Financial Econometrics Project – Elia Landini – Simon Mitrofanoff – Lorenzo Alessandro Uberti Bona Blotto.

Abstract

Introduction

A growing literature has been studying the effect of tariffs and the populist rise I protectionist policies in developed economies as an effective measure is boosting localized domestic GDP while reducing the competitiveness of foreign goods. In this project we look at the effect of tariff announcements, and implementation in the USA under the Biden , Trump presidencies and examine their comparative effect on European markets. The Average tariffs rate on all imports between 2020 and 2024 in the US was circa to 1.8%, since the second presidency of President Trump this has risen to 11.8% [[1]](#footnote-1). The European Union hasn’t been exempted from these hikes in Tariff Rates as it currently is paying an additional 15% Ad valorem tariff rate on US imports. [[2]](#footnote-2) The European Union is a current global mass exporter total exports being valued at $2.08 trillion dollars, of which circa to 21% ($ 571bn)[[3]](#footnote-3) is exported to the US this creates a high level of exposure to US tariffs implementations on European markets since exporters face higher costs and reduced demand, directly lowering output and profits in affected industries. This propagates through input, output linkages: intermediate goods producers, logistics, and suppliers also see weaker orders, depressing industrial production across countries. This exposure to Global Market instability as a direct link to US Tariffs coincides with or main research question, being how in effect do US Tariffs (via changes in bilateral U.S., EU trade) affect European industrial production, stock markets, and exchange rates?

This project employs monthly data in a panel framework covering the 27 European Union member states spanning between 2020 and 2025, with the end goal of being able to analyse the transmission of US trade policy shocks to the European economy and financial markets. We attempt to capture this effect by focalising on three distinctive dependent variables which aim to capture both the real, financial and external dimensions of exposure. To proxy for real economic activity, we use the Industrial Production Index (IPI), as indicators for market-based expectations and assets price adjustments, we will peg to the respective European stock index levels and returns; this is for the 11 European Countries with respective Stock Indexes. and finally in order to be able to effectively analyse the capital flow responses and exchange rate dynamics we are also using the bilateral USD exchange rate. We model the non-linear adjustment of these variables to U.S trade policy utilizing a Panel Smooth Transition Regression framework, whereby letting the transition variable (i.e. the regime) be the U.S. bilateral imports and exports with each European country. We decided to use this variable due toits ability to capture the characteristics of trade linages and therefore allow us to model the exposure of US tariffs and trade policy shifts, such that through letting the estimated coefficients to vary smoothly, the model will identify distinctive regimes correspond to periods of low and high US Tariff Pressure allowing us to garner a richer understanding of the non-linear propagation of trade shocks.

We isolate trade specific channels from broader macro-financial factors by employing country specific controls being: GDP per capita, Harmonised Index of Consumer Prices (HICP\_, and the unemployment while also layering over global controls that account for external financial commodity conditions, such as crude oil prices, the U.S nominal Broad Dollar index, CBPE Volatility index and US 10 yr Treasury yield.

Methodically, the project is intended to shed light on how US trade pressure transmit to European economies with the end goal being to gauge the effect of vulnerability of European markets to US tariff cycles and also to see whether the economic and financial responses differ between low and high exposure countries within the EU.

DATA and TRANSFORMS

In order to test to see the effect of US trade pressure and its propagation on real activity, financial markets and exchange rates we build a multi-country panel for European economies. We look at country level monthly data (dependent of each series) spanning from the early 1990’s to 2025. In order to cater to the PSTR model we define our transition variable to as the US general customs value of imports for each country, this is subdivided by the NAICS scores which describe the industry in which the imported goods originate from.

The main sources of data which we utilised were from EUROSTAT, Federal Reserve Economic Data (FRED), World Bank, Yahoo Finance and DBNomics.

We retrieved the IPI indicators, Unemployment figures and GDP from EUROSTAT, the proxy for real activity being production indicators for level 1 sectors, the triad: Mining (denoted as sector B), Manufacturing (sector C) and Electricity (sector D). This data was collected for 27 member states spanning over a period of the mid 1990’s to 2025 on a monthly basis. We also retrieved the country specific controls for including unemployment for each Eu member state, this data was originally presented on a quarterly basis which we then up sampled by converting the quarterly data into monthly. The unemployment data represented the percentage of the population in the labour force divided by age, class and sex. On top of this we also choose to use the HICP indicator, which is the harmonized index of consumer prices allowing for comparability across countries[[4]](#footnote-4). The data has already been treated with the following formula:

Which allows the data to be presented in the monthly data form of the annual rate of change (%). And finally the Quarterly GDP at current prices was also retrieved from Eurostat which was also disaggregated monthly data this one done in a similar fashion to the HICP with the end goal to increase then granularity of the data.

