CGPA WORKING PAPER
2026-04

Bilateral Import Demand Elasticities and Balanced Trade Protection

Hiau Looi Kee
Cristina Neagu
Yoto V. Yotov

DREXEL UNIVERSITY
Center for
Global Policy Analysis
LeBow College of Business

Bilateral Import Demand Elasticities and Balanced Trade Protection*

Hiau Looi Kee
The World Bank

Cristina Neagu
The World Bank

Yoto V. Yotov
Drexel University

February 3, 2026

Abstract

We propose a theory-based tariff index – the Balanced Trade Tariff Index (BTTI) – a uniform tariff that results in balanced bilateral trade. The BTTI decomposes into a preference-adjusted tariff term and a trade deficit term. Constructing the BTTI requires bilateral product-level import demand elasticities, which we estimate via a translog GDP function with US data, 2010-2023. The elasticities are heterogeneous across products, trade partners, and depending on the direction of trade, with broader implications for quantifying the gains from trade. The resulting BTTIs are significantly smaller than the 'Liberation Day' tariffs for most countries, and incurring less deadweight losses.

JEL Classification Codes: F13, F14, F16
Keywords: Reciprocal Tariffs, Balanced Trade, Bilateral Import Demand Elasticity, Trade Deficits

*Acknowledgments will be added later. Contact information: Hiau Looi Kee <hlkee@worldbank.org>, Development Research Group - Trade, The World Bank, 1818 H Street N.W., MSN G 2-031, Washington, DC 20433, USA; Cristina Neagu <ineagu@worldbank.org>, Development Research Group - Trade, The World Bank, 1818 H Street N.W., MSN G 2-041, Washington, DC 20433, USA; Yoto V. Yotov <yotov@drexel.edu>, School of Economics, Center for Global Policy Analysis (CGPA), Drexel University, Philadelphia, PA 19104, USA.

1 Introduction

The motivation for this paper is twofold. First, on April 2, 2025, US policy changed dramatically with the announcement of the 'Liberation Day' tariffs:[1] a minimum of 10% on all imported products, with higher tariffs on exporting countries with which the US has larger trade deficits. Under this proposal, many small developing countries, such as Ghana, Guyana, and Madagascar saw their tariffs potentially jumping from 0% to 53%, 61%, and 85%, respectively.

While some economists were unsure about the objective and the ad hoc, atheoretical construction of these tariffs, many people found the notion of 'fairness and reciprocity' appealing.[2] More importantly, regardless of the debate surrounding them, some of the 'Liberation Day' tariffs were implemented, especially on imports from developing countries. For example, Laos and Myanmar are currently facing a uniform tariff of 40%, around a tenfold increase from the original 3-5%.[3] Thus, without judging the merits of raising tariffs to balance bilateral trade,[4] this paper focuses on offering a 'structural' index of trade balance protection, grounded in theory, as a comparison to the 'Liberation Day' tariffs, and to highlight the disproportionate burden and uncertainty faced by small developing countries.

Second, it is now widely accepted that the 'trade elasticity' is the single most important parameter for evaluating the impact of trade policy on trade and welfare (Arkolakis et al., 2012). Perhaps not surprisingly, the trade elasticity also played a very important role in the construction of the 'Liberation Day' tariffs. Moreover, it is well established that trade elasticities are very heterogeneous across a number of dimensions, e.g., sectors (Broda and Weinstein, 2006; Fontagné et al., 2022), countries (Broda et al., 2017), level of development (Adão et al., 2024), and time (Boehm et al., 2023; Anderson and Yotov, 2025a).[5] However, we are not aware of any studies that demonstrate the importance of bilateral trade elasticities and explore the significance of heterogeneous elasticities for the construction

[1] Also known as the International Emergency Economic Powers Act (IEEPA) tariffs.

[2] For example, https://paulkrugman.substack.com/p/trump-goes-crazy-on-trade (Paul Krugman's blog); https://www.pewresearch.org/politics/2025/08/14/trumps-tariffs-and-one-big-beautiful-bill-face-more-opposition-than-support-as-his-job-rating-slips/ (Pew Research Center's poll).

[3] By Sep 30, 2025, tariff revenue collected under these tariffs is reported as high as $90 billion. https://www.crfb.org/blogs/tariff-revenue-soars-fy-2025-amid-legal-uncertainty (Committee for a Responsible Federal Budget, Blog on Oct 27, 2025).

[4] Many economists, e.g., Rogoff (2025), would agree that the existing bilateral trade deficit is driven by the fundamentals such as comparative advantage, macroeconomic factors, saving/investment, FDI, exchange rates and comparative advantage, and not necessarily tariffs. Given the existing bilateral deficits, if tariffs were to increase, then import may decrease (depending on the respective import demand elasticities), which may thus lead to narrowing bilateral trade deficit. This does not mean that raising tariff is the best or optimal way to address bilateral trade imbalances, but perhaps as a policy instrument, it is a plausible, even if ineffective way (and not without costs in terms of losing efficiency, distorting comparative advantage).

[5] Adão et al. (2024) and Carrére et al. (2020) offer theory foundations for the heterogeneity of the trade elasticity.

of weighted tariff indexes and the 'Liberation Day' tariffs in particular.

Against this backdrop, we make three contributions. First, on the theory front, we derive a simple theory-based tariff index – the Balanced Trade Tariff index (BTTI) – which is the uniform tariff that results in balanced bilateral trade, given the existing tariffs and imports of the trade partners. Second, on the empirical front, we estimate product-level *bilateral* import demand elasticities consistent with theory. We demonstrate that these elasticities vary significantly not only across products and trading partners but also depending on the direction of trade flows (e.g., for EU imports from the US vs. for US imports from the EU). Third, on the policy front, we use our theory and the bilateral elasticity estimates to construct the BTTI for the United States and its main trading partners, and we discuss the differences between the BTTI, 'Liberation Day' tariffs, and other tariff indexes, as well as the implied deadweight losses (DWLs).

We show that, while attaining the stated objective of balancing bilateral trade more rationally by taking into account the heterogeneous import demand elasticities, the BTTIs are on average significantly lower than the 'Liberation Day' tariffs, and incurring much less DWLs. For example, the BTTIs of Ghana, Guyana, and Madagascar are 0.8%, 1.6% and 13.3%, respectively; much smaller than the corresponding 'Liberation Day' tariffs of 37.8%, 55.7%, and 83.9%. Most importantly, the implied DWLs are also lower, at 0.1%, 0.44% and 5.0% of imports, as opposed to 235.6%, 357.5% and 121.1%, respectively for the three countries.

From a theory perspective, by construction, the BTTI is the trading partner-specific uniform tariff that reduces import, taking as given the existing bilateral applied tariff and trade deficit. The BTTI can be decomposed into two structural components: (i) an elasticity-adjusted weighted tariff term, and (ii) a trade deficit term. Without any trade deficit, the BTTI simplifies to a preference-adjusted weighted tariff, which is higher if the existing applied tariff is higher. Furthermore, unsurprisingly, the BTTI increases with the size of the bilateral trade deficit, as it takes a higher uniform tariff to reduce a larger imbalance. In addition, the BTTI also increases if the bilateral imports are less elastic, as a higher tariff is necessary to break the closer ties between countries, perhaps locked in by production network due to GVC, such as that of US-China and US-Canada/Mexico trade. Inelastic import demand can also be driven by the inherent characteristics of the products, such as necessity vs. luxury items, as well as labor intensive products, driven by comparative advantage due to endowments.

Several features of the BTTI are attractive. First, the BTTI offers a theoretically-grounded alternative to the 'Liberation Day' tariffs. In addition, the BTTI has limited data requirements, i.e., constructing the BTTI only requires information on bilateral bilateral trade, tariffs, and import demand elasticities. The BTTI is straightforward to construct, and, due to its partial equilibrium set up leading to separability by trade partner, does not require access to special computational capabilities.

At the same time, the simplicity of BTTI comes with some caveats. For example, the BTTI is short-run and partial equilibrium in nature, not considering any general equilibrium feedback due to price setting behavior, inter-sectoral and cross-country linkages, investment decisions, exchange rates, and the substitution effects due to tariff changes or income effects due to tariff revenue, which may affect the import elasticities and therefore the BTTIs in the long-run. These caveats thus assume away any strategic or retaliatory actions of the exporting countries and could mean that the model behind the derivation of BTTIs is more applicable for small, developing countries, or the time span is short enough to not consider any feedback actions from the larger exporting countries.

While limited in data requirements, the theory of BTTI mandated the need to have product-level *bilateral* import demand elasticities, which are not readily available in the existing literature. To address this challenge, we build on the classic work of Kohli (1991) and Harrigan (1997) to implement a translog GDP function specification, with data of the US bilateral product-level import from its top 100 trading partners, for 2010-2023. In this set up, imports from each partner country are considered as inputs to the translog GDP production function of the US. By estimating the translog parameter from the share equation of each product, bilateral import demand elasticities can then be constructed based on the share of each trading partner. We further address endogneity and selection bias according to Semykina and Wooldridge (2010).

We draw several conclusions based on our elasticity estimates for the US. First, consistent with existing studies (Broda and Weinstein, 2006; Fontagné et al., 2022), we find that the trade elasticities are very heterogeneous across products, e.g., they vary between -1.30 for Textiles vs. -5.14 for Plastics, Rubber, Wood and Paper. In addition, we confirm existing findings (Broda et al., 2017) that the trade elasticities vary widely across countries too, e.g., the average elasticity on imports from the EU is -2.67, and it is -3.32 for imports from Mexico. Third, it is reassuring that the average (across sectors and trade partners) elasticity that we obtain for the US is -3.85, which is very close to the benchmark estimate of 4 from Simonovska and Waugh (2014) and the more recent estimate for the

US of 3.45 from Ganapati and Hottman (2025).[6]

Finally, and most novel, our estimates reveal that the trade elasticities are very heterogeneous depending on the direction of trade flows, e.g., for EU imports of a given product from the US vs. for US imports of the same product from the EU. The lack of correlation between the import demand elasticities of the US and the China further drives home this point. We believe that this is a significant empirical result with potentially important implications for measuring and explaining bilateral trade cost asymmetries and also for welfare analysis of the gains from trade. The latter is consistent with recent findings from Adão et al. (2024) who obtain heterogeneous trade elasticity estimates that vary depending on the number of exporters in a market and the country's level of development. The heterogeneity in the trade elasticities translates into larger gains from trade for the rich/developed countries.

Armed with the bilateral import demand elasticities, we use tariff data for 2023 to construct and analyze the BTTIs for the United States. We find the following. First, the BTTIs are sizable and heterogeneous. The aggregate BTTI in our sample is 16.8%, and it varies from 0.6% for Angola to 60%, 65%, and 114% for Fiji, Bangladesh, and Botswana, respectively. Most of the Asian economies that have close GVC ties with the US also have larger BTTIs. Second, despite the large indexes for some countries, most of the BTTIs are relatively small, e.g., nearly 90% of the BTTIs are smaller than 40%. Third, the larger share of the BTTIs (i.e., about 86%) is due to the deficit component of our structural index. Fourth, the BTTIs are significantly smaller than the 'Liberation Day' tariffs (nearly 3 times at the aggregate level). The correlation between the two indexes (0.48) is positive but not very strong, and we demonstrate that this result is due to the heterogeneity in our import-demand elasticities. This highlights two key omissions in the construction of the 'Liberation Day' tariffs: (i) the heterogeneity in the import demand elasticities and (ii) the role of comparative advantage.

Importantly, some of the largest BTTIs are for developing countries that run large trade surpluses with the US. The reason why Fiji, Bangladesh and Botswana have the highest BTTIs is illuminating, as they are driven by both the inelastic import demands and comparative advantage. The main imported products from Fiji and Botswana are bottled water and diamonds, the classic example of necessity vs. luxury goods, while the main import products from Bangladesh are ready-made garments, which is

[6] While we estimate import demand elasticities, which are defined as the percentage change in import quantity when price increases by 1 percent, without specifying the underlying preference structure, Simonovska and Waugh (2014) and Ganapati and Hottman (2025) estimate the elasticity of substitution, which under the CES preference and is equivalent to the (negative) import demand elasticity.

labor-intensive.[7] The US bilateral trade deficits with these countries are purely driven by comparative advantage due to endowments, coupled with the inelastic demands on these products, push up the BTTIs. This also highlights the disagreement many economists have with regards to the objective of 'balancing bilateral trade deficit' with tariffs: high tariffs may not be effective in decreasing the imports of products that have inelastic demand or comparative disadvantage. They may instead just push up the prices, causing undue burden on the US consumers and the small developing countries that export these products.

