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Global demand and supply elasticities and the impact of tariff shocks*

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Abstract

This study applies the Quadratic Almost Ideal Demand System (QUAIDS) to the Asian Development Bank's Multi-Region Input-Output (MRIO) dataset to estimate global demand and supply elasticities across intermediate vs. final, and domestic vs. foreign sectors. Using pooled data from 2021–2023, results show that supply is generally less responsive to income changes than demand, but more reactive to price changes, particularly for intermediate goods. Over time, demand for foreign intermediate and final goods has outpaced supply, reflecting a growing dependence on foreign inputs with low substitutability. At a more detailed sectoral level, demand elasticities exhibit stronger income and substitution effects, especially in Household final demand and intermediate Services, while supply elasticities are predominantly price-driven, with greater responsiveness in sectors such as Construction, Manufacturing, and Agriculture. These elasticities are then used to simulate welfare impacts of ongoing trade tensions between the USA and the rest of the world, using the latest bilateral tariff data. Findings indicate a global welfare loss of approximately -1.3%, with some countries, particularly those highly dependent on US imports with limited substitution options, face losses up to 5.6%. Counter-tariffs also adversely affect sanctioning countries; for example, Canada could experience revenue losses of up to 5%, while others see welfare losses ranging from 0.5-1.8%. Despite retaliatory tariffs, the USA faces minimal welfare losses. This framework presented in this paper showcases how monitoring elasticities can support with adapting policies to potential trade-related price shocks.

Keywords: production, trade, demand and supply elasticities, demand systems, QUAIDS, tariffs, price shocks

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1 Introduction

The world has experienced staggering economic growth over the past decades. Despite periods of economic downturns, the global GDP reached USD 93.35 trillion in 2023, nearly twice the value of USD 48.44 trillion recorded in 2000 (World Bank, 2025). In 2023, international trade accounted for nearly 59% of the world's total output (50% in 2000), while global exports were approximately 29% of global GDP (23.5% in 2000) (World Bank, 2025). This substantial flow of goods and services can be attributed to the rapid growth and integration of countries in global value chains (GVCs), increasing trade openness, technological advancements and declining shipping costs, all of which facilitate swift responses to changes in market demand (WTO, 2023). However, as past events have also shown, these deep interlinkages and dependence on imported goods also make countries highly vulnerable to exogenous shocks (World Bank, 2020).

Following the 2008 global financial crisis, trade expansion dropped to an annual rate of 3% compared to the 7% pre-crisis (Constantinescu et al., 2016). This shift is also accompanied by higher fragmentation of value chains, as countries and sectors have become more specialized, new markets and technological advancements emerge, and trade alliances are realigned (Timmer et al., 2021; Lewis et al., 2022; Baier & Standaert, 2024). Furthermore, recent geopolitical developments, such as the abrupt imposition of US tariffs on its allies in the first quarter of 2025, signal potential trade conflicts that threaten to undermine the very framework that once enabled global prosperity (Constantinescu et al., 2020; WTO, 2023).

In order to understand the extent of these dependencies and how vulnerable the global economy is to price shocks, such those created by the on-going tariff wars, this paper introduced a framework to evaluate and compare demand and supply elasticities using three innovative approaches. First, it utilizes the latest global Multi-Region Input-Output (MRIO) dataset from the Asian Development Bank (ADB).[1] The data comes in both in real and nominal values for 62 countries – primarily Europe, Asia, and North America – plus the Rest of the World, covers 35 sectors, and is available from 2007 to 2023. This allows us to not only explore cross-sectional elasticities in depth but also observe how they evolve over time. Second, since we have access to an input-output structure, we can go beyond bilateral trade-based elasticities estimates and bring in a *whole-of-economy* structural perspective. We achieve this by differentiating between demand and supply elasticities for intermediate and final demand further delineated by domestic and foreign producers and consumers. This baseline 2x2 system is also extended to explore more disaggregated intermediate and final demand sectors. Third, we employ the Quadratic Almost Ideal Demand System (QUAIDS), a robust demand estimation that can incorporates non-linear income and expenditure functions and non-linear price elasticities. This allows us to conduct a more robust sensitivity analysis to various shocks without imposing strict assumptions to recover more precise country or sector-level estimates.

Using pooled data from 2021–2023, the results show that supply is generally less responsive to income changes than demand, but is more reactive to price changes, particularly for intermediate goods. Demand for domestic goods tends to be highly responsive to income shifts, while foreign goods exhibit weaker expenditure responses. Own-price elasticities indicate that, as expected, demand declines as prices rise, with stronger substitution effects observed for foreign goods. At a finer sectoral level, demand elasticities reflect stronger income and substitution effects in sectors such as Household Final Demand and Services. In contrast, supply elasticities are primarily price-driven, with notable responsiveness in sectors like Construction, Manufacturing, and Agriculture. Supply elasticities are generally close to one, indicating a proportional adjustment to price changes, and domestic supply tends to respond slightly more than foreign supply.

[1] https://www.adb.org/what-we-do/data/regional-input-output-tables

An analysis of elasticities over time indicate that the demand for foreign intermediate and final goods has outpaced supply, reflecting a growing reliance on foreign inputs with limited substitutability. This trend suggests deepening global supply chain integration, particularly as intermediate domestic goods show limited responsiveness to foreign price changes. Some interesting sector-specific patterns also emerge. For example, Agriculture and Services have shifted somewhat toward domestic sourcing, while, over time, Construction and Manufacturing have become increasingly dependent on foreign inputs.

The demand system is subjected to tariff shocks introduction as price increase on foreign goods from sanctioning countries. The last available tariff data is used to determine the USA tariff rates on different countries and counter-tariffs on the USA.[2] Results show that global welfare loss from expenditure reduction on the demand side is in the range of -1.3%. Countries that already spend a higher share of their budget on imported goods, and have a higher dependence on USA imports with low substitutability face significant welfare losses of up to -5.6%. This includes USA's largest trading partners Mexico and Canada, while Asian, some European countries are the next in terms of welfare losses. Some EU countries and China, are not as adversely impacted due to a higher share of domestic spending and relatively low dependence on American goods. Counter-tariffs on the USA also hurt the sanctioning counties since some of them rely heavily on exports to the USA with revenue losses in the range of 0.5-1.8%. In contrast, Canada faces a revenue loss of 5% due to counter tariffs due to its deep integration with the US economy. Despite retaliatory tariffs, from countries such as Canada, China, and the EU, the USA faces minimal welfare losses. Although the results are based on elasticity-driven responses and do not capture deeper input-output linkages, demand-side spillovers, or market adjustment frictions that may lead to second-round effects, the analysis still offers valuable insights for assessing trade-related price shocks and informing policy responses.

The remainder of the paper is organized as follows; Section 2 reviews the literature on demand systems, trade models, and various global estimate studies. Section 3 describes the estimation model, while Section 4 provides an overview of the data sources and the estimation strategy used for the analysis. Section 5 presents the results of the elasticity estimates, and Section 6 conducts a hypothetical shock experiment. Section 7 discusses the implications of our findings and provides directions for future research.

2 Literature review

Microeconomic theory forms the foundation for demand estimation.[3] We consider a utility-maximizing agent facing a budget constraint that he or she wants to maximize by purchasing an optimal bundle of goods for a given set of prices. However, in the real world we do not observe utility, but rather *revealed preferences* through total expenditure, prices, and shares of goods bought. This is called the *indirect utility function* or IUF. Observing the IUF of a large set of agents allows us to generate demand functions for each good from which elasticities can be derived.

Elasticities show an agent's responsiveness to income, own price, and cross-price changes. Since these estimates have significant policy relevance, the choice of demand system, which determines how the IUF is defined, affects how responses to shocks are measured (Pollak & Wales, 1995; Meyer et al., 2011). Given the long history of consumer theory, there have been numerous innovations in demand systems ranging from the classic Cobb-Douglas, to Linear Expenditure Systems, Translog, and to the Almost Ideal Demand System (AIDS). These demand systems come with a host of variations where each iteration tries

[2]For this version, tariff data from 8th April 2025 was used. At the time of writing the article, tariffs were changing on a daily basis and thus might not reflect the latest situation.

[3]See Mas-Colell et al. (1995) or Varian (1992) for excellent introductions to this topic.

to improve upon its predecessors. Newer methods, such as the Quadratic AIDS or QUAIDS incorporate non-linear income (or expenditure) functions and non-linear cross-price interactions. This allows us to evaluate the response to shocks more accurately without imposing restrictive assumptions, such as linearity or homotheticity conditions, allowing for a finer evaluation of shock across different agent groups (Pollak & Wales, 1995).

2.1 Micro foundations

The earliest applications of elasticity estimates use the Cobb-Douglas model. This model, developed in the early 20th century and widely attributed to Paul Douglas and Charles Cobb (for a detailed exposition, see Humphrey 1997), assumes that consumption of each good is proportional to income, leading to constant budget shares across all levels of expenditure. Although simple and tractable, the Cobb-Douglas model is highly restrictive and unable to capture variations in consumption patterns observed in empirical data. Despite its significant limitations, such as unit elasticity of substitution, the Cobb-Douglas model laid the foundation for subsequent demand systems (Stigler, 1954) and various economic extensions. A well-known innovation is Arrow et al. (1961) that proposed the more generalizable Constant Elasticity of Substitution (CES) function that still remains pivotal in economic theory today.

The Linear Expenditure System (LES), introduced in Klein & Rubin (1947) and expanded in the canonical Stone (1954) paper, represents expenditure on goods as a linear function of prices and total budget. This demand system also introduced subsistence consumption, where the budget is allocated first and then the remaining is divided between the goods according to their respective elasticities. This innovation in the LES, combined with better availability of data through household surveys and computational power, made it very applicable to earlier empirical studies (Pollak & Wales, 1978; Goldberger, 1969).

The Transcendental Logarithmic or Translog model, developed in the 1970s by Christensen et al. (1975) introduced flexible functional forms to capture non-constant elasticities of substitution across the goods. Unlike the LES and Cobb-Douglas systems, the Translog allowed for a more realistic representation of substitution effects and expenditure allocations by relaxing restrictive assumptions about separability and linear homothetic preferences. The Translog model is highly flexible and can be applied to any arbitrary utility or cost function and excels at capturing price elasticities. Translog still remains a central framework for demand estimation and has seen several key extensions. Of these, the main one worth mentioning here is the Price-Independent Generalized Logarithmic or the Piglog model (Muellbauer, 1976), which shifted the focus away from prices to income effects by making the indirect utility a function of incomes.

With further availability of data and better computational power, subsequent developments focused on deriving more accurate demand functions or Engel curves. Adapting the Piglog model, Deaton & Muellbauer (1980) developed the Almost Ideal Demand System (AIDS). The AIDS model offered a theoretically consistent approach for estimating expenditure shares and price elasticities while maintaining aggregation, homogeneity, and symmetry properties of its predecessors. One of its primary strengths is its ability to approximate arbitrary demand systems while remaining computationally feasible. A limitation of the AIDS model is that it assumes linear Engel curves which do not fully capture variations in consumer behavior across different income groups.

In order to capture these nonlinearities, the Quadratic Almost Ideal Demand System (QUAIDS) extended the AIDS model by incorporating a quadratic expenditure term (Pollak & Wales, 1995) that can also capture non-homogenous responses across different income groups, to more accurately evaluate distributional impacts (Pollak & Wales, 1978). The QUAIDS framework also subsumes Translog's non-linear evolution of cross-price elasticities making it a highly robust tool for testing income and price shocks (Deaton & Muellbauer, 1980; Matsuda, 2006).

Several studies have applied non-linear demand systems including QUAIDS to estimate elasticities. Pollak & Wales (1978) was one of the first applications to introduce quadratic expenditure systems to show both linear and non-linear demand functions for household budgets highlighting that the latter significantly improves accuracy of results. Blundell et al. (1993) and Banks et al. (1997) use pooled cross-sectional household budget data from the UK to assess the effects of policy changes. Similarly, Matsuda (2006) used QUAIDS to analyze food demand in Japan, and Abdulai & Aubert (2004) for food demand in Tanzania. Aguiar & Bils (2015) employs QUAIDS to examine consumption inequality in relation to income inequality. He & Liu (2016) applies a quadratic model to examine China's demand for road transport from 2002 to 2014.

2.2 Elasticities in trade models

The micro-founded demand systems discussed above can evaluate elasticities for cross-sectional data. Thus, in these frameworks, elasticities over time are comparisons of repeated cross sections or some models simply pool data to determine short-run or long-run elasticities. In contrast, trade models provide strong empirical foundations for time-series estimations, but there are also overlaps in methodologies between these two fields.

Trade models build on Ricardian theory which starts with the comparative advantage assumption where differences in technology and productivity allow countries to specialize in certain products. This allows them to trade more efficiently, increasing the overall global welfare, instead of simply relying on their own production (*autarky*).

One of the earliest trade applications include the Rotterdam model (Theil, 1965; Barten, 1977) which regresses the change in demand on log of prices and expenditure to evaluate elasticities. This framework has also been extended to capture more non-linear demand responses, similar to Translog in recent applications (Barnett & Seck, 2008). In general, most empirical applications use the gravity model to evaluate elasticities using bilateral trade data, controlling for various factors such as economic size, technology, productivity, institutional quality, and geographic distances (Marc J. Melitz et al., 2015; Yotov et al., 2016). These applications have also seen considerable innovations in theory and methods to better capture variations in responses to changes in trade relationships, tariffs, policy changes, and other shocks (Novy, 2013; Costinot & Rodriguez-Clare, 2014; Bergstrand et al., 2013; Head & Mayer, 2014; Baier & Standaert, 2024).

Other Ricardian frameworks include the Armington and Eaton-Kortum models. The canonical Armington model (Armington, 1969) assumes that goods from different countries are imperfect substitutes, leading to trade driven by preferences rather than absolute cost advantages. The empirical framework is usually derived from Robert C. Feenstra & Timmer (2015) and has been widely applied to estimate elasticities (Temere, 2017; Feenstra et al., 2017; Ahmad et al., 2020). The Eaton-Kortum (EK) model extends the research on trade elasticity by incorporating heterogeneity in productivity between firms and countries in order to analyze the welfare implications of trade costs, productivity differences, substitutability between products and trade gains (Eaton & Kortum, 2002; Eaton et al., 2012). The framework has been designed to assess changes in policies and tariffs, for example Simonovska & Waugh (2014) assesses the distributional impacts of trade liberalization, particularly for developing economies where productivity variations play a significant role in trade dynamics. Boehm et al. (2023) uses the EK framework to derive short-term versus long-term trade elasticities under tariff changes to emphasize delayed adjustment processes in global trade dynamics.

2.3 Existing global elasticity estimates

Empirical literature on global elasticity estimations is relatively small given data limitations. Selected studies from this pool are discussed here.

Devarajan et al. (2023) derive Armington elasticities for 191 countries including estimating import and export elasticities for developing regions using error correction models and find that poorer countries are less responsive to shocks. Similarly, Feenstra et al. (2017); Devarajan et al. (2023) evaluates the export supply elasticities that show asymmetric responses between high- and low-income countries. Timmer et al. (2021) introduce a framework to measure supply-chain fragmentation and its impact on global trade elasticity. They find that changes in the demand mix and patterns of fragmentation can help explain changes in global elasticities. They use this framework to evaluate the impact of the 2008 financial crisis. Simonovska & Waugh (2014) propose a new simulated method of moments to estimate trade elasticities for disaggregated data for 123 countries in 2004. They find that welfare gains from trade are much higher than usually estimated.

Broda & Weinstein (2006) use six-digit product-level data for USA imports from 1994 to 2003. They estimate product-level elasticities and show how an increase in product varieties through increased trade significantly improved the welfare. They also propose an adjusted price index to correct for welfare gains. Similarly, Ghodsi et al. (2022) offers detailed product-level estimates for 167 countries to show substantial sectoral differences in import elasticities. They also highlight the increasing importance of intermediate goods as countries become more integrated in global value chains. This paper also corroborates this result.

Bussière et al. (2020) evaluate exchange rate elasticities for 51 emerging and developing economies using product-level bilateral trade data and show that trade responds positively to exchange rate depreciation and can be a vital instrument to address global trade balances. Additionally, the ECB (2014) analyzed global trade and GDP data from 1981 to 2013, highlighting increased responsiveness of global trade to GDP fluctuations over time. The report also highlights a significant slowdown in trade growth after the 2008 financial crisis. The WTO (2010) draws similar conclusions that also highlight structural shifts in the global economy after the financial crisis. Caliendo & Parro (2015) evaluate the impact of NAFTA tariff reductions on export and imports of its members. They conclude that if the structure of production and input-output linkages are not taken into account, welfare estimates are significantly lower. They propose a novel decomposition method in a general equilibrium framework to evaluate the effects of policy changes. Huntington et al. (2019) reviews several studies that estimate energy-sector related demand elasticities for emerging economies and OECD countries and suggest that price elasticities are relative similar across these two groups while income elasticities are larger indicating an increase in energy use intensity as economies become richer.

Several papers also underscore the importance of estimation methods, aggregation level, and time horizons and how they impact elasticity estimates. For example, Meyer et al. (2011); Bajzik et al. (2019); Ahmad et al. (2020); World Bank (2020) compare the different elasticity estimates and unsurprisingly, find considerable variations and biases based on data sources, sample sizes, and choice of demand systems. Ossa (2015) highlights aggregation bias by demonstrating that accounting for finer variations between industries significantly increases estimated trade gains. This occurs because certain industries are disproportionately influencing economic activity, and neglecting these can lead to underestimating trade benefits. Yilmazkuday (2023) proposes a novel framework to capture multi-sector elasticities by changing how domestic expenditure is aggregated to show unbiased welfare gains. In a similar vein, Imbs & Mejean (2015) analyze sector-specific and aggregate trade elasticities for the USA and show that aggregation tends to constantly underestimate the large spectrum of underlying variations.

3 Theoretical model

We start with an agent that maximizes his or her utility $U(\mathbf{x})$ subject to a budget constraint:

$$\max_{\mathbf{x}} U(\mathbf{x}) \text{ s.t. } \sum_i p_i x_i = m \tag{3.1}$$

The solution is an optimal bundle $\mathbf{x} = (x_1, \ldots, x_n)$ for a given set of prices $\mathbf{p} = (p_1, \ldots, p_n)$ that maximizes utility. In share terms, the demand of each good equals $w_i = p_i x_i / m$ in which case the budget constraint becomes $\sum_i w_i = 1$. The use of shares is also more conventional for demand systems so it will also be used in the remaining technical notes.

The solution of the optimization problem yields the *Marshallian demand* functions for each good $x_i = w_i m / p_i$. If we substitute this back in the utility function $U(x)$, we recover the *indirect utility function* or the IUF:

$$V(\mathbf{p}, m) = U(x_1(\mathbf{p}, m), \ldots, x_n(\mathbf{p}, m) = U(w_1 m/p_1, \ldots, w_n m/p_n) = U(w_1, \ldots, w_n)\frac{m}{\sum_i w_i \ln p_i} \tag{3.2}$$

where the denominator is the share-weighted index of prices.

Although the direct utility function, $U(\mathbf{x})$, and the indirect utility function, $V(\mathbf{p}, m)$, are quantitatively the same (or duals of each other), they have different interpretations. While in the former, we derive the bundle that optimizes a given level of utility, the IUF tells us how much utility an agent will get from *choosing* a specific bundle. Since we observe budgets and prices, elasticity estimation starts with the IUF where the functional form varies with demand systems.

From the IUF, the Marshallian demand for each good x_i can be recovered using *Roy's identity*:

$$x_i(\mathbf{p}, m) = \frac{\partial V / \partial p_i}{\partial V / \partial m} \tag{3.3}$$

where the numerator is the change in utility due to changes in prices, while the denominator is the change in utility due to a change in income.

Differentiating the log-linear form of Eq. 3.3 w.r.t. m gives us the income or expenditure elasticity η_i:

$$\eta_i = \frac{\partial x_i}{\partial m}\frac{m}{x_i} = 1 + \frac{\partial w_i}{\partial \ln m} \quad \begin{cases} \eta_i > 1 & \text{Luxury good} \\ 0 < \eta_i < 1 & \text{Normal good} \\ \eta_i < 0 & \text{Inferior good} \end{cases} \tag{3.4}$$

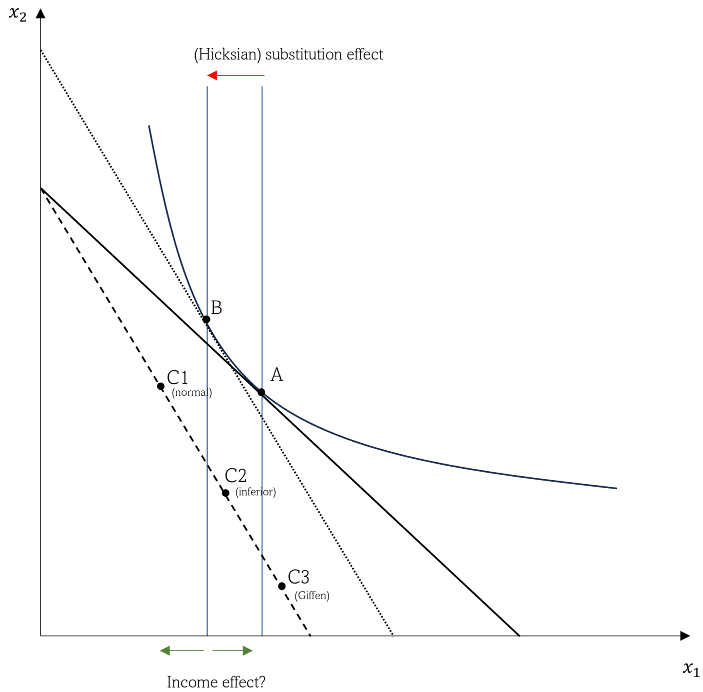
and similarly differentiating w.r.t. $\mathbf{p}$ gives us own (γ_{ii}) and cross price elasticities (γ_{ij}):

$$\gamma_{ii} = \frac{\partial x_i}{\partial p_i}\frac{p_i}{x_i} = \frac{\partial w_i}{\partial \ln p_i}\frac{1}{w_i} - 1 \qquad \begin{cases} \gamma_{ii} < -1 & \text{Elastic demand} \\ -1 < \gamma_{ii} < 0 & \text{Inelastic demand} \end{cases}$$
$$\gamma_{ij} = \frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i} = \frac{\partial w_i}{\partial \ln p_j}\frac{1}{w_i} \qquad \begin{cases} \gamma_{ij} > 0 & \text{Substitutes} \\ \gamma_{ij} < 0 & \text{Complements} \end{cases} \tag{3.5}$$

3.1 Compensated versus uncompensated elasticities

The change in demand can be decomposed into *substitution* and *income* effects as illustrated in Figure 3.1. In the figure, an agent starts with bundle A on the budget constraint m for two goods x_1 and x_2. An increase in price of x_1 pivots the budget constraint inward along the intercept on the y-axis. Shifting the new budget constraint back to the tangent of the original utility function gives us point B that represents the substitution effect from $A \rightarrow B$ or change in consumption at new prices keeping income constant. This represents *compensated* or *Hicksian* demand $(h(\mathbf{p}, u))$ where we hypothetically increase the income of the agent to reach the original utility.

Figure 3.1: Compensated versus Uncompensated demand



The movement from B to Cs represents how the change in income truly influences consumption and here we can have three cases. Point $C1$ shows that price increases or income decreases lead to less consumption, with a downward-sloping demand curve ($\partial x_i/\partial m > 0$, $\partial x_i/\partial p < 0$) representing a *normal* good. The point $C2$ implies that a price increase reduces income but increases consumption, where the substitution effect is stronger than the income effect ($\partial x_i/\partial m < 0$, $\partial x_i/\partial p < 0$), representing an *inferior* good such that demand decreases as income increases. Point $C3$ implies that price increases greatly decrease income, yet lead to higher consumption, with the income effect overpowering the substitution effect ($\partial x_i/\partial m < 0$, $\partial x_i/\partial p < 0$). This extremely rare case represents a highly inferior, or a *Giffen*, good where the demand curve is upward sloping. This can occur for essential items with no close substitutes available.

Formally, we can write total change in demand as:

$$\frac{\partial x_i}{\partial p_i} = \frac{\partial h_i}{\partial p_i} + \frac{\partial x_i}{\partial p} \tag{3.6}$$

where $h(\mathbf{p}, u)$ is the Hicksian expenditure function.[4] If we multiply both sides by p_i/x_i, we derive the *Slutsky equation* in terms of elasticities:

$$\frac{\partial x_i}{\partial p_i}\frac{p_i}{x_i} = \underbrace{\frac{\partial h_i}{\partial p_i}\frac{p_i}{x_i}}_{\text{Substitution effect}} - \underbrace{x_i\frac{\partial x_i}{\partial m}\frac{p_i}{x_i}}_{\text{Income effect}} \tag{3.7}$$

which in share terms equals:

$$\frac{\partial x_i}{\partial p_i}\frac{p_i}{x_i} = \frac{\partial h_i}{\partial p_i}\frac{p_i}{x_i} - w_i\frac{\partial x_i}{\partial m}\frac{m}{x_i} \tag{3.8}$$

Or more tersely:

$$\epsilon^u_{ik} = \epsilon^c_{ik} - \eta_i w_i \tag{3.9}$$

where ϵ^u is the uncompensated (Marshallian) elasticity, ϵ^c is the compensated (Hicksian) elasticity, and η is income or expenditure elasticity. This equation also provides the relation between the elasticity estimates.

3.2 Evaluating income or price shocks on elasticity estimates

Estimating demand for goods $i = \{1, ..., n\}$ generates a $(1 \times n)$ vectors of income elasticities and $(n \times n)$ matrices for both compensated and uncompensated price elasticities. As n becomes large, these matrices also expand exponentially, making it difficult to meaningfully interpret all values. To produce more readable outputs, we can also derive the change in shares w_i from price or income shocks using the budget, prices, shares, and recovered elasticities as follows:

$$\frac{\Delta w_i}{w_i} = 1 + \sum_j \left(\epsilon^u_{ij}\frac{\Delta p_j}{p_j}\right) + (\eta_i - 1)\frac{\Delta m}{m} \tag{3.10}$$

Here, the change in shares can be evaluated as a combination of prices and income changes and estimated uncompensated price (ϵ^u) and income elasticities (η). Additionally, $i = j$ represents own-price elasticity while $i \neq j$ are cross-price elasticities. In summary, the change in shares can be derived as an elasticity-weighted sum of price and income changes.

Note that we can use both actual baseline shares (w), or estimated shares ($\hat{w}$) to evaluate the shocks. Results for elasticity estimates are shown on $\hat{w}$ to represent an average values at means, while in the tariff shock experiment, changes on actual shares are evaluated to ensure a more accurate representation of country-specific results.

[4] This implies solving an expenditure minimizing problem: $min_{\mathbf{x}} \sum_i p_i x_i$ subject to $U(\mathbf{x}) = u$. In other words, we derive the minimum expenditure needed to achieve a given level of utility $U(\mathbf{x})$. This is similar to finding point B in Figure 3.1.

3.3 The QUAIDS model

The QUAIDS demand system is a hybrid, borrowing the strongest features of Translog, Piglog, and AIDS frameworks. The IUF in QUAIDS is given as:

$$V(p,m) = \frac{1}{b(p)}(\ln m - \ln a(p)) - \frac{\lambda_i}{b(p)}(\ln m - \ln a(p))^2 \tag{3.11}$$

where the aggregator $a(p)$ is a Translog price index that captures autonomous, own, and cross-price effects, with the following functional form:

$$\ln a(p) = \alpha_0 + \sum_i \alpha_i \ln p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \tag{3.12}$$

The aggregator $b(p)$ represents the log-linear price system similar to a Cobb-Douglas index:

$$b(p) = \sum_i \beta_i \ln p_i \tag{3.13}$$

where β_i are price weights. The term λ_i is the quadratic Engel curve coefficient that captures non-linear income effects.

We can derive the share of good i as:

$$w_i = \underbrace{\alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i (\ln m - \ln a(p))}_{\text{AIDS}} + \frac{\lambda_i}{b(p)}(\ln m - \ln a(p))^2 \tag{3.14}$$

where the first two terms on the right-hand side represent the AIDS model, while the last term captures non-linear income effects implying that the marginal effect of income on demand can increase or decrease at different income levels.

Here α_i are the intercepts or autonomous consumption shares with the constraint that $\sum_i \alpha_i = 1$, β_i are income elasticity coefficients where $\sum_i \beta_i = 0$, and λ_i are quadratic income elasticity coefficients where $\sum_i \lambda_i = 0$. Additionally, γs are price effects such that $\sum_i \gamma_{ij} = 0$, and Slutsky symmetry constraints imply that $\gamma_{ij} = \gamma_{ji}$.

Differentiating Eq. 3.14 w.r.t. m and plugging it in Eq. 3.4 recovers the QUAIDS income elasticity in share terms:

$$\eta_i = 1 + \frac{1}{w_i}(\beta_i + 2\lambda_i (\ln m - \ln a(p))) \tag{3.15}$$

Similarly, differentiating Eq. 3.14 w.r.t. p_i and p_j gives us own and cross price elasticities:

$$\epsilon_{ii} = \frac{1}{w_i}\left(\gamma_{ij} - \beta_i \sum_k \gamma_{kj} w_k - 2\lambda_i (\ln m - \ln a(p)) \sum_k \gamma_{kj} w_k\right) - \delta_{ij} \tag{3.16}$$

where $i = j$ recovers own price elasticity. In the above formula, index k represents all the goods in the system, and δ_{ij} is a Kronecker delta function which equals 1 if $i = j$, and 0 otherwise.

The QUAIDS model can be easily reduced to other demand systems using the following restrictions, making it relatively costless to recover other estimates:

Table 3.1: Deriving other demand systems from QUAIDS

Model	**Restrictions**	**Key effects**
AIDS	$\lambda_i = 0$	No quadratic income effects, linear Engel curves
LES	$\lambda_i = 0$, $\gamma_{ij} = 0$	No cross-price effects, fixed expenditure shares as income changes
Cobb-Douglas	$\lambda_i = 0$, $\gamma_{ij} = 0$, $\beta_i = 0$	Constant expenditure shares, no response to price changes

Section B provides the derivation of the Translog model. Model comparisons of these different demand systems are discussed in Appendix C.

4 Data and Methodology

Elasticities are estimated using the Asian Development Bank's (ADB) Multi-regional Input-Output (MRIO) tables.[5] This database have a coverage of 62 countries plus the Rest of the World (RoW) where the input-output interactions are defined for 35 sectors. The coverage is skewed towards Asian and European countries plus the larger economies in the Americas. The remaining countries are subsumed within the RoW. The full list of countries, and they broad regional assignments are given in Table A.1. This is not optimal but to the best of our knowledge, this is currently the best possible database available that provide sufficient level of depth since its predecessor the World Input Output Database (WIOD) (Timmer et al., 2015), that has been extensively used for global elasticity estimates (Tarne et al., 2018).[6]

Taken together, the data set gives us an intermediate matrix with dimension 2205 $\times$ 2205, or more than 4.8 million intermediate flows per year. Similarly, each country-sector also contributes to final demand sectors that are represented by household consumption, government spending, and gross fixed capital formation (GFCF).[7] This gives us an additional 2205 $\times$ (63$\times$3) = 416,745 observations for the final demand matrix. All the tables are available in current prices and constant 2010 prices allowing us to extract relative unit costs that we proxy for prices.

The estimation system for a simplified two-country example is visualized in Figure 4.1. Country 1 columns show total expenditures in intermediate and final goods. The expenditure on these goods is either supplied domestically or imported from abroad. From this system we recover *demand* elasticities based on the expenditure incurred by Country 1. Similarly, the Country 1 rows show goods supplied by for intermediate and final demand and for domestic and foreign consumption allowing us to estimate *supply* elasticities.

[5] https://www.adb.org/what-we-do/data/regional-input-output-tables

[6] https://www.rug.nl/ggdc/valuechain/wiod

[7] Change in inventories and revaluation of capital accounts in the final demand section have been dropped due to poor data and low observations.

Figure 4.1: Elasticities in an MRIO structure

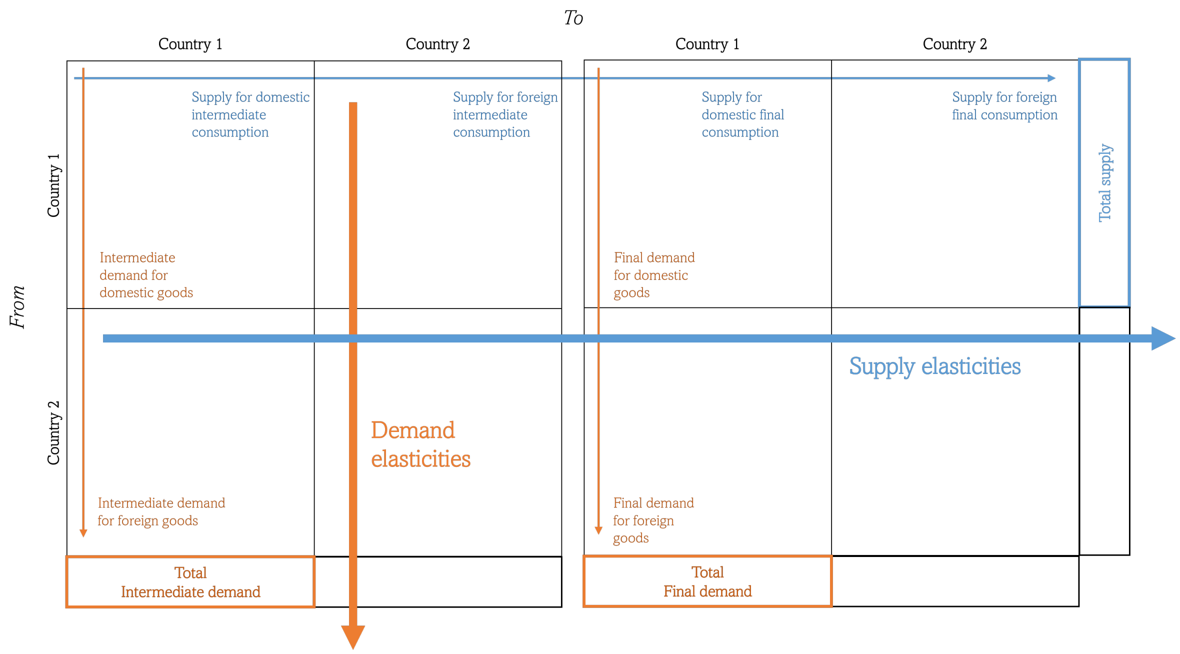
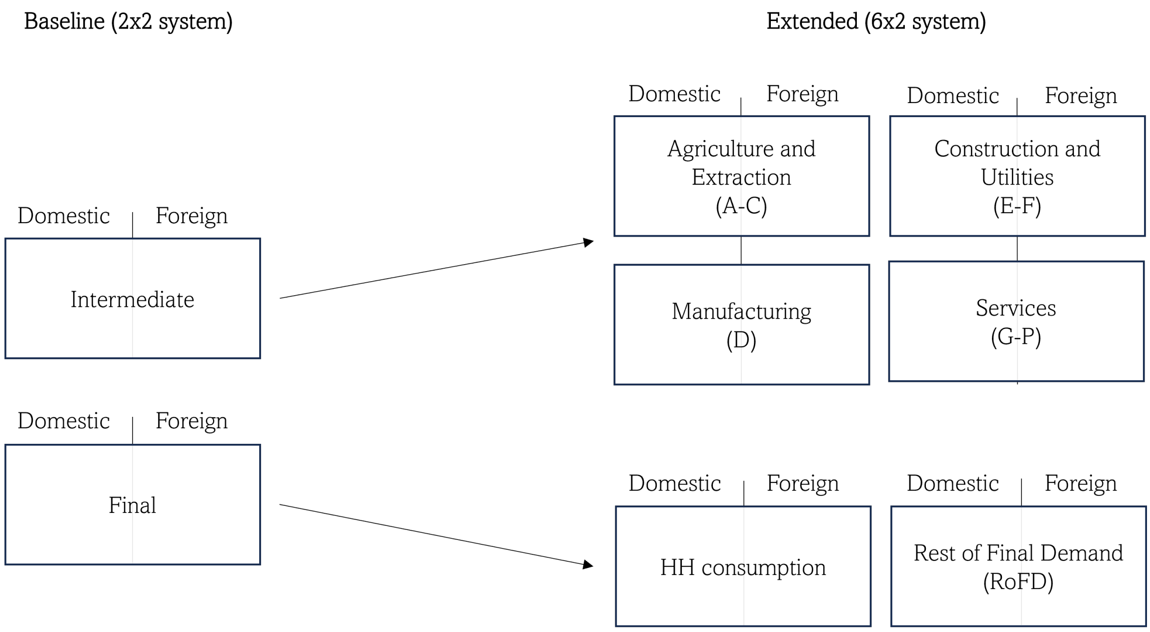


Figure 4.2: Elasticity estimation models



4.1 Sectoral aggregation and estimation strategy

Since we have the full MRIO structure, we conduct two estimations shown in Figure 4.2. First is the *baseline* where we distinguish between intermediate and final consumption further split into domestic and final goods. This represents the baseline 2×2 system.

