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SHIPPING CHOKEPOINT DISRUPTIONS AND FOOD PRICE TRANSMISSION ACROSS IMPORTING ECONOMIES

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Abstract:

This study examines how maritime activity indicators inform assessments of shipping chokepoint risks to food importing economies within global trade networks. It combines a measurement assessment of a constructed observation frame covering 20 economies during 2010 to 2021 with descriptive analysis of Panama Canal transit and cargo records for 2017 to 2020. Annual percentage changes and cumulative comparisons reveal that canal transits declined by 1.32 percent while cargo volumes increased by 6.14 percent. This divergence demonstrates that fewer vessel movements can coexist with greater transported quantities, making transit counts insufficient as standalone indicators of supply interruption. The analysis distinguishes shipping activity, operational disruption, route exposure, and food import composition as separate dimensions of maritime vulnerability. Its conceptual contribution refines the application of trade cost theory by clarifying which observed transport measures can inform interpretations of potential delivery constraints. For policymakers and import managers, the findings support integrating vessel monitoring with cargo quantities, delivery reliability, and affected food routes when assessing contingency needs and targeting supply resilience measures.

Key Words: Maritime Chokepoints; Food Import Vulnerability; Trade Costs; Maritime Transport Indicators; Descriptive Analysis.

1. Introduction:

A disruption at a maritime chokepoint can interrupt food deliveries without producing an equivalent increase in domestic food prices. This distinction matters because transport authorities monitor vessel and cargo movements, while households experience changes in food availability and purchasing power. Bailey and Wellesley (2017) show that food trade risks depend jointly on disruptive hazards, exposure to affected routes, and vulnerability within importing economies. Their assessment identifies exposure among both lower-income food-deficit economies and higher-income importers, including Japan, South Korea, and countries bordering the Persian Gulf. Maritime dependence therefore creates a shared logistical concern, but its consequences cannot be inferred from national income or geographical proximity alone. Understanding how transport constraints connect to domestic food markets is necessary for determining whether preparedness should prioritize alternative routes, procurement arrangements, or domestic supply buffers.

The substantive concern is the potential erosion of food affordability when external supply constraints reach domestic consumers. The Food and Agriculture Organization of the United Nations et al. (2011) document how international food price instability can impose persistent costs on households in import-dependent economies. However, vulnerability to international food prices does not establish vulnerability to a particular shipping disruption. Commodity prices, exchange rates, transport conditions, and domestic distribution costs represent distinct sources of price movement. A maritime explanation must therefore connect a documented transport constraint to the food imports exposed to it and distinguish that connection from broader international price developments. This distinction has practical significance because measures addressing a commodity price shock may differ from those intended to maintain deliveries through an obstructed transport corridor.

The economic value of transport time provides a basis for explaining the first stage of this connection. Hummels and Schaur (2013) demonstrate that delivery time constitutes a trade barrier by examining exporters' choices between faster air transport and slower maritime transport. Their findings establish that transit time carries an economic cost, although they do not estimate domestic food price responses to chokepoint interruptions. Applied to food importing economies, this mechanism suggests that disrupted passage may raise delivered costs through longer journeys, additional transport expenses, and less predictable replenishment. These pressures need not pass fully to consumers because firms may adjust procurement arrangements or absorb costs through their margins. Evidence that border and retail prices respond differently to external cost changes supports the need to distinguish import costs from consumer outcomes (Cavallo et al., 2021). The theoretical expectation is consequently conditional: transport constraints may increase supply costs, while domestic pricing arrangements influence how much pressure reaches consumers.

The closest chokepoint research establishes the importance of distinguishing network exposure from disruption severity. Wellesley et al. (2017) develop the Chatham House Maritime Analysis Tool to estimate the volume and value of staple foods passing through maritime chokepoints. Their approach connects bilateral food trade with transport routes and provides a basis for assessing exposure. Its analytical focus differs from estimating domestic food price responses: identifying food flows that traverse a corridor does not establish the price consequences of interrupted passage. Disruption intensity describes the constraint affecting transport operations, whereas exposure describes an economy's connection to that constraint. Food import dependence introduces a further dimension concerning the role of external supply. Preserving these distinctions is necessary to determine whether vulnerability reflects the severity of an event, concentrated routing, or dependence on imported food.

Research on international food price transmission explains why these distinctions matter beyond maritime logistics. Bekkers et al. (2017) examine transmission from international food prices to domestic consumer food prices across 147 countries. They identify income per capita as an important explanation of cross-country variation, with stronger transmission in lower-income economies, while trade policy measures also influence transmission. Their findings caution against assuming that international market exposure produces a uniform consumer response. They also provide a close comparison for the present research question: international commodity price transmission concerns changes in globally traded food prices, whereas chokepoint transmission concerns constraints on delivery through specific routes. The reviewed evidence does not establish whether those route-specific constraints explain domestic food price developments separately from broader international market conditions (Bekkers et al., 2017; Wellesley et al., 2017).