A comparison between the BTTIs and import-weighted applied tariffs reveals that the import-weighted tariffs are significantly smaller than the BTTIs. The correlation between the two indexes is low too with a correlation of 0.30. In addition, even though the import-weighted tariffs and the preference-adjusted tariffs are highly correlated (i.e., the correlation is 0.95), there are some substantial differences in the levels even between these two sets of tariffs. The implication of this result is that taking into account the import demand elasticities can be very important for the construction of average tariffs.

We also construct BTTIs based on product-level and average/aggregate import demand elasticities. The correlations between these indexes and our main BTTIs are positive but far from perfect, highlighting the potential importance of proper measurement and allowing for heterogeneous import demand elasticities. Finally, we calculate hypothetical BTTIs in a scenario when the US trade partners fully eliminate their tariffs on US exports. We find that (i) the new BTTIs are significantly smaller (e.g., falling from 14% to 6% for the EU and from 17% to 6% for Mexico) and (ii) the US will run trade surplus with some of the liberalizing countries (e.g., Canada, China, India and Japan), which implies negative BTTIs.

To analyze the welfare implications of BTTI, we follow Feenstra (1995) to measure the partial equilibrium short-run DWL from tariffs. As expected, the BTTI will result in significant DWLs for some countries, with variation corresponding to the variation of the BTTIs. Specifically, we find that the DWL of BTTI as a share of imports, varies from less that 0.1% for Bahrain, Ecuador, Kazakhstan, and North Macedonia to more than 15% for Sri Lanka, Bangladesh, and Botswana. Importantly

[7] Fiji is a major exporter of bottled water, with the brand "Fiji Water" being a well-known example that ships its product to over 60 countries. In 2023, the country exported over $267 million worth of water, with the majority going to the United States. Likewise, Botswana is one of the world's largest diamond exporters, and the US was the 4th largest export destination for Botswana's diamonds, with $456 million in exports in 2023. Bangladesh, with its abundance of low cost labor, is the second largest apparel exporter in the world, and the US is its top destination importing more than $8.5 billion in 2023.

however, the DWL obtained with the 'Liberation Day' tariffs are significantly larger than those that are obtained with the BTTI, for all but 5 countries in our sample. At the aggregate level, the DWL of the 'Liberation Day' tariffs are nearly 6 times larger than the BTTI-induced DWL, suggesting that BTTI could achieve the stated goal of balancing trade with a much lower welfare cost, particularly for products from small developing countries.

Our work is related to four strands of the literature. First, on the theory front, the model used to derive BTTI is built on the seminal trade restrictiveness indexes of Anderson and Neary (1996, 2003), further utilizing the partial equilibrium simplification developed in Feenstra (1995). Most recently, Anderson and Yotov (2025b) rely on theory foundations from Anderson and Neary (1996, 2003) to develop a tariff reciprocity index – a True Cost of Protection (TCP) index – that consistently aggregates bilateral product-level tariffs into country-specific general equilibrium tariff indexes. The TCP and BTT indexes differ in terms of methods and purpose. Specifically, the TCP index is a computationally demanding general equilibrium index that is developed the context of the CES structural gravity model of trade (Eaton and Kortum, 2002; Anderson and van Wincoop, 2003; Arkolakis et al., 2012) and it measures the level or reciprocal tariffs without aiming balanced trade. As described earlier, the BTTI is a partial equilibrium index that does not rely on a particular preference structure, it is easy and straightforward to construct, while targeting balanced trade.

Second, we contribute to the literature that estimates import demand elasticities. We follow the classic approach of Kohli (1991) and Harrigan (1997) to estimate import demand elasticities based on the aggregate translog GDP function approach, but at a more disaggregate product level. More closely related are several papers that obtain non-model based elasticity estimates are Kee et al. (2008, 2013), which explore the importance of country specific heterogeneous product level import demand elasticities in determining trade and welfare impacts of different countries. More recently, Kee and Nicita (2024) allow the heterogeneous product level import demand elasticities to differ across trading partners to study the trade impacts of Brexit. Similar to these papers, we take a non-model based approach. However, our contributions differ in terms of theory (i.e., we build the BTTI), estimation methods (i.e., we focus on estimating the tariff-inclusive translog GDP functions for the US, the EU, Canada, Mexico, China, and Japan), application (i.e., we study the US balanced trade protection and the implied welfare loss), and implications with respect to the heterogeneity of the trade elasticity (i.e., we show that the trade elasticities are very different depending on the direction of trade flows, e.g., from the US to the EU vs. from the EU to the US).

Third, we contribute to the voluminous literature that estimates trade elasticities.[8] As it is well known that under the CES framework, the implied trade elasticity is the elasticity of substitution, which also equals to the (negative) import demand elasticity. Apart from the different estimation methods and purposes, our main contribution to this literature is the exploration of the heterogeneity of the trade elasticity across various dimensions without assuming any CES framework. Specifically, as noted earlier, we confirm that our average elasticity estimate is close to the benchmark index from Simonovska and Waugh (2014), and that trade elasticities vary significantly across products (Broda and Weinstein, 2006; Fontagné et al., 2022), countries (Broda et al., 2017), and time (Boehm et al., 2023; Anderson and Yotov, 2025a). However, our most novel finding is that they also vary depending on the direction of trade flows. This empirical result is consistent with the theory from Carrére et al. (2020) and has potentially important applications for the measurement of asymmetric bilateral trade costs and welfare calculations in 'new quantitative trade models' (NQTMs).

Finally, our paper is related to recent work that is motivated by or quantifies the impact of the reciprocal 'Liberation Day' tariffs of the US. Most of this work has been exclusively policy oriented, e.g., Hinz et al. (2025) by the Kiel Institute for the World Economy and McKibbin et al. (2025) by the Peterson Institute for International Economics. However, there are also some recent academic papers. For example, Rotunno and Ruta (2025) use a 'new quantitative trade model' to evaluate the trade and welfare implications of various policy responses to the 'Liberation Day' tariffs. More recently, Ignatenko et al. (2025) offer a rich quantitative analysis of the long-term effects of these tariffs, also obtain an optimal uniform 'Liberation Day' tariff equivalent of 19% in response the aggregate trade deficit. Relying on different theory, estimation methods, and data, to balance the aggregate trade deficit, the BTTI we obtain across products and trade partners is 16.8%.

Most relevant to our study but coming from a macro prospective by using a time-series analysis based on detailed quarterly tariff data of the US, Schmitt-Grohé and Uribe (2025) estimate the effects of transitory and permanent tariff shocks and find that transitory tariff increases improve the trade balance, whereas permanent increases leave it largely unchanged. The BTTI, by design, is to balance

[8] Without attempting to provide an exhaustive list of references, some prominent papers from this literature include Broda et al. (2006), Broda and Weinstein (2006), Egger et al. (2012), Simonovska and Waugh (2014), Soderbery (2015), Caliendo and Parro (2015), (Broda et al., 2017), Imbs and Mejean (2017), Yilmazkuday (2019b), Yilmazkuday (2019a), Anderson and Yotov (2020), Chen and Novy (2022), Fontagné et al. (2022), Boehm et al. (2023), Adão et al. (2024), and Anderson and Yotov (2025a).

trade in a short-run partial equilibrium setting, thus our analysis is consistent with their findings.

Finally, motivated by the 'Liberation Day' tariffs, Itskhoki and Mukhin (2025) focus on long-term trade deficits and demonstrate that (i) the links between tariffs and trade deficits are generally not related to trade competitiveness, and (ii) tariffs can close a persistent trade deficit if and only if they change the value of, or the returns on, the country's international financial position. We ask a complementary question that is consistent with ongoing trade policies, i.e., 'What are the tariffs that can eliminate the US trade deficits?', and we demonstrate that the corresponding BTTIs are, on average, three times smaller than the corresponding 'Liberation Day' tariffs.

The rest of the paper is organized as follows. Section 2 introduces the theory behind the BTTI. Section 3 describes the estimation methods to obtain the product-level bilateral import elasticities, which are needed to construct the BTTI. Section 4 describes the data used in this study. Section 5 reports the results on the elasticity estimations and the BTTIs. Section 6 concludes the paper.

2 Theoretical Foundations

This section presets our theory. Subsection 2.1 introduces the Balanced Trade Tariff Index. Subsection 2.2 defines a 'most favored nation' (MFN) BTTI. Subsection 2.3 calculates the deadweight loss of tariffs. Finally, subsection 2.4 extends the theory to accommodate a scenario in which one country fully liberalizes trade with respect to a trading partner in order to decrease the BTTI imposed by this partner.

2.1 The Balanced Trade Tariff Index: A Simple Theoretical Approach

Facing the world price p^n for each good n, country c imposes a tariff of t^n_{cd} on imports from country d. This leads an import price of $p^n_{cd} = p^n(1 + t^n_{cd})$, and import demand of $q^n_{cd}(t^n_{cd})$. We assume that the world price p^n is not affected by tariffs of c. The import value at the border, which we observe in the data, reflects the world price, and not the tariff inclusive import price, resulting in the total imports of c from d as

$$IMP_{cd}(t_{cd}) = \sum_n IMP^n_{cd}(t^n_{cd}) = \sum p^n q^n_{cd}(t^n_{cd}). \tag{1}$$

Concurrently, country d also imposes tariffs on products from c, which leads to total imports of IMP_{dc}, which we also observe in data. Presumably, the tariffs of d on products from c are high enough, such that country c has a bilateral trade deficit, TD_{cd}, with respect to country d:

$$TD_{cd}(t_{cd}) \equiv IMP_{cd}(t_{cd}) - IMP_{dc} = \sum_n p^n q^n_{cd}(t^n_{cd}) - IMP_{dc} \geq 0. \tag{2}$$

Equation (2) implies that country c could adjust its tariffs to affect TD_{cd}, at any given level of IMP_{dc}. To balance bilateral trade, country c could change its tariff, t^n_{cd}, to a uniform tariff, T_{cd}, which we refer to as the Balanced Trade Tariff Index (BTTI) such that $TD_{cd}(T_{cd}) = 0$:

$$\begin{aligned} \text{Definition of BTTI:}\Big\{T_{cd}|TD_{cd}(T_{cd}) &\equiv 0\Big\} \Rightarrow & (3) \\ IMP_{cd}(T_{cd}) &\equiv IMP_{dc} \\ \sum_n p^n q^n_{cd}(T_{cd}) &\equiv IMP_{dc}. & (4) \end{aligned}$$

Combining equations (2) and (4), we have the following derivation:

$$\begin{aligned} TD_{cd} &= \sum_n [p^n q^n_{cd}(t^n_{cd}) - p^n q^n_{cd}(T_{cd})] & (5) \\ &= \sum_n p^n [q^n_{cd}(t^n_{cd}) - q^n_{cd}(T_{cd})] & (6) \\ &= \sum_n p^n [\frac{\partial q^n_{cd}(t^n_{cd})}{\partial t^n_{cd}} (t^n_{cd} - T_{cd})] & (7) \\ &= \sum_n p^n [\frac{\partial \ln q^n_{cd}}{\partial t^n_{cd}} q^n_{cd}(t^n_{cd})(t^n_{cd} - T_{cd})] & (8) \\ &= \sum_n p^n q^n_{cd}(t^n_{cd}) [\frac{\partial \ln q^n_{cd}}{\partial \ln p^n_{cd}} \frac{\partial \ln p^n_{cd}}{\partial t^n_{cd}} (t^n_{cd} - T_{cd})] & (9) \\ &= \sum_n IMP^n_{cd}(t^n_{cd}) [\frac{\partial \ln q^n_{cd}}{\partial \ln p^n_{cd}} \frac{\partial \ln [p^n(1+t^n_{cd})}{\partial t^n_{cd}} (t^n_{cd} - T_{cd})] & (10) \\ &= \sum_n [IMP^n_{cd}(t^n_{cd}) \epsilon^n_{cd} \frac{1}{1+t^n_{cd}} (t^n_{cd} - T_{cd})], \text{where} & (11) \\ \epsilon^n_{cd} &\equiv \frac{\partial \ln q^n_{cd}(t^n_{cd})}{\partial \ln p^n_{cd}} < 0, & (12) \end{aligned}$$

denotes country c's import demand elasticity for product n from country d. Assuming that the import demand function, $q^n_{cd}(t)$, is a continuous and differentiable function of tariffs, Equation (7) thus expresses the discrete changes of imports in (6) as the multiplications of partial derivatives of imports with respect to changes in tariffs, with the total changes in tariffs. Equation (8) expresses (7) in logarithm, while (9) further rewrites (8) to show how tariffs affect imports through prices. Equation

(10) expresses imports as the multiplication of import prices and quantities, which can further be rewritten as (11), highlighting the effects of preferences in determining trade deficits, TD, through the import demand elasticity, ϵ, defined in (12).

