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THE RESPONSE OF NET EXPORTS TO IMPORT TAXES

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Abstract: *This paper evaluates the hypothesis that there is an insignificant relationship between net exports (NX) and import tariffs. By analyzing the relationship between import tariffs and NX for 78 countries from 1970 to 2024, I find that there is a negative and significant relationship between import tariffs and net exports for a global sample and a sample that excludes Africa, Europe, and Latin America and the Caribbean. Two empirical methods are utilized to deal with intellectual uncertainties about data adequacy and parameter estimates: (i) a frequentist regression model that is less suitable for sampling adequacy and stable parameter estimates, and (ii) a Bayesian alternative for credible intervals and sampling adequacy. The paper finds that scatter plots have the potential of generating credible economic misperceptions by diachronic transmissions. The paper concludes that the hypothesis fails to provide general theoretical appeal.*

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Key words: Bayesian theory, Bootstrapping, Equal-Tailed Intervals, Highest Density Interval, Import taxes, Net exports, Scatter plots, Posterior predictive density

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I. 1INTRODUCTION

This paper evaluates the hypothesis that there is an insignificant relationship between net exports (NX) and import tariffs. By analyzing the relationship between import tariffs and NX for 78 countries from 1970 to 2024, I find that there is a negative and significant relationship between import tariffs and net exports for a global sample and a sample that excludes Africa, Europe, and Latin America and the Caribbean. Two empirical methods are utilized to deal with intellectual uncertainties about data adequacy and parameter estimates: (i) a frequentist regression model that is less suitable for sampling adequacy and stable parameter estimates, and (ii) a Bayesian alternative for credible intervals and sampling adequacy. The paper finds that scatter plots have the potential of generating credible economic misperceptions by diachronic transmissions. The paper concludes that the hypothesis fails to provide general theoretical appeal.

The paper is structured as follows: (i) Methodology, (ii) Empirical findings and (iii) Conclusion. The methodology section provides information about variable selection and the source of data (information). The preconditions for misperceptions of scatter plots are discussed, followed by discussions of regression and Bayesian analyses. The shortcomings of frequentist estimates (apart from the utility of such models) are juxtaposed against the Bayesian paradigm of credible intervals and varying parameter estimates. The section highlights the importance of economic theories during moments of intellectual uncertainties.

A sample of 78 countries is broken down into regional and non-regional subdivisions to test the general applicability of the fundamental hypothesis (its validity). Countries in Africa, LAC, and Europe are considered for the inquiry. Because the frequentist method is less suitable for such an exercise, a Bayesian method that is insensitive to sample sizes and precise parameter estimates is utilized to augment the OLS for better results and stability of estimates.

The empirical findings of the paper are reported in Section III. The findings of regression analysis account for small and significant variations in NX as a result of import taxes for the general sample and the sample that excluded countries of Africa, LAC, and Europe. After establishing the possibility of a negative and significant relationship between import tariffs and NX, the results of Bayesian credible intervals are presented for the general sample and the relevant regions. A conclusion is presented at the end of the paper.

2. METHODOLOGY

The paper uses two variables to evaluate the prevailing hypothesis that there is no significant relationship between tariffs and net exports, a credible economic misperception that can be derived from less revealing scatter plots. This section incorporates some basic macroeconomic models that have been provided by Mankiw (2010), Blanchard and Johnson (2013), and Van den Berg (2016) to appropriately position the discussions of NX.

2.1 The data and variables

The data for this research have been collected from the World Bank's World Development indicators (2025). Two variables are of special interest to evaluate the hypothesis that there is no significant relationship between net exports (NX) and import taxes: (i) The weighted mean tariff rate applied to all products as a percentage, and (ii) Net exports. The time series data consist of information from 1970 to 2024, but the series were eventually transformed into cross-sectional data for 78 countries that are listed in the appendix to this paper. However, information about taxes became available from the late 1980s.

The tariff rate is defined as:

Weighted mean applied tariff is the average of effectively applied rates weighted by the product import shares corresponding to each partner country. Data are classified using the Harmonized System of trade at the six- or eight-digit level. Tariff line data were matched to Standard International Trade Classification (SITC) revision 3 codes to define commodity groups and

import weights. To the extent possible, specific rates have been converted to their ad valorem equivalent rates and have been included in the calculation of weighted mean tariffs. Import weights were calculated using the United Nations Statistics Division's Commodity Trade (Comtrade) database. Effectively applied tariff rates at the six- and eight-digit product level are averaged for products in each commodity group. When the effectively applied rate is unavailable, the most favored nation rate is used instead. (WDI, 2025).

The data for NX are derived from exports (X), imports (I), and national income (Y) at current prices to ensure standardization. Therefore, NX is denoted as (X-I)/Y in the paper, partly because the computation of national income does not exclude services. As such, taxes may be underreported when taxes on services are excluded from these types of studies.

Imports of goods includes change in the economic ownership of goods from non-residents to residents of the compiling economy, irrespective of physical movement of goods across national borders. Imports of services includes services provided by non-residents to residents. This indicator is expressed in current prices, meaning no adjustment has been made to account for price changes over time. This indicator is expressed in United States dollars (WDI, 2025).

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Gross domestic product (GDP) is a measurement of a country's national income. Since some countries are richer than others, it is important to control for variations in national wealth for standardization of measurement and econometric interpretation of results to ensure consistency without bias. The NX-GDP ratios facilitate standard measurements and unbiased estimates.