Now focusing on the data obtained from the FRED database; we used it to collect a good portion of the macro financial variables with the aim of providing a standardized, high frequency, and continuously updated U.S. and international financial indicators. We have set out a twofold objective with these series being: to construct the bilateral exchange-rate dependent variables for each European country with the idea of allowing us to analyse the external competitiveness and currency transmission to the Euro-Dollar market; and also to define the global financial control variables that capture worldwide monetary, risk and commodity price conditions which in turn affect all countries simultaneously. For all the series retrieved from FRED, we downloaded them in non-seasonally adjusted form and converted to monthly frequency align with the rest of our panel data set.

Foreign exchange section is constructed by using bilateral spot-exchange rates between the U.S. Dollar and the Euro as well as all non-euro using countries[[5]](#footnote-5), this ensures consistent directional convention, i.e. the price of one unit of local currency in U.S dollars. For the daily frequency exchange rate, the summary of the which data series we utilised can be found in the table in the appendix [Insert FRED series Table]. For the daily frequency exchange rate series such as the DEXUSEU and DEXSDUS, we aggregated the monthly means using <<resample(“M”).mean>>, which acts as a ‘smoother’ of short-term volatility and allowed us to match the monthly structure of macroeconomics indicators. We also retrieved some series in the inverse direction i.e. the SEK per USD and DKK per USD, these for simply inverted as follows:

This would give us the common convention of “US dollars per local currency”. Furthermore, although intuitive, we replicated the euro rate across all euro adopting currencies. We then standardized each data set into three columns denoted by country, time and the USD – Local Spot Exchange rate.

We also utilised the FRED database to retrieve the set of global control variables intended to proxy for the worldwide macro-financial conditions relevant to the respective European economies. These we the ‘MCOILBRENTEU’ Brent Crude Oil Price, measured in US dollars per barrel and used to represent the energy market stock prices, ‘TWEXBGSMTH’, the nominal Broad US dollar index as way to summarize the overall strength of the dollar relative to the global trading partners; ‘DGS10’ which is the Market yield on US 10 year Treasury Rate Bonds as a proxy for the global interest-rate and risk free yield movements; and finally the ‘VIXCLS’ which is the CBOE Volatility index (VIX) as a measure of global risk sentiment and financial market uncertainty. These series have all be aggregated to monthly averages, ensuring that the time consistency across our sources is maintained, we choose not to seasonally adjust or detrend since these variables are inherently cyclical and they are meant to capture the contemporaneous macro-financial environment. The aggregation step was intended to reduce high-frequency noise while preserving trend information suitable for the PSTR modelling we are applying, which is centred around regime shifts rather than daily fluctuations.

Yahoo finance API, which provides publicly available price and volume information for the major country stock indices. We use these retained series to capture the financial market responses of European economies responses to US trade pressure, complementing the real and external indicators obtained from EUROSTAT and FRED. For each country, monthly closing price and traded volume was extracted between 2015 to 2025. This was done for all European economies with an active stock exchange.[[6]](#footnote-6) For datasets with Multindex columns these were flattened into a single index for consistency and renamed to the relevant variables, this was done to allow us to directly merge with the pre-attained macroeconomic and financial controls. Furthermore, Yahoo Finance reports index prices in local currencies, hence we converted everything to be expressed in US dollars to maintain the comparability with the rest of the FRED and trade variables. The closing price (USD) variable is the stepping stone to the construct the monthly log returns:

Which measures the percentage monthly change in the national stock index for country i. The log returns are then used as one of the dependent variables within the PSTR to capture how equity markets react under different regimes of US trade exposure. We decided that we wanted to include the volume column within our data frame for stocks, as a way to represent the number of securities trades during the month, as a measure of completeness but we handled this with a caution since within the data frame for some countries there were missing observations due to inconsistent reporting. In such cases, volume is excluded from the overall econometric analysis. These stock-index series for the 11 available countries are intended to provide a forward-looking financial indicator sanative to macroeconomics expectations, competitiveness, and policy uncertainty. Their inclusion alongside industrial production exchange rates and trade indicators ensures that both real and financial channels of adjustment to US tariff shocks are jointly analysed.