The second is an *extended* 6x2 system that uses four intermediate sector aggregates and two final demand aggregates. The four intermediate groups – Agriculture and Extraction, Manufacturing, Construction and Utilities, and Services – are derived from the ADB MRIO sector classifications using the mapping given in Table A.2.[8]. The data is kept at the country-sector to country-*mapped sector* level to ensure that we have as many observations as possible to avoid losing information from the aggregation processes.

This four-sector aggregation is chosen for two reasons. First, some sectors such as E (Electricity gas, and water supply) and P (Private households with employed persons), mostly have only domestic flows and therefore have incomplete I-O data entering as missing or zero values. Since the demand system estimation requires complete information in terms of prices, shares, and expenditures, rows with missing information are automatically dropped from the procedure, resulting in generally poor or spurious estimates. Second, a large number of sectors increases the non-linearity in the estimation considerably as each pair of non-linear cross-price elasticities need to be estimated. While it is theoretically possible to do this estimation, the results can be problematic due to the nature of public or service-based sectors where observations are few, and outputs and prices are difficult to measure.

The final demand system is split into household consumption (HH) and the Rest of Final Demand (RoFD), which is the sum of government expenditure and Gross Fixed Capital Formation (GFCF). The decision to aggregate the last two categories was due to low data availability.

It is also important to note here that the expected share and elasticity estimates in the extended system are a full decomposition of the baseline system and highlight sectoral variations that might be averaged out in more aggregated systems (also in line with Ossa 2015; Yilmazkuday 2023).

4.2 Temporal aggregation and data trends

The MRIO data is available from 2007 to 2023, or 17 years, where each year can be used for cross-sectional analysis. Due to noise in the data, year-by-year estimations show unusually large jumps over time. To smooth these out, data are aggregated on a three-year rolling basis (2007–2009, ..., 2018–21, 2019-2022, 2020-2023) giving us 14 reapeated cross sections.[9]

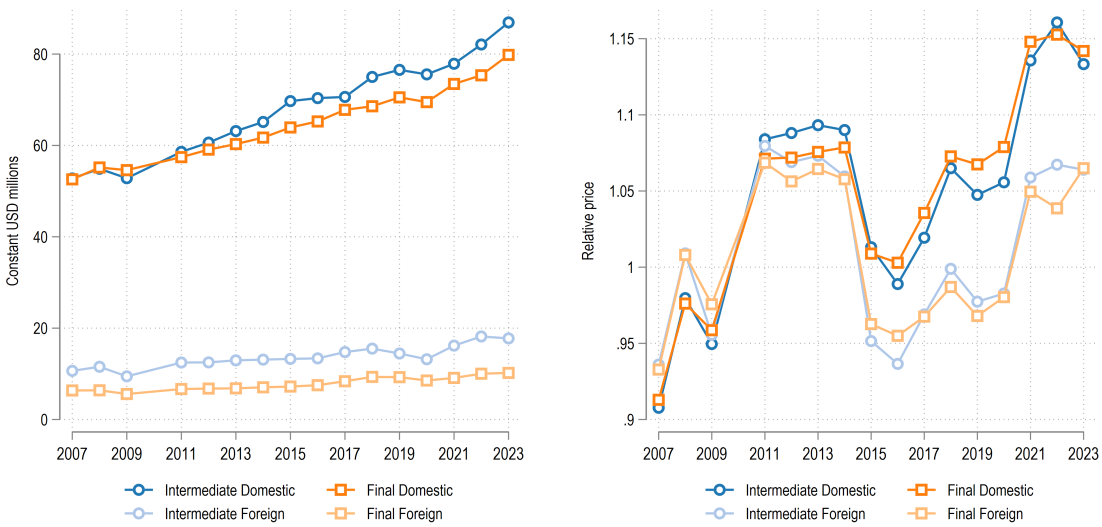
There are also advantages to stacking the data. Pooled data increase the observations for a relatively demanding estimation procedure, especially in the extended 6x2 system. Additionally, it smooths out data spikes that can cause the estimation procedure to hit certain unsolvable boundary conditions resulting in non-convergence issues.

Figure 4.3 shows the time trends for real expenditure and relative prices. Panel (a) indicates a consistent increase in domestic demand, while import expenditure remains fairly constant, showing a minor upward trend over time. Relative prices, shown in panel (b), reveal more interesting developments. All four categories experience a price decline following the 2008 global financial crisis, increasing again until 2011, and then plateauing. Starting in 2014, we can see divergence in prices, with foreign good prices declining faster than domestic good prices. After 2019 prices increase again, but unevenly, eventually

[8] Franco-Bedoya et al. (2021) use a similar mapping.

[9] Data for 2010 is missing in the database, so the window that contain 2010 uses only two available years.

Figure 4.3: Data trends for the baseline 2x2 demand system



(a) Real expenditure

(b) Relative prices

slowing down in 2021. The last three time periods also show higher variations in the movements driven by events such as COVID-19 policies and other supply bottlenecks.

5 Results

Throughout the remaining paper, cross-sectional results are presented for the latest three-year pooled data from 2021-2023. In time-series graphs only the last year of the pool samples is marked for brevity. Comparison with other models such as AIDS, Cobb-Douglas, LES, and Translog are provided in Section C while variations in elasticity estimates over time are shown in Section D including how elasticity estimates change across different aggregations.

5.1 The baseline 2x2 system

Table 5.1 presents demand and supply elasticities from the QUAIDS model using the pooled 2021-2023 data. Expenditure elasticities (η) for domestic goods in panel (a) are slightly above one, highlighting a proportionally greater spending increase with income growth, unlike foreign goods where values are below one. Uncompensated own-price elasticities are all negative indicating that demand declines as prices increase. Variations and ranges indicate the sensitivity to price changes, such as -0.82 for Intermediate Foreign and -0.62 for Final Foreign goods. Positive cross-price elasticities suggest substitution between domestic and foreign goods in both intermediate and foreign good blocks, but here we see much more biased responses to price changes. Change in demand of intermediate domestic 0.44 as compared to 0.12 for the reverse. This indicates a quicker shift away from domestic goods if they see a price increase but the response is more muted if the price of foreign goods go up implying higher dependence. A similar pattern can also be observed for final demand cross price elasticities. Narrow interval bands denote low variability, although here we also see strong variations where signs even change from negative to positive for some categories. Uncompensated own-price elasticities are larger in magnitude that their compensated counterparts for domestic goods (e.g. -0.82 vs -0.39 for Intermediate Domestic, or -0.82

vs -0.43 for Final Domestic), reflecting income effects play a stronger role here. Broadly, income effects are comparatively smaller for foreign goods showing that prices play a stronger role budget allocation decisions.

Table 5.1: Estimated elasticities for the baseline 2x2 system (2021-2023)

(a) Demand

	(1) Expend. (η)	(2) Compensated (Hicksian) (ϵ^c)				(3) Uncompensated (Marshallian) (ϵ^u)			
		Int. Dom.	Int. For.	Fin. Dom.	Fin. For.	Int. Dom.	Int. For.	Fin. Dom.	Fin. For.
Int Domestic	1.10	-0.39	0.29	0.18	-0.08	-0.82	0.12	-0.22	-0.18
	[1.09,1.11]	[-0.49,-0.29]	[0.22,0.36]	[0.10,0.26]	[-0.14,-0.02]	[-0.92,-0.72]	[0.05,0.19]	[-0.30,-0.14]	[-0.24,-0.12]
Int Foreign	0.73	0.73	-0.64	-0.03	-0.05	0.44	-0.76	-0.30	-0.12
	[0.70,0.76]	[0.56,0.90]	[-0.88,-0.41]	[-0.20,0.14]	[-0.23,0.12]	[0.27,0.62]	[-0.99,-0.52]	[-0.47,-0.13]	[-0.30,0.06]
Final Domestic	1.08	0.20	-0.01	-0.43	0.25	-0.23	-0.18	-0.82	0.15
	[1.07,1.10]	[0.11,0.28]	[-0.09,0.06]	[-0.54,-0.32]	[0.19,0.31]	[-0.32,-0.14]	[-0.26,-0.11]	[-0.93,-0.72]	[0.09,0.22]
Final Foreign	0.68	-0.37	-0.10	1.03	-0.56	-0.64	-0.20	0.78	-0.62
	[0.63,0.72]	[-0.64,-0.10]	[-0.41,0.22]	[0.78,1.28]	[-0.87,-0.26]	[-0.91,-0.37]	[-0.51,0.11]	[0.53,1.03]	[-0.93,-0.32]

(b) Supply

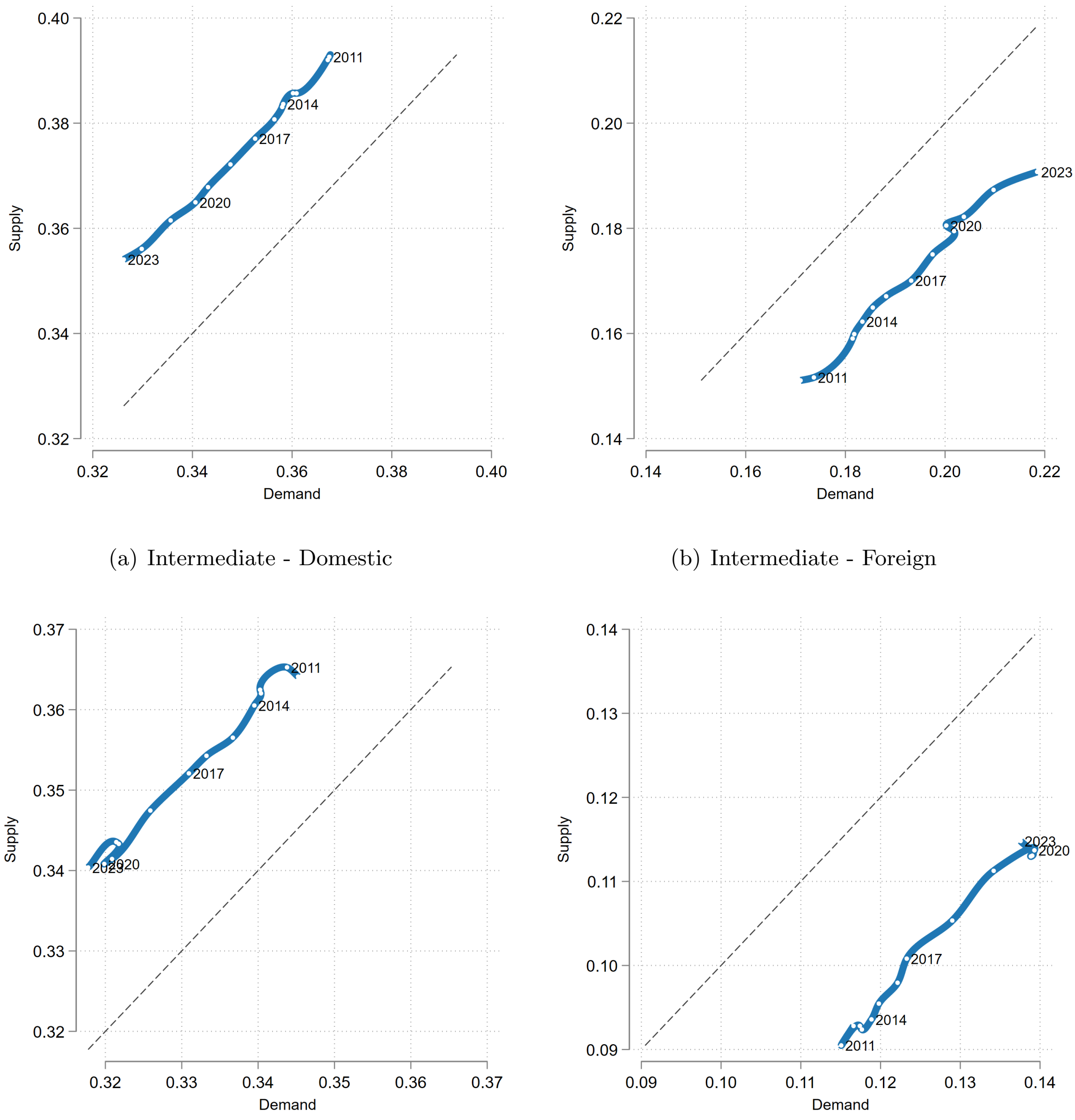
	(1) Income (η)	(2) Compensated (Hicksian) price (ϵ^c)				(3) Uncompensated (Marshallian) price (ϵ^u)			
		Int. Dom.	Int. For.	Fin. Dom.	Fin. For.	Int. Dom.	Int. For.	Fin. Dom.	Fin. For.
Int Domestic	1.07	-0.88	0.65	0.06	0.17	-1.30	0.49	-0.34	0.08
	[1.06,1.08]	[-1.04,-0.72]	[0.49,0.81]	[-0.05,0.17]	[0.09,0.25]	[-1.46,-1.14]	[0.33,0.65]	[-0.45,-0.23]	[0.00,0.16]
Int Foreign	0.78	1.70	-1.99	0.32	-0.04	1.39	-2.10	0.04	-0.10
	[0.75,0.80]	[1.28,2.12]	[-2.52,-1.45]	[0.01,0.64]	[-0.26,0.18]	[0.97,1.81]	[-2.64,-1.57]	[-0.28,0.35]	[-0.32,0.12]
Final Domestic	1.07	0.06	0.13	-0.24	0.04	-0.36	-0.03	-0.63	-0.05
	[1.05,1.08]	[-0.06,0.18]	[0.00,0.26]	[-0.41,-0.06]	[-0.05,0.14]	[-0.48,-0.24]	[-0.16,0.10]	[-0.80,-0.45]	[-0.15,0.05]
Final Foreign	0.76	0.81	-0.07	0.18	-0.93	0.51	-0.18	-0.10	-0.99
	[0.73,0.80]	[0.43,1.19]	[-0.46,0.33]	[-0.24,0.61]	[-1.29,-0.56]	[0.13,0.88]	[-0.58,0.21]	[-0.52,0.32]	[-1.36,-0.62]

The supply income elasticities in Table 5.1 panel (b) are also close to one, suggesting that supply responds almost proportionally to changes in prices, although higher for domestic sectors. Compensated own-price elasticities show a much large variation in the intensity of supply reduction resulting from prices increases, e.g. -0.88 for Intermediate Domestic and -1.99 for Intermediate Foreign goods. In contrast, uncompensated elasticities exhibit much stronger responses (-1.30 for Intermediate Domestic, -2.10 for Intermediate Foreign), highlighting that exports are much more sensitive to income shocks than imports. Most confidence intervals are also narrow, but generally larger than their demand counterparts.

Comparison of demand and supply elasticities reveals additional differences in responsiveness. While both expenditure and income elasticities (η) are generally close to one, supply elasticities foreign goods are slightly lower than their demand counterparts indicating weaker supply responses. Own-price elasticities show that demand is less responsive than supply to changes in prices. Cross-price effects also differ, with stronger substitution in supply elasticities. For example, Intermediate Foreign reacts more strong to Intermediate Domestic price changes on the supply side (0.65) as compared to the demand side (0.29). In general, cross-price adjustments on the demand side are generally more moderate.

Figure 5.1 compares the evolution of estimated demand and supply shares $\hat{w}$ for the 2x2 categories. The 45-degree line shows the distance from equality for easy comparison. Over time, Intermediate Domestic and Final Domestic shares have gradually declined while slightly moving away from the equality line, suggesting reduced spending on domestic goods. Regardless, both domestic categories have the dominant shares among the four groups despite losing importance. Intermediate Foreign and Final Foreign shares have increased, with demand persistently exceeding supply and also moving away from the 45-degree line in recent years. These trends indicate a shift toward greater reliance on foreign goods, particularly intermediate goods. We can also observe that final goods show much more volatility after 2020 indicating

Figure 5.1: Demand and Supply comparisons for estimated shares ($\hat{w}$) - Baseline



(a) Intermediate - Domestic

(b) Intermediate - Foreign

(c) Final - Domestic

(d) Final - Foreign

that these categories are highly sensitive to shocks.

Additional estimations are provided in Section D. Table D.1 Shows changes in estimated QUAIDS model parameters for demand elasticities. Here we observe a change in preferences from domestic towards foreign goods.

5.2 The extended 6x2 system

Table 5.2 presents the demand and supply elasticities for the extended 6×2 system, enabling a more detailed sectoral comparison. Expenditure and income elasticities broadly mirror the patterns observed in the simpler 2×2 system, with domestic goods exhibiting stronger responsiveness to income changes than their foreign counterparts. On the supply side, elasticities are generally larger than those on the demand side, indicating a higher sensitivity of producers to price and income signals compared to consumers.