Gross domestic product is the total income earned through the production of goods and services in an economic territory during an accounting period. It can be measured in three different ways: using either the expenditure approach, the income approach, or the production approach. This indicator is expressed in current prices, meaning no adjustment has been made to account for price changes over time. This indicator is expressed in United States dollars (WDI, 2025).

Two estimating methods assist the empirical inquiry: (i) The basic frequentist ordinary least squares (OLS) regression model, and (ii) The much more involving Bayesian probability assessments beyond specific parameter estimates and data limitations. Helpful discussions of the Bayesian methodology can be found in Lynch (2007), Makowski et al. (2019), and Carlberg (2022). In effect, this study adopts a two-pronged approach: (i) The study of a random sample of countries from all over the world, based on available information, and (ii) A decomposition of the sample into regional cohorts—Africa, Latin America and the Caribbean (LAC), Europe, and a residual sample—to check for regional variations of the fundamental hypothesis. Evidently, the latter objective is less suitable for frequentist inquiries because of data limitations. The Bayesian approach augments that limitation (constraint). The next sub-section examines some intriguing scatter plots that generate credible economic misperception—the basis of this paper (or inquiry).

2.2 Intriguing scatter plots

What are scatter plots? Scatter plots are illustrations that use data points to evaluate the relationship between two variables at a time. The illustrations are usually intended to identify positive and negative relationships, or neutrality between the variables of choice. Without penetrating analysis of data, scatter plots can cause perpetual iterations of errors that trigger credible economic misperceptions.[1]

[1] A credible economic misperception is premised on an initial spurious economic assertion (or finding) that generates a large following and persistence of thought (a diachronic transmission) because of a false plausibility (plausible deniability). Misperception can be reinforced by socio-economic and cognitive biases, resulting in intellectually and socially harmful consequences that are not necessarily deliberate.

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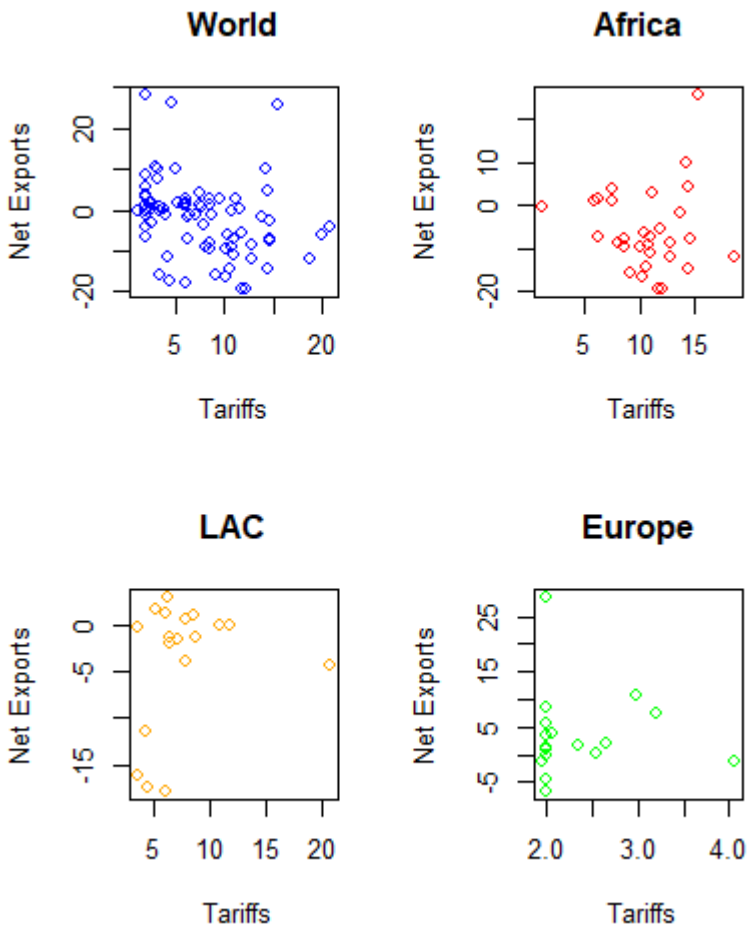

Figure 1: Scatterplots of Averaged Net Exports and Import Tariffs (1970-2024)

Consider Figure 1. It is promptly enticing to conclude, by visual inspection, that there is no relationship between net exports (NX) and import tariffs, an assertion that could easily be replicated. Yet when it comes to a closer examination or investigation of the *World* data, one can actually conclude that there is a negative and significant relationship between NX and import taxes. Indeed, such a finding remains unchanged for a controlled sample that excludes Africa, LAC, and Europe. I examine the functional relationship as a preliminary inquiry.