The regime variable as mentioned before, is the US imports from European Union Member states, obtained from the US international trade commission (USITC) Dataweb. This data reports the general customs value of goods imported into the United States by country of origin, industry classification and month. We manually extracted the series corresponding to January 2020 to December 2025. ‘Import General Customs Value’ is a measure for the total declared import value, which is the relevant magnitude for trade policy analysis since the U.S tariffs apply to the customs value of goods rather than to their physical quantity.

We disaggregated imports according to tom the ten 4-digit NAICS (North American Industry Classification System) codes [see table in appendix]. This level of industrial detail allows the dataset to capture heterogeneity between sectors. The dataset is decomposed into a country, industry, month triplet (i,j,t) where I denote the export EU member state, J the respective NAICS, and t the time index. We standardised this data by renaming codes and correcting country codes and by sorting by the triplet for reproducibility. No transformations were applied to the nominal USD values in order to maintain the level of information for the tariff-intensity measurement.

If we look at this from an economic standpoint, the series captures the degree of bilateral trade integration and exposure of U.S trade policy. Hence, we can interpret its as, a high import value indicates a strong trade intensity and hence greater sensitivity to US import value (transition variable), determining the US exposure regime. The PSTR model thus allows the elasticities of the dependent variables to vary smoothly between low pressure and high-pressure trade regimes.

We transform this variable for the estimation side by taking its natural logarithm:

And we lagged this by one period to mitigate the simultaneity bias and reflect the short reporting delay in international trade statistics. We believe that this data was particularly suited to identify trade-regime shifts because it directly measures real policy exposure instead of tariff rates or qualificative indicators. By combing this temporal and cross-country variation in import intensity, it should provide a continuous signal of the US-EU trade relationship tightness, which is precisely what the PSTR framework exploits to model nonlinear and state dependent economic responses.

[TARIFF EXPLANATORY VARIABLE SECTION]

Model and Specification

We study whether the effects of global/macro controls on European outcomes vary non-linearly with the intensity of US trade exposure. We are going to follow strongly the model and specification detailed by Teräsvirta, 2004. [[7]](#footnote-7) and adapt it slightly in order to account for our study specifications.

The proposed regression that we are intending to run is detailed below:

Where:

: Vector of Dependent Variables (IPI growth, Stock Return, USD exchange rate)

: main regressor which is capturing the change in tariff pressure

: vector of control variables (GDP, HICP, Unemployment etc)

: logistic transition function with two location parameters (i.e m=2)

: Country fixed effect

: time fixed effects

: error term

The Logistic transition function being:

Where:

: is the transition variable (standardized log of U.S imports from country i )

: smoothness parameter, higher values imply sharper transitions

: location parameters determining the range of import exposure where the slope of the tariffs index changes the most.

The specification detailed above allows us to interpret it such that: for the distinct three trade exposure regimes (being low, medium, high): low sensitivity of European outcomes to US tariffs are apparent when (), intermediate regime where the coefficients will evolve smoothly, i.e denoting medium exposure, is when and logically strong trade linkages, where tariffs have the greatest effect when ) denoting the prevalence of high exposure.

Where the coefficients should be interpreted as the being the marginal effect of the tariff index when trade exposure is low, is the change in the marginal effect of the tariff index as exposure moves between the respective regimes due to the interaction with the term, is the baseline effect of the control variables with being the variation of these effects under high US trade exposure.

Our proposed methodology

Appendix Graphs and Tables

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1. Statisita - https://www.statista.com/statistics/1557485/average-tariff-rate-all-imports-us/ [↑](#footnote-ref-1)
2. Atalantic Council Tariff Tracker - <https://www.atlanticcouncil.org/programs/geoeconomics-center/trump-tariff-tracker/> [↑](#footnote-ref-2)
3. Trading Economics - https://tradingeconomics.com/european-union/exports-by-country [↑](#footnote-ref-3)
4. https://ec.europa.eu/eurostat/web/hicp [↑](#footnote-ref-4)
5. Bulgaria ( Bulgarian Lev), Sweden (Swedish Krona), Denmark (Danish Krona), Czech Republic (Czech Koruna), Hungary (Hungarian Forint), Poland (Polish Zloty) and Romania (Romanian Leu) [↑](#footnote-ref-5)
6. ATX (Austria), BFX (Belgium), PX (Czech Republic), OMXC25 (Denmark), OMXH25 (Finland), CAC 40 (France), DAX (Germany), ISEQ (Ireland), FTSE MIB (Italy) and IBEX 35 (Spain). [↑](#footnote-ref-6)
7. Gonzalez, Andres & Terasvirta, Timo & van Dijk, Dick. (2005). Panel Smooth Transition Regression Models. 604. [↑](#footnote-ref-7)