On the demand side, compensated own-price elasticities show expected negative values, with Manufacturing and Service sectors exhibiting relatively inelastic response to price changes. Some own-price elasticities, such as those for Intermediate Construction, Services, and Final Household, are positive for foreign goods, indicating unusually strong demand in these sectors despite price increases. In contrast, demand for foreign agricultural goods shows a strong negative response, indicating a high price sensitivity. There is also little difference between compensated and uncompensated elasticities, suggesting that prices, rather than income effects, are the primary drivers of demand changes across most sectors at finer levels of disaggregation.

On the supply side, as shown in Table 5.2b, Agricultural and Extraction, and Services exhibit positive own-price elasticities, indicating that their supply increases with rising prices, likely due to limited availability of close domestic substitutes. Similarly, sectors such as Construction and Utilities, Manufacturing, and Household Domestic also demonstrate relatively high and positive own-price elasticities, suggesting a strong responsiveness to market price incentives in the decision to supply. These findings point to a degree of flexibility in production or reallocation capacity in these sectors. In contrast, some sectors, such as the Rest of Final Demand and Intermediate Construction, show more muted or even negative responses, possibly reflecting structural constraints or less elastic production technologies. Comparing compensated and uncompensated elasticities across sectors shows that price effects consistently outweigh income effects, underscoring that producers' behavior is largely driven by relative price changes rather than shifts in overall income or demand levels.

Demand and supply elasticities differ notably in both magnitude and drivers. Demand elasticities tend to show greater sensitivity to both prices and income, particularly in sectors like Household Final demand and Services, reflecting consumer preferences and substitution behavior. In contrast, supply elasticities are generally more price-driven, with income playing a minimal role. Key supply-side sectors such as Construction, Manufacturing, and Agriculture exhibit strong positive price responses, indicating greater flexibility and responsiveness to market incentives. These differences highlight the distinct mechanisms underlying consumption versus production decisions.

Figure 5.2 shows the time evolution of the estimated demand and supply shares $\hat{w}$ for the 6x2 system. Manufacturing Domestic and Services Domestic consistently show a supply surplus. Conversely, Agriculture & Extraction Foreign and Construction & Utilities Foreign have demand outpacing supply. Over time, demand in Manufacturing Foreign has grown to surpass supply, highlighting the increasing role of foreign manufacturing inputs. This is also the only category that crosses the 45-degree line indicating a substantive shift in responsiveness on both the demand and the supply shares. This is also mirrored

Table 5.2: Demand elasticities for the full system (2021-2023)

(a) Demand

	(1) Exp. (η)	(2) Compensated (Hicksian) (ϵ^c)											
		Agri/Ext Dom.	Agri/Ext For.	Manu. Dom.	Manu. For.	Const Dom.	Const. For.	Serv. Dom.	Serv. For.	HH Dom.	HH For.	RoFD. Dom.	RoFD For.
Agri+Ext Dom	1.15	-0.25	0.19	1.06	0.39	0.00	-0.83	2.96	0.56	0.40	0.62	-4.34	-0.75
	[1.11,1.19]	[-0.63,0.12]	[-0.11,0.50]	[0.39,1.72]	[-0.17,0.95]	[-0.32,0.32]	[-1.18,-0.48]	[2.19,3.73]	[-0.00,1.12]	[0.15,0.66]	[0.30,0.93]	[-5.32,-3.36]	[-1.33,-0.18]
Agri+Ext For	0.59	1.04	-2.35	3.62	1.13	-0.38	-2.12	0.27	3.77	1.05	-1.59	-3.25	-1.18
	[0.38,0.79]	[-0.61,2.68]	[-4.96,0.27]	[-0.05,7.29]	[-2.07,4.32]	[-2.12,1.35]	[-4.17,-0.08]	[-4.03,4.56]	[0.49,7.06]	[-0.26,2.36]	[-3.21,0.04]	[-8.40,1.89]	[-4.33,1.98]
Man. Dom	1.16	0.15	0.10	-0.76	0.52	0.22	-0.17	-0.25	-0.09	0.21	-0.63	0.29	0.41
	[1.14,1.18]	[0.06,0.25]	[-0.00,0.19]	[-1.11,-0.42]	[0.31,0.74]	[0.10,0.35]	[-0.30,-0.04]	[-0.55,0.04]	[-0.30,0.12]	[0.10,0.33]	[-0.77,-0.50]	[-0.12,0.71]	[0.19,0.63]
Man For	0.83	0.09	0.05	0.82	-0.52	0.67	0.18	-0.30	-0.39	0.41	0.01	-0.93	-0.08
	[0.80,0.86]	[-0.04,0.21]	[-0.09,0.18]	[0.48,1.15]	[-0.91,-0.12]	[0.50,0.84]	[0.00,0.35]	[-0.69,0.09]	[-0.68,-0.09]	[0.24,0.58]	[-0.18,0.21]	[-1.43,-0.43]	[-0.40,0.23]
Const+Util Dom	1.12	0.00	-0.03	0.59	1.12	-0.68	0.30	0.37	-0.15	-0.09	-1.71	-0.38	0.65
	[1.09,1.16]	[-0.12,0.12]	[-0.15,0.09]	[0.25,0.92]	[0.83,1.41]	[-0.94,-0.41]	[0.13,0.48]	[-0.02,0.76]	[-0.44,0.13]	[-0.29,0.12]	[-1.93,-1.49]	[-0.95,0.18]	[0.35,0.95]
Const+Util For	0.63	-0.99	-0.47	-1.41	0.93	0.96	0.62	-0.15	0.79	0.75	-3.03	1.23	0.77
	[0.56,0.71]	[-1.41,-0.57]	[-0.92,-0.02]	[-2.45,-0.37]	[0.02,1.85]	[0.40,1.52]	[-0.16,1.40]	[-1.37,1.07]	[-0.12,1.70]	[0.28,1.22]	[-3.60,-2.47]	[-0.32,2.78]	[-0.16,1.71]
Serv Dom	1.05	0.34	0.01	-0.20	-0.15	0.11	-0.01	-0.50	0.29	0.09	0.41	-0.02	-0.36
	[1.03,1.07]	[0.25,0.43]	[-0.09,0.10]	[-0.44,0.03]	[-0.35,0.04]	[-0.01,0.23]	[-0.13,0.10]	[-0.88,-0.13]	[0.09,0.49]	[-0.01,0.20]	[0.28,0.54]	[-0.41,0.38]	[-0.56,-0.15]
Serv For	0.63	0.24	0.29	-0.27	-0.72	-0.17	0.28	1.06	0.73	-0.13	0.33	-0.37	-1.26
	[0.58,0.68]	[-0.00,0.47]	[0.04,0.55]	[-0.89,0.35]	[-1.27,-0.17]	[-0.49,0.15]	[-0.04,0.60]	[0.32,1.79]	[-0.01,1.46]	[-0.41,0.16]	[-0.02,0.67]	[-1.30,0.56]	[-1.83,-0.69]
HH Dom.	1.06	0.04	0.02	0.14	0.17	-0.02	0.06	0.08	-0.03	-0.68	0.02	0.09	0.12
	[1.04,1.08]	[0.01,0.06]	[-0.00,0.04]	[0.07,0.21]	[0.10,0.24]	[-0.07,0.03]	[0.02,0.10]	[-0.01,0.16]	[-0.09,0.04]	[-0.79,-0.57]	[-0.05,0.09]	[-0.04,0.22]	[0.05,0.18]
HH. For	0.56	0.25	-0.12	-1.77	0.02	-1.84	-1.03	1.44	0.31	0.08	0.10	1.96	0.59
	[0.50,0.63]	[0.12,0.38]	[-0.24,0.00]	[-2.15,-1.39]	[-0.33,0.37]	[-2.07,-1.60]	[-1.22,-0.84]	[1.00,1.89]	[-0.02,0.64]	[-0.23,0.38]	[-0.34,0.55]	[1.32,2.59]	[0.23,0.94]
RoFD. Dom.	1.11	-0.62	-0.09	0.29	-0.59	-0.14	0.15	-0.02	-0.13	0.14	0.69	0.19	0.14
	[1.08,1.14]	[-0.76,-0.48]	[-0.22,0.05]	[-0.12,0.70]	[-0.91,-0.27]	[-0.36,0.07]	[-0.04,0.33]	[-0.51,0.47]	[-0.44,0.19]	[-0.06,0.34]	[0.47,0.92]	[-0.64,1.01]	[-0.20,0.48]
RoFD. For.	0.80	-0.37	-0.11	1.39	-0.18	0.85	0.32	-1.53	-1.47	0.61	0.71	0.48	-0.69
	[0.74,0.86]	[-0.65,-0.09]	[-0.39,0.18]	[0.64,2.13]	[-0.88,0.51]	[0.46,1.24]	[-0.07,0.70]	[-2.40,-0.66]	[-2.13,-0.81]	[0.26,0.96]	[0.28,1.14]	[-0.68,1.63]	[-1.64,0.25]

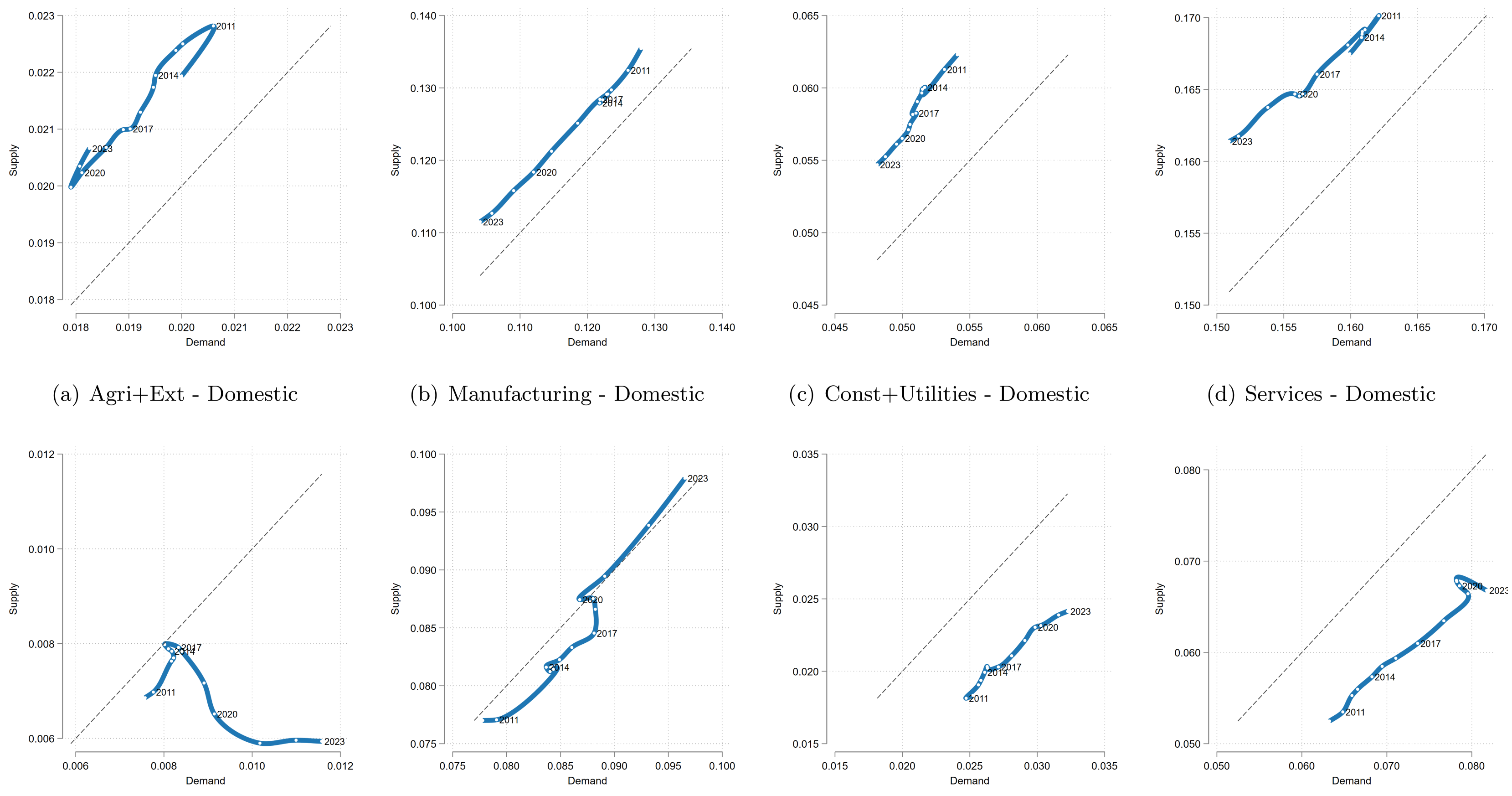
	(3) Uncompensated (Marshallian) price (ϵ^u)											
	Agri/Ext Dom.	Agri/Ext For.	Manu. Dom.	Manu. For.	Const Dom.	Const. For.	Serv. Dom.	Serv. For.	HH Dom.	HH For.	RoFD Dom.	RoFD For.
Agri+Ext Dom	-0.28	0.19	0.90	0.29	-0.06	-0.85	2.75	0.51	0.16	0.56	-4.51	-0.80
	[-0.65,0.10]	[-0.12,0.49]	[0.23,1.56]	[-0.28,0.85]	[-0.38,0.26]	[-1.20,-0.50]	[1.98,3.52]	[-0.06,1.07]	[-0.10,0.41]	[0.24,0.87]	[-5.49,-3.53]	[-1.37,-0.23]
Agri+Ext For	1.02	-2.35	3.54	1.07	-0.42	-2.13	0.17	3.75	0.92	-1.61	-3.34	-1.20
	[-0.62,2.67]	[-4.96,0.26]	[-0.14,7.21]	[-2.12,4.27]	[-2.15,1.32]	[-4.18,-0.09]	[-4.13,4.46]	[0.46,7.04]	[-0.38,2.23]	[-3.24,0.01]	[-8.48,1.81]	[-4.36,1.95]
Man. Dom	0.13	0.09	-0.93	0.42	0.16	-0.19	-0.46	-0.15	-0.04	-0.69	0.13	0.36
	[0.03,0.23]	[-0.01,0.19]	[-1.27,-0.58]	[0.20,0.63]	[0.03,0.29]	[-0.32,-0.06]	[-0.75,-0.16]	[-0.36,0.06]	[-0.15,0.08]	[-0.82,-0.55]	[-0.29,0.54]	[0.14,0.58]
Man For	0.07	0.04	0.70	-0.59	0.62	0.16	-0.45	-0.43	0.23	-0.03	-1.05	-0.12
	[-0.06,0.20]	[-0.09,0.18]	[0.36,1.03]	[-0.99,-0.19]	[0.45,0.80]	[-0.01,0.33]	[-0.83,-0.06]	[-0.72,-0.13]	[0.07,0.40]	[-0.23,0.16]	[-1.55,-0.54]	[-0.43,0.20]
Const+Util Dom	-0.02	-0.03	0.43	1.02	-0.74	0.28	0.17	-0.21	-0.33	-1.77	-0.54	0.61
	[-0.14,0.10]	[-0.15,0.09]	[0.09,0.76]	[0.73,1.31]	[-1.00,-0.47]	[0.11,0.46]	[-0.22,0.56]	[-0.49,0.08]	[-0.53,-0.13]	[-1.99,-1.55]	[-1.11,0.02]	[0.31,0.91]
Const+Util For	-1.00	-0.47	-1.50	0.88	0.93	0.61	-0.26	0.76	0.61	-3.07	1.14	0.75
	[-1.42,-0.59]	[-0.93,-0.02]	[-2.54,-0.46]	[-0.04,1.79]	[0.37,1.48]	[-0.17,1.38]	[-1.49,0.96]	[-0.15,1.67]	[0.14,1.08]	[-3.63,-2.50]	[-0.41,2.69]	[-0.19,1.69]
Serv Dom	0.32	0.00	-0.35	-0.25	0.06	-0.03	-0.69	0.24	-0.13	0.36	-0.17	-0.40
	[0.23,0.41]	[-0.09,0.09]	[-0.58,-0.12]	[-0.45,-0.05]	[-0.06,0.17]	[-0.15,0.09]	[-1.06,-0.32]	[0.04,0.44]	[-0.24,-0.03]	[0.23,0.48]	[-0.56,0.23]	[-0.60,-0.20]
Serv For	0.22	0.29	-0.36	-0.78	-0.20	0.27	0.94	0.70	-0.26	0.30	-0.46	-1.29
	[-0.01,0.46]	[0.04,0.55]	[-0.97,0.26]	[-1.33,-0.23]	[-0.52,0.11]	[-0.05,0.59]	[0.21,1.68]	[-0.04,1.43]	[-0.55,0.02]	[-0.05,0.64]	[-1.39,0.47]	[-1.85,-0.72]
HH Dom.	0.02	0.01	-0.01	0.08	-0.08	0.04	-0.11	-0.08	-0.91	-0.03	-0.06	0.07
	[-0.01,0.04]	[-0.01,0.04]	[-0.08,0.06]	[0.01,0.15]	[-0.13,-0.03]	[0.00,0.08]	[-0.20,-0.02]	[-0.14,-0.02]	[-1.02,-0.79]	[-0.11,0.04]	[-0.19,0.07]	[0.01,0.14]
HH. For	0.24	-0.12	-1.85	-0.03	-1.87	-1.04	1.34	0.29	-0.04	0.08	1.88	0.56
	[0.11,0.37]	[-0.24,0.00]	[-2.22,-1.47]	[-0.38,0.32]	[-2.10,-1.63]	[-1.23,-0.85]	[0.90,1.79]	[-0.04,0.62]	[-0.35,0.26]	[-0.37,0.52]	[1.24,2.51]	[0.21,0.92]
RoFD. Dom.	-0.65	-0.09	0.14	-0.69	-0.20	0.13	-0.22	-0.18	-0.10	0.64	0.03	0.09
	[-0.79,-0.50]	[-0.23,0.05]	[-0.28,0.55]	[-1.01,-0.37]	[-0.42,0.01]	[-0.06,0.31]	[-0.71,0.27]	[-0.50,0.14]	[-0.30,0.10]	[0.41,0.86]	[-0.80,0.85]	[-0.24,0.43]
RoFD. For.	-0.39	-0.11	1.28	-0.26	0.81	0.30	-1.67	-1.51	0.44	0.67	0.36	-0.73
	[-0.67,-0.10]	[-0.40,0.18]	[0.53,2.02]	[-0.95,0.43]	[0.42,1.20]	[-0.08,0.69]	[-2.54,-0.80]	[-2.17,-0.85]	[0.08,0.79]	[0.24,1.10]	[-0.79,1.52]	[-1.67,0.22]

(b) Supply

	(1) Inc. (η)	(2) Compensated (Hicksian) (ϵ^c)											
		Agri/Ext Dom.	Agri/Ext For.	Manu. Dom.	Manu. For.	Const Dom.	Const. For.	Serv. Dom.	Serv. For.	HH Dom.	HH For.	RoFD. Dom.	RoFD For.
Agri+Ext Dom	1.17	-0.19	0.12	0.22	-0.13	-0.68	0.18	4.01	0.43	-0.01	0.66	-3.62	-0.99
	[1.13,1.20]	[-0.62,0.25]	[0.01,0.23]	[-0.57,1.01]	[-0.98,0.72]	[-1.04,-0.32]	[-0.21,0.57]	[3.12,4.90]	[-0.31,1.17]	[-0.39,0.37]	[0.29,1.03]	[-5.06,-2.18]	[-2.00,0.02]
Agri+Ext For	0.81	0.53	0.92	0.74	-0.12	0.67	-1.86	1.33	-1.71	0.30	0.29	9.35	-10.45
	[0.77,0.86]	[0.06,1.01]	[-1.38,3.21]	[-0.41,1.90]	[-2.50,2.25]	[0.22,1.12]	[-3.26,-0.47]	[0.13,2.54]	[-3.81,0.40]	[-0.16,0.77]	[-0.16,0.74]	[-12.67,31.38]	[-32.44,11.54]
Man. Dom	1.13	0.03	0.02	-0.90	0.66	-0.10	0.00	-0.24	-0.32	0.22	0.09	0.50	0.05
	[1.12,1.15]	[-0.08,0.15]	[-0.01,0.06]	[-1.31,-0.49]	[0.35,0.97]	[-0.25,0.04]	[-0.13,0.14]	[-0.58,0.10]	[-0.60,-0.05]	[0.06,0.38]	[-0.06,0.24]	[-0.05,1.04]	[-0.30,0.40]
Man For	0.81	-0.03	-0.01	1.13	0.46	0.80	0.08	-0.72	-2.71	0.47	0.06	0.64	-0.17
	[0.78,0.84]	[-0.24,0.18]	[-0.14,0.13]	[0.59,1.67]	[-0.46,1.38]	[0.55,1.05]	[-0.29,0.45]	[-1.35,-0.09]	[-3.38,-2.04]	[0.19,0.75]	[-0.20,0.32]	[-0.85,2.13]	[-1.46,1.12]
Const+Util Dom	1.03	-0.25	0.06	-0.27	1.20	-0.85	0.57	-0.39	0.78	-0.67	0.70	-0.93	0.07
	[1.00,1.07]	[-0.39,-0.12]	[0.02,0.10]	[-0.64,0.10]	[0.82,1.57]	[-1.17,-0.54]	[0.42,0.71]	[-0.85,0.06]	[0.49,1.06]	[-0.96,-0.38]	[0.44,0.95]	[-1.60,-0.26]	[-0.27,0.41]
Const+Util For	0.67	0.20	-0.48	0.04	0.36	1.72	-1.33	-0.05	-1.22	0.21	0.44	-0.36	0.48
	[0.62,0.72]	[-0.24,0.64]	[-0.84,-0.12]	[-1.04,1.12]	[-1.31,2.02]	[1.28,2.16]	[-2.61,-0.04]	[-1.22,1.11]	[-2.75,0.32]	[-0.26,0.68]	[-0.01,0.89]	[-4.07,3.35]	[-3.00,3.95]
Serv Dom	1.05	0.46	0.04	-0.19	-0.33	-0.12	-0.01	-0.20	0.20	0.16	-0.04	0.04	-0.00
	[1.03,1.06]	[0.36,0.56]	[0.00,0.07]	[-0.47,0.08]	[-0.63,-0.04]	[-0.26,0.02]	[-0.12,0.11]	[-0.65,0.24]	[-0.02,0.43]	[0.00,0.32]	[-0.19,0.11]	[-0.44,0.53]	[-0.29,0.29]
Serv For	0.75	0.17	-0.16	-0.90	-4.40	0.85	-0.44	0.72	5.90	0.28	-0.30	-3.33	1.61
	[0.72,0.78]	[-0.13,0.47]	[-0.35,0.04]	[-1.67,-0.14]	[-5.50,-3.31]	[0.54,1.15]	[-0.99,0.11]	[-0.07,1.50]	[4.57,7.22]	[-0.05,0.62]	[-0.61,0.01]	[-5.40,-1.26]	[-0.24,3.47]
HH Dom.	1.05	-0.00	0.01	0.14	0.18	-0.17	0.02	0.13	0.07	-0.71	0.09	0.17	0.08
	[1.03,1.06]	[-0.04,0.03]	[-0.00,0.02]	[0.04,0.24]	[0.07,0.28]	[-0.24,-0.09]	[-0.02,0.06]	[0.00,0.26]	[-0.01,0.14]	[-0.86,-0.55]	[-0.01,0.19]	[-0.01,0.35]	[-0.01,0.17]
HH. For	0.68	0.25	0.03	0.24	0.09	0.72	0.15	-0.14	-0.28	0.37	-1.02	-0.17	-0.25
	[0.63,0.72]	[0.11,0.39]	[-0.01,0.07]	[-0.16,0.63]	[-0.31,0.49]	[0.46,0.98]	[-0.00,0.30]	[-0.64,0.36]	[-0.58,0.01]	[-0.03,0.78]	[-1.45,-0.59]	[-0.89,0.55]	[-0.60,0.10]
RoFD. Dom.	1.10	-0.52	0.31	0.49	0.37	-0.36	-0.05	0.05	-1.18	0.26	-0.06	$-\infty$	$+\infty$
	[1.07,1.13]	[-0.73,-0.31]	[-0.42,1.04]	[-0.05,1.03]	[-0.49,1.23]	[-0.62,-0.10]	[-0.52,0.43]	[-0.55,0.66]	[-1.92,-0.45]	[-0.02,0.54]	[-0.33,0.21]		
RoFD. For.	0.90	-0.57	-1.39	0.19	-0.40	0.10	0.24	-0.01	2.31	0.51	-0.37	$+\infty$	$-\infty$
	[0.85,0.95]	[-1.15,0.01]	[-4.30,1.53]	[-1.21,1.58]	[-3.41,2.61]	[-0.43,0.63]	[-1.54,2.02]	[-1.45,1.43]	[-0.35,4.96]	[-0.04,1.05]	[-0.90,0.15]		

	(3) Uncompensated (Marshallian) price (ϵ^u)											
	Agri/Ext Dom.	Agri/Ext For.	Manu. Dom.	Manu. For.	Const Dom.	Const. For.	Serv. Dom.	Serv. For.	HH Dom.	HH For.	RoFD Dom.	RoFD For.
Agri+Ext Dom	-0.21	0.12	0.06	-0.23	-0.74	0.16	3.80	0.37	-0.27	0.60	-3.79	-1.03
	[-0.65,0.22]	[0.01,0.23]	[-0.74,0.85]	[-1.08,0.63]	[-1.10,-0.38]	[-0.23,0.55]	[2.91,4.70]	[-0.37,1.11]	[-0.65,0.12]	[0.23,0.96]	[-5.23,-2.35]	[-2.04,-0.02]
Agri+Ext For	0.52	0.91	0.63	-0.19	0.63	-1.88	1.19	-1.75	0.13	0.25	9.24	-10.48
	[0.04,0.99]	[-1.38,3.20]	[-0.53,1.78]	[-2.56,2.18]	[0.18,1.07]	[-3.27,-0.48]	[-0.02,2.40]	[-3.85,0.35]	[-0.34,0.59]	[-0.20,0.70]	[-12.79,31.26]	[-32.47,11.51]
Man. Dom	0.01	0.02	-1.06	0.56	-0.17	-0.02	-0.45	-0.38	-0.03	0.03	0.33	0.01
	[-0.11,0.12]	[-0.02,0.06]	[-1.47,-0.65]	[0.25,0.88]	[-0.31,-0.02]	[-0.15,0.12]	[-0.79,-0.10]	[-0.65,-0.11]	[-0.19,0.13]	[-0.12,0.18]	[-0.21,0.88]	[-0.34,0.36]
Man For	-0.05	-0.01	1.02	0.39	0.75	0.06	-0.86	-2.75	0.29	0.02	0.52	-0.20
	[-0.26,0.16]	[-0.15,0.12]	[0.48,1.55]	[-0.53,1.32]	[0.51,1.00]	[-0.30,0.43]	[-1.49,-0.23]	[-3.42,-2.08]	[0.01,0.57]	[-0.24,0.28]	[-0.97,2.02]	[-1.49,1.09]
Const+Util Dom	-0.27	0.05	-0.42	1.11	-0.91	0.55	-0.58	0.73	-0.89	0.64	-1.08	0.03
	[-0.41,-0.14]	[0.01,0.09]	[-0.79,-0.05]	[0.74,1.48]	[-1.23,-0.59]	[0.40,0.69]	[-1.03,-0.12]	[0.44,1.01]	[-1.18,-0.61]	[0.39,0.90]	[-1.74,-0.41]	[-0.31,0.37]
Const+Util For	0.19	-0.48	-0.06	0.30	1.68	-1.34	-0.17	-1.25	0.06	0.41	-0.46	0.45
	[-0.25,0.63]	[-0.85,-0.12]	[-1.14,1.02]	[-1.37,1.97]	[1.24,2.12]	[-2.63,-0.05]	[-1.34,1.00]	[-2.79,0.29]	[-0.41,0.53]	[-0.04,0.86]	[-4.17,3.25]	[-3.02,3.92]
Serv Dom	0.44	0.03	-0.34	-0.42	-0.18	-0.02	-0.39	0.15	-0.07	-0.10	-0.11	-0.04
	[0.34,0.54]	[-0.00,0.06]	[-0.61,-0.07]	[-0.71,-0.13]	[-0.32,-0.04]	[-0.14,0.09]	[-0.84,0.06]	[-0.07,0.37]	[-0.23,0.09]	[-0.25,0.05]	[-0.59,0.38]	[-0.32,0.25]
Serv For	0.16	-0.16	-1.01	-4.47	0.80	-0.45	0.58	5.86	0.12	-0.34	-3.44	1.59
	[-0.14,0.46]	[-0.36,0.03]	[-1.77,-0.25]	[-5.56,-3.37]	[0.50,1.11]	[-1.00,0.10]	[-0.20,1.37]	[4.54,7.18]	[-0.21,0.45]	[-0.65,-0.03]	[-5.51,-1.37]	[-0.27,3.44]
HH Dom.	-0.02	0.00	-0.01	0.09	-0.22	-0.00	-0.06	0.01	-0.94	0.03	0.02	0.04
	[-0.06,0.01]	[-0.01,0.01]	[-0.11,0.09]	[-0.01,0.20]	[-0.30,-0.15]	[-0.04,0.04]	[-0.18,0.07]	[-0.06,0.09]	[-1.09,-0.79]	[-0.06,0.13]	[-0.16,0.20]	[-0.04,0.13]
HH. For	0.24	0.02	0.14	0.04	0.68	0.14	-0.26	-0.32	0.23	-1.05	-0.26	-0.27
	[0.10,0.38]	[-0.02,0.06]	[-0.25,0.54]	[-0.36,0.44]	[0.42,0.95]	[-0.01,0.29]	[-0.76,0.24]	[-0.62,-0.02]	[-0.18,0.63]	[-1.48,-0.63]	[-0.98,0.45]	[-0.62,0.08]
RoFD. Dom.	-0.54	0.30	0.34	0.28	-0.42	-0.07	-0.14	-1.24	0.02	-0.12	$-\infty$	$+\infty$
	[-0.75,-0.34]	[-0.42,1.03]	[-0.20,0.88]	[-0.58,1.14]	[-0.68,-0.16]	[-0.54,0.41]	[-0.75,0.46]	[-1.98,-0.50]	[-0.26,0.30]	[-0.39,0.15]		
RoFD. For.	-0.59	-1.39	0.06	-0.47	0.06	0.23	-0.17	2.26	0.31	-0.42	$+\infty$	$-\infty$
	[-1.17,-0.01]	[-4.31,1.53]	[-1.33,1.46]	[-3.48,2.54]	[-0.47,0.59]	[-1.55,2.01]	[-1.61,1.27]	[-0.39,4.92]	[-0.24,0.86]	[-0.95,0.10]		

Figure 5.2: Demand vs Supply estimated shares ($\hat{w}$) for intermediate goods - Extended 6x2 system



(a) Agri+Ext - Domestic

(b) Manufacturing - Domestic

(c) Const+Utilities - Domestic

(d) Services - Domestic

(e) Agri+Ext - Foreign

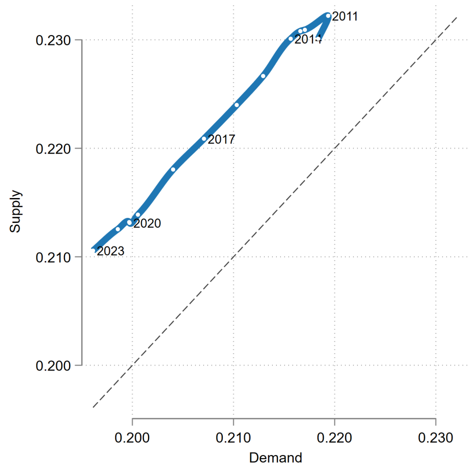
(f) Manufacturing - Foreign

(g) Const+Utilities - Foreign

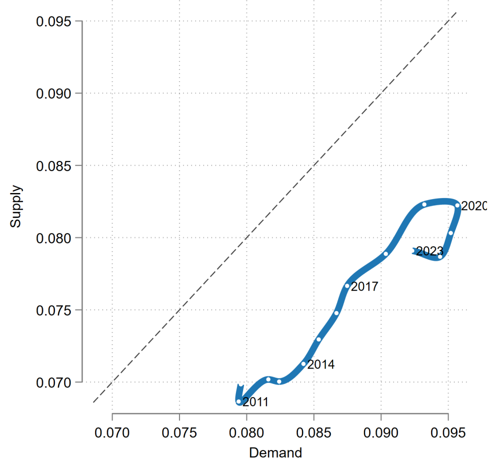
(h) Services - Foreign

by a sharp decline in Manufacturing Domestic. Similarly, demand for Services Foreign clearly outstrips supply, pointing to a greater dependence on imports. Certain sectors exhibit cyclical trends, possibly in response to macroeconomic shifts, policy changes, or global trade dynamics. For instance, Agriculture & Extraction Domestic initially experiences supply growth relative to demand, followed by a decline, hinting at structural changes in this sector. Likewise, Manufacturing Foreign displays periodic variability, potentially linked to economic cycles or policy shifts.

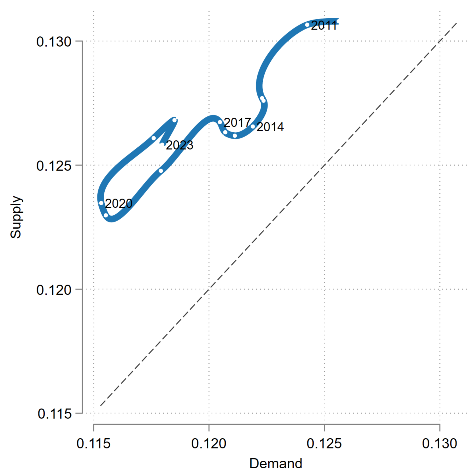
Figure 5.3: Demand vs Supply estimated shares ($\hat{w}$) for final demand goods - Extended 6x2 system



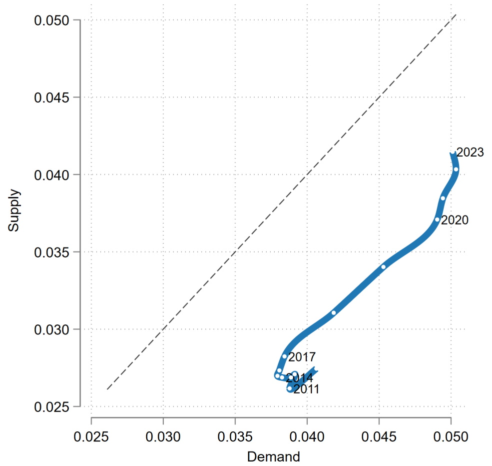
(a) Households - Domestic



(b) Households - Foreign



(c) Rest of Final Demand - Domestic



(d) Rest of Final Demand - Foreign

Figure 5.3 compares estimated demand and supply shares $\hat{w}_i$ for final demand goods. It highlights that while Households Domestic remains the largest category, its supply has surpassed demand even though the shares have declined for both over time. Conversely, Households Foreign exhibits growing demand that now exceeds supply, indicating increased preference for imported goods. Rest of Final Demand (RoFD) Domestic shows cyclical supply-demand variations, whereas RoFD Foreign demonstrates a strong trend of demand outpacing supply, again suggesting greater foreign dependency.