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2.3 Regression models and frequentist assumptions

The theoretical purpose of regression analysis is to establish a relationship between dependent and independent variables by minimizing error sum of squares. Ultimately, a researcher is interested in the response of dependent variables to incremental (marginal) changes in independent variables (slope coefficients). The changes can be significant or insignificant (see the t-tests). The proper specification and significance of a model could also be tested (F-test). There are some regularity conditions that must be met to achieve best linear and unbiased estimates.[2] Equation 1 specifies a generic regression model:

$$y_i = \beta_0 + \sum_{j=1}^{k} \beta_j x_{ij} + \varepsilon_i ; \quad (1)$$

where y_i is a dependent (or response) variable for observation (i),

β_0 is the intercept value, the mean value of y when all x variables are zero,

$\sum_{j=1}^{k}$ is a summation operator that represents the presence (value) of all the predictor variables and their respective coefficients from j=1 to j=k,

β_j is the regression coefficient for the *j*-th independent (or predictor) variable, representing a change in the dependent variable for an incremental (one-unit) change in the *j-th* predictor variable when other variables in the specification are conditioned to be invariant (unchanged),

x_{ij} is the value of the *j-th* independent variable for observation *i*, and ε_i is the stochastic error term for observation *i*, representing the difference between the observed value of y_i and $\hat{y}$ (the value predicted by a model). The error term is usually presumed to be independent of the coefficients of the predictors and normally distributed with a zero mean and constant variance.

[2] See Gujarati and Porter (pp. 188-190) for a concise review of the OLS assumptions, including linearity in parameters, homoskedasticity, and autocorrelation; see also Studenmund (pp. 84-91). The expectations of a best linear and unbiased estimator (BLUE) must be met for regression results to be credible (gain external validity).

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The model requires assumptions for it to produce the best linear and unbiased estimates. However, some of the restrictions are inapplicable to this two-variable (bivariate) model that targets a fundamental and precise hypothesis. For example, issues of autocorrelation, heteroskedasticity, and multicollinearity have been avoided. The variables have been transformed to ensure homoskedasticity of estimates by using variables that are denominated in national income and weights. The results of the bivariate regression are presented in Table 1.

II(d) The Bayesian theory

To deal with conceptual uncertainties, the basic Bayesian probabilistic proposition can be stipulated as follows:

$$p(\theta \mid \lambda) = \frac{p(\lambda \mid \theta) p(\theta)}{p(\lambda)}; \quad (2)$$

where the probability of observing the value of NX (θ), given the data on import taxes (λ), is equal to the likelihood function multiplied by the marginal probability of the targeted parameter (θ). The ultimate Bayesian objective is to derive a posterior predictive distribution (PPD) (the left-hand side of Equation 2) by maximizing the product of the likelihood function and the marginal probability of the targeted parameter. The PPD results are presented in the next section.

The sampling density of the data, $p(\lambda)$, is a constant, thereby making it a good candidate for a density function that is proportional to the likelihood function. The likelihood function evaluates the probability of observing the data, given the hypothesis, $p\ (\lambda \mid \theta)$, to ultimately determine the

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maximum likelihood.[3] This is a bit reassuring when data are unreliable or inadequate. The prior distribution augments the likelihood function.

Priors are also probability distributions of the beliefs that are held before observing the data. Of course, researchers can plead ignorance, or they can use informed priors that are based on prior research but unrelated to the targeted data. Not all priors are alike.[4] A Gaussian prior has been utilized for this paper, partly because of its attractive properties as well as the nature of this research (see also Figure 2). Since the sampling density of the data is constant, Equation 2 also defines a proportional relationship between the posterior and the likelihood (proportional likelihood) function:

$$p(\theta \mid \lambda) \propto p(\lambda \mid \theta). \tag{3}$$

Equation 3 is an algorithm for updating prior beliefs about the hypothesis (or parameter) via Markov Chain Monte Carlo (MCMC) or bootstrapping procedures (in this case) as more information becomes available. The posterior distribution has some proforma methods of estimation.[5]

[3] The likelihood function represents a joint probability of events conditional on θ (the parameter). The function is maximized by taking its derivative with respect to the relevant parameter (θ) and setting it to zero since the slope of a curve is at 0 when it is at its peak.
[4]For example, there are Laplace, Gaussian, Lasso and Ridge priors.

[5] Posterior Precision (PP)= $\left(\frac{1}{\sigma_p^2}\right)+\left(\frac{1}{\sigma_\lambda^2 * n}\right)$, where the variance is for the posterior (p) and data (λ) respectively and n is for the sample size, posterior mean=$\left(\frac{\bar{X}}{\sigma^2}\right)_p+\left(\frac{\mu_s}{\sigma_\lambda^2}\right) / PP$, and posterior variance = 1/PP. The PP represents the degree of certainty or information in the posterior distribution that summarizes prior knowledge about a parameter after observing data.

Unlike the regression results of Table 1 that target a specific parameter estimate, for example, -0.57, or precise parameter estimates like the mean percentage values of net exports (2.45 and 8.05), the Bayesian approach targets a credible interval within which a parameter value could be situated with a reasonable degree of probability. Specific estimates can become moving targets within a precise range of probabilities. The Bayesian approach is attractive for a variety of reasons, but at least three significant ones are relevant to this research: (i) It does not depend on variations in sample sizes or the adequacy of sample sizes (scientific simulations of information or data generate data in dynamic forms, bootstrapping); (ii) Its empirical results (estimates) are probabilistic, and (iii) It accommodates dynamic possibilities of variations in parametric estimates. Therefore, the Bayesian approach tackles some of the major problems that are associated with regression analysis.

Three critical dimensions underpin the Bayesian approach: (i) An apriori scientific rather than arbitrary belief of the subject of inquiry (a prior) (though the belief could be ignorant as well); (ii) The available data; and (iii) An update of prior information based on new information to remediate the presence of ignorance and errors. The dynamic process leads to a posterior distribution within which a parametric estimate is expected to fall (a credible interval). The Bayesian findings are reported in Table 2 and Figure 4 to compensate for the inadequacy of the frequentist regression results.

The Bayesian priors can be derived from economic theories (social and scientific knowledge); for example, a basic open macroeconomic identity offers a lot of information about international trade and predictive effects of taxes on international trade and aggregate consumption. Consider the basic open macroeconomic identity that is nominally measured by the aggregate expenditure model (Equation 4):

$$Y=C+I+G+NX; \quad (4)$$

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where *Y* is for the value of aggregate nominal income, *C* is for household consumption, I is for investment spending, *G* is for government spending, and *NX* is for net exports (the fundamental controversy that this paper is intended to address). Of course, it is more meaningful to conceptualize the determinants of the variables in the identity as follows:

(i) Household consumption is a function of disposable income (*Y-T*); where *T* is for taxes.

(ii) Investment is a function of interest rate (*r*) (real, more so than nominal),

(iii) Government spending is contingent on parsimony, extravagance, national revenue, and political compromise or hostility.

(iv) Net exports are usually limited to exchange rate (e), but in more realistic terms, to a range of domestic and international variables that are associated with domestic and international consumption, investments, the real exchange rate, and trade policies, including import taxes (for example, see Van den Berg, p. 345).

Equation 4 can be expanded to visualize the effects of taxes on household consumption and government expenditures:

$$Y = \beta(Y - T) + I + G + NX; \tag{5}$$

where β is a sensitivity parameter that captures the marginal propensity to consume (MPC). Equation 5 can also be modified to capture the sensitivity of national income to changes in household consumption and government spending or revenue (exogenous factors).

$$\begin{aligned} &Y(1-\beta) = -\beta T + G... \\ &Y = \left(\frac{1}{1-\beta}\right)[-\beta T + G]. \end{aligned} \tag{6}$$

$$\begin{aligned} &\frac{\partial Y}{\partial G} = \frac{1}{1-\beta} \\ &\partial Y = \left(\frac{1}{1-\beta}\right) * \partial G. \end{aligned} \tag{7}$$

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$$\frac{\partial Y}{\partial T} = \frac{1}{1-\beta}$$
$$\partial Y = \left(\frac{-\beta}{1-\beta}\right) * \partial T. \quad (8)$$

Preliminary deductions from Equations 7 and 8 indicate that household consumption and government spending are unavoidably dependent on the direction of assessed taxes. A change in taxes, such as a tax increase, adversely depresses disposable income, leading to lower consumption of domestic and foreign goods, where the partial symbol defines the changes in national output with respect to changes in government spending (G) and taxes (T).

In an open economy, exports and imports depend on all of the domestic and foreign variables that influence the components of domestic and foreign aggregate demand such as C, I, G, C*, I*, G*, ε, TPOL, and *TPOL**; where ε is for the real exchange rate, *TPOL* is for trade policies, and the asterisks are for the foreign variables (Van den Berg, p. 345).[6]

I have discussed the law of sanctions and international trade (Warburton, 2016), welfare and production effects of international trade (Warburton, 2017), and trade disputes and politics (Warburton, 2021, pp. 408-25) elsewhere. Invariably, apart from import tariffs, these issues significantly affect NX in diverse ways that are consistent with the regression results of Table 1 (the insufficient amount of explained variations in the dependent variable). Consequently, the hypothesis that the effects of import taxes on NX are insignificant instantly conflicts with a prior belief of impediments to trade (a potential Bayesian prior).

[6] For the sake of brevity and relevance, discussions about savings and investment, or the association of deficits with import taxes are beyond the scope of this paper. For further discussions of the fundamental macro identity see Mankiw, pp.27-28, and pp.60-67, Blanchard and Johnson, pp. 56-58, Sachs and Larrain, pp. 149-180, and Van den Berg, pp. 340-7.

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Are primitive scientific beliefs about taxes and NX (consumption) spurious? Bayesians would argue that even primitive scientific beliefs can be updated to provide better estimates for the stability of unsettled arguments and glaring uncertainties. Evidently, instructive economic theories (discussed earlier) provide significant guidance for shaping apriori beliefs. Apart from the incontrovertible tax-consumption nexus, it is reasonable to presume that the value of NX approximates a normal distribution (see Figure 2).

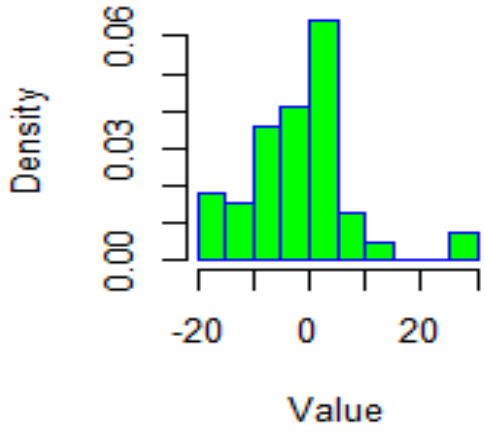

Figure 2: Global Probability density of NX

The frequency distribution of the *Global* NX repurposes the data for a clearer perspective of the distribution (density) of the data based on class sizes of NX. The selection of an appropriate prior density distribution becomes a salient issue. That is, it will be inappropriate to select a binomial prior instead of a Gaussian prior when the issue at hand is not dichotomous. The empirical findings of this paper are reported in the next section.