Evidence on import pricing further supports separating external costs from consumer outcomes. Gopinath et al. (2010) show that invoicing currency influences exchange rate transmission into import prices. Cavallo et al. (2021) find that tariff effects differ between border prices and retail prices, with more limited retail responses consistent with adjustments in firms' margins. These studies examine exchange rates and tariffs rather than maritime disruptions, but they establish a relevant analytical principle: the source of a cost change and the stage at which prices are measured affect the interpretation of transmission. Domestic food inflation therefore cannot be treated as a direct reading of shipping conditions. Route exposure may also condition the response to a disruption because only food flows connected to the affected corridor encounter that particular constraint. This conditional mechanism is conceptually distinct from a direct association between exposure and prices, and its empirical assessment requires evidence that price responses differ with exposure.

Measurement is central to resolving the research question. Domestic food price inflation concerns changes in consumer food prices, whereas headline inflation incorporates a wider consumption basket. International commodity prices, landed import prices, and retail food prices also represent different stages of the supply chain. Bekkers et al. (2017) explicitly distinguish the international food price signal from domestic consumer food prices, while Cavallo et al. (2021) demonstrate the importance of separating border and retail responses. Comparable discipline is required for maritime measures. Vessel counts describe traffic frequency, while cargo volumes describe transported quantities; neither independently establishes operational disruption. Likewise, food imports as a share of merchandise imports describe trade composition rather than the proportion of domestic food consumption supplied from abroad. Preserving these distinctions prevents an available indicator from being interpreted as evidence about a different substantive construct.

This study aims to clarify the relationship between shipping chokepoint disruptions and domestic food price transmission across importing economies during 2010 to 2021. Its guiding research question is how disruption intensity, exposure to affected corridors, and food import dependence should be distinguished when assessing domestic food price responses. Specifically, the study examines the transmission mechanism associated with disruption intensity, distinguishes route exposure from food import dependence, and assesses whether the available maritime indicators represent constraints relevant to consumer food prices. The geographical frame comprises 20 importing economies across Africa, Asia, Europe, and the Middle East, organized at the country-year level. This comparative scope is relevant because the research question concerns how a common transport network connects economies with different import structures. It defines the analytical coverage without assuming equivalent disruptions or price responses across economies.

The intended contribution is to connect chokepoint risk assessment with food price transmission through explicit distinctions among transport constraints, route exposure, import composition, and consumer outcomes. Relative to Wellesley et al. (2017), the focus extends from identifying food flows exposed to chokepoints toward clarifying their connection with domestic prices. Relative to Bekkers et al. (2017), it separates logistical delivery constraints from international commodity price signals. This framing provides a basis for distinguishing decisions intended to secure transport access from those addressing domestic price pressures. Its international relevance rests on mechanisms that can apply across importing economies, while the magnitude and timing of price responses depend on the routes, products, and domestic markets involved.

2. Theory, Conceptual Framework and Hypotheses Development:

2.1 Theoretical Foundation and Transmission Mechanisms:

International trade cost theory provides the analytical foundation for examining how shipping chokepoint disruptions transmit through international supply chains into domestic food markets. Maritime transport connects food exporters, shipping operators, importers and domestic consumers through interdependent logistics and pricing decisions. Disruptions to shipping corridors may increase transit time, restrict transport capacity and raise the costs of delivering imported commodities. Hummels and Schaur, 2013, establish the economic value of transportation time, while Ahn et al., 2011, demonstrate how trade constraints affect international exchange. These findings support the theoretical expectation that transport disruptions may alter import costs, although domestic food price responses depend on market conditions and transmission mechanisms.

The analytical framework distinguishes three potential sources of price transmission: disruption intensity, exposure to affected shipping corridors and dependence on imported food. Disruption intensity represents the initial logistical constraint, exposure determines the extent to which an importing economy encounters that constraint, and import dependence describes the potential sensitivity of domestic food supply to international market conditions. These mechanisms are conceptually distinct because a substantial shipping disruption need not generate a comparable price response in economies with different trade routes, import structures and domestic supply conditions.

Two competing mechanisms determine the expected direction of food price transmission. The cost transmission mechanism predicts higher domestic food prices when transportation constraints increase the landed cost of imports. Conversely, substitution among suppliers, alternative shipping routes and domestic production may weaken transmission. Consequently, a positive relationship is theoretically plausible but cannot be treated as an established empirical finding for the economies under examination.

2.2 Shipping Chokepoint Disruption Intensity and Food Price Transmission:

Shipping chokepoint disruption intensity represents the severity of constraints affecting maritime transit through strategically important transport corridors. Transit delays, restrictions and changes in shipping traffic provide conceptually relevant measures of disruption intensity. According to Hummels and Schaur, 2013, transportation time represents an economically significant component of international trade costs. Longer delivery times can therefore increase the cost of importing food commodities.

The transmission mechanism operates through transport costs, delivery uncertainty and adjustments in import supply. When shipping disruptions constrain cargo movement, importers may face higher logistical expenses and less predictable delivery schedules. These pressures can affect domestic food prices when importers pass additional costs through distribution and retail markets. However, the strength of this relationship depends on market competition, available inventories and the ability to substitute transport routes or suppliers.

Ahn et al., 2011, provide evidence that international trade responds to constraints affecting cross border transactions. Their findings support the broader relevance of trade frictions but do not directly establish the effect of maritime disruptions on domestic food inflation. Accordingly, a positive relationship between shipping disruption intensity and food price inflation remains a theoretical expectation rather than a demonstrated relationship within the research sample.

2.3 Chokepoint Exposure and Food Price Transmission:

Chokepoint exposure describes the extent to which an importing economy depends on maritime routes affected by transport disruptions. Unlike disruption intensity, which characterizes the severity of an external constraint, exposure captures differences in the potential transmission of that constraint across importing economies. Economies relying more heavily on affected corridors may face greater adjustments in transportation costs and import availability.

The theoretical mechanism follows from differences in route dependence and the availability of alternative transport arrangements. Importers with access to substitute shipping corridors may reduce the consequences of a disruption, whereas those dependent on a limited number of routes may encounter stronger cost pressures. Hummels and Schaur, 2013, provide a theoretical and empirical basis for treating transportation time as an important determinant of trade costs.

Exposure may therefore explain differences in domestic price responses even when economies experience the same international disruption. Nevertheless, the expected relationship requires observed measures of affected route usage and domestic food inflation. Neither measure is populated in the supplied dataset.

2.4 Food Import Dependence and Food Price Transmission:

Food import dependence represents the relative importance of imported food commodities within an economy's merchandise import structure. It captures an aspect of potential vulnerability to international supply constraints. Greater dependence on imported food may increase sensitivity to external transport costs when domestic substitutes are limited.

The mechanism operates through import procurement, distribution costs and domestic supply adjustment. Importers facing higher external costs may adjust purchase volumes, supplier selection or selling prices. The extent of transmission depends on the contribution of imported products to domestic food consumption and the capacity of domestic producers to respond to changes in import availability.

The World Bank's World Development Indicators provide a measure of food imports as a percentage of merchandise imports. This indicator can describe the composition of merchandise imports but does not directly measure the proportion of domestic food consumption supplied through imports. It therefore cannot independently establish the extent of domestic food price exposure to international shipping disruptions.

2.5 Conceptual Framework and Empirical Identification:

The conceptual framework identifies shipping chokepoint disruptions as the principal explanatory construct and domestic food price inflation as the outcome of interest. Disruption intensity represents the severity of maritime transport constraints, chokepoint exposure represents dependence on affected shipping routes, and food import dependence represents the importance of food within merchandise imports.

The proposed relationships are theoretical associations rather than identified causal effects. Establishing their direction and magnitude requires numerical observations for the explanatory variables and the dependent variable, measured consistently across economies and years.

The supplied country and year panel identifies 20 importing economies over the period 2010 to 2021, but its numerical observations remain unpopulated. Consequently, the available data do not permit statistical estimation of the three proposed relationships. Confirmatory hypotheses cannot be specified as testable and resolvable using the supplied observations without introducing unsupported measurements.

3. Data:

This analysis establishes the provenance, geographical coverage, temporal structure and measurement requirements for examining shipping chokepoint disruptions and food price transmission across importing economies. It distinguishes the constructed country and year observation frame from verified empirical measurements to ensure that sample construction, variable definitions and analytical claims remain consistent with the available evidence.

3.1 Data Sources, Population, and Sample Construction:

The analysis covers the period 2010 to 2021 and adopts an annual country panel structure to examine potential relationships between maritime shipping disruptions and domestic food price developments. The supplied research workbook identifies 20 importing economies and 12 annual periods, producing 240 country and year records. The geographical frame includes economies in Africa, Asia, Europe and the Middle East, providing variation in economic geography and potential exposure to international maritime transport networks. These records represent a constructed observation frame rather than a verified empirical estimation sample.

The workbook identifies the World Bank World Development Indicators as the intended source for food imports, consumer price inflation, merchandise imports and official exchange rates. The corresponding series identifiers are TM.VAL.FOOD.ZS.UN, FP.CPI.TOTL.ZG, TM.VAL.MRCH.CD.WT and PA.NUS.FCRF. These indicators provide internationally standardized definitions and accessible source documentation. However, the workbook contains source references and extraction endpoints rather than downloaded numerical observations. The specific source release, extraction date and historical revision status are not documented. The indicator metadata and access routes are available through the World Bank data platform.

The target population comprises food importing economies potentially exposed to international maritime transport disruptions. The accessible frame consists of 20 economies identified in the workbook: Bangladesh, Egypt, Greece, India, Indonesia, Italy, Japan, Jordan, Kenya, Morocco, Pakistan, the Philippines, Saudi Arabia, South Africa, South Korea, Sri Lanka, Tanzania, Tunisia, Türkiye and the United Arab Emirates. The workbook does not establish a probability sampling procedure, a population enumeration or empirical eligibility criteria explaining the selection of these economies. Consequently, the geographical coverage cannot be interpreted as statistically representative of all importing economies.

The observation unit is the country and calendar year. The annual structure permits potential examination of variation across economies and over time, subject to the availability of comparable measurements. Food import shares represent annual trade composition, merchandise imports represent annual monetary flows, consumer inflation represents annual price changes, and official exchange rates represent period averages. These measures are conceptually distinct and require consistent temporal alignment before integration.

Table 1: Sample Construction and Observation Coverage

Sample Construction Stage	Economies	Country Year Records	Documentation
Constructed country frame	20	240	Selected economies and annual periods
Geographical exclusions	0 documented	0 documented	No exclusion rules recorded

Duplicate country year records	0	0	Unique country and year combinations
Constructed annual panel	20	240	Twelve annual records per economy
Records containing verified numerical indicators	0	0	Empirical fields unpopulated
Complete records for the proposed relationship	0	0	Outcome and shipping disruption measures unavailable

The constructed observation frame is balanced because each economy has one record for every year from 2010 through 2021. This structural balance does not establish empirical data completeness. None of the 240 records contains numerical observations for the proposed explanatory or outcome measures. No documented exclusions, imputation procedures or model specific sample reductions are available.

3.2 Data Integration, Cleaning, and Quality Assurance:

The workbook organizes observations using ISO three letter country identifiers and calendar years. These fields provide the intended integration keys for combining national economic indicators with maritime transport measurements. The country and year combinations are unique, and the constructed panel contains no duplicate records. However, the available records do not demonstrate a completed integration of observations from different statistical providers.

The intended annual frequency is consistent with the World Development Indicators series identified in the workbook. Food imports are expressed as a percentage of merchandise imports, merchandise import values are denominated in current United States dollars, and official exchange rates are expressed in local currency units per United States dollar. Consumer price inflation is measured as an annual percentage change. These definitions establish measurement compatibility requirements but do not demonstrate completed currency harmonization, price deflation or temporal aggregation.

The absence of numerical observations is a source availability limitation rather than evidence of zero economic activity. Accordingly, blank observations cannot be replaced with zero without introducing measurement error. The workbook contains no documented interpolation, statistical imputation, winsorization or outlier adjustment. It also provides no empirical basis for evaluating extreme observations, discontinuities or conflicts between alternative data providers.

The available panel structure permits verification of country identifiers, annual coverage and observation uniqueness. It does not permit numerical consistency checks, cross source comparisons, missingness analysis by measured value or validation against external benchmarks. The analytical distinction between a structurally complete observation frame and an empirically complete dataset is therefore essential for interpreting the sample.

3.3 Variable Measurement, Construction, and Validation:

The analytical framework distinguishes shipping chokepoint disruption intensity, chokepoint exposure and food import dependence as conceptually relevant explanatory dimensions. Domestic food price inflation represents the intended outcome. The workbook additionally identifies headline consumer inflation, merchandise imports and official exchange rates as potential economic controls.

Food import dependence is represented by the World Development Indicators measure of food imports as a percentage of merchandise imports. This indicator describes the composition of merchandise trade rather than the proportion of domestic food consumption supplied by imports. Headline consumer inflation measures overall consumer price changes and cannot substitute for food specific inflation without changing the dependent construct.

The workbook also identifies food import value as a potential derived measure using the food import share and total merchandise imports. Its calculation requires verified numerical values for both components. No derived observations are available, and no composite shipping disruption index has been constructed.

Table 2: Variable Dictionary and Measurement Coverage

Variable or Indicator	Analytical Role	Definition and Measurement	Source and Identifier	Unit and Frequency	Transformation and Direction	Missing Value Rule	Coverage
Food price inflation	Dependent variable	Annual change in national food consumer prices	National statistical sources or IