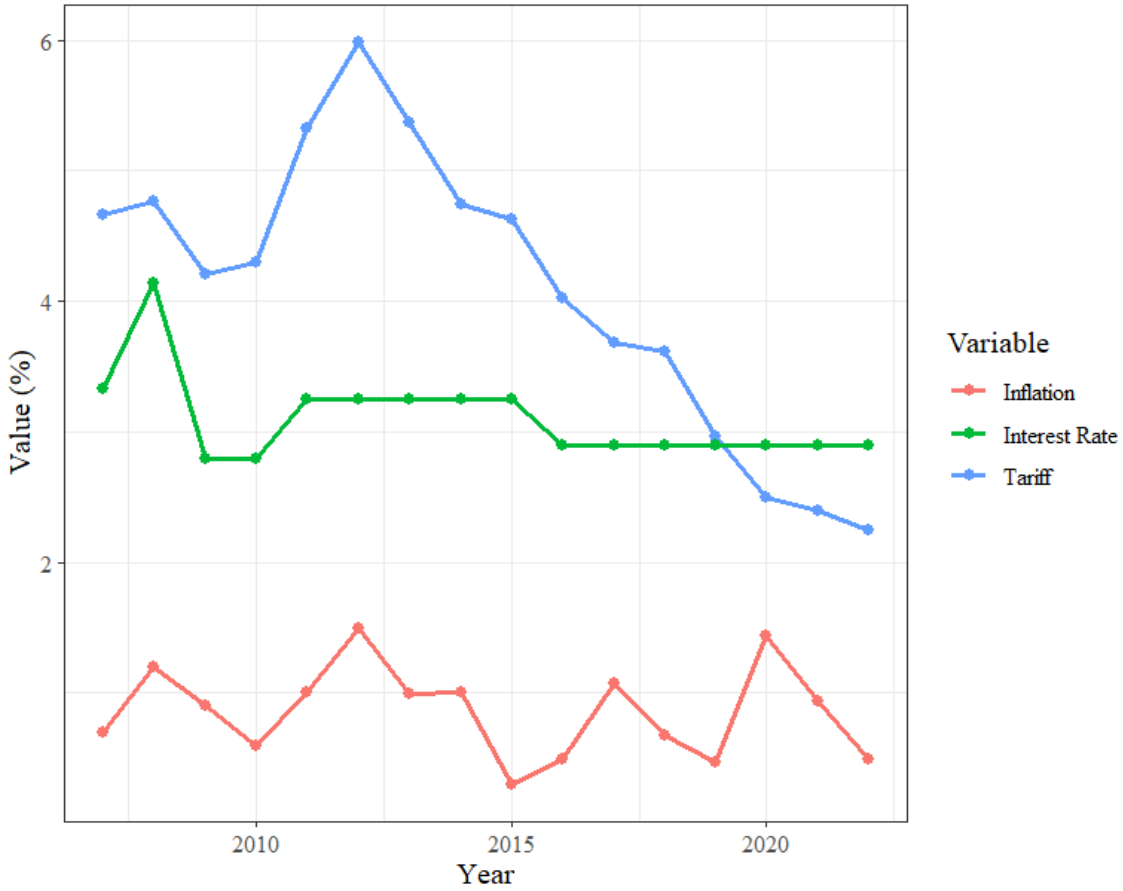
Source: Own estimation

Table A.9: Correlation table for Eurozone.

Variable	Tariff Rate	GDP per Capita Growth	Unemployment	Inflation	FDI/GDP	Debt/GDP	$\mathbf{Inflation_{t-1}}$	$\mathbf{Interest\ Rate}_{t-1}$	Interest Rate
Tariff Rate	1.0000	-0.0657	0.0864	-0.4655	-0.1188	-0.3872	-0.4625	0.0795	0.0941
GDP per Capita Growth	-0.0657	1.0000	-0.0997	0.2220	0.0005	0.1241	0.1981	-0.0917	-0.1149
Unemployment	0.0864	-0.0997	1.0000	-0.4773	0.0875	0.2772	-0.4640	-0.1286	-0.1032
Inflation	-0.4655	0.2220	-0.4773	1.0000	-0.1390	-0.0753	0.9860	0.3141	0.2483
FDI/GDP	-0.1188	0.0005	0.0875	-0.1390	1.0000	0.2920	-0.1367	-0.2990	-0.2985
Debt /GDP	-0.3872	0.1241	0.2772	-0.0753	0.2920	1.0000	-0.1122	-0.7947	-0.8153
$\mathbf{Inflation_{t-1}}$	-0.4625	0.1981	-0.4640	0.9860	-0.1367	-0.1122	1.0000	0.3560	0.2919
$\mathbf{Interest\ Rate}_{t-1}$	0.0795	-0.0917	-0.1286	0.3141	-0.2990	-0.7947	0.3560	1.0000	0.9888
Interest Rate	0.0941	-0.1149	-0.1032	0.2483	-0.2985	-0.8153	0.2919	0.9888	1.0000

Source: Own estimation

Figure A.10: Annual Tariff, Interest Rate and Inflation for China over time



Source: Own Estimation

Table A.11: Descriptive statistics for China.

Variable	Mean	SD	Min	Max	Q1	Median	Q3
Tariff Rate	4.0718	1.1217	2.1800	5.9900	3.2825	4.2492	4.7400
GDP per Capita Growth	0.9008	0.6450	0.0297	2.4067	0.2176	0.8551	1.4659
Unemployment	4.5908	0.1384	4.3100	5.0000	4.5300	4.5883	4.6421
Inflation	0.2113	0.5604	-1.2313	2.6000	-0.1901	0.1005	0.5076
FDI/GDP	0.0002	0.0000	0.0001	0.0003	0.0001	0.0001	0.0002
Debt/ GDP	0.4528	0.1471	0.2672	0.7545	0.3340	0.3968	0.5606
$\mathbf{Inflation_{t-1}}$	0.2099	0.5616	-1.2313	2.6000	-0.1902	0.1004	0.5079
$\mathbf{Interest\ Rate}_{t-1}$	3.0911	0.3138	2.7900	4.1400	2.9000	2.9000	3.2500
Interest Rate	3.0921	0.3143	2.7900	4.1400	2.9000	2.9000	3.2500

Source: Own estimation

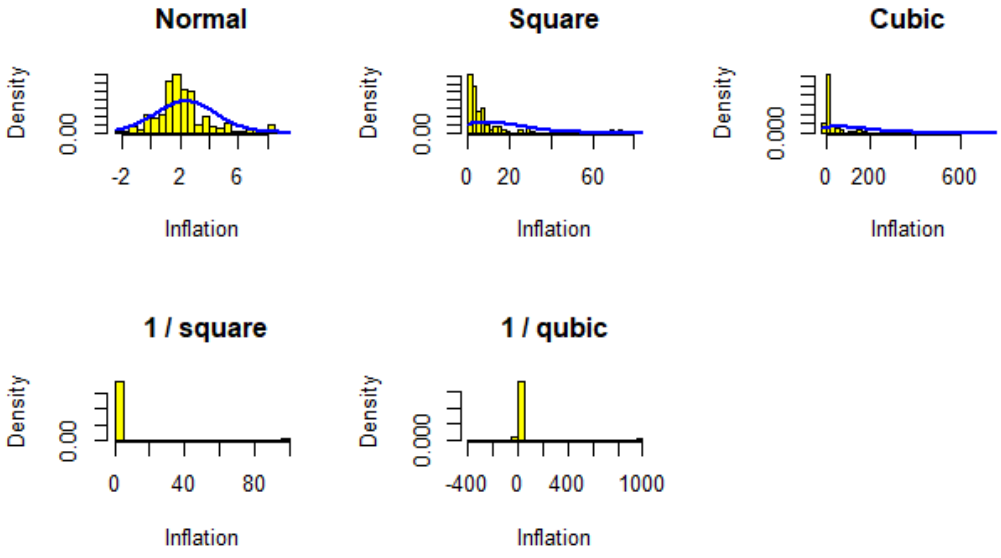
Table A.12: Correlation table for China.