3. EMPIRICAL FINDINGS

The specification of NX as a function of exchange rates is pervasive. Yet it is logically conceivable to see why tariff-induced depreciations of domestic currencies can also affect net exports (review the effects of trade policies, TPOL, in the previous section). The problems and

limitations of regression analysis make Bayesian analysis a useful alternative to OLS because of the flexibility and adaptability of the Bayesian method to parametric challenges.

For the global sample, the amount of variation in NX that is explained by import taxes (0.09%) is small but very significant (see also the t-stat and F-Stat for parameter value and model specification respectively) (recall the discussion of the determinants of NX in the previous section). However, the explained variation increases significantly to 0.26% when countries from Africa, LAC, and Europe are extracted from the global sample, suggesting that there must be a mixture of countries, including Australia, Canada, Pakistan, and the US, for which import taxes will have significant impact on NX. The mixed empirical results strongly indicate that the fundamental hypothesis of no association between import taxes and NX fails to secure a general theoretical appeal.

Table 1: OLS Regression of NX and Import Tariffs

Dependent variable: Net exports
Independent variable: Weighted import taxes[ψ]

	NX Mean	NX Response	t-Stat (p-value)	F-stat (p-value)	Sample Size	R^2
World	2.45	-0.57	-2.7 (0.00)**	7.27 (0.009)**	78	0.09
Africa	-5.57	-0.008	-0.04	0	30	0
Latin America & Caribbean	-7.16	0.44	1.06	1.13	18	0.07
Europe	4.17	-0.25	- 0.07	0	17	0
Others	8.05	-0.72	-1.7*	3.08*	13	0.26

Note: Others= Australia, Bangladesh, Brunei Darussalam, Canada, China, India, Indonesia Japan, Korea, Rep., Malaysia, New Zealand, Pakistan, and the United States.
ψ Weighted import taxes on goods and services as a percentage of national income at current US dollars (see variable description in the methodology section)
* Accommodating 10% of frequentist error.
** Accommodating less than 5% of frequentist error.
Data source: World Bank's World Development Indicators (WDI) (2025)

Though the findings of regression models at granular (regional) levels are less appealing, a diversity of samples could strongly support the empirical argument (or hypothesis) that there is indeed a negative and significant relationship between import taxes and NX. Aforesaid, the exogenous factors impinging on international trade are diverse and refractory. Yet this study has focused on the functional relationship between net exports and tariffs to avoid some very noisy intrusions.

Significantly, Africa and Latin America are heavily dependent on imports because of excess capacities, the quality of governance, and structural asymmetries (or rigidities) since the 1960s (or even earlier). The irregularities have also accounted for excessive sovereign indebtedness within the regions. Therefore, countries in these regions are unsurprisingly import-oriented (they run current account deficits, mainly for short-term consumption) even with marginal increases in tariffs that also reduce their trade balances.

In the presence of intellectual uncertainties, a natural inclination is to pursue probabilistic inquiries about data insufficiency and parameter estimates. The results of the Bayesian approach, discussed in the previous section, are presented in Figures 3 and 4, and Table 3. Table 2 provides a summary of prior estimates to test some primitive assertions based on information from 1970-2024 rather than the entire sample (an expedient derivation of prior beliefs in the absence of redeeming alternatives). The results are generally counterintuitive, except for Africa and LAC, partly because of the mean values and variations in the data of the prior. A prior for the *World* data was not considered because of lack of variation. Importantly, information about taxes was generally unavailable until the late 1980s and thereafter. The results of a 95% credible interval are reported for all probability densities.

Table 2: Data and prior expectations of Net Exports (1970-2024)

	Mean	Standard	Prior	Prior Standard

		Deviation	Mean	Deviation
World	-2.28	9.64	..	..
Africa	-5.76	9.5	-5.8	11
Europe	3.58	7.79	2.5	7.8
LAC	-3.86	6.89	-4	6.75
Others	2.68	8.7	2	5.5

Note: Data for prior expectations are derived from information between 1989 and 2005 to reduce undue arbitrariness.
Data source: World Bank's World Development Indicators (2025).

There is a closeness of prior estimates to real data in the case of LAC. The posterior predictive distribution uses a Gaussian distribution in this case (see also Table 2). Additionally, restrictions are imposed on the mean values. Figure 4 corrects for the limitations or shortcomings of the previous regression analysis.

The results of Table 3 and Figure 4 are derived from posterior predictions of a Bayesian model, incorporating the mean and slope of Table 1. Gaussian priors are utilized to provide relatively stable results about the relationship between NX and import taxes. The Gaussian prior keeps parameter values close to the mean in a manner that is also consistent with the maximum likelihood of obtaining parameter estimates or the actual data.

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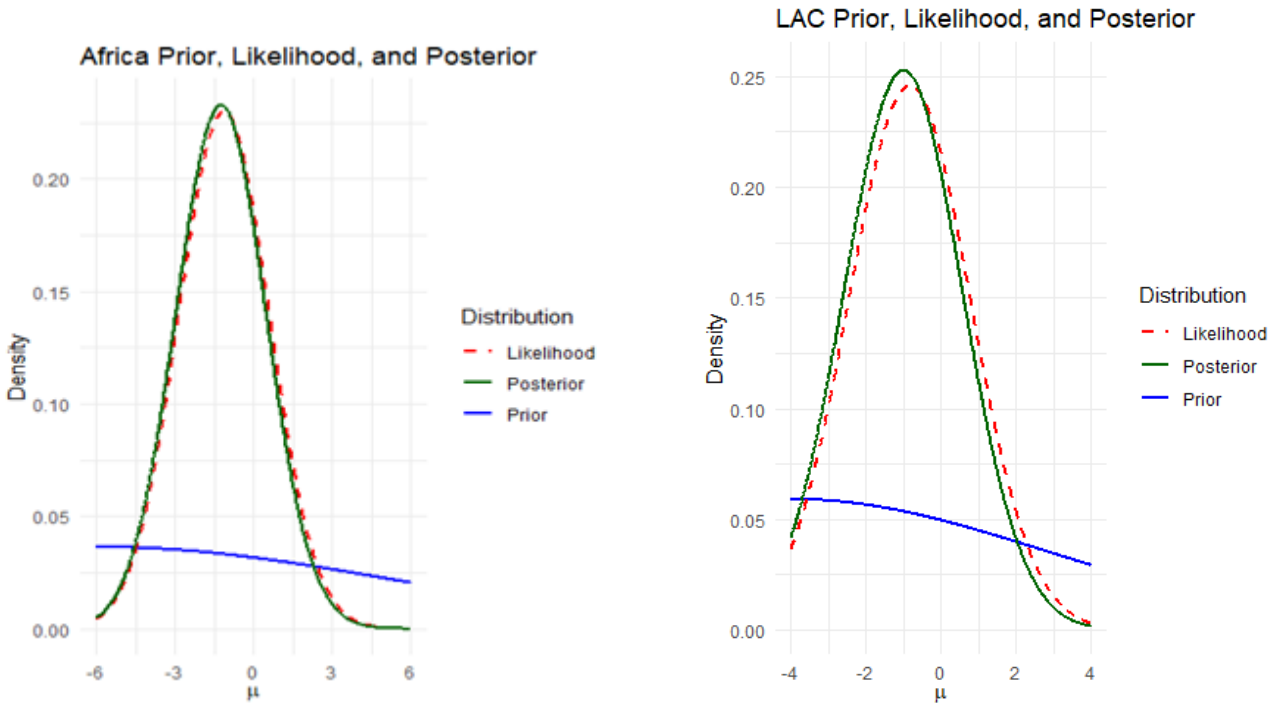

Figure 3: likelihood and posterior distributions for Africa and LAC (no credible intervals)

Credible Intervals usefully redefine parameter uncertainty. Having concluded that there is a negative and significant relationship between import taxes and NX, it should be interesting to know, with a reasonable degree of credibility, the effect of tax increases on net exports during normal times. For example, a frequentist might conclude that a 1% increase in import taxes could reduce NX by 0.57% (see Table 1).[7] The frequentist estimate translates to about 3.75% impact on NX (3.75 ≈ 2.45 – 2.28* -0.57); see Tables 1 and 2. An alternative approach is to find am interval within which a parametric estimate is likely to fall with a reasonable amount of probability (credibility) and without constraining and shifting sample sizes. The lower and upper bounds are

[7] Notice that the variables are already operationalized in percentages and that a double log specification is redundant. It should also be noteworthy that the estimation is contingent on variations of sample sizes.

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estimated to be 2.2 and 2.6 respectively (see Figure 4 *Global* Posterior predictive distribution, PPD).

Accordingly, the Bayesian inference provides a distribution of possible values (effects) known as a "posterior distribution," with sensitivities to the density of the distribution. Conventionally, given the observed data on import taxes, the effect of import taxes on NX have a 95% probability of falling within the credible interval (if a 95% credible interval is subsumed) (see Figure 4).[8]

Figure 4 estimates two popular forms of Bayesian credible intervals, the Highest Density Interval (HDI) and the Equal-Tailed Intervals (ETIs). The HDI identifies the highest posterior density interval, which is comparatively narrower and expected to contain the real/true parameter value based on prior beliefs and the corresponding data. All points within the band have a higher probability density than points outside the interval.

Table 3: Posterior predictive distribution of NX

	Mean PPD	SD	10%	50%	90%	Obser-vations	Sampling	Stability $\hat{R}$
World	2.4	0.1	2.3	2.4	2.6	100	4000	1
Africa	-5.5	0.1	-5.7	-5.5	-5.4	100	4000	1
LAC	-7.1	0.1	-7.3	-7.1	-7.0	100	4000	1
Europe	4.2	0.1	4,1	4.2	4.3	100	4000	1
Others	8.1	0.1	7.9	8.1	8.3	100	4000	1

[8] Makowski et al., and Kruschke raise some very interesting issues about credible bands, suggesting that 89% probability could be equally attractive and significant without the adoption of the 95% probability that had dominated the frequentist tradition. Kruschke (2014) finds that 95% probability might not be stable for Bayesian posterior distributions without enough sampling simulations (less than 10,000). However, diagnostic tests can help to establish stability (see *R hat* of Table 3); see Makowski et al. for discussions about the merits and demerits of selecting the probability benchmarks.

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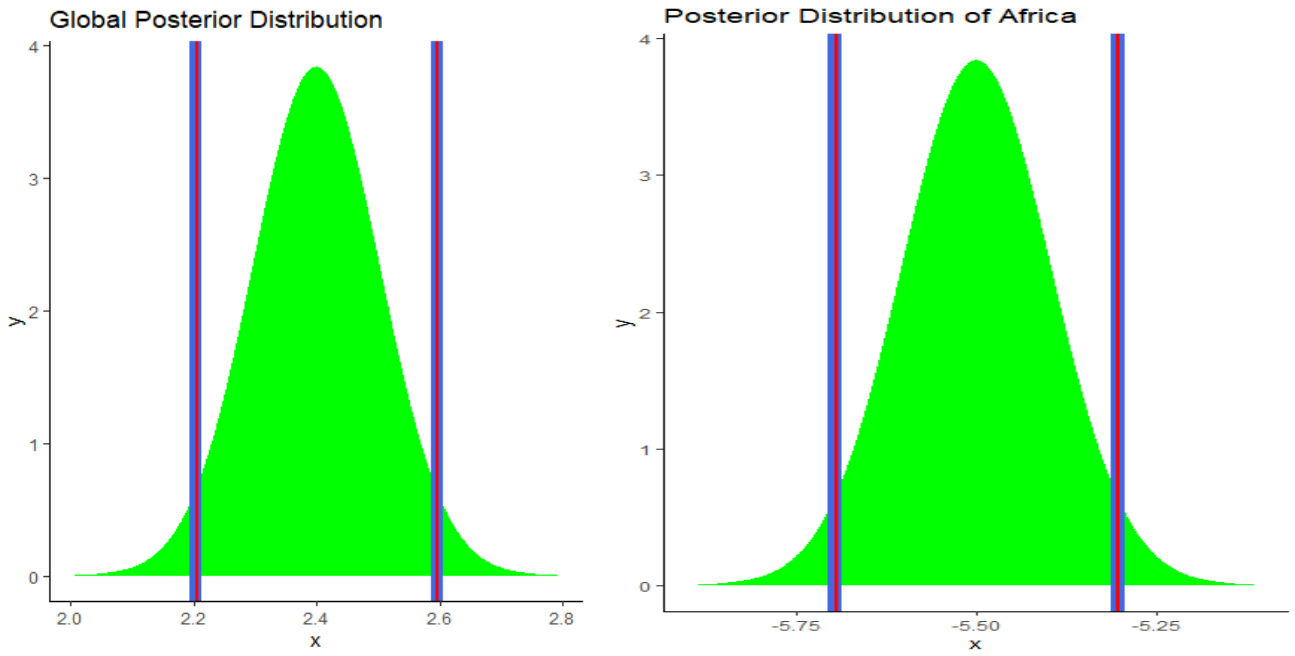
Note: PPD= Posterior predictive distribution (density); SD = standard deviation. *R hat* is a stability measurement to ensure that the values of the parameters are stable (credible) and not spurious (this value must be less than 1.1). LAC= Latin America and the Caribbean.
A programming language (R) is used to derive all Markov Chain Monte Carlo (MCMC) simulations (of the bootstrap rather than parametric bootstrap variety) from a Bayesian model with a Gaussian prior distribution.[9] The 10%, 50%, and 90% percentiles are the values below which 10%, 50%, and 90% of the distribution's mass lies respectively. There is a 90% probability that future observations of NX will fall below 2.6% as a result of import taxes in normal times. The seemingly small margins tend to generate insignificant relationships between NX and taxes in normal times.
Data source: World Bank's World Development Indicators (WDI) (2025).



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[9] The parametric bootstrap variety does not rely on original data for iterated sampling. The data are automatically generated, usually with a seed number for multiple samples.

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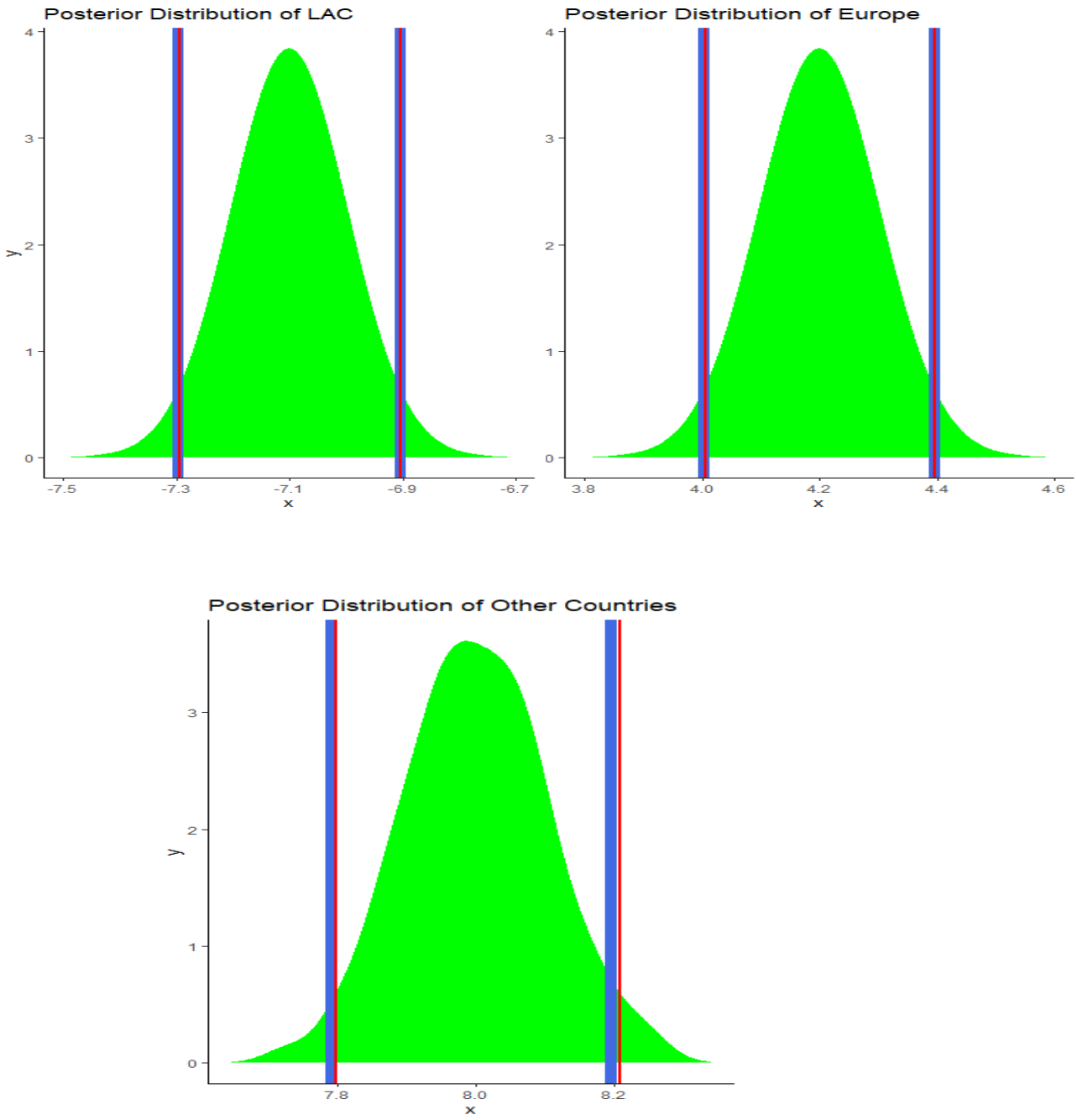