Equation (11) allows us to solve for T_{cd} as follows:

$$T_{cd} = \frac{-TD_{cd} + \sum_n \epsilon_{cd}^n \frac{1}{1+t_{cd}^n} IMP_{cd}^n(t_{cd}^n) t_{cd}^n}{\sum_n \epsilon_{cd}^n \frac{1}{1+t_{cd}^n} IMP_{cd}^n(t_{cd}^n)}. \tag{13}$$

Equation (13) shows that, given that $\epsilon \leq 0$, the higher is the bilateral trade deficit, the higher is the level of the uniform tariff necessary to bring back the trade balance, modulated with the import demand elasticity at product level.

Rearranging some terms in equation (13) enables us to define the BTTI as a combination of two structural components:

$$BTTI_{cd} \equiv T_{cd} = \sum_n t_{cd}^n \frac{\frac{\epsilon_{cd}^n}{1+t_{cd}^n} IMP_{cd}^n(t_{cd}^n)}{\sum_n \frac{\epsilon_{cd}^n}{1+t_{cd}^n} IMP_{cd}^n(t_{cd}^n)} + \frac{-TD_{cd}}{\sum_n \frac{\epsilon_{cd}^n}{1+t_{cd}^n} IMP_{cd}^n(t_{cd}^n)}. \tag{14}$$

The first term in (14) denotes preference–adjusted import-weighted average tariffs and the second term is the trade deficit induced tariff, which depends on the level of the existing trade deficit between c and d. BTTI is higher when (i) the bilateral trade deficit is larger, and (ii) the import demand is less elastic. The decomposition of the BTTI enables us to explore the relative importance of its two components and to benchmark our index against alternative measures such as import-weighted tariffs or the 'Liberation Day' tariffs of the US government.

We note the resemblance between the 'Liberation Day' tariffs and the second term of (14):[9]

$$\Delta\tau = \frac{x_i - m_i}{\epsilon * \varphi * m_i} = \frac{-TD_i}{\sum_n IMP_i^n}, \tag{15}$$

where the numerator is the negative bilateral trade deficit, $-TD_i$, and the denominator is simplified to bilateral imports, when the overall import demand elasticity, ϵ, is assumed to be 4, and the pass-through rate, φ, is assumed to be 1/4, and these two terms canceled out. It is also clear that BTTI puts larger weights on the more elastic products when constructing denominator, which is the preference-adjusted total bilateral import. This leads to a lower deficit-induced tariff.

[9] https://ustr.gov/sites/default/files/files/Issue_Areas/Presidential%20Tariff%20Action/Reciprocal%20Tariff%20Calculations.pdf

2.2 A ‘Most-Favored-Nation’ BTTI

From (14), it is straightforward to derive the uniform tariff that can applied to all trading partners, i.e., on a ‘Most favored nation’ (MFN) basis, in order to balances the aggregate trade:

$$BTTI_c \equiv T_c = \sum_d \sum_n t^n_{cd} \frac{\frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})}{\sum_d \sum_n \frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})} + \frac{-\sum_d TD_{cd}}{\sum_d \sum_n \frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})}, \tag{16}$$

where $BTTI_c$ is the uniform MFN tariff (T_c) that country c applies to all imported products from all partner countries in order to balance its aggregate trade deficit, $\sum_d TD_{cd}$. $BTTI_c$ is higher when (i) the aggregate trade deficit is larger, and (ii) the import demand is less elastic.

2.3 The Partial Equilibrium Deadweight Loss of Tariffs

To infer the deadweight loss (DWL) of tariffs, we follow the partial equilibrium formula of Feenstra (1995), which is the sum of all the product-level Harberger’s triangles:

$$DWL_{cd}(t^n_{cd}) \equiv \sum_n \frac{1}{2} \Delta q^n_{cd} \Delta p^n_{cd} \tag{17}$$

$$= \frac{1}{2} \sum_n \frac{\partial q^n_{cd}}{\partial p^n_{cd}} \frac{p^n_{cd}}{q^n_{cd}} \frac{q^n_{cd}}{p^n_{cd}} [\Delta p^n_{cd}]^2 \tag{18}$$

$$= \frac{1}{2} \sum_n \epsilon^n_{cd} \frac{q^n_{cd}}{p^n_{cd}} [p^n t^n_{cd}]^2 \tag{19}$$

$$= \frac{1}{2} \sum_n \frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd} [t^n_{cd}]^2. \tag{20}$$

The welfare loss calculation based on (20) can be constructed when country c imposes product-level heterogeneous tariffs on d. If all products faced a uniform tariff, such as BTTI or the ’Liberation Day’ tariff, (20) can be further simplified to

$$DWL_{cd}(T_{cd}) = \frac{1}{2} \frac{[T_{cd}]^2}{1+T_{cd}} \sum_n \epsilon^n_{cd} IMP^n_{cd}. \tag{21}$$

2.4 BTTI with Partner’s Unilateral Liberalization

What would happen if partner country d fully liberalizes when faced with the threat of higher tariffs from c? This will induce an increase in the imports of d from c, IMP_{dc}, which will lead to a lower bilateral trade deficit, TD_{cd}. To derive the new BTTI, we first need to derive the new imports of d

from c, $IMP_{dc}(0)$, when d unilaterally liberalizes:

$$IMP_{dc}(t_{dc}) = \sum_n IMP^n_{dc}(t^n_{dc}) = \sum p^n q^n_{dc}(t^n_{dc}) \tag{22}$$

$$IMP_{dc}(0) = \sum_n IMP^n_{dc}(0) = \sum p^n q^n_{dc}(0). \tag{23}$$

Subtracting (22) from (23), noting that $IMP_{dc}(t_{dc})$ is observed in data, helps us calculate $IMP_{dc}(0)$ via the following derivations:

$$\begin{aligned}
IMP_{dc}(0) - IMP_{dc}(t_{dc}) &= \sum p^n [q^n_{dc}(0) - q^n_{dc}(t^n_{dc})] && (24)\\
&= \sum p^n q^n_{dc}(t^n_{dc})[\frac{\partial \ln q^n_{dc}}{\partial t^n_{dc}}(-t^n_{dc})] && (25)\\
&= \sum_n IMP^n_{dc}(t^n_{dc})[\frac{\partial \ln q^n_{dc}}{\partial \ln p^n_{dc}} \frac{\partial \ln [p^n(1+t^n_{dc})}{\partial t^n_{dc}}(-t^n_{dc})] && (26)\\
&= \sum_n [IMP^n_{dc}(t^n_{dc})\epsilon^n_{dc}\frac{1}{1+t^n_{dc}}(-t^n_{dc})] \geq 0 \Rightarrow && (27)\\
IMP_{dc}(0) &= IMP_{dc}(t_{dc}) + \sum_n [IMP^n_{dc}(t^n_{dc})\epsilon^n_{dc}\frac{1}{1+t^n_{dc}}(-t^n_{dc})]. && (28)
\end{aligned}$$

Equation (28) shows that when d lowers its tariffs, from t^n_{dc} to $0, \forall n$, its imports from c will be higher, which results in a lower trade deficit of c with respect to d:

$$\begin{aligned}
TD_{cd}(0) &= IMP_{cd}(t_{cd}) - IMP_{dc}(0) && (29)\\
&= IMP_{cd}(t_{cd}) - IMP_{dc}(t_{dc}) - \sum_n [IMP^n_{dc}(t^n_{dc})\epsilon^n_{dc}\frac{1}{1+t^n_{dc}}(-t^n_{dc})] && (30)\\
&= TD_{cd} - \sum_n [IMP^n_{dc}(t^n_{dc})\epsilon^n_{dc}\frac{1}{1+t^n_{dc}}(-t^n_{dc})] \leq TD_{cd}. && (31)
\end{aligned}$$

Substituting (30) into (14), we have the BTTI when the trading partner fully liberalizes:

$$T_{cd}(0) = \sum_n t^n_{cd} \frac{\frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})}{\sum_n \frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})} + \frac{-TD_{cd}(0)}{\sum_n \frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})} = T_{cd} - \frac{\sum_n \frac{\epsilon^n_{dc}}{1+t^n_{dc}} IMP^n_{dc}(t^n_{dc}) t^n_{dc}}{\sum_n \frac{\epsilon^n_{cd}}{1+t^n_{cd}} IMP^n_{cd}(t^n_{cd})}. \tag{32}$$

The first term of (32) is the original BTTI under the current bilateral trade deficit, and the second term is the 'discounted tariff' when d fully liberalizes, which leads to an increase in its imports from c. If the existing tariffs of d on products from c is really high, or if the import demand of d with respect to products from c is very elastic, the unilateral liberalization of d may induce a large increase in imports of d from c, which may therefore lead to a bigger reduction in BTTI. Note that it is mathematically possible that when country d completely liberalizes, its bilateral imports from c may increase so much such that c is now running a trade surplus with d. In turn, this could imply a negative BTTI.

3 Estimating Product-level Bilateral Import Demand Elasticities

An important implication of our theory is that to construct the BTTIs we need product-level bilateral trade elasticities. This section describes the procedures to estimate the bilateral import demand elasticities that will be used to construct the BTTI.

Assuming no price setting behavior for all goods, $n = 1, ..., N$, with factors, $m = 1, ..., M$, the GDP function of the US for each period t, facing ad-valorem tariff-inclusive price vector, p^t, and factor endowment vector, v^t, is defined as:

$$\begin{aligned} \ln G(p^t, v^t) = a_{00} \quad &+ \quad \sum_{n=1}^{N} a_{0n} \ln p_n^t + \frac{1}{2} \sum_{n=1}^{N} \sum_{k=1}^{N} a_{nk} \ln p_n^t \ln p_k^t \\ &+ \quad \sum_{m=1}^{M} b_{0m} \ln v_m^t + \frac{1}{2} \sum_{m=1}^{M} \sum_{l=1}^{M} b_{ml} \ln v_m^t \ln v_l^t + \sum_{n=1}^{N} \sum_{m=1}^{M} c_{nm} \ln p_n^t \ln v_m^t, \end{aligned} \quad (33)$$

where the net output vector $q^t = (q_1^t, q_2^t, ..., q_N^t)$ is chosen to maximize GDP, with positive elements denoting outputs, which include exports, and negative numbers denoting inputs, which include imported goods as in Kohli (1991) and Harrigan (1997).