6 Simulating tariff shocks

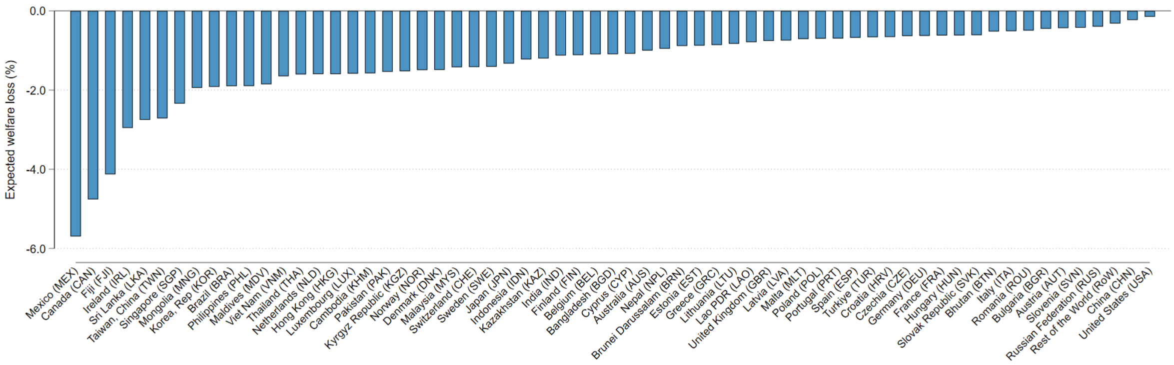
In this section, we evaluate tariff shocks to elicit short-run responses across countries in the database for the 2x2 system. As of writing this section in April 2025, USA had imposed a blanket 10% tariff on all countries. In addition to this, selected countries got hit with much higher rates. These are summarized in Table A.1. For example, the EU countries face an average tariff of 20%. Additionally, USA's largest trading partners, Mexico and Canada face a 25% tariff rate. Some relatively poorer countries face even higher rates such as Laos (48%), Vietnam (46%), Sri Lanka (44%), Bangladesh (37%) and Switzerland (32%). This unilateral move by the USA, has resulted in counter tariffs where notable countries include China (34%), Canada (25%) while European countries are considering rates around 25%.

Since we have varying baseline budget shares, import shares from sanctioning countries, and elasticities, we evaluate how these USA tariffs and counter-tariffs play out across different countries. We also estimate welfare losses by calculating the percentage change in the expenditure (demand) or income (supply) functions before and after tariffs. Table E.1 shows the results for all countries in the ADB database, while the last row shows the global impact of tariff wars. Here we observe that on the demand side, prices of both intermediate and final goods increase by +0.05. On average, the dependence on imports from countries that impose tariffs for intermediate goods is around 8.9% while for foreign goods it is 7.9%. Despite price increases, the share of budget spent on foreign goods goes up at the expense of a reduction in the demand for domestic goods, whose prices do not change. This signifies high dependencies on foreign goods, and as a result of purchasing more expensive products, the expenditure function moves inward, resulting in a net welfare loss of approximately 1.32%.

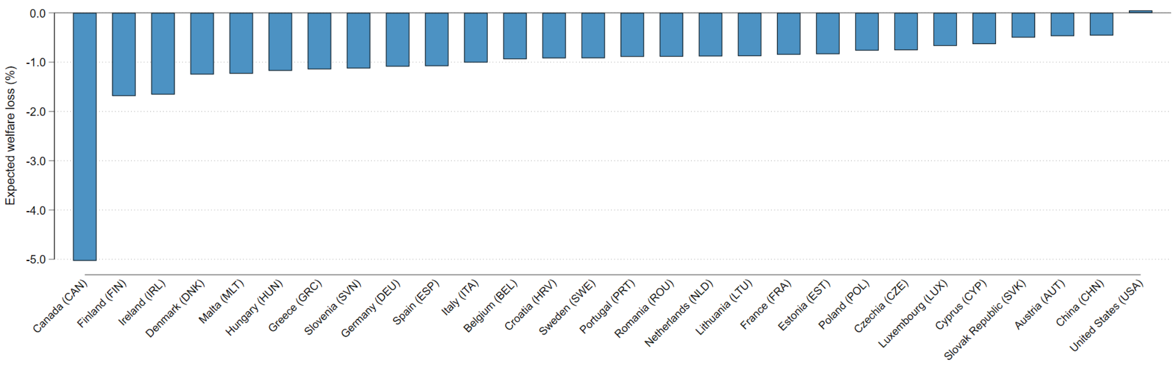
At the country level, we can observe how the tariffs play out very differently given different initial conditions for each country. For example, Germany has a much larger share of domestic consumption with dependence on USA imports equal to approximately 6-7% for intermediate and foreign goods each. As a result, the tariff does lead to a welfare loss, but it is relatively small in magnitude (-0.63%). Similarly, China, which also has a large share of the demand for domestic goods, faces a welfare loss of -0.23% from both tariffs and counter-tariffs. If we compare this with another country like Fiji, a small island developing country that faces a tariff of 34%, the effects are much more pronounced, resulting in a significant loss of around -4.1%. Since several South Asian countries were also hit with unusually large tariffs, that also face large losses, in particular Sri Lanka (-2.75%), India (-1.126%), and Bangladesh (-1.09%). Looking at the USA's largest trading partners and neighbors, Canada and Mexico, we also observe massive welfare losses of -4.8% and and -5.7% respectively. Both countries rely heavily on US imports for intermediate and final goods with much larger shares for Canada. In order to afford the more expensive imported goods, both countries also significantly reduce their spending on domestic purchases. The counter-sanctions on the USA result in a relatively small welfare loss of -0.15%. This is despite the fact that 46% of its intermediate imports and 49% of its final demand imports are from sanctioning countries. But looking closely, we observe that its budget share for both categories is very small. As a result of high the world having a high dependence on USA exports and low spending on foreign goods implies that the USA almost nets out its losses. Figure 6.1 shows the net expenditure losses for all countries in the database and highlights the deep impacts at the global level of tariff wars. Several Asian countries are on the top of the list, while several European countries like Norway and Denmark are likely to face significant losses. On the other end of the spectrum, countries like Russia, Slovenia, Austria, Italy are relatively better sheltered.

We also conduct a similar analysis on the supply side where we look at the changes across the 2x2 categories for sanction-imposing countries. The complete list is summarized in Table E.2. At the aggregate level, we see that sanctioning countries shift supply strongly to domestic intermediate consumption at

Figure 6.1: Welfare losses



(a) Demand-side expenditure losses on sanctioned countries



(b) Supply-side income losses on sanctioning countries the expense of all the other categories. Overall, supply-side welfare loss is around -1%. Given the strong demand for USA goods, it shows up as the only country that has a negligible but a net marginal gain of +0.05%. The comparison of export to sanctioned countries shows how much counter-sanctions can hurt domestic economies as well. Within European countries, we can observe that 6% of the Netherlands exports for intermediate and final goods go to the United States, resulting in a welfare loss -0.8%. In contrast, Ireland export to the USA is around 13% for both intermediate and final demand categories, and therefore faced a much larger loss of -1.7%.

Figure 6.1b ranks the sanctioning countries in order of income losses. Here, Canada comes out as the largest loser from counter-tariffs resulting in a welfare loss of almost 5%. From the other countries, Finland, Ireland, Denmark, Hungary have the highest losses from counter-tariffs, while Germany, Italy, Spain face more than 1% losses. China faces the smallest loss of roughly 0.5%. Overall, we observe that tariffs and counter-tariffs would continue to hurt not only the sanctioned but also the sanctioning economies. At the time of writing this, the threat of escalation implies that we are likely to see worsening of the situation, and since global dependence on imports is high, and as the elasticities show us, substitutability is low, more damage is likely to be done to the global economy.

The results of tariff shocks should be interpreted with caution and three points should be taken into account. First, the demand system assumes that we are operating at an efficient frontier. Therefore, rebalancing the budget portfolio implies costless and frictionless allocation changes, for example, increasing or decreasing the share of domestic goods to counter balance the increase in prices of foreign goods. While this might be true, since we have estimated elasticities that tell us how much substitution can take place, rebalancing might still take some time and have other unintended effects. Second, and in relation to the first point, the demand system is a supply-side framework that does not tell us about demand-side adjustments. Welfare loss can result in income losses that can further reduce demand creating spiraling dynamics. While we do estimate how much the budget line shifts inward, a full evaluation would require a proper macro framework that can also capture demand-side distributional impacts. Third, while we do assume that domestic and foreign goods are interlinked since elasticities show us how much substitutability or complementarity exists, we do not really account for deeper input-output interlinkages. This can again result in second-round losses as value chain shocks can percolate through global networks. Since we know that certain intermediate imported goods are not easily substitutable, it is also very likely that they reverberate via domestic price shocks, an effect that we are not currently considering. Despite these caveats, the analysis is still powerful in showing the impacts of tariff wars, at least for the near future, where structural changes are not very persistent. Furthermore, we can easily expand the analysis to finer sectors and products as well to see a deeper decomposition of the welfare changes.

7 Conclusions

In recent decades, trade has been a primary driver of global economic growth through integration in global value chains (GVCs). On the downside, the increasing complexity of GVCs has also amplified economic vulnerabilities, since domestic production must respond to domestic and foreign demand. Furthermore, in order to produce this output, countries also require both domestic and foreign inputs. These inputs are usually not always substitutable, especially in an era of increasing specialization combined with just-in-time production and low shipping costs. Past events, such as the COVID-19 pandemic, Suez canal blockage, extreme climate events, and more recently, geopolitical tensions have revealed that these risks are likely to amplify as tariff wars fragment the global economy further. Elasticities can help us systematically understand these vulnerabilities, especially in evaluating demand and supply responsiveness to price and income shocks.

This paper estimates demand and supply elasticities derived from country-sector interactions from Asian Development Bank's Multi-Region Input-Output (MRIO) dataset. The dataset provides comprehensive information for 62 countries plus the Rest of the World for 35 sectors. The data is available for both nominal and real values and from 2007 to 2023, allowing us to explore structural changes in elasticities over time. Data is pooled at three-year rolling intervals to minimize noise. Estimation is done using the Quadratic Almost Ideal Demand System (QUAIDS), a robust framework that excels at capturing non-linear income and price elasticities. Two sets of results are provided. The first is the *baseline* where we distinguish between intermediate and final consumption further divided into domestic and final goods in a 2×2 system. The second *extended* 6x2 system uses four intermediate sector aggregates (Agriculture and Extraction, Manufacturing, Construction and Utilities, and Services) and two final demand aggregates (Household consumption, and the Rest of Final Demand).

The results show that expenditure and income elasticities typically hover around one, while the supply elasticities for foreign goods are marginally lower than those of demand, showing less robust supply responses. Own-price elasticities show that supply reacts more to price variations than demand, especially for foreign goods. Greater supply elasticities also imply that producers are quicker to adapt their output in response to price changes as opposed to demand. Cross-price elasticities indicate stronger substitution on the supply side, while demand changes are milder, highlighting divergence between consumers and producers that can also potentially create macro imbalances. Over time, domestic demand shares have declined, particularly for the intermediate sectors, indicating a greater dependence on imports. A comparison of demand and supply shares over time also reflects structural shifts with domestic sectors losing market share. In addition, consistent demand exceeding supply for foreign goods implies potential constraints on domestic production capacity or the competitive edge of foreign producers.

The demand estimates for 2021-2023 are subjected to tariff shocks from the USA and counter-tariffs using the latest available information. These shocks are introduced as price hikes on import of foreign goods from sanctioning countries for demand elasticities and exports to sanctioned countries in supply elasticities. The findings indicate a global welfare loss on the demand side of approximately -1.3%. Nations with a large portion of their budget dedicated to imports, particularly those heavily relying on US imports with limited substitution options, face substantial welfare declines. This group includes the USA's primary trading partners, Mexico and Canada, followed by Asian and some European countries. In contrast, some EU countries and China endure less impact due to higher domestic spending and minimal reliance on US imports. Sanctioning countries also incur losses from counter-tariffs on the US, suffering revenue declines between 0.5-1.8% because of their export dependence on the US. Specifically, Canada experiences a 5% revenue reduction due to its extensive economic ties with the USA. Despite facing counter-tariffs from countries such as Canada and China, the USA faces minimal welfare losses due to its pivotal role in the global market. Overall, the analysis shows how tariffs and counter-tariffs play out across the countries with different economic structures and baseline conditions.

In terms of applications, policymakers can use elasticity estimates to strengthen economic resilience and evaluate strategies to enhance domestic production capacities. Additionally, such an analysis can help to focus on strategic trade agreements, and tariff policies can help secure stable supply relationships while minimizing excessive dependence on riskier trading partners. In addition, continuous monitoring of elasticity trends can be integrated into long-term economic planning to assess how trade relationships and sectoral dependencies evolve in response to external shocks. Such an analysis can also support additional work, for example, by informing elasticities in macro models or more advanced input-output analysis to evaluate second-round effects that might persist longer than the initial shock.

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A Key tables

Table A.1: Countries in the ADB MRIO database by regions

ISO3	Name	Region	USA Tariff	Counter Tariff
AUS	Australia	East Asia and Pacific	10	
BRN	Brunei Darussalam	East Asia and Pacific	24	
KHM	Cambodia	East Asia and Pacific	49	
CHN	China	East Asia and Pacific	34	34
FJI	Fiji	East Asia and Pacific	32	
HKG	Hong Kong	East Asia and Pacific	34	
IDN	Indonesia	East Asia and Pacific	32	
JPN	Japan	East Asia and Pacific	24	
KOR	Korea, Rep	East Asia and Pacific	26	
LAO	Lao PDR	East Asia and Pacific	48	
MYS	Malaysia	East Asia and Pacific	24	
MNG	Mongolia	East Asia and Pacific	10	
PHL	Philippines	East Asia and Pacific	18	
SGP	Singapore	East Asia and Pacific	25	
TWN	Taiwan, China	East Asia and Pacific	32	
THA	Thailand	East Asia and Pacific	37	
VNM	Viet Nam	East Asia and Pacific	46	
AUT	Austria	European Union (EU)	20	25
BEL	Belgium	European Union (EU)	20	25
BGR	Bulgaria	European Union (EU)	20	
HRV	Croatia	European Union (EU)	20	25
CYP	Cyprus	European Union (EU)	20	25
CZE	Czechia	European Union (EU)	20	25
DNK	Denmark	European Union (EU)	20	25
EST	Estonia	European Union (EU)	20	25
FIN	Finland	European Union (EU)	20	25
FRA	France	European Union (EU)	20	25
DEU	Germany	European Union (EU)	20	25
GRC	Greece	European Union (EU)	20	25
HUN	Hungary	European Union (EU)	20	25
IRL	Ireland	European Union (EU)	20	25
ITA	Italy	European Union (EU)	20	25
LTU	Lithuania	European Union (EU)	20	25
LUX	Luxembourg	European Union (EU)	20	25
MLT	Malta	European Union (EU)	20	25
NLD	Netherlands	European Union (EU)	20	25
POL	Poland	European Union (EU)	20	25
PRT	Portugal	European Union (EU)	20	25
ROU	Romania	European Union (EU)	20	25
SVK	Slovak Republic	European Union (EU)	20	25
SVN	Slovenia	European Union (EU)	20	25
ESP	Spain	European Union (EU)	20	25
SWE	Sweden	European Union (EU)	20	25
CHE	Switzerland	European Union (EU)	32	
KAZ	Kazakhstan	Rest of Europe and Central Asia	27	
KGZ	Kyrgyz Republic	Rest of Europe and Central Asia	20	
LVA	Latvia	Rest of Europe and Central Asia	20	25
NOR	Norway	Rest of Europe and Central Asia	20	25
RUS	Russian Federation	Rest of Europe and Central Asia	10	
TUR	Turkiye	Rest of Europe and Central Asia	10	
GBR	United Kingdom	Rest of Europe and Central Asia	10	25
BGD	Bangladesh	South Asia	37	
BTN	Bhutan	South Asia	10	
IND	India	South Asia	27	
MDV	Maldives	South Asia	10	
NPL	Nepal	South Asia	10	
PAK	Pakistan	South Asia	30	
LKA	Sri Lanka	South Asia	44	
BRA	Brazil	Latin America and Caribbean	10	
MEX	Mexico	Latin America and Caribbean	25	
CAN	Canada	North America	25	25
USA	United States	North America		
RoW	Rest of the World	Rest of the World	10	

Note: The table has been combined using various news sources including https://www.cbsnews.com/news/trump-reciprocal-tariffs-liberation-day-list/ and https://www.tradecomplianceresourcehub.com/2025/04/04/trump-2-0-tariff-tracker/. Both accessed on 8th April, 2025. The information might already be outdated at the time of reading this paper.

Table A.2: Mapping of ADB MRIO to broad sectors for analysis

ADB sector name	ADB sector id	NACE code	Broad sector	Description
Agriculture, hunting, forestry, and fishing	c1	AtB	A-C	Agriculture and natural resource extraction
Mining and quarrying	c2	C		
Food, beverages, and tobacco	c3	D15t16	D	Manufacturing
Textiles and textile products	c4	D17t18		
Leather, leather products, and footwear	c5	D19		
Wood and products of wood and cork	c6	D20		
Pulp, paper, paper products, printing, and publishing	c7	D21t22		
Coke, refined petroleum, and nuclear fuel	c8	D23		
Chemicals and chemical products	c9	D24		
Rubber and plastics	c10	D25		
Other nonmetallic minerals	c11	D26		
Basic metals and fabricated metal	c12	D27t28		
Machinery, nec	c13	D29		
Electrical and optical equipment	c14	D30t33		
Transport equipment	c15	D34t35		
Manufacturing, nec; recycling	c16	D36t37		
Electricity, gas, and water supply	c17	E	E-F	Construction and utilities
Construction	c18	F		
Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	c19	G50	G-P	Services
Wholesale trade and commission trade, except of motor vehicles and motorcycles	c20	G51		
Retail trade, except of motor vehicles and motorcycles; repair of household goods	c21	G52		
Hotels and restaurants	c22	H		
Inland transport	c23	I60		
Water transport	c24	I61		
Air transport	c25	I62		
Other supporting and auxiliary transport activities; activities of travel agencies	c26	I63		
Post and telecommunications	c27	I64		
Financial intermediation	c28	J		
Real estate activities	c29	K70		
Renting of M&Eq and other business activities	c30	K71t74		
Public administration and defense; compulsory social security	c31	L		
Education	c32	M		
Health and social work	c33	N		
Other community, social, and personal services	c34	O		
Private households with employed persons	c35	P		

B The Translog model

The Translog direct utility function takes the following functional form:

$$\ln U = \alpha_0 + \sum_i \alpha_i \ln x_i + \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln x_i \ln x_j \tag{B.1}$$

where the first terms with α_0 and α_1 represent a standard log-linear Cobb-Douglas function. Here the term α_0 also represents the baseline preference for a good i. The last term with β_{ij} represents cross-price elasticities with symmetry conditions $\beta_{ij} = \beta_{ji}$.

In order to derive the indirect utility function, we maximize Eq. B.1 subject to the expenditure constraint $\sum_i p_i x_i = m$, which gives us:

$$\ln v = \alpha_0 + \sum_i \alpha_i (\ln m - \ln p_i) - \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln p_i \ln p_j \tag{B.2}$$

Applying Roy's identity, the Marshallian demand function can be recovered as follows:

$$x_i = \frac{m}{p_i} \left(1 + \frac{\sum_j \beta_{ij} \ln p_j}{\alpha_i} \right) \tag{B.3}$$

From which we can derive the share of good i:

$$w_i = \alpha_i + \sum_j \beta_{ij} \ln p_j + \delta_i (\ln m - \ln a(p)) \tag{B.4}$$

where $a(p)$ is the aggregator function defined in Eq. 3.12. From which we can recover the elasticities as follows:

$$\begin{aligned} \text{Expenditure Elasticity:} \quad & \eta_i = 1 + \frac{\delta_i}{s_i} \\ \text{Own-Price Elasticity:} \quad & \gamma_{ii} = \frac{\beta_{ii}}{s_i} - \delta_i - 1 \\ \text{Cross-Price Elasticity:} \quad & \gamma_{ij} = \frac{\beta_{ij}}{s_i} \end{aligned} \tag{B.5}$$

C Comparison of multiple demand systems

Table C.1: Demand elasticities for the baseline 2x2 system (2021-2023)

	(1) QUAIDS	(2) AIDS	(3) Cobb-Douglas	(4) LES	(5) Translog
α					
Int Domestic (α_1)	0.165***	0.048***	0.326***	0.329***	0.125***
	(0.030)	(0.012)	(0.003)	(0.003)	(0.015)
Int Foreign (α_2)	0.282***	0.467***	0.218***	0.216***	0.401***
	(0.029)	(0.011)	(0.003)	(0.003)	(0.013)
Final Domestic (α_3)	0.282***	0.141***	0.318***	0.318***	0.189***
	(0.037)	(0.015)	(0.004)	(0.004)	(0.013)
β					
Int Domestic (β_1)	0.002	0.031***			
	(0.007)	(0.001)			
Int Foreign (β_2)	0.019***	-0.028***			
	(0.007)	(0.001)			
Final Domestic (β_3)	-0.016*	0.020***			
	(0.009)	(0.002)			
$\mathbf{\Gamma}$					
Int dom x Int dom (γ_{11})	0.078***	0.080***			0.051***
	(0.020)	(0.020)			(0.014)
Int dom x Int for (γ_{12})	0.061***	0.058***			0.042***
	(0.014)	(0.014)			(0.009)
Int dom x Fin dom (γ_{13})	-0.078***	-0.081***			-0.062***
	(0.017)	(0.017)			(0.012)
Int for x Int for (γ_{22})	0.020	0.025			0.024*
	(0.019)	(0.019)			(0.013)
Int for x Fin dom (γ_{23})	-0.053***	-0.052***			-0.031***
	(0.014)	(0.014)			(0.009)
Fin dom x Fin dom (γ_{33})	0.068***	0.069***			0.043***
	(0.020)	(0.020)			(0.013)
Int dom x Fin for (γ_{14})					-0.040***
					(0.008)
Int for x Fin for (γ_{24})					-0.008
					(0.009)
Fin dom x Fin for (γ_{34})					0.047***
					(0.008)
Fin for x Fin for (γ_{44})					0.022**
					(0.009)
λ					
Int Domestic (λ_1)	0.002***				
	(0.000)				
Int Foreign (λ_2)	-0.003***				
	(0.000)				
Final Domestic (λ_3)	0.002***				
	(0.001)				
μ					
Int Domestic (μ_1)				-5.164***	
				(1.434)	
Int Foreign (μ_2)				-0.932	
				(0.778)	
Final Domestic (μ_3)				-3.860***	
				(1.434)	
Final Domestic (μ_4)				-0.719	
				(0.501)	
N	6325	6325	6325	6325	6325

Notes: α are baseline expenditure shares where $\sum_i \alpha_i = 1$, β are expenditure elasticities where $\sum_i \beta_i = 0$. λ are quadratic expenditure elasticities where $\sum_i \lambda_i = 0$. $\mathbf{\Gamma}$ are own- and cross-price elasticities where $\sum_i \gamma_{ij} = 0$. Symmetry conditions imply $\gamma_{ij} = \gamma_{ji}$ except in the Translog model.

Table C.2: Supply elasticities for the baseline 2x2 sytem (2021-2023)

	(1) QUAIDS	(2) AIDS	(3) Cobb-Douglas	(4) LES	(5) Translog
α					
Int Domestic (α_1)	0.399***	0.145***	0.354***	0.354***	0.271***
	(0.042)	(0.015)	(0.003)	(0.003)	(0.008)
Int Foreign (α_2)	-0.063*	0.359***	0.191***	0.191***	0.268***
	(0.036)	(0.013)	(0.003)	(0.003)	(0.007)
Final Domestic (α_3)	0.586***	0.236***	0.340***	0.341***	0.288***
	(0.051)	(0.018)	(0.004)	(0.004)	(0.008)
β					
Int Domestic (β_1)	-0.029***	0.016***			
	(0.007)	(0.001)			
Int Foreign (β_2)	0.062***	-0.013***			
	(0.006)	(0.001)			
Final Domestic (β_3)	-0.054***	0.008***			
	(0.009)	(0.001)			
$\mathbf{\Gamma}$					
Int dom x Int dom (γ_{11})	-0.121***	-0.124***			-0.065***
	(0.032)	(0.032)			(0.017)
Int dom x Int for (γ_{12})	0.218***	0.219***			0.119***
	(0.032)	(0.033)			(0.018)
Int dom x Fin dom (γ_{13})	-0.140***	-0.138***			-0.065***
	(0.022)	(0.022)			(0.011)
Int for x Int for (γ_{22})	-0.209***	-0.207***			-0.096***
	(0.041)	(0.041)			(0.021)
Int for x Fin dom (γ_{23})	0.025	0.018			0.002
	(0.025)	(0.025)			(0.011)
Fin dom x Fin dom (γ_{33})	0.119***	0.126***			0.075***
	(0.033)	(0.033)			(0.015)
Int dom x Fin for (γ_{14})					0.022***
					(0.008)
Int for x Fin for (γ_{24})					-0.007
					(0.008)
Fin dom x Fin for (γ_{34})					0.001
					(0.008)
Fin for x Fin for (γ_{44})					-0.004
					(0.007)
λ					
Int Domestic (λ_1)	0.002***				
	(0.000)				
Int Foreign (λ_2)	-0.003***				
	(0.000)				
Final Domestic (λ_3)	0.003***				
	(0.000)				
μ					
Int Domestic (μ_1)				3.085	
				(1.945)	
Int Foreign (μ_2)				1.659	
				(1.048)	
Final Domestic (μ_3)				2.961	
				(1.874)	
Final Domestic (μ_4)				0.998	
				(0.631)	
N	6278	6278	6278	6278	6278

Notes: α are baseline expenditure shares where $\sum_i \alpha_i = 1$, β are expenditure elasticities where $\sum_i \beta_i = 0$. λ are quadratic expenditure elasticities where $\sum_i \lambda_i = 0$. $\mathbf{\Gamma}$ are own- and cross-price elasticities where $\sum_i \gamma_{ij} = 0$. Symmetry conditions imply $\gamma_{ij} = \gamma_{ji}$ except in the Translog model.

D Variations in elasticity parameters

Table D.1: QUAIDS demand elasticity parameters over different time periods (baseline)

	(1) 2007-09	(2) 2011-13	(3) 2014-16	(4) 2017-19	(5) 2021-23
α					
Int Domestic (α_1)	0.261***	0.300***	0.234***	0.186***	0.165***
	(0.025)	(0.025)	(0.026)	(0.032)	(0.030)
Int Foreign (α_2)	0.212***	0.220***	0.234***	0.242***	0.282***
	(0.020)	(0.021)	(0.022)	(0.028)	(0.029)
Final Domestic (α_3)	0.307***	0.255***	0.245***	0.268***	0.282***
	(0.029)	(0.030)	(0.031)	(0.038)	(0.037)
β					
Int Domestic (β_1)	0.003	-0.009	0.003	0.005	0.002
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Int Foreign (β_2)	0.013***	0.014***	0.015***	0.020***	0.019***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)
Final Domestic (β_3)	-0.014*	-0.001	-0.002	-0.012	-0.016*
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
$\mathbf{\Gamma}$					
Int dom x Int dom (γ_{11})	-0.146***	-0.062	0.157***	0.204***	0.078***
	(0.045)	(0.057)	(0.050)	(0.033)	(0.020)
Int dom x Int for (γ_{12})	0.065**	-0.011	-0.028	0.048**	0.061***
	(0.025)	(0.033)	(0.028)	(0.020)	(0.014)
Int dom x Fin dom (γ_{13})	0.031	-0.007	-0.096**	-0.145***	-0.078***
	(0.036)	(0.046)	(0.045)	(0.028)	(0.017)
Int for x Int for (γ_{22})	0.071*	0.102**	0.172***	0.158***	0.020
	(0.039)	(0.050)	(0.035)	(0.026)	(0.019)
Int for x Fin dom (γ_{23})	-0.008	-0.003	0.028	-0.002	-0.053***
	(0.024)	(0.032)	(0.028)	(0.020)	(0.014)
Fin dom x Fin dom (γ_{33})	0.028	-0.014	0.048	0.027	0.068***
	(0.040)	(0.051)	(0.048)	(0.032)	(0.020)
λ					
Int Domestic (λ_1)	0.001***	0.002***	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Int Foreign (λ_2)	-0.002***	-0.002***	-0.002***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Final Domestic (λ_3)	0.002***	0.001***	0.001***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
N	6306	6293	6288	6344	6325

Notes: α are baseline expenditure shares where $\sum_i \alpha_i = 1$, β are expenditure elasticities where $\sum_i \beta_i = 0$. λ are quadratic expenditure elasticities where $\sum_i \lambda_i = 0$. $\mathbf{\Gamma}$ are own- and cross-price elasticities where $\sum_i \gamma_{ij} = 0$. Symmetry conditions imply $\gamma_{ij} = \gamma_{ji}$.

Table D.2: QUAIDS demand elasticity parameters over different time aggregations (baseline)

	(1) 2023 (1 year)	(2) 2021-23 (3 years)	(3) 2019-23 (5 years)	(4) 2013-23 (10 years)	(5) 2007-23 (Full sample)
α					
Int Domestic (α_1)	0.108***	0.165***	0.181***	0.212***	0.247***
	(0.041)	(0.030)	(0.023)	(0.016)	(0.013)
Int Foreign (α_2)	0.328***	0.282***	0.271***	0.239***	0.221***
	(0.040)	(0.029)	(0.021)	(0.015)	(0.011)
Final Domestic (α_3)	0.307***	0.282***	0.266***	0.265***	0.273***
	(0.051)	(0.037)	(0.029)	(0.020)	(0.016)
β					
Int Domestic (β_1)	0.020*	0.002	0.000	-0.001	-0.005
	(0.011)	(0.007)	(0.005)	(0.004)	(0.003)
Int Foreign (β_2)	0.009	0.019***	0.018***	0.020***	0.020***
	(0.011)	(0.007)	(0.005)	(0.003)	(0.003)
Final Domestic (β_3)	-0.022	-0.016*	-0.012*	-0.010**	-0.010***
	(0.014)	(0.009)	(0.007)	(0.005)	(0.004)
$\boldsymbol{\Gamma}$					
Int dom x Int dom (γ_{11})	0.078**	0.078***	0.084***	0.114***	0.080***
	(0.031)	(0.020)	(0.017)	(0.015)	(0.014)
Int dom x Int for (γ_{12})	0.042*	0.061***	0.069***	0.047***	0.044***
	(0.022)	(0.014)	(0.012)	(0.009)	(0.009)
Int dom x Fin dom (γ_{13})	-0.070***	-0.078***	-0.077***	-0.094***	-0.078***
	(0.025)	(0.017)	(0.014)	(0.013)	(0.012)
Int for x Int for (γ_{22})	-0.033	0.020	0.043***	0.075***	0.076***
	(0.031)	(0.019)	(0.016)	(0.012)	(0.011)
Int for x Fin dom (γ_{23})	-0.025	-0.053***	-0.047***	-0.026***	-0.022**
	(0.022)	(0.014)	(0.011)	(0.009)	(0.009)
Fin dom x Fin dom (γ_{33})	0.031	0.068***	0.049***	0.047***	0.043***
	(0.031)	(0.020)	(0.017)	(0.015)	(0.014)
λ					
Int Domestic (λ_1)	0.001	0.002***	0.002***	0.002***	0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Int Foreign (λ_2)	-0.003***	-0.003***	-0.003***	-0.003***	-0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Final Domestic (λ_3)	0.003***	0.002***	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
N	2115	6325	10547	23160	33666

Notes: α are baseline expenditure shares where $\sum_i \alpha_i = 1$, β are expenditure elasticities where $\sum_i \beta_i = 0$. λ are quadratic expenditure elasticities where $\sum_i \lambda_i = 0$. $\boldsymbol{\Gamma}$ are own- and cross-price elasticities where $\sum_i \gamma_{ij} = 0$. Symmetry conditions imply $\gamma_{ij} = \gamma_{ji}$.

E Country tables

Table E.1: Change in demand shares from tariffs (2021-2023 pooled)