Figure 4: Posterior distributions of the world, including sampled regions

Note: The world = 2.2 and 2.6, Africa = -5.75 and -5.25, LAC= -7,3 and -6.9, Europe 4 and 4.4, and others =7.8 and 8,2. Makowski et al. (2019) provide a reliable R programming language for posterior distributions that has been slightly modified to accommodate differences in posterior predictive values and aesthetics.

The ETI eliminates about 5% (2.5% on each side or percentile distributions of 2.5 and 97.5%) of the distribution, thereby creating a wider band by default. The distribution of expected results are technically invariant. The range of possible adverse effects of import tariffs on net exports fall within very narrow and virtually inseparable HDI and ETI credible bands (usual in symmetric distributions, Makowski et al.); see the credible results of Figure 4 for a 95% percentile distribution. The horizontal axes report the lower and upper bounds (range of possible effects of taxes on NX) for the *World,* Africa, LAC, Europe, and Others in the sample (see the Appendix).

4. CONCLUSION

This paper cannot find general and convincing evidence that there is an insignificant relationship between NX and tariffs. Preliminary analysis reveal that scatter plots can provide misleading results when they are not stringently evaluated against economic theories and alternative econometric (or statistical) procedures.

The OLS results suggest there is a collection of countries for which an inversely significant relationship between import tariffs and NX could be established. Poorer countries of Africa and LAC could provide counterintuitive empirical results because of latent capacities, the quality of governance, structural rigidities, and higher consumption propensities (imports). These preconditions are usually noisy indications for questionable empirical analysis in search of general appeal. Significantly, given the structural irregularities, this paper concludes that scatter plots must be used with great precaution when they are utilized to propose general economic theories (findings). The posterior predictive distributions reveal a mixture of NX outcomes that

are associated with import tariffs, ranging from positive effects to negative effects with 95% probability.

As a policy matter, though international trade is influenced by diverse domestic and foreign factors, tariffs are not insignificant to the consumption of domestic and foreign goods even when their share of explained variation in NX is potentially negligible. This reality must be relevant to the arbitration of trade policies. In as much as higher taxes reduce aggregate consumption, retaliatory import taxes (trade policies) considerably reduce potential and real export capacities. Consequently, policies that are related to exports and imports cannot be disassociated from the (in)stability of net exports (NX).

APPENDIX

The sample of countries

Algeria	Chile	Guinea	Pakistan
Argentina	China	Guinea-Bissau	Panama
Australia	Colombia	Honduras	Paraguay
Austria	CAR	Iceland	Peru
Bahamas, The	Congo, Rep.	India	Portugal
Bangladesh	Costa Rica	Indonesia	Rwanda
Belgium	Cote d'Ivoire	Italy	Senegal
Belize	Cuba	Japan	Sierra Leone
Benin	Denmark	Kenya	South Africa
Bolivia	Ecuador	Korea, Rep.	Spain
	Egypt, Arab		
Botswana	Rep.	Madagascar	Sweden
Brazil	El Salvador	Malaysia	Switzerland

Brunei Darussalam	Finland	Mali	Uganda
Bulgaria	France	Mexico	United Kingdom
Burkina Faso	Gabon	Morocco	United States
Burundi	Gambia, The	Netherlands	Uruguay
Cabo Verde	Germany	New Zealand	Zambia
Cameroon	Ghana	Nicaragua	Zimbabwe
Canada	Greece	Niger	
Chad	Guatemala	Norway	

Note: CAR= Central African Republic
Data source: World Bank's WDI (2025).

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