For the purpose of this study, we first define each good n as a HS-digit product from a specific exporting country. Later on, due to the degree of freedom consideration in the estimation, we pool across different exporting countries for each HS 6-digit product. Furthermore, for ease of the estimation, we assume there are only two factor of endowments, labor (L) and capital (K). To reduce the number of translog parameters, we further apply a semiflexible functional form developed by Diewert and Wales (1988) to reparametrize $\ln G^t(p^t, v^t)$ so that $\ln G^t(p^t, v^t)$ satisfies homogeneity and symmetry restrictions, with respect to prices and factor endowments. The Envelope theorem implies that, at the equilibrium, the share of good n in GDP at period t is

$$s_n^t(p^t, v^t) \equiv \frac{p_n^t q_n^t(p^t, v^t)}{G^t(p^t, v^t)} = a_{0n} + a_{nn} \ln \frac{p_n^t}{p_k^t} + c_{nL} \ln \frac{L^t}{K^t}, \ \forall n = 1, ..., N. \quad (34)$$

Note that if good n is an input, as in the case of imports, then $s_n^t < 0$ is the negative share of n in GDP, while if good n is an output, such as exports, then $s_n^t > 0$ is the positive share of n in GDP. In Equation (34), $\overline{\ln p_k^t} = \sum_{k \neq n} \frac{a_k}{\sum_{k \neq n} a_k} \ln p_k^t$ is a weighted average of the log prices of all non-n goods. For every good n, $\overline{\ln p_k^t}$ can be constructed using the GDP deflator net of the price of good n, adjusted by the share of non-n goods,[10]

$$\ln p_{-n}^t = (\ln p^t - \bar{s}_n^t \ln p_n^t)/(1 - \bar{s}_n^t), \text{ where } \bar{s}_n^t = 0.5(s_n^t + s_n^{t-1}). \tag{35}$$

This approximation introduces an additive error term to reflect measurement error in each share equation, κ_n^t:

$$s_n^t(p^t, v^t) = a_{0n} + a_{nn} \ln \frac{p_n^t}{p_{-n}^t} + c_{nL} \ln \frac{L^t}{K^t} + \kappa_n^t, \forall n = 1, ..., N. \tag{36}$$

Equation (36) forms the basis to estimate the translog parameter, a_{nn}, which is used to construct the own-price elasticity, ε_{nn},

$$\varepsilon_{nn}^t \equiv \frac{\partial q_n^t(p^t, v^t)}{\partial p_n^t} \frac{p_n^t}{q_n^t} = (\frac{a_{nn}}{s_n^t} + s_n^t - 1) \leq 0, \ \forall s_n^t < 0. \tag{37}$$

Non-negative own-price demand elasticity implies the following structural restriction on a_{nn}, which we will impose in the construction of ε_{nn} post estimation:

$$a_{nn} \geq s_n^t(1 - s_n^t). \tag{38}$$

To estimate the translog parameter, a_{nn}, based on equation (36), we need to address a few econometric issues. The first involves the endogeneity of tariff-inclusive relative prices, $\ln \frac{p_n^t}{p_{-n}^t}$. For each good n, the tariff-inclusive relative price is constructed based on the unit value of each HS 6-digit good from each trading partner, relative to the GDP deflator of the US, net of the influence of each good's price on the GDP deflator. The tariff-inclusive relative price could be endogenous to the share of each good, s_n^t, leading to inconsistent estimates. Moreover, if prices are not fixed, an increase in tariffs may also cause foreign prices to change and affect $\ln \frac{p_n^t}{p_{-n}^t}$. To address these endogeneity issues, we use the tariff-inclusive relative price of the European Union (EU), $\ln \frac{p_{n,EU}^t}{p_{-n,EU}^t}$, as the instrument in a Fixed Effects Two Stage Least Square (FE-2SLS) regression. The identification assumption is that

[10] Caves et al. (1982).

relative prices are affected by common shocks: while the price of a product in the EU and the US could be correlated due to the world market conditions, the share of each good in the GDP of the US should not be correlated with the trade policy and prices of the EU a priori. One of the reasons the US prices and the EU prices are correlated is because they faced the common exogenous shocks, such as productivity/technology, and climate/weather/natural disaster/pandemic, as well as China shocks and the wars in other countries. These exogenous events affect product prices in the world markets hence caused the US and EU prices to move together. At the same time the EU prices should not be affecting or be influenced by the share of a product in the US's imports; hence, they are consistent with the exclusion restrictions and acceptable as an instrumental variable for the US prices:

$$1st \text{ stage: } \ln \frac{p_n^t}{p_{-n}^t} = \beta_n + \beta_n^t + b_n \ln \frac{p_{n,EU}^t}{p_{n,EU}^t} + b_{nm} \ln \frac{L^t}{K^t} + e_n^t, \tag{39}$$

$$2nd \text{ stage: } s_n^t = \alpha_{0n} + \alpha_n^t + a_{nn} \widehat{\ln \frac{p_n^t}{p_{-n}^t}} + c_{nm} \ln \frac{L^t}{K^t} + \kappa_n^t, \forall n = 1, ..., N, \tag{40}$$

where $\widehat{\ln \frac{p_n^t}{p_{-n}^t}}$ denotes the predicted value of $\ln \frac{p_n^t}{p_{-n}^t}$ from the first stage regression, Equation (39). The dependent variable in the second stage regression is the share of the imported product in the GDP of the US (which is by construction negative or zero). The right-hand side variables include the predicted tariff-inclusive relative price of this product, the relative endowments of the EU, together with year fixed effects α_n^t and exporting country fixed effects α_{0n}. Equation (40) forms the base-line for our elasticity estimates.

The second econometric issue is the potential selection bias due to US imports being non random. In fact, it is well documented that international trade is often highly concentrated (Helpman et al., 2008). Within our sample of bilateral imports of the 5050 HS 6-digit level products between the US and its top 100 partners, 71 percent of the product-exporting country observations are zeros, while China exports more than 97 percent of the products. The issue of sample selection bias cannot be ignored. To correct for sample selection, we use a multi-step sample selection model for panel data, developed in Semykina and Wooldridge (2010). This approach is particularly suitable for panel data with endogenous right-hand-side variables and unobserved heterogeneity that can be controlled by panel fixed effects. Semykina and Wooldridge (2010) also provide a selection bias test which allows us to identify products that need such corrections.

To test for selection bias, we define a dummy variable, D_n^t, which indicates the presence of trade for each HS 6-digit product, n, in year t,

$$D_n^t = \begin{cases} 1, & \text{if } s_n^t < 0 \\ 0, & \text{otherwise.} \end{cases}$$

We then apply the following procedure: First, for each HS 6-digit product n and each year t, we run a cross sectional probit regression:

$$P(D_n^t = 1 | z_n^t) = \Phi(z_n^t \delta^t + \bar{z}_n \zeta^t), \tag{41}$$

where the dependent variable equals one if there is non-zero trade between the US and the partner country in that year, and zero otherwise. The right-hand-side variables of this probit regression include z_n^t, and $\bar{z}_n$. Matrix z_n^t represents all the exogenous right-hand-side variables and instruments, which are the tariff-inclusive relative price of the product in the EU and the relative endowments. The variable $\bar{z}_n$ represents the cross years averages of the tariff-inclusive relative price of the EU for product n, and the cross years average relative endowments of the US. The resulting estimates are used to obtain the inverse Mills ratio, $\hat{\lambda}_n^t = \lambda(z_n^t \hat{\delta}^t + \bar{z}_n \hat{\zeta}^t) = \phi(z_n^t \hat{\delta}^t + \bar{z}_n \hat{\zeta}^t) / \Phi(z_n^t \hat{\delta}^t + \bar{z}_n \hat{\zeta}^t)$, with $\phi(.)$ and $\Phi(.)$ denoting the pdf and cdf of a normal distribution.

Second, for $D_n^t = 1$, the tariff-inclusive relative price of the product in the EU and the inverse Mills ratio are then used as the instruments to estimate the following FE-2SLS regression for every product, n:

$$s_n^t \quad = \quad \alpha_{0n} + \alpha_n^t + a_{nn} \widehat{\ln \frac{p_n^t}{p_{-n}^t}} + \rho \hat{\lambda}_n^t + c_{nm} \ln \frac{L^t}{K^t} + \kappa_n^t. \tag{42}$$

Third, we use the t-statistic with heteroskedasticity robust standard error to test $H_0 : \rho = 0$. Selection bias is present if ρ is tested to be statistically significant.

For the products that have non-zero trade and for which the selection bias has tested positive, we correct for such bias by using the tariff-inclusive relative price of the EU, the partner country average tariff-inclusive relative price of the EU, and average relative endowments as instruments in the following Pooled 2SLS regression:

$$s_n^t \quad = \quad \alpha_t^n + a_{nn} \widehat{\ln \frac{p_n^t}{p_{-n}^t}} + \rho \hat{\lambda}_{nc}^t + a_{\bar{n}} \overline{\ln \frac{p_{n,EU}}{p_{-n,EU}}} + c_{nm} \ln \frac{L^t}{K^t} + c_{\overline{nm}} \overline{\ln \frac{L}{K}} + \kappa_{nd}^t, \tag{43}$$

where $\bar{x}$ denotes the average value of x. Note that in this pooled 2SLS specification, partner country fixed effects are replaced with country averages.

Finally, given the assumption that products from different exporting countries are differentiated, each of these HS 6-digit-exporter pairs should have unique translog parameters, a_{nn} and c_{nm}. However, there are only 14 years of data for each HS 6-digit-exporter pair, which is too limited in terms of degrees of freedom. Thus, for each HS 6-digit product, we pool across all exporting countries and years to implement the above specification, by estimating the average a_{nn} and c_{nm} for all exporting countries.

4 Data

This section describes the data and procedures used to construct the variables for estimating bilateral trade elasticities of 6-digit products imported by the US from its top 100 trading partners. The main variables include the US bilateral tariffs, import values and quantities, all at the HS 6-digit level (2007 revision). The raw data for these variables are from WITS (UN Comtrade), which are subjected to further cleaning to address errors and missing values, which we will describe below. Macroeconomic variables for the US, including GDP (current and constant US dollars), GDP deflators, labor force, and gross capital formation, are from the World Bank World Development Indicators (WDI).

Import shares, relative prices, and endowments. For each HS 6-digit product in each year, the import share of each trading partner is constructed according to Equation (34), which is by dividing the (negative) bilateral tariff-inclusive import value with the current GDP, and the price is measured by the unit value, which equals the ratio of import value to import quantity (with the same unit of measurement for quantity). To get the tariff-inclusive price, we multiply the unit value with (1 + bilateral ad-valorem tariff rate). The price of other goods is constructed according to Equation (35) with the US GDP deflator, import share, and the tariff-inclusive price. The log of the relative endowments are measured as the log difference between labor and capital formation of the US.

Using the relative price of EU as instrument. The relative price of the EU is used as the instrumental variable for the relative price of the US, and is constructed exactly the same way as described above. For the purpose of this project, the United Kingdom and Croatia are excluded because they were not EU members for the entire period (2010–2023). This also allows us to have separate bilateral import demand elasticities for products from these two countries. The EU-wide GDP deflators are computed as the ratio of EU GDP in current US dollars to EU GDP in constant 2015 US dollars.

Constructing bilateral tariffs for 2010-2023. To construct the bilateral tariffs of the US and the EU, we begin with raw tariff-line importer-year datasets downloadable from WITS. These datasets report tariffs by duty regime rather than by specific trading partner, and thus require processing to allocate each duty regime to the correct partners, account for preferential-exclusion flags, and assign tariffs originally attributed to "World" to relevant bilateral partners. The resulting set of MFN, preferential, and applied tariffs by tariff line, exporter, and year is then used to compile 6-digit-level tariffs through the following two-step procedure. First, the minimum tariff value across tariff lines is computed for each exporter-year combination, retaining non-MFN tariffs as applied rates where relevant and capping extreme tariff values at 3000 percent. Second, HS 6-digit level tariffs are calculated as the average of these minimum tariff-line duties. Nomenclature concordances are then applied to produce datasets in all seven HS revisions (H0–H6), and country-year panels are constructed for EU members according to their membership timelines. The current analysis is based on HS 2007 (H3) revision, in order the capture the relevant new goods added in the more recent years.

Missing tariffs and missing trade. For our current project, the relevant tariff data needed to estimate the product-level bilateral import demand elasticities of the US, is the bilateral tariff data of the US and the EU, for 2010-2023. The tariff panel construction described above for the US and the EU do not have any missing data or require further cleaning. Likewise, for tariff data for China, Canada and Japan, which have complete bilateral tariff panels for the sample period. However, for other countries, such as India and Mexico, the bilateral tariff panels have missing country-years due to missing preferential tariffs. Specifically, country-year datasets in which preferential tariffs are entirely absent—despite MFN tariffs being reported and preferential tariffs available in prior years, such as India for 2011-2013; Mexico for 2011-2013, 2015-2016 and 2019-2020—are removed to avoid false interpolation (i.e., assuming MFN is applied when preferential tariffs actually apply). In these cases, missing years are filled by carrying forward the latest available complete data (Mexico tariff of 2018 is used for 2020). This is under the assumption that countries will report tariffs when there are changes such that no reported tariff implies no change in tariffs. Each tariff panel is subsequently merged with

BACI bilateral trade data, with MFN tariffs incorporated as applied rates for countries not covered by preferential agreements. In this setup, the zero-trade records are included in our dataset, thereby preventing positive-selection bias in the estimation of trade elasticities.[11]

Quantity units. To ensure harmonization between the US and the EU data, a pending unit-standardization step aligns quantity units. Within each 6-digit product and exporter combination, the procedure retains the unit most prevalent across years, prioritizing kilograms when available. This step ensures consistency in unit values of the US and the EU, prior to estimating bilateral trade elasticities.