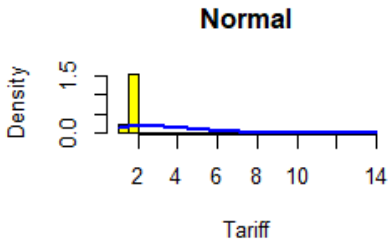
Variable	Tariff Rate	GDP per Capita Growth	Unemployment	Inflation	FDI/GDP	Debt/GDP	Inflation_{t-1}	$\text{Interest Rate}_{t-1}$	Interest Rate
Tariff Rate	1.0000	0.4128	-0.3852	0.0852	0.6829	-0.8934	0.0967	0.4937	0.4818
GDP per Capita Growth	0.4128	1.0000	-0.3017	0.1827	0.7076	-0.4999	0.1770	0.3444	0.2969
Unemployment	-0.3852	-0.3017	1.0000	-0.1300	-0.3287	0.4034	-0.1367	-0.1759	-0.1518
Inflation	0.0852	0.1827	-0.1300	1.0000	0.1230	-0.0789	0.1991	0.0431	-0.0246
FDI/GDP	0.6829	0.7076	-0.3287	0.1230	1.0000	-0.7622	0.2872	0.6301	0.5818
Debt /GDP	-0.8934	-0.4999	0.4034	-0.0789	-0.7622	1.0000	-0.0930	-0.5356	-0.5382
Inflation_{t-1}	0.0967	0.1770	-0.1367	0.1991	0.2872	-0.0930	1.0000	0.1122	0.0483
$\text{Interest Rate}_{t-}$	0.4937	0.3444	-0.1759	0.0431	0.6301	-0.5356	0.1122	1.0000	0.9390
Interest Rate	0.4818	0.2969	-0.1518	-0.0246	0.5818	-0.5382	0.0483	0.9390	1.0000

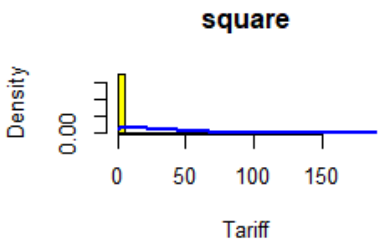
Source: Own estimation

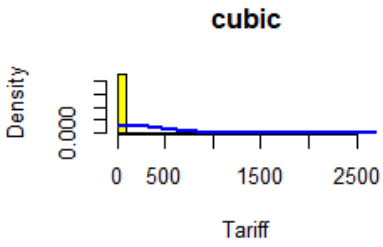
8.2 Appendix B: Data manipulation and Results

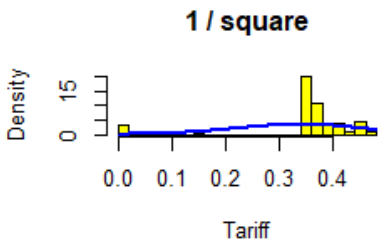
Figure B.1: Possible variable transformations, USA.