Country	Intermediate domestic		Intermediate Foreign					Final Domestic		Intermediate Foreign					
	w	Δ_w	Dependence	Price	Δ_p	w	Δ_w	w	Δ_w	Dependence	Price	Δ_p	w	Δ_w	Welfare loss
Australia(AUS)	0.440	-0.001	11.495	1.120	0.050	0.056	0.001	0.449	0.000	11.130	1.087	0.046	0.056	0.000	-1.000
	0.438			1.170		0.057		0.449			1.133		0.056		
Austria(AUT)	0.346	-0.000	2.919	1.052	0.014	0.196	0.000	0.363	-0.000	2.420	1.027	0.014	0.095	0.000	-0.432
	0.345			1.066		0.196		0.363			1.041		0.096		
Bangladesh(BGD)	0.295	-0.001	4.775	1.073	0.040	0.082	0.001	0.591	-0.000	4.457	1.089	0.039	0.031	0.000	-1.094
	0.294			1.114		0.083		0.591			1.128		0.032		
Belgium(BEL)	0.286	-0.000	6.348	1.033	0.034	0.287	0.001	0.297	-0.002	5.258	1.037	0.036	0.129	0.001	-1.096
	0.286			1.067		0.289		0.295			1.073		0.130		
Bhutan(BTN)	0.153	-0.000	0.721	1.033	0.007	0.127	0.000	0.549	-0.001	1.089	1.088	0.010	0.170	0.001	-0.519
	0.153			1.040		0.128		0.548			1.098		0.171		
Brazil(BRA)	0.408	-0.003	21.941	1.092	0.095	0.076	0.002	0.493	-0.001	18.681	1.103	0.095	0.024	0.001	-1.899
	0.405			1.186		0.078		0.492			1.198		0.025		
Brunei Darussalam (BRN)	0.172	0.001	4.385	1.071	0.029	0.336	-0.000	0.420	-0.000	2.423	1.068	0.022	0.072	-0.000	-0.884
	0.173			1.100		0.336		0.420			1.090		0.072		
Bulgaria(BGR)	0.373	-0.000	1.229	1.068	0.011	0.202	0.000	0.332	-0.000	1.306	1.038	0.011	0.092	0.000	-0.450
	0.373			1.079		0.203		0.332			1.049		0.093		
Cambodia(KHM)	0.206	-0.001	2.692	1.152	0.047	0.275	0.002	0.446	-0.002	2.126	1.138	0.047	0.073	0.000	-1.574
	0.205			1.199		0.277		0.444			1.185		0.073		
Canada(CAN)	0.366	-0.007	51.287	1.163	0.316	0.100	0.002	0.448	0.003	49.683	1.179	0.311	0.087	0.001	-4.759
	0.358			1.479		0.102		0.451			1.490		0.088		
China(CHN)	0.589	-0.002	7.704	1.088	0.091	0.051	0.002	0.345	-0.001	12.315	1.061	0.093	0.014	0.002	-0.229
	0.587			1.179		0.053		0.344			1.155		0.016		
Croatia(HRV)	0.289	-0.000	3.226	1.060	0.017	0.203	-0.000	0.379	-0.000	1.078	1.072	0.026	0.129	0.001	-0.657
	0.289			1.077		0.202		0.379			1.097		0.129		
Cyprus(CYP)	0.269	0.000	6.406	1.044	0.020	0.292	-0.000	0.292	-0.001	2.622	1.032	0.018	0.147	0.001	-1.080
	0.269			1.064		0.292		0.291			1.051		0.148		
Czechia(CZE)	0.410	-0.000	2.906	1.052	0.022	0.198	0.001	0.279	-0.001	2.487	1.027	0.018	0.112	0.000	-0.635
	0.410			1.074		0.199		0.278			1.045		0.113		
Denmark(DNK)	0.321	-0.001	9.921	1.040	0.043	0.212	0.001	0.359	-0.001	4.871	1.050	0.036	0.108	0.001	-1.491
	0.320			1.083		0.213		0.358			1.086		0.109		
Estonia(EST)	0.323	0.001	2.394	1.080	0.021	0.228	0.001	0.280	-0.002	1.975	1.060	0.018	0.169	0.001	-0.875
	0.323			1.101		0.229		0.278			1.078		0.170		
Fiji(FJI)	0.222	-0.001	11.033	1.120	0.087	0.154	0.001	0.457	0.000	13.157	1.129	0.094	0.167	-0.000	-4.125
	0.221			1.207		0.154		0.458			1.223		0.167		
Finland(FIN)	0.412	0.001	4.790	1.045	0.034	0.140	0.001	0.377	-0.003	3.225	1.037	0.027	0.071	0.001	-1.114
	0.413			1.078		0.141		0.374			1.063		0.071		
France(FRA)	0.408	-0.001	7.343	1.053	0.040	0.117	0.001	0.403	-0.001	5.353	1.051	0.039	0.073	0.001	-0.620
	0.407			1.094		0.117		0.402			1.090		0.074		
Germany(DEU)	0.401	-0.001	7.360	1.049	0.044	0.138	0.001	0.369	-0.001	6.565	1.042	0.038	0.092	0.001	-0.629
	0.400			1.093		0.139		0.368			1.080		0.093		
Greece(GRC)	0.264	-0.000	3.387	1.045	0.025	0.193	0.000	0.448	-0.000	2.633	1.047	0.025	0.095	0.000	-0.860
	0.263			1.070		0.194		0.447			1.071		0.096		
Hong Kong (HKG)	0.355	-0.001	7.486	1.110	0.045	0.116	0.001	0.451	-0.000	9.142	1.089	0.043	0.078	0.001	-1.596
	0.353			1.156		0.117		0.451			1.132		0.079		
Hungary(HUN)	0.334	-0.000	3.414	1.041	0.018	0.252	0.000	0.279	-0.000	1.983	1.026	0.014	0.135	0.000	-0.617
	0.334			1.059		0.252		0.278			1.040		0.136		
India(IND)	0.386	-0.001	7.929	1.117	0.082	0.111	0.001	0.476	-0.001	13.920	1.092	0.077	0.027	0.001	-1.126
	0.385			1.199		0.112		0.475			1.169		0.028		
Indonesia(IDN)	0.409	-0.000	6.802	1.091	0.060	0.082	0.001	0.481	-0.001	4.425	1.109	0.050	0.029	0.001	-1.221
	0.408			1.151		0.083		0.480			1.160		0.029		
Ireland(IRL)	0.120	-0.001	36.340	1.114	0.077	0.499	-0.000	0.225	-0.001	17.489	1.049	0.053	0.156	0.002	-2.954
	0.120			1.191		0.499		0.224			1.102		0.157		
Italy(ITA)	0.423	-0.000	4.165	1.052	0.027	0.117	0.001	0.404	-0.001	2.562	1.042	0.023	0.055	0.000	-0.510
	0.423			1.079		0.118		0.404			1.065		0.055		
Japan(JPN)	0.379	-0.003	14.174	1.056	0.114	0.076	0.003	0.508	-0.002	12.993	1.119	0.099	0.037	0.002	-1.329
	0.376			1.170		0.079		0.506			1.218		0.039		
Kazakhstan(KAZ)	0.391	-0.001	4.840	1.023	0.029	0.083	0.001	0.445	-0.000	4.288	1.057	0.024	0.082	0.000	-1.201
	0.390			1.052		0.084		0.444			1.081		0.082		
Korea, Rep (KOR)	0.432	-0.003	11.502	1.086	0.096	0.156	0.002	0.361	-0.001	16.132	1.083	0.106	0.052	0.002	-1.917
	0.429			1.182		0.158		0.360			1.189		0.053		
Kyrgyz Republic (KGZ)	0.168	0.000	4.825	1.107	0.041	0.142	0.001	0.444	-0.002	3.340	1.078	0.043	0.246	0.002	-1.523
	0.168			1.148		0.142		0.442			1.122		0.248		
Lao PDR (LAO)	0.246	-0.000	0.942	1.121	0.026	0.189	0.001	0.465	-0.001	1.463	1.134	0.025	0.100	0.000	-0.788
	0.246			1.147		0.190		0.464			1.159		0.100		
Latvia(LVA)	0.309	0.001	1.965	1.081	0.020	0.196	0.001	0.320	-0.002	1.692	1.073	0.015	0.176	0.000	-0.747
	0.310			1.101		0.197		0.318			1.088		0.176		
Lithuania(LTU)	0.294	0.000	4.183	1.076	0.019	0.237	-0.001	0.293	0.000	3.125	1.083	0.024	0.176	0.000	-0.829
	0.294			1.095		0.236		0.294			1.107		0.176		
Luxembourg(LUX)	0.361	-0.001	11.877	1.027	0.030	0.453	0.001	0.103	-0.000	6.642	1.041	0.027	0.083	0.001	-1.584
	0.360			1.057		0.454		0.103			1.069		0.083		
Malaysia(MYS)	0.455	-0.001	7.569	1.087	0.055	0.155	0.001	0.322	-0.001	8.067	1.105	0.055	0.068	0.001	-1.422
	0.454			1.142		0.156		0.321			1.160		0.069		
Maldives(MDV)	0.310	-0.001	7.196	1.143	0.037	0.175	0.000	0.330	0.000	7.903	1.092	0.043	0.185	0.001	-1.851
	0.309			1.180		0.176		0.330			1.135		0.185		
Malta(MLT)	0.237	-0.000	2.603	1.031	0.018	0.471	0.001	0.198	-0.001	1.921	1.042	0.037	0.094	-0.000	-0.710
	0.237			1.050		0.471		0.197			1.079		0.094		
Mexico(MEX)	0.333	-0.007	47.800	1.155	0.334	0.146	0.004	0.417	-0.001	38.870	1.161	0.315	0.104	0.003	-5.694
	0.326			1.489		0.150		0.416			1.477		0.108		
Mongolia(MNG)	0.355	0.001	9.280	1.112	0.048	0.184	0.000	0.311	-0.003	4.934	1.061	0.047	0.149	0.002	-1.943
	0.356			1.159		0.185		0.308			1.108		0.151		
Nepal(NPL)	0.209	-0.000	1.772	1.029	0.020	0.121	0.001	0.579	-0.001	1.915	1.062	0.025	0.090	0.001	-0.953
	0.209			1.049		0.122		0.578			1.087		0.091		
Netherlands(NLD)	0.333	-0.001	9.538	1.057	0.057	0.234	0.002	0.259	-0.003	9.206	1.051	0.061	0.175	0.002	-1.597
	0.332			1.114		0.236		0.256			1.112		0.177		
Norway(NOR)	0.364	0.002	6.479	1.037	0.047	0.121	0.001	0.426	-0.004	5.742	1.033	0.039	0.089	0.001	-1.493
	0.366			1.084		0.122		0.422			1.072		0.090		
Pakistan(PAK)	0.360	-0.000	6.077	1.107	0.050	0.072	0.001	0.538	-0.002	5.236	1.103	0.045	0.030	0.000	-1.537
	0.359			1.157		0.074		0.536			1.148		0.030		

Country	Intermediate domestic		Intermediate Foreign					Final Domestic		Intermediate Foreign					
	w	Δ_w	Dependence	Price	Δ_p	w	Δ_w	w	Δ_w	Dependence	Price	Δ_p	w	Δ_w	Welfare loss
Philippines(PHL)	0.322	-0.001	8.684	1.081	0.066	0.134	0.003	0.482	-0.002	6.675	1.095	0.050	0.062	0.000	-1.897
	0.322			1.146		0.137		0.479			1.145		0.062		
Poland(POL)	0.433	0.000	3.144	1.062	0.028	0.158	0.001	0.310	-0.002	3.734	1.050	0.026	0.099	0.000	-0.700
	0.434			1.090		0.159		0.308			1.076		0.099		
Portugal(PRT)	0.364	-0.000	3.643	1.021	0.024	0.158	0.000	0.387	-0.000	2.283	1.017	0.026	0.091	0.000	-0.695
	0.364			1.045		0.158		0.387			1.043		0.092		
Rest of the World (RoW)	0.527	-0.001	13.490	1.064	0.050	0.084	0.001	0.333	-0.001	10.245	1.040	0.049	0.056	0.001	-0.319
	0.526			1.114		0.085		0.332			1.089		0.057		
Romania(ROU)	0.350	-0.000	1.291	1.051	0.014	0.150	0.001	0.416	-0.001	2.263	1.049	0.015	0.084	0.000	-0.495
	0.350			1.065		0.151		0.415			1.064		0.084		
Russian Federation (RUS)	0.469	-0.000	4.960	1.077	0.018	0.053	0.000	0.426	-0.001	3.998	1.048	0.016	0.053	0.000	-0.397
	0.469			1.095		0.053		0.425			1.064		0.053		
Singapore(SGP)	0.443	-0.001	16.365	1.098	0.088	0.318	0.002	0.188	-0.002	16.037	1.015	0.073	0.051	0.001	-2.341
	0.442			1.186		0.321		0.186			1.088		0.052		
Slovak Republic (SVK)	0.317	0.001	0.939	1.070	0.020	0.278	0.001	0.274	-0.003	0.933	1.057	0.017	0.132	0.001	-0.612
	0.317			1.090		0.279		0.271			1.073		0.133		
Slovenia(SVN)	0.247	-0.000	1.357	1.038	0.011	0.303	0.000	0.322	-0.000	1.519	1.034	0.010	0.128	0.000	-0.424
	0.247			1.049		0.304		0.321			1.045		0.128		
Spain(ESP)	0.403	-0.000	6.086	1.054	0.031	0.122	0.001	0.411	-0.001	3.055	1.054	0.027	0.064	0.000	-0.678
	0.403			1.085		0.122		0.410			1.081		0.065		
Sri Lanka (LKA)	0.340	-0.001	3.990	1.056	0.058	0.101	0.002	0.522	-0.003	4.667	1.051	0.060	0.037	0.001	-2.752
	0.339			1.115		0.104		0.520			1.111		0.038		
Sweden(SWE)	0.323	-0.001	7.483	1.041	0.039	0.163	0.001	0.403	-0.002	5.548	1.034	0.037	0.110	0.001	-1.410
	0.323			1.079		0.164		0.401			1.072		0.112		
Switzerland(CHE)	0.395	-0.001	11.200	1.048	0.049	0.202	0.001	0.318	-0.000	9.720	1.024	0.044	0.086	0.001	-1.417
	0.393			1.097		0.203		0.318			1.068		0.087		
Taiwan, China (TWN)	0.370	-0.002	10.439	1.117	0.131	0.194	0.003	0.355	-0.003	12.287	1.081	0.112	0.081	0.002	-2.712
	0.368			1.248		0.197		0.352			1.193		0.083		
Thailand(THA)	0.407	-0.001	6.072	1.057	0.066	0.168	0.001	0.351	-0.001	6.490	1.044	0.065	0.074	0.001	-1.601
	0.406			1.123		0.169		0.349			1.109		0.075		
Turkiye(TUR)	0.428	-0.001	5.950	0.997	0.027	0.117	0.001	0.390	-0.000	4.629	1.081	0.029	0.065	0.000	-0.663
	0.427			1.024		0.117		0.390			1.109		0.066		
United Kingdom (GBR)	0.354	-0.001	12.345	1.065	0.043	0.105	0.001	0.457	-0.000	9.603	1.086	0.040	0.084	0.001	-0.758
	0.353			1.108		0.106		0.456			1.126		0.085		
United States (USA)	0.378	-0.008	45.978	1.067	0.333	0.042	0.007	0.541	-0.003	48.665	1.029	0.329	0.040	0.004	-0.147
	0.370			1.400		0.049		0.537			1.358		0.044		
Viet Nam (VNM)	0.377	-0.001	3.696	1.141	0.085	0.294	0.003	0.248	-0.003	5.520	1.088	0.071	0.080	0.001	-1.649
	0.376			1.226		0.297		0.246			1.160		0.081		
Total	0.345	-0.001	8.891	1.073	0.057	0.178	0.001	0.383	-0.001	7.868	1.067	0.055	0.094	0.001	-1.315
	0.345			1.130		0.179		0.382			1.122		0.094		

Table E.2: Change in supply shares of countries imposing tariffs (2021-2023 pooled)

Country	Intermediate domestic		Intermediate Foreign					Final Domestic		Intermediate Foreign					
	w	Δ_w	Dependence	Price	Δ_p	w	Δ_w	w	Δ_w	Dependence	Price	Δ_p	w	Δ_w	Welfare loss
Austria(AUT)	0.342	0.004	4.943	1.021		0.190	-0.004	0.359	0.000	5.911	0.990		0.108	-0.001	-0.471
	0.346			1.038		0.187		0.360			1.007		0.107		
Belgium(BEL)	0.285	0.008	6.410	1.048		0.285	-0.007	0.296	-0.001	5.890	1.046		0.135	-0.000	-0.939
	0.293			1.078		0.278		0.294			1.082		0.134		
Canada(CAN)	0.365	0.061	66.911	1.111		0.127	-0.053	0.447	-0.004	70.123	1.101		0.061	-0.005	-5.029
	0.426			1.505		0.075		0.443			1.534		0.056		
China(CHN)	0.585	0.015	9.456	1.317		0.035	-0.011	0.342	-0.004	22.891	1.247		0.038	-0.000	-0.458
	0.600			1.416		0.024		0.339			1.389		0.038		
Croatia(HRV)	0.294	0.006	2.651	0.950		0.205	-0.004	0.386	-0.002	3.577	0.951		0.116	-0.000	-0.920
	0.301			0.972		0.200		0.384			0.980		0.115		
Cyprus(CYP)	0.272	0.004	2.969	0.939		0.312	-0.004	0.291	-0.000	3.767	0.936		0.125	-0.001	-0.632
	0.276			0.962		0.308		0.291			0.957		0.125		
Czechia(CZE)	0.403	0.006	2.939	1.121		0.194	-0.004	0.274	-0.001	3.057	1.108		0.129	-0.000	-0.756
	0.409			1.148		0.190		0.272			1.137		0.129		
Denmark(DNK)	0.303	0.011	8.492	0.965		0.220	-0.009	0.339	-0.001	7.121	0.995		0.139	-0.001	-1.250
	0.313			1.000		0.211		0.337			1.036		0.138		
Estonia(EST)	0.323	0.006	2.704	1.299		0.264	-0.004	0.280	-0.001	7.881	1.264		0.133	-0.001	-0.836
	0.328			1.328		0.260		0.279			1.300		0.132		
Finland(FIN)	0.414	0.015	8.231	1.063		0.145	-0.011	0.379	-0.003	11.481	1.058		0.062	-0.001	-1.687
	0.429			1.119		0.134		0.376			1.122		0.061		
France(FRA)	0.413	0.011	7.316	0.963		0.107	-0.008	0.408	-0.002	13.430	0.963		0.073	-0.001	-0.848
	0.424			1.007		0.098		0.406			1.027		0.072		
Germany(DEU)	0.391	0.016	8.624	1.055		0.147	-0.011	0.360	-0.004	10.728	1.023		0.102	-0.000	-1.090
	0.407			1.114		0.135		0.356			1.102		0.102		
Greece(GRC)	0.273	0.010	3.475	0.891		0.171	-0.006	0.464	-0.003	5.329	1.055		0.092	-0.000	-1.145
	0.283			0.924		0.165		0.460			1.097		0.092		
Hungary(HUN)	0.331	0.009	3.614	1.043		0.252	-0.006	0.276	-0.002	5.811	1.041		0.141	-0.000	-1.175
	0.340			1.077		0.246		0.274			1.089		0.140		
Ireland(IRL)	0.095	0.015	13.913	1.148		0.512	-0.013	0.178	-0.001	12.219	1.065		0.215	-0.001	-1.656
	0.110			1.202		0.499		0.177			1.125		0.214		
Italy(ITA)	0.423	0.012	6.836	0.949		0.098	-0.009	0.404	-0.003	11.451	0.966		0.075	-0.001	-1.006
	0.435			0.996		0.089		0.401			1.030		0.075		
Lithuania(LTU)	0.291	0.006	3.838	1.196		0.271	-0.005	0.291	-0.001	3.986	1.176		0.146	-0.001	-0.877
	0.298			1.227		0.267		0.290			1.209		0.145		
Luxembourg(LUX)	0.326	0.006	4.151	1.115		0.406	-0.005	0.093	-0.001	3.554	1.132		0.175	-0.000	-0.671
	0.333			1.139		0.402		0.092			1.161		0.174		
Malta(MLT)	0.222	0.009	2.903	1.029		0.372	-0.005	0.185	-0.005	2.407	1.023		0.221	0.001	-1.234
	0.231			1.081		0.367		0.181			1.070		0.221		
Netherlands(NLD)	0.316	0.008	6.166	1.019		0.278	-0.007	0.246	-0.001	6.628	1.015		0.160	-0.000	-0.881
	0.325			1.052		0.271		0.245			1.051		0.160		
Poland(POL)	0.423	0.007	3.304	1.036		0.163	-0.005	0.303	-0.002	3.625	1.023		0.111	-0.000	-0.764
	0.431			1.065		0.158		0.301			1.056		0.111		
Portugal(PRT)	0.368	0.007	5.475	0.988		0.146	-0.006	0.390	-0.001	7.140	0.988		0.096	-0.001	-0.891
	0.375			1.019		0.140		0.389			1.030		0.095		
Romania(ROU)	0.361	0.008	3.393	1.197		0.145	-0.005	0.429	-0.002	3.930	1.197		0.065	-0.000	-0.889
	0.369			1.237		0.140		0.427			1.239		0.065		
Slovak Republic (SVK)	0.319	0.004	1.722	1.018		0.236	-0.002	0.275	-0.001	6.432	1.024		0.170	-0.000	-0.501
	0.323			1.031		0.233		0.275			1.042		0.169		
Slovenia(SVN)	0.243	0.009	2.467	1.031		0.313	-0.005	0.316	-0.004	3.741	1.059		0.128	-0.000	-1.126
	0.252			1.060		0.308		0.312			1.098		0.128		
Spain(ESP)	0.397	0.013	5.293	0.950		0.114	-0.009	0.405	-0.003	6.138	0.956		0.084	-0.000	-1.080
	0.410			0.993		0.105		0.402			1.010		0.083		
Sweden(SWE)	0.315	0.008	7.055	0.943		0.194	-0.007	0.393	0.000	8.826	0.972		0.097	-0.001	-0.919
	0.323			0.975		0.187		0.393			1.009		0.096		
United States (USA)	0.385	0.099	100.000	1.283		0.043	-0.076	0.551	-0.020	100.000	1.315		0.021	-0.003	0.050
	0.485			2.047		-0.033		0.531			2.096		0.018		
Total	0.339	0.014	10.902	1.060		0.212	-0.011	0.334	-0.003	12.753	1.060		0.115	-0.001	-1.060
	0.353			1.136		0.202		0.332			1.146		0.114		