5 Empirical Results and Analysis

This section presents our findings. Subsection 5.1 reports and discusses the estimates of the bilateral import demand elasticities, and Subsection 5.2 analyzes the BTTIs for the US and the corresponding deadweight losses.

5.1 Product-level Bilateral Import Demand Elasticities

The estimating sample that we use to obtain the import demand elasticities consists of the top 100 trading partners of the US, for a total of 5,052 HS 6-digit (2007 revision) products over the period 2010 to 2023. We pooled all these trading partners and years together to estimate the translog parameter a_{nn} from the share equation with fixed effect IV regressions, according to equation (40). We also run the probit selection regression, according to equations (41) and (42), to test for selection bias, with ρ significantly different from 0. For those products with significant selection bias, we estimate the pooled 2SLS regression as specified in equation (43). Overall, we have 159 products with selection bias which needed to run the pooled 2SLS regression, and the other 4,565 products passed the selection bias test and only needed the fixed effect IV regressions. The rest of the 328 products cannot be estimated due to not having enough observations to run the regressions.

Based on the a_{nn} estimates, we construct bilateral import demand elasticities according equation (37). We further impose the structural restriction from equation (38) to have non-negative import

[11] Teti (2024) develops an alternative approach to confront the problems of false interpolation bias due to missing tariffs, and positive selection biases due to missing trade. Unlike our WITS-based procedure, tariff and trade data from multiple sources, such as WTO and ITC, in addition to WITS, are meticulously combined with an algorithm in Teti (2024), for a wide range of countries up to 2021, under HS 1988/1992 revision. Given that we need data for 2010-2023 for the elasticity estimations, and to construct BTTI using tariff of 2023, HS 2007 revision will be more relevant for our current application due to the inclusion of new goods (e.g. iphones, EVs, solar panels, etc.) in the recent years.

demand elasticities. Furthermore, we drop the tiny trade shares (share<0.0000005 of the US GDP) and only focus on data from 2021 to 2023 to avoid the distortions due to the COVID pandemic. Finally, we drop the top and bottom 5% of the elasticity estimates due to extreme values. We replace the missing elasticity estimates using the average elasticities at the closest aggregate levels, sequentially based on bilateral estimates at HS 5-digit to HS 1-digit, and partner country level.

Figure 1 presents the distribution of the wide-ranging estimated elasticities at HS 6-digit level across the different exporting countries to the US. Table 1 presents the average elasticity estimates by the broad HS 1-digit groups, which showcases the heterogeneous elasticities across products, ranging from -1.30 in Textiles to -5.14 in Plastics, Rubber, Wood and Paper.

The elasticities vary significantly across the US trade partners too. This is captured in Table 2. For example, the US average import elasticity estimates for products from the EU, China, Canada, Mexico and India are -2.67, -2.90, -2.71, -3.32, and -3.61, respectively. The differences partly reflect the varying product mix of these exporting countries to the US, as well as the share of these countries in the US total trade. Countries with close GVC ties, such as China, are shown to have lower elasticities, relative to countries with less trade with the US, such as Ghana, with an average elasticity of -15.73. The overall average US import demand elasticity is -3.85, placing comfortably between the benchmark elasticity estimate of 4 from Simonovska and Waugh (2014) and the more recent elasticity estimate for the US of 3.45 from Ganapati and Hottman (2025).

Using the same methodology, we further estimate the import demand elasticities of selected trading partners of the US, namely, the EU, China, Canada, Mexico, Japan and India. Table 3 presents the average import demand elasticities of these countries across all products and partners, and with respect to products from the US. The average import demand elasticities by HS1-digit products are also listed in this table. Compared to Table 2, it shows that while the average elasticity of the US for products from the EU is -2.67, the average elasticity of the EU for products from the US is -2.34, with an overall import demand elasticity of the EU equal to -2.87. This demonstrates that import demand elasticities also vary by the direction of the trade such that different import countries may have different elasticities with respect to the same products of the same trading partners. Similarly, the average import demand elasticity of China and Mexico with respect to products from the US are -2.90 and -2.51, respectively.

Figure 2 plots the elasticities of the US against the elasticities of the EU on the same products between the two countries. The lack of pattern suggests that bilateral product-level import demand elasticities are highly heterogeneous and vary by the direction of trade. The case of US-China trade offers a stark example. With a correlation coefficient of less than 0.1, there is virtually no correlation between the US' import demand elasticities for products from China and the China's import demand elasticities for the same product from the US. Similar conclusions can be made by comparing the average import elasticities of these partner countries at HS-1 digit level with the US averages as listed in Table 1, indicating the wide ranging variations of import demand elasticities, across products, importers and exporters.

The directional variation of the import demand elasticities that we obtain is novel in relation to the existing literature. While we do not explore this result further in the current paper, we believe that it is a significant empirical result with potentially important implications for measuring and explaining bilateral trade cost asymmetries and also for welfare analysis of the gains from trade. The latter is consistent with recent findings from Adão et al. (2024) who obtain heterogeneous trade elasticity estimates that vary depending on the number of exporters in a market and the country's level of development. The heterogeneity in the trade elasticities translates into larger gains from trade for the rich/developed countries.

5.2 The Balanced Trade Tariff Index

Armed with the bilateral import demand elasticities from the previous section and using tariff data for 2023, we construct the BTTI for the United States according to Equation (14). To highlight some of the important properties of the BTTI, we benchmark it against some existing tariff indexes, e.g., the 'Liberation Day' tariffs of the US and the widely-used import-weighted applied tariffs. Before we proceed, we note that the BTTIs for some of the countries in our sample are negative due to US trade surpluses with those countries. These countries are omitted from the analysis in this section, which only focuses on the positive BTTIs, i.e., for the countries that will face US tariffs. Our results are reported in Table 4, and we visualize some of them in Figures 3 and 4.

Column (1) of Table 4 lists the countries with whom the US is running bilateral trade deficits in 2023, with the last row, labeled 'ALL', is constructed using the aggregate trade of all the countries listed above. Column (2) reports the import-weighted bilateral applied tariffs of the US. These are the actual tariffs faced by the country in Column (1) when entering the US in 2023. It ranges from 0% or near 0% for many countries such as Agola (AGO) and Mexico (MEX), because of preferential access due to existing trade agreements, to 8.3% and 10.8% for Pakistan (PAK) and Bangladesh (BGD). The overall average import-weighted applied tariff is only 1.4% for all these countries.

Column (3) of Table 4 reports the 'Liberation Day' tariffs of the US announced in April 2025. In stark contrast to the applied tariffs in Column (2), these 'Liberation Day' tariffs are much higher, ranging from around 1% for Ecuador (ECU) and Kazakhstan (KAZ) to more than 95% in Cambodia (KHM) and Lesotho (LSO). In fact, many low-income developing countries such as LSO and Botswana (BWA) faced 0% applied tariff in 2023, are facing the among the highest 'Liberation Day' tariffs, suggesting that these small developing countries are disproportionately burdened under the new tariff policy. The overall average of the 'Liberation Day' tariffs is 46.8%, which is 33 times higher than the average applied tariffs of 2023.

Column (4) presents our BTTI estimates faced by the individual countries to balance the bilateral trade, as well as the 'Most-Favored-Nation' BTTI for 'ALL', estimated at 16.8% according (16) to balance the aggregate trade. Columns (5) and (6) further decompose the BTTIs into the two structural components, i.e., (i) the trade deficit terms vs. (ii) the preference-adjusted tariffs. Several findings stand out. First, the BTTIs are sizable and heterogeneous. Specifically, the mean of the BTTI is 16.8%, and it varies from 0.6% and 0.8% for AGO (Angola) and GHA (Ghana), respectively, to 60% and 114% for Fiji (FJI), and BWA.[12] Importantly, most of the countries with the largest BTTIs are Asian economies with GVC ties with the US.[13] Second, despite the large indexes for some countries, most of the BTTIs are relatively small, e.g., the median of the BTTIs is 12.7% and about 90% of the indexes are smaller than 40%.

Third, the BTTI is largely driven by the deficit component (i.e., about 86% on average). This can be seen from a comparison between Columns (4) and (3) of Table 4 and also from Figure 3. Thus, perhaps not surprisingly, the correlation between the BTTIs and the trade deficit terms is large (0.99). However, while positive, the correlation between the trade deficit terms and the preference-adjusted tariffs is relatively low (0.20). A possible interpretation and implication of this result is that the US trade deficits have accumulated with countries that faced lower tariffs, which is quite intuitive.

A comparison between the BTTIs and the 'Liberation Day' tariffs, which is visualized in Figure

[12] The main imported items of the US from Botswana and Fiji are diamonds and bottled water, respectively, which are very inelastic in demand, causing the BTTIs to be large.

[13] Other countries with the largest BTTIs are PAK, JOR, CHN, THA, VNM, MUS, LKA, NPL, BGD.

3, leads to two important conclusions. First, with an average of 48.4%, the 'Liberation Day' tariffs are significantly larger (i.e., nearly 3 times larger) than the average BTTIs. This is confirmed in the bottom row of Table 4, labeled 'ALL', where we report the 'Most-Favored-Nation' BTTI, which is the average/MFN-type uniform tariff for all products that balance aggregate trade deficit from all countries listed above, is 16.8%. Second, the correlation between the two indexes is positive (0.48) but not very strong. As we demonstrate below, this result is due to the heterogeneous import-demand elasticities that are used to construct the BTTIs from Column (4). This highlights the importance of two key components that are missing in the construction of the 'Liberation Day' tariffs: (i) the heterogeneity in the import demand elasticities and (ii) the role of comparative advantage.

The reason why Fiji, Bangladesh, and Botswana have among the highest BTTIs nicely illustrate this point. The main import products from these countries are bottled water, ready-made garments, and diamonds, the classic examples of necessity and luxury items with inelastic demand, and labor-intensive products supported by endowments. Under the famous brand 'Fiji Water', the US import most of bottled water from Fiji, which amount to $267 million in 2023. Likewise, Botswana is one of the world's largest diamond exporters, and the US was the 4th largest destination, with $456 million in exports in 2023. On the other hand, Bangladesh, with the abundance of unskilled workers, is the second largest exporters of apparels in the world, exporting more than $8.5 billion of garment products to the US in 2023. The US bilateral trade deficits with these countries are purely driven by comparative advantage dictated by endowments, coupled with the inelastic demand on these products, drive up the BTTIs. This explains why many economists disagree with the objective of 'balancing bilateral trade deficit' with 'Liberation Day' tariffs: while a high tariff may not be effective in decreasing the imports of products that have inelastic demand, it may push up the prices and cause undue burden to the US consumers and these developing countries.

Comparing the import-weighted applied tariffs in Column (2) with the BTTIs from Column (4) leads to the following conclusions. First, as expected, the import-weighted tariffs are significantly smaller than the BTTIs. Second, and more importantly, even though the import-weighted tariffs and the preference-adjusted tariffs are highly correlated (i.e., the correlation is 0.95), there are some substantial differences between the two sets of tariffs. This can seen clearly from Figure 4. The implication of this result is that taking into account the import demand elasticities is important for the construction of average tariffs.

Finally, columns (7) and (8) of Table 4 report two additional BTTIs: (i) BTTIs that are constructed with import-demand elasticities at the product-level; and (ii) BTTIs that are constructed with an average import-demand elasticity for the US;[14] The correlation between the BTTIs from columns (4) and (7) is 0.70 – high but far from perfect. Moreover, we see some very significant differences between the two BTTIs, e.g, compare the BTTIs for AGO and BWA, among others. These differences are due to the bilateral heterogeneity of the import demand elasticity and highlight the potential importance of proper measurement and allowing for such heterogeneity.

The differences between the BTTIs in Column (4) and those from Column (8), which are obtained with an average elasticity index for the US, are even larger, thus reinforcing our previous conclusion about the importance of allowing for heterogeneous import demand elasticities. Finally, we note that, even though the BTTIs from Column (8) are significantly smaller than the 'Liberation Day' tariffs in Column (3), the correlation between these indexes is very high at 0.95. This explains the low correlation between our main BTTIs from Column (4) and the 'Liberation Day' tariffs and, once again, highlights the importance of the heterogeneity of the trade elasticities.