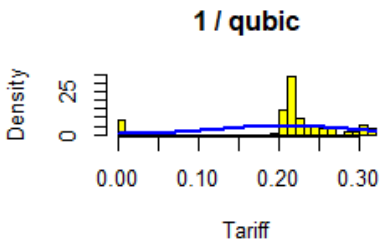


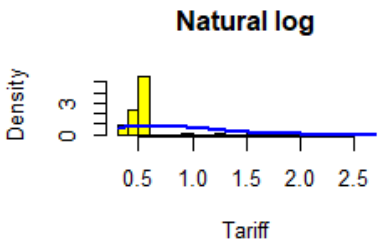

Normal
Density
0.0 1.5
2 4 6 8 10 14
Tariff

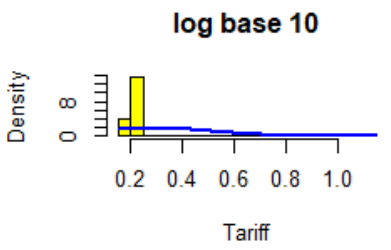

square
Density
0.00
0 50 100 150
Tariff

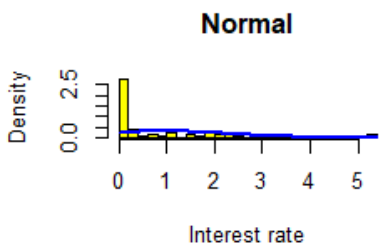

cubic
Density
0.000
0 500 1500 2500
Tariff

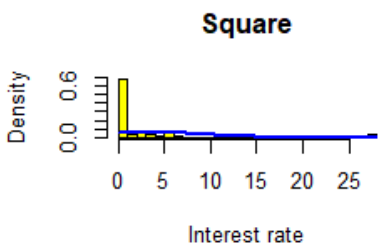

1 / square
Density
0 15
0.0 0.1 0.2 0.3 0.4
Tariff

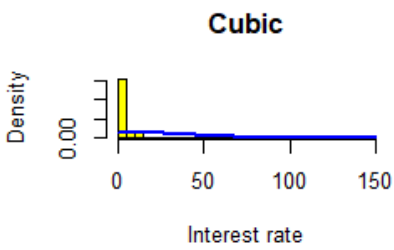

1 / qubic
Density
0 25
0.00 0.10 0.20 0.30
Tariff

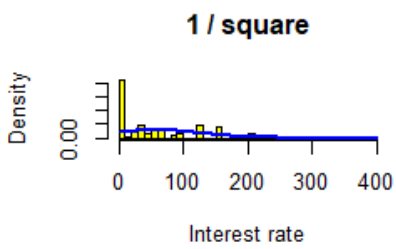

Natural log
Density
0 3
0.5 1.0 1.5 2.0 2.5
Tariff

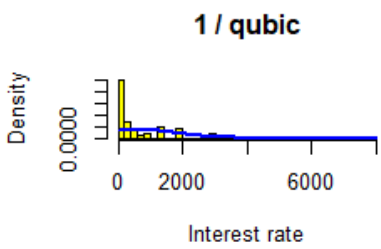

log base 10
Density
0 8
0.2 0.4 0.6 0.8 1.0
Tariff

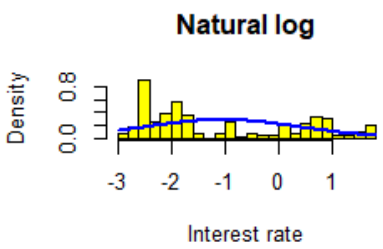

Normal
Density
0.0 2.5
0 1 2 3 4 5
Interest rate


Square
Density
0.0 0.6
0 5 10 15 20 25
Interest rate


Cubic
Density
0.00
0 50 100 150
Interest rate


1 / square
Density
0.00
0 100 200 300 400
Interest rate


1 / qubic
Density
0.0000
0 2000 6000
Interest rate


Natural log
Density
0.0 0.8
-3 -2 -1 0 1
Interest rate

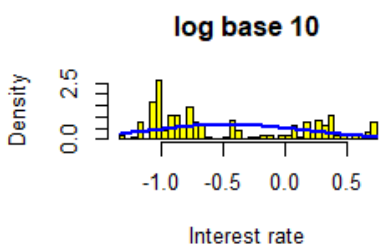

log base 10
Density
0.0 2.5
-1.0 -0.5 0.0 0.5
Interest rate

Table B.2: Shapiro-Wilk normality test for the US

Variable	W Statistic	p-value	Conclusion
Inflation	0.*90056*	< .001	Not normally distributed
Interest rate	0.*68435*	< .001	Not normally distributed
Tariff Rate	0.*38619*	< .001	Not normally distributed

Source: Own estimation

Table B.3: VIF Results, USA.

Variables Model 1	VIF
Tariff	1.213
Inflation_{t-1}	1.315
GDP per Capita Growth	1.046
FDI/GDP	1.124
Debt/GDP	1.173
Unemployment	1.313

Variables Model 2	VIF
Tariff	1.476
Inflation_{t-1}	2.620
$\text{Interest rate}_{t-1}$	3.304
GDP per Capita Growth	1.109
GDP per Capita	16.231
Debt/GDP	11.795
Unemployment	3.144

Variables Model 3 PCA	VIF
Tariff	1.0501
GDP per Capita Growth	1.0461
PC 1	1.0458
PC 2	1.0230

Variables Model 4	VIF	Variables Model 4	VIF
Tariff	1.221	Tariff	1.221
Inflation	1.345	Inflation	21.400
GDP per Capita Growth	1.044	GDP per Capita Growth	1.146
FDI/GDP	1.131	FDI/GDP	1.142
Debt/GDP	1.177	Debt/GDP	1.177
Unemployment	1.322	Unemployment	1.322
Inflation_{t-1}		Inflation_{t-1}	20.92

Source: Own estimation

*Table B.4: Principal Components Analysis (PCA) path **a** results, USA.*

Component	PC 1	PC 2	PC 3	PC 4	PC 5
Standard Deviation	1.556	1.3054	0.7692	0.4977	0.1910
Proportion of Variance	0.484	0.3408	0.1183	0.0496	0.0073
Cumulative Proportion	0.484	0.8248	0.9432	0.9927	1.0000

Source: Own estimation

Table B.5: Shapiro-Wilk normality test for Japan

Variable	W Statistic	p-value	Conclusion
Inflation	0.90071	< .001	Not normally distributed
Interest rate	0.70342	< .001	Not normally distributed
Tariff Rate	0.97188	.001	Not normally distributed

Source: Own estimation

Table B.6: VIF Results, Japan.

Variable Model 1	VIF
Tariff	1.330
Inflation_{t-1}	1.045
GDP per Capita Growth	1.055
GDP per Capita	1.138
Debt/GDP	2.340
Unemployment	2.309

Source: Own estimation

Table B.7: Shapiro-Wilk normality test for Eurozone

Variable	W Statistic	p-value	Conclusion
Inflation	0.77095	< .001	Not normally distributed
Interest rate	0.92190	< .001	Not normally distributed
Tariff Rate	0.67035	< .001	Not normally distributed

Source: Own Estimation

Table B.8: VIF Results, Eurozone.

Variables Model 1	VIF
Tariff	1.758
Inflation_{t-1}	1.885
GDP per Capita Growth	1.086
FDI/GDP	1.100
Debt/GDP	1.545
Unemployment	1.382

Variables Model 2	VIF
Tariff	1.885
Inflation_{t-1}	3.378
$\text{Interest rate}_{t-1}$	7.004
GDP per Capita Growth	1.105
GDP per Capita	15.264
Debt/GDP	7.530
Unemployment	8.898

Variables Model 3 PCA	VIF
Tariff	1.210
GDP per Capita Growth	1.055
PC 1	1.241
PC 2	1.041

Variables Model 4	VIF
Tariff	1.701
Inflation_{t-1}	1.892
GDP per Capita Growth	1.093
GDP per Capita	1.123
Debt/GDP	1.496
Unemployment	1.412

Source: Own estimation

*Table B.9: Principal Components Analysis (PCA) path **a** results, Eurozone.*

Component	PC 1	PC 2	PC 3	PC 4	PC 5
Standard Deviation	1.4641	1.4480	0.7821	0.3307	0.1963
Proportion of Variance	0.4287	0.4194	0.1223	0.0219	0.0077
Cumulative Proportion	0.4287	0.8481	0.9704	0.9923	1.0000

Table B.10: Shapiro-Wilk normality test for China.

Variable	W Statistic	p-value	Conclusion
Tariff Rate	0.942	< .001	Not Normally Distributed
Inflation	0.980	.008	Not Normally Distributed
Interest Rate	0.716	< .001	Not Normally Distributed

Source: Own Estimation

Table B.11: VIF Results, China.

Variables Model 1	VIF
Tariff	5.046
Inflation_{t-1}	1.156
GDP per Capita Growth	2.0928
FDI/GDP	4.034
Debt/GDP	6.555
Unemployment	1.238

Variables Model 2 PCA	VIF
Tariff	3.901
Inflation_{t-1}	1.070
GDP per Capita Growth	1.905
Unemployment	1.218
PC 1	5.459

Source: Own elaboration

*Table B.12: Principal Components Analysis (PCA) path **c** results, China.*

Component	PC 1	PC 2
Standard Deviation	1.328	0.486
Proportion of Variance	0.882	0.118
Cumulative Proportion	0.882	1.000

Table B.13: VIF Results for Robustness Check, USA.

Variables Model 1	VIF
Tariff	1.213
Inflation_{t-1}	1.315
GDP per Capita Growth	1.046
FDI/GDP	1.124
Debt/GDP	1.173
Unemployment	1.313

8.3 Appendix C: Documentation of Generative AI Usage

This Appendix provides a detailed account of the cures , generative AI tools during the development and the writing of this thesis. These tools are to support coding and data analysis. All output generated was critically evaluated and were necessarily modified by me to a line with the objectives of this research.

Tools used

ChatGPT

- Purpose: Generating the code for Principal Component Analysis (PCA). Additionally, it provided assistance with debugging parts of the code.
- My role: these suggestions, where reviewed and evaluated by myself To ensure correctness and alignment with the research question.

- My reflexion : It helped me improve my coding and made me able to understand minor bags by myself.