What are the welfare implications due to these different tariffs? Table 5 reports the DWLs (in shares of import value) that correspond to the tariff indexes from Table 4, which are constructed based on the formula from section 2.3. Not surprisingly, the variation across the DWL in the different columns follows to the variation of the corresponding tariff indexes from Table 4. For example, given that the import-weighted bilateral applied tariffs of the US is quite low, the corresponding DWLs listed in Column (2) of Table 5 are also small, ranging from 0% in AGO to 4% in Myanmar (MMR), with a overall DWL of 0.1% of aggregate imports.

Column (3) shows that, on the contrary, under the 'Liberation Day' tariffs, DWL ranges from 0.2% in ECU to 382% in Libya (LBY), with an overall DWL of 24.5% of the aggregate imports, which is 245 times higher than the implied DWL due to applied tariffs of 2023. This highlights the arguments of many economists against the use of tariffs to balance trade, as the resulting DWL could be tremendous. Column (4) presents the DWL as a share of imports due to the BTTI, which are also higher than the DWL due to the applied tariff in Column (2), with variation corresponding to the variation of the BTTIs. Specifically, we find that the DWLs of BTTI vary from less that 0.1% of imports for Bahrain, Ecuador, Kazakhstan, and North Macedonia to more than 15% for Sri Lanka,

[14] The product-level and the average import demand elasticities are constructed from our bilateral elasticity estimates, which are aggregated with import-weights. The average elasticity that we obtain for the US is -3.85.

Bangladesh, and Botswana.

Most importantly, the DWLs of the BTTIs in Column (4) of Table 5, are significantly smaller than those that are obtained with the 'Liberation Day' tariffs in Column (3). At the aggregate level, the DWL of the 'Liberation Day' tariffs are nearly 6 times larger than the BTTI-induced DWL based on the 'Most-Favored-Nation' BTTI for all countries, which is the uniform tariff for all products from all countries, reported in the bottom row as 'ALL' of Table 5. In fact, the DWLs of the 'Liberation Day' tariffs are higher than that of BTTIs for all but 5 of the listed countries. Columns (5) and (6) report the DWLs of BTTIs using US product level elasticities as well as the overall average US elasticities. Compared to Column (4), the DWLs induced by BTTI constructed using product elasticities are higher for two-thirds of the countries.

Overall, compared to the announced 'Liberation Day' tariffs, not only could the BTTI achieve the stated goal of balancing bilateral trade more rationally, since it is grounded in theory, it also incurs much lower welfare losses. Moreover, the weakly negative correlation between the DWLs due to BTTI vs. the 'Liberation Day' tariffs (-0.08) in fact suggests that, while the 'Liberation Day' tariffs generate larger DWLs (in terms of share of imports) for small developing countries, it is not the case for BTTI.

We conclude with a brief discussion of the results from the liberalization scenario from Section 2.4. To obtain the US BTTIs under these conditions, we first calculate the US trade imbalances when its trade partners remove all tariffs. In turn, this requires product-level bilateral elasticities for the US trade partners and, as discussed in Section 5.1, we obtain these elasticities for six key trade partners of the US, including Canada, China, the EU, India, Japan, and Mexico.

Three main results stand out from this experiment. First, as expected, all BTTIs that we obtain are smaller than the corresponding benchmark indexes in Column (4) of Table 4. Second, the new BTTIs and the differences between them and the benchmark indexes are quite heterogeneous. For example, the BTTI for the EU decreases from 14.2% to 5.9%, while the BTTI for Mexico falls from 17% to 11.8%. Finally, we find that full trade liberalization for US exports would result in US trade surpluses with Canada, China, India and Japan. Thus, the implied BTTIs for these countries are negative: -5.9% for Canada, -13.6% for China, and a very large BTTI of -16.4% for India, and -5.9% for Japan.

6 Conclusion

The devil is in the details, and the reality is more complicated than theory. Trade, driven broadly by comparative advantage, happens at the disaggregated product level with different trading partners, resulting in differences in tariffs and trade deficits across products and countries. To eliminate bilateral trade imbalances, whether or not that is a worthy objective, requires matching disaggregated and heterogeneous import elasticities.

This paper proposes the BTTI, a uniform tariff that aims at eliminating bilateral trade deficits in a theoretically consistent way. We construct the BTTI with bilateral product-level import demand elasticities, estimated via the translog GDP function approach using US bilateral trade data with its top 100 trading partners from 2010 to 2023. While BTTIs are sizable relative to the existing tariffs, they are smaller than the 'Liberation Day' tariffs, which are a-theoretical and with no consideration of the heterogeneous trade elasticities across products and trading countries. The implied deadweight loss as a share of import is also significantly smaller with the BTTIs than the 'Liberation Day' tariffs, suggesting that BTTIs could achieve the stated goal of balancing bilateral trade at a much lower costs, particularly for products from small developing countries.

References

Adão, R., Arkolakis, C., and Ganapati, S. (2024). From heterogeneous firms to heterogeneous trade elasticities: The aggregate implications of firm export decisions. NBER Working Papers 28081, National Bureau of Economic Research, Inc.

Anderson, J. and Neary, P. (1996). A new approach to evaluating trade policy. *Review of Economic Studies*, 63(1):107–25.

Anderson, J. and Neary, P. (2003). The Mercantilist index of trade policy. *International Economic Review*, 44(2):627–649.

Anderson, J. and van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review*, 93(1):170–192.

Anderson, J. E. and Yotov, Y. V. (2020). Short Run Gravity. *Journal of International Economics*, 126:September.

Anderson, J. E. and Yotov, Y. V. (2025a). Gravity in transition. *Review of International Economics*, 33(3):616–630.

Anderson, J. E. and Yotov, Y. V. (2025b). Tariff Reciprocity. NBER Working Papers 34052, National Bureau of Economic Research, Inc.

Arkolakis, C., Costinot, A., and Rodríguez-Clare, A. (2012). New Trade Models, Same Old Gains? *The American Economic Review*, 102(1):94–130.

Boehm, C. E., Levchenko, A. A., and Pandalai-Nayar, N. (2023). The Long and Short (Run) of Trade Elasticities. *American Economic Review*, 113(4):861–905.

Broda, C., Greenfield, J., and Weinstein, D. (2006). From Groundnuts to Globalization: A Structural Estimate of Trade and Growth. *NBER Working Paper No. 12512*.

Broda, C., Greenfield, J., and Weinstein, D. E. (2017). From groundnuts to globalization: A structural estimate of trade and growth. *Research in Economics*, 71(4):759–783.

Broda, C. and Weinstein, D. E. (2006). Globalization and the Gains From Variety. *The Quarterly Journal of Economics*, 121(2):541–585.

Caliendo, L. and Parro, F. (2015). Estimates of the Trade and Welfare Effects of North American Free Trade Agreement. *The Review of Economic Studies*, 82(1):1–44.

Carrére, C., Mrázová, M., and Neary, J. P. (2020). Gravity Without Apology: the Science of Elasticities, Distance and Trade. *Economic Journal*, 130(628):880–910.

Caves, D., Christensen, L., and Diewert, E. (1982). Multilateral Comparisons of Output, Input, and Productivity using Superlative Index Numbers. *Economic Journal*, 92:73–86.

Chen, N. and Novy, D. (2022). Gravity and Heterogeneous Trade Cost Elasticities. *Economic Journal*, 132(644):1349–77.

Diewert, E. and Wales, T. (1988). A Normalized Quadratic Semiflexible Function Form. *Journal of Econometrics*, (37).

Eaton, J. and Kortum, S. (2002). Technology, Geography and Trade. *Econometrica*, 70(5):1741–1779.

Egger, P. H., Larch, M., and Staub, K. E. (2012). Trade Preferences and Bilateral Trade in Goods and Services: A Structural Approach. *CEPR Working Paper No. 9051.*

Feenstra, R. (1995). Estimating the effects of trade policy. *Handbook of International Economics*, 3.

Fontagné, L., Guimbard, H., and Orefice, G. (2022). Tariff-based product-level trade elasticities. *Journal of International Economics*, 137:103593.

Ganapati, S. and Hottman, C. (2025). Did Foreigners Pay Our Tariffs? Quantity Discounts, Scale Economies and incomplete Pass-Through. *Working Paper.*

Harrigan, J. (1997). Technology, Factor Supplies, and International Specialization: Estimating the Neoclassical Model. *merican Economic Review*, 87(4).

Helpman, E., Melitz, M., and Rubinstein, Y. (2008). Estimating trade flows: trading partners and trading volumes. *Quarterly Journal of Economics*, 123(2).

Hinz, J., Mahlkow, H., and Wanner, J. (2025). The KITE Model Suite: A Quantitative Framework for International Trade Analysis. Working Paper Series KITE White Paper, The Kiel Institute.

Ignatenko, A., Lashkaripour, A., Macedoni, L., and Simonovska, I. (2025). Making America great again? The economic impacts of Liberation Day tariffs. *Journal of International Economics*, 157(C):None.

Imbs, J. and Mejean, I. (2017). Trade Elasticities. *Review of International Economics*, 25(2):383–402.

Itskhoki, O. and Mukhin, D. (2025). The optimal macro tariff. NBER Working Papers 33839, National Bureau of Economic Research, Inc.

Kee, H. L., Neagu, C., and Nicita, A. (2013). Is Protectionism on the Rise? Assessing National Trade Policies during the Crisis of 2008. *The Review of Economics and Statistics*, 95(1):342–346.

Kee, H. L. and Nicita, A. (2024). Quantifying Economic Impacts of Trade Agreements with Heterogeneous Trade Elasticities. *Review of International Economics*, 32(3):1270–1299.

Kee, H. L., Nicita, A., and Olarreaga, M. (2008). Import demand elasticities and trade distortions. *Review of Economics and Statistics*, 90(4):666–682.

Kohli, U. (1991). Technology, Duality, and Foreign Trade: The GNP Function Approach to Modeling Imports and Exports.

McKibbin, W. J., Noland, M., and Shuetrim, G. (2025). The global economic effects of Trump's 2025 tariffs. Working Paper Series WP25-13, Peterson Institute for International Economics.

Roguff, K. (2025). *Our Dollar, Your Problem: An Insider's View of Seven Turbulent Decades of Global Finance, and the Road Ahead*. Yale University Press.

Rotunno, L. and Ruta, M. (2025). Trade Partners' Responses to US Tariffs. IMF Working Papers 2025/147, International Monetary Fund.

Schmitt-Grohé, S. and Uribe, M. (2025). Transitory and Permanent Import Tariff Shocks in the United States: An Empirical Investigation,. *NBER working paper*, (33997).

Semykina, A. and Wooldridge, J. (2010). Estimating Panel Data Models in the Presence of Endogeneity and Selection. *Journal of Econometrics*, 157.

Simonovska, I. and Waugh, M. (2014). The elasticity of trade: Estimates and evidence. *Journal of International Economics*, 92(1):34–50.

Soderbery, A. (2015). Estimating Import Supply and Demand Elasticities: Analysis and Implications. *Journal of International Economics*, 96(1):1–17.

Teti, F. (2024). Missing Tariffs. *CESifo Working Paper*, (11590).

Yilmazkuday, H. (2019a). Estimating the Trade Elasticity Over Time. *Economics Letters*, 183(C):1–1.

Yilmazkuday, H. (2019b). Understanding the International Elasticity Puzzle. *Journal of Macroeconomics*, 59(C):140–153.

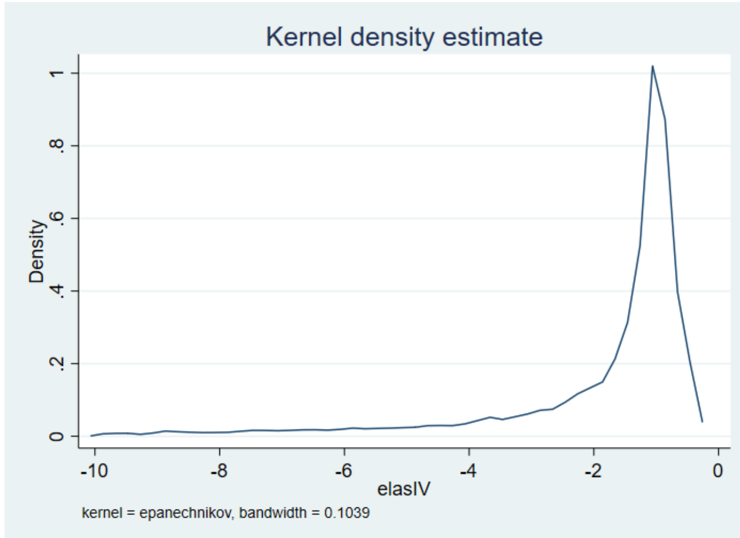


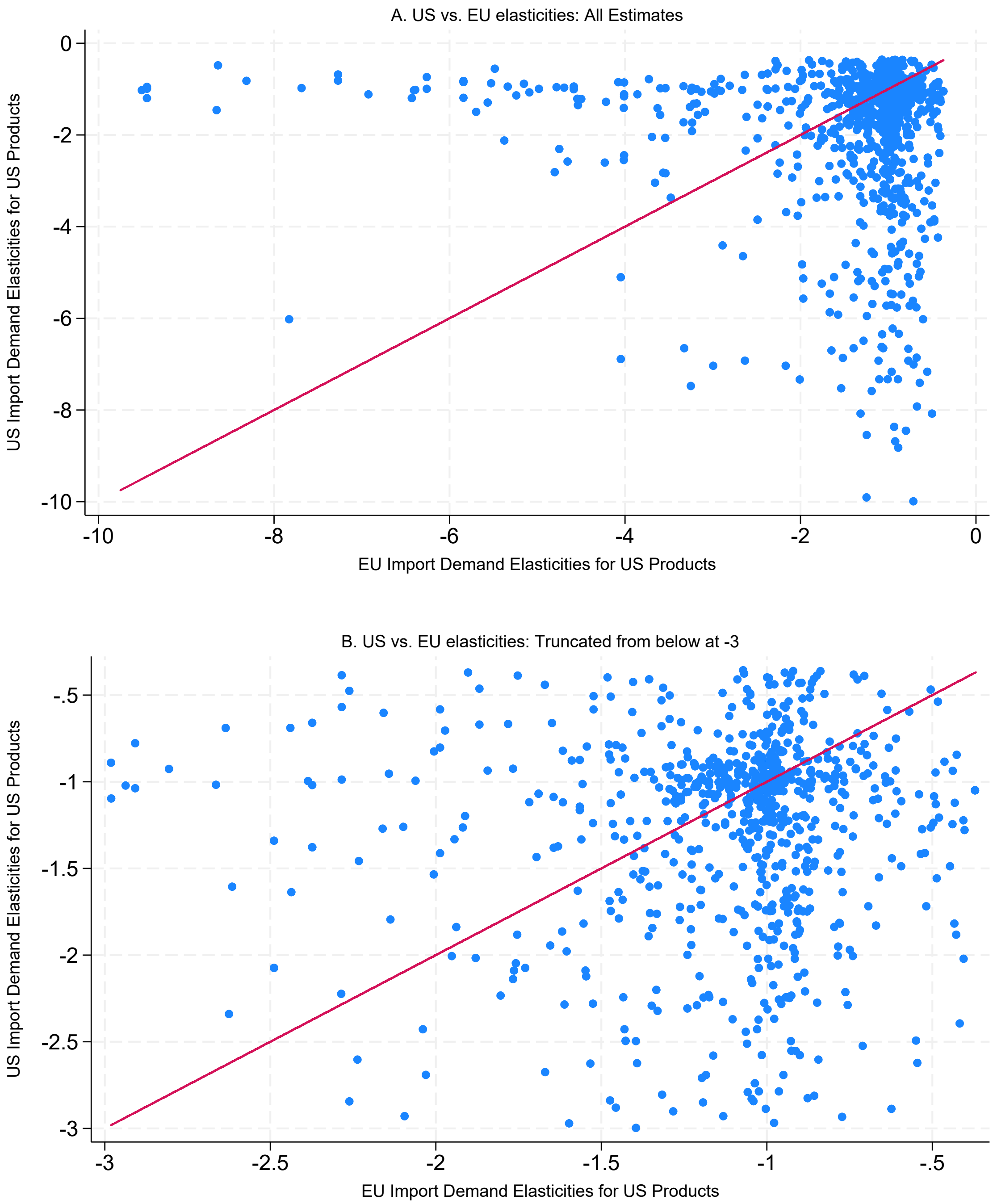
Figure 1: The Estimated Product-Level Bilateral Import Elasticities of the US

Table 1: The Estimated Average US Import Elasticity by HS 1-digit Groups

HS1	Descriptions	Elasticity
0	Animal & vegetable products	-2.91
1	Food products	-2.59
2	Food preparations, beverages & minerals	-3.47
3	Chemicals & allied industries	-2.93
4	Plastics, rubber, wood & paper	-5.14
5	Textiles	-1.30
6	Apparel, leather, stone & glass	-3.73
7	Base metals	-4.80
8	Machinery, electronics & transport equipment	-3.99
9	Miscellaneous manufactures	-4.39

Notes: These are the average estimated US import demand elasticity facing products within each HS1-digit groups.

Figure 2: US vs. EU import demand elasticities



Note: This figure plots the US import demand elasticities of a product from the EU against the EU import demand elasticities of the same product from the US. The top panel includes all estimates, while the results in panel B are truncated from below at -3.

Table 2: The Estimated Average US Import Elasticity by Exporting Countries

Exporter	Elasticity	Exporter	Elasticity	Exporter	Elasticity	Exporter	Elasticity	Exporter	Elasticity
AGO	-56.96	CRI	-3.82	IDN	-3.99	MEX	-3.32	SAU	-4.94
ARE	-4.81	CUW	-53.09	IND	-3.61	MKD	-0.78	SEN	-8.29
ARG	-7.03	DOM	-7.38	IRQ	-1.51	MMR	-13.94	SER	-7.04
AUS	-6.37	DZA	-10.77	ISL	-2.40	MOZ	-9.99	SGP	-5.97
AZE	-24.47	ECU	-5.13	ISR	-2.81	MUS	-1.30	SLV	-2.91
BGD	-2.44	EGY	-4.60	JAM	-4.78	MYS	-5.62	SUR	-1.97
BHR	-2.11	ETH	-13.26	JOR	-2.61	NAM	-17.22	TCD	-24.01
BHS	-3.36	EUN	-2.67	JPN	-3.59	NGA	-8.18	THA	-3.43
BLR	-19.69	FJI	-0.93	KAZ	-3.22	NIC	-4.75	TTO	-2.79
BOL	-2.55	GAB	-1.09	KEN	-10.00	NOR	-4.18	TUN	-8.42
BRA	-5.33	GBR	-3.68	KHM	-5.30	NPL	-1.30	TUR	-4.43
BWA	-0.71	GEO	-0.61	KOR	-4.18	NZL	-2.72	TWN	-4.03
CAN	-2.71	GHA	-15.73	KWT	-1.72	OMN	-9.28	TZA	-3.82
CHE	-5.50	GNQ	-6.32	LAO	-15.01	PAK	-6.96	UKR	-6.03
CHL	-5.86	GTM	-4.59	LBN	-2.55	PAN	-2.91	URY	-3.96
CHN	-2.90	GUY	-12.46	LBY	-24.87	PER	-4.34	VEN	-8.46
CIV	-10.34	HKG	-6.08	LKA	-3.07	PHL	-5.75	VNM	-4.15
CMR	-2.36	HND	-4.34	LSO	-7.24	PRY	-1.37	ZAF	-5.63
COG	-24.26	HRV	-1.10	MAR	-4.72	QAT	-5.29	ZAR	-4.42
COL	-5.53	HTI	-4.26	MDG	-9.18	RUS	-5.61	WLD	-3.85

Notes: These are the average estimated US import demand elasticities on products of each exporting country.

Table 3: The Estimated Average Import Elasticity of Selected Partner Countries

	EUN	CHN	MEX	CAN	JPN	IND
Animal & vegetable products	-2.85	-4.81	-3.36	-5.29	-3.27	-2.49
Food products	-2.67	-4.65	-4.85	-3.74	-2.73	-3.57
Food preparations, beverages & minerals	-3.08	-4.24	-2.34	-3.62	-2.87	-4.26
Chemicals & allied industries	-3.09	-3.50	-4.08	-8.96	-2.48	-3.30
Plastics, rubber, wood & paper	-2.35	-6.08	-4.36	-11.33	-2.85	-4.58
Textiles	-2.08	-6.48	-6.34	-3.58	-1.75	-4.25
Apparel, leather, stone & glass	-2.52	-1.29	-6.28	-11.61	-3.74	-2.98
Base metals	-3.28	-4.84	-4.75	-9.33	-2.59	-5.10
Machinery, electronics & transport equipment	-3.09	-3.18	-5.60	-17.45	-2.99	-3.00
Miscellaneous manufactures	-2.20	-2.62	-4.34	-12.12	-2.13	-2.87
Overall	-2.87	-3.93	-4.86	-11.08	-2.84	-3.68
USA	-2.34	-2.9	-2.51	-7.14	-2.27	-3.27

Notes: These are the average estimated import demand elasticity for products within each HS1-digit groups, of the countries listed. Also listed are the average estimated import demand elasticity overall and specific to products from the US for these countries.

Table 4: The Balanced Trade Tariff Index (BTTI) vs. Other Tariffs, USA.

(1) Country ISO3 Code	(2) Import Weighted Applied Tariff	(3) Liberation Day Tariff	(4) BTTI	(5) Deficit Term	(6) Preference Adjusted Term	(7) BTTI-Product Elasticity	(8) BTTI-Average Elasticity
AGO	0.00	34.06	0.60	0.60	0.00	6.15	8.85
BGD	10.83	74.30	64.68	53.83	10.85	50.97	31.98
BHR	0.00	1.56	0.96	0.96	0.00	0.84	0.41
BLR	1.34	67.97	4.76	3.50	1.27	18.16	19.15
BWA	0.00	80.92	114.12	114.12	0.00	29.83	21.02
CAN	0.10	33.21	13.78	13.74	0.04	8.87	8.72
CHE	2.34	27.64	9.62	7.41	2.21	11.11	9.56
CHN	2.78	64.79	25.18	23.53	1.65	24.76	19.87
CIV	0.33	20.42	5.32	5.26	0.05	8.20	5.63
COG	0.00	35.75	1.14	1.14	0.00	6.67	9.29
CRI	0.09	10.37	2.12	2.10	0.02	2.28	2.77
DZA	1.65	62.32	6.95	5.43	1.52	16.38	18.10
ECU	1.14	0.91	0.93	0.15	0.78	1.47	1.35
EUN	1.69	31.07	14.17	12.27	1.90	13.26	9.82
FJI	1.71	57.09	60.04	58.11	1.94	46.81	16.65
GHA	0.01	37.81	0.83	0.83	0.00	7.66	9.83
GNQ	0.89	68.54	18.45	16.58	1.87	19.89	18.84
GUY	0.06	55.65	1.57	1.55	0.02	9.82	14.52
IDN	3.74	60.77	20.92	18.76	2.16	20.41	19.71
IND	2.73	51.52	22.81	20.44	2.37	24.41	16.33
ISL	0.59	7.31	4.18	3.36	0.82	1.92	2.48
ISR	0.07	50.63	22.87	22.80	0.07	21.67	13.23
JOR	0.04	52.70	25.15	25.14	0.01	25.43	13.72
JPN	1.62	43.57	15.70	13.66	2.04	14.81	13.07
KAZ	1.44	1.20	1.63	0.36	1.27	1.56	1.72
KHM	5.29	97.22	21.94	19.86	2.08	26.61	31.37
KOR	0.00	47.98	12.66	12.66	0.01	12.91	12.47
LAO	3.44	92.82	13.26	7.77	5.49	49.36	28.22
LBY	1.76	72.88	4.75	2.98	1.76	14.19	21.03
LKA	7.48	82.67	41.17	33.79	7.38	42.35	30.05
LSO	0.00	96.60	15.59	15.59	0.00	23.14	25.09
MDG	0.03	83.94	13.32	13.28	0.04	31.59	21.83
MEX	0.07	45.25	16.97	16.94	0.03	13.14	11.82
MKD	2.13	2.78	4.87	3.37	1.50	2.17	2.42
MMR	5.52	78.44	12.69	7.07	5.62	21.12	26.61
MUS	0.49	50.70	41.11	40.54	0.57	28.19	13.68
MYS	0.85	56.93	14.04	11.78	2.26	19.19	15.72
NGA	0.00	54.87	2.55	2.55	0.00	9.70	14.26
NIC	0.19	38.16	7.41	7.34	0.07	10.28	10.09
NPL	1.15	62.58	47.09	46.07	1.01	30.39	17.50
NZL	4.05	13.10	8.64	6.17	2.47	9.01	7.32
OMN	0.00	21.79	5.38	5.38	0.00	7.98	5.66
PAK	8.34	64.60	22.90	15.50	7.41	33.79	26.27
PHL	1.33	32.95	9.54	8.40	1.14	10.64	9.87
RUS	0.51	87.80	15.91	15.60	0.31	21.48	23.39
SAU	1.74	10.82	4.23	2.38	1.85	3.95	4.59
SER	2.57	19.01	5.85	3.03	2.82	7.17	7.55
TCD	0.00	68.74	2.86	2.86	0.00	11.73	17.85
THA	1.26	69.26	25.81	24.43	1.38	23.39	19.41
TTO	0.03	36.76	21.78	21.75	0.03	8.39	9.58
TUN	1.85	26.04	5.23	3.69	1.54	8.03	8.56
TWN	1.25	57.69	18.56	16.91	1.64	21.30	16.38
VEN	1.80	36.21	6.13	4.31	1.82	8.23	11.38
VNM	3.47	91.87	38.86	36.42	2.44	40.29	27.78
ZAF	0.08	46.30	9.74	9.68	0.06	11.30	12.10
ZAR	0.00	35.68	10.02	10.02	0.00	13.37	9.27
ALL	1.40	46.83	16.75	15.58	1.17	15.89	13.63

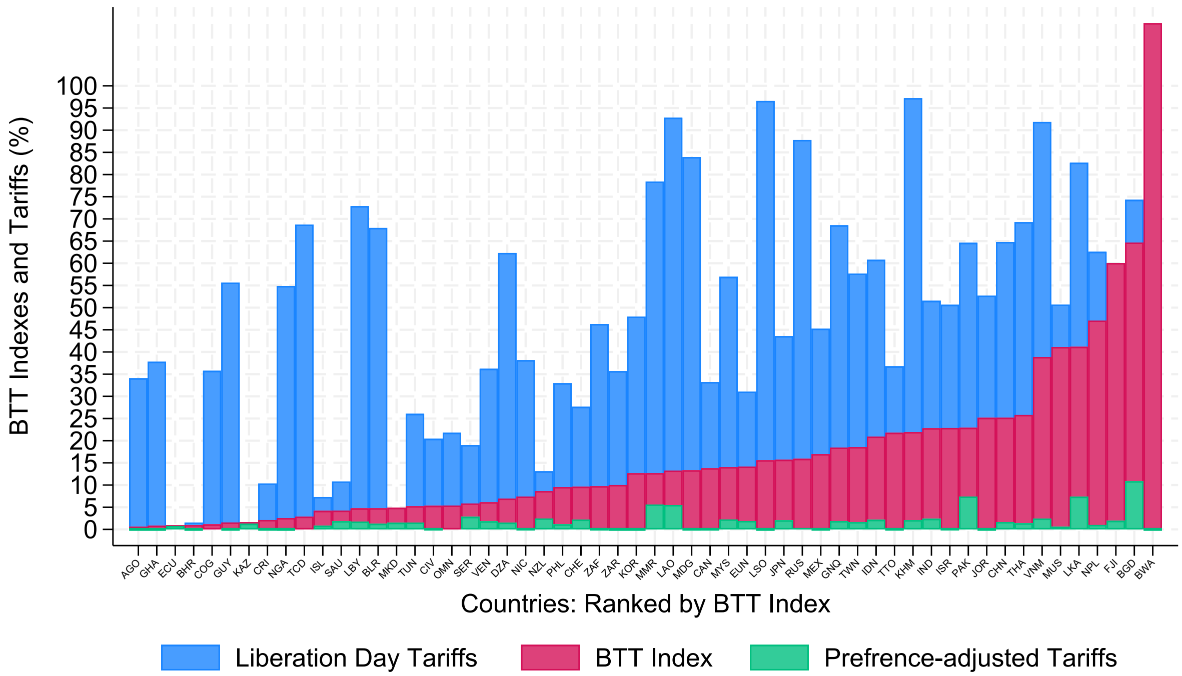
Notes: This table reports various tariff indexes. Column (1) lists the three-letter ISO country codes in alphabetical order. Column (2) reports import-weighted applied tariffs. Column (3) reports the 'Liberation Day' tariffs, calculated based on the formula that was used by the USTR. Column (4) shows the BTTI, which is decomposed into the trade deficit term in Column (5) and the preference-adjusted term in Column (6). Column (7) construct BTTI based on product-level elasticities, while column (8) uses an average elasticity for the US to construct BTTI. The last row, labeled 'All,' is based on data for all the countries listed in the table. BTTI for ALL is the MFN BTTI as shown in (16), which is the uniform tariff for all products from all partner countries that will balance the aggregate trade.

Table 5: The Deadweight Loss of Tariffs (in Share of Imports), USA.

(1) Country	(2) Applied Tariff	(3) Liberation Day Tariff	(4) BTTI	(5) BTTI-prod	(6) BTTI-average
AGO	0.00	246.42	0.10	10.16	20.48
BGD	1.03	24.23	19.43	13.17	5.93
BHR	0.00	0.02	0.01	0.01	0.00
BLR	0.83	270.74	2.13	27.49	30.29
BWA	0.00	12.83	21.56	2.43	1.29
CAN	0.01	10.01	2.02	0.87	0.85
CHE	0.35	11.40	1.61	2.12	1.59
CHN	0.18	35.65	7.09	6.88	4.61
CIV	0.01	6.73	0.52	1.21	0.58
COG	0.00	148.05	0.20	6.56	12.41
CRI	0.00	2.40	0.11	0.13	0.18
DZA	0.19	139.44	2.63	13.44	16.17
ECU	0.07	0.02	0.03	0.06	0.06
EUN	0.14	9.50	2.27	2.00	1.13
FJI	0.09	10.39	11.28	7.48	1.19
GHA	0.00	235.64	0.16	12.39	19.97
GNQ	0.09	58.69	6.05	6.95	6.29
GUY	0.04	357.50	0.44	15.77	33.07
IDN	0.40	37.99	5.99	5.72	5.37
IND	0.25	22.61	5.47	6.18	2.96
ISL	0.04	0.55	0.18	0.04	0.07
ISR	0.00	18.91	4.73	4.29	1.72
JOR	0.00	19.07	5.30	5.40	1.73
JPN	0.15	21.52	3.47	3.11	2.46
KAZ	0.10	0.02	0.04	0.04	0.05
KHM	0.69	119.76	9.86	13.97	18.72
KOR	0.00	29.49	2.70	2.80	2.62
LAO	2.62	281.66	9.79	102.83	39.16
LBY	0.38	382.03	2.67	21.94	45.43
LKA	1.27	49.16	15.77	16.55	9.12
LSO	0.00	147.10	6.51	13.48	15.60
MDG	0.01	121.05	4.95	23.96	12.36
MEX	0.00	18.83	3.29	2.04	1.67
MKD	0.17	0.03	0.09	0.02	0.02
MMR	4.05	202.05	8.37	21.58	32.78
MUS	0.04	10.73	7.53	3.90	1.03
MYS	0.31	51.02	4.27	7.63	5.28
NGA	0.00	208.99	0.68	9.22	19.12
NIC	0.02	27.40	1.33	2.49	2.40
NPL	0.06	16.52	10.34	4.86	1.79
NZL	0.25	1.65	0.75	0.81	0.54
OMN	0.00	7.89	0.56	1.19	0.61
PAK	1.87	56.76	9.56	19.10	12.24
PHL	0.29	16.21	1.65	2.03	1.76
RUS	0.08	115.89	6.17	10.72	12.52
SAU	0.10	2.44	0.40	0.35	0.47
SER	0.51	9.80	1.04	1.55	1.71
TCD	0.00	336.19	0.96	14.78	32.47
THA	0.14	40.73	7.61	6.37	4.53
TTO	0.00	8.35	3.29	0.55	0.71
TUN	0.65	19.29	0.93	2.14	2.42
TWN	0.10	36.59	5.04	6.48	4.00
VEN	0.15	41.16	1.51	2.67	4.97
VNM	0.29	56.83	14.05	14.95	7.80
ZAF	0.01	35.05	2.07	2.75	3.13
ZAR	0.00	16.71	1.62	2.81	1.40
ALL	0.12	24.47	4.22	4.00	2.81

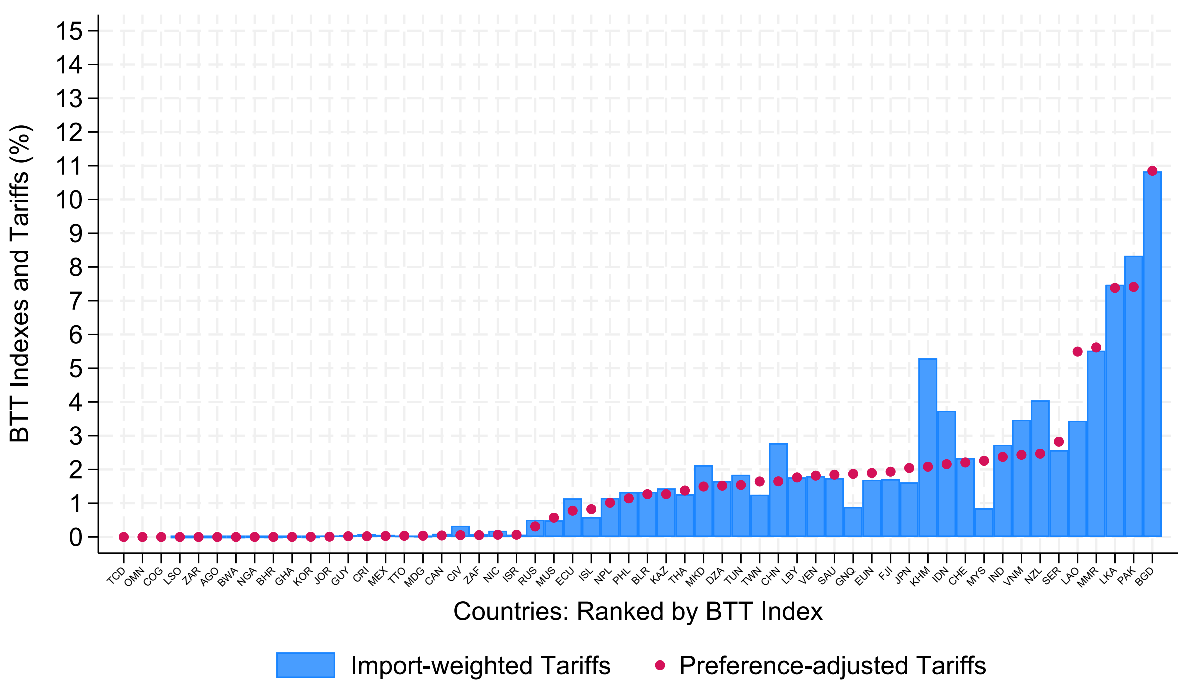
Notes: This table reports the DWL that corresponds to various tariff indexes. Column (1) lists the three-letter ISO country codes in alphabetical order. Column (2) includes the DWL based on the bilateral applied tariffs in 2023. Column (3) reports DWL of the 'Liberation Day' tariffs. Column (4) reports the DWL of the BTTI. Column (5) reports the DWL based on the BTTI computed using product-level elasticities, while Column (6) reports the DWL based on the BTTI computed using average elasticity for the US. The last row, labeled 'All,' is based on data for all countries listed in the table.

Figure 3: BTTI and tariffs



Note: This figure visualizes the BTTI (in red color), along with the 'Liberation Day' tariffs (in blue color), and the preference-adjusted tariff terms (in green color). The countries are ordered based on their BTTI, from the lowest to the largest.

Figure 4: Import-weighted vs. preference-adjusted tariffs



Note: This figure plots the import-weighted vs. preference-adjusted tariffs for the US.The countries are ordered based on the preference-adjusted tariffs, from the lowest to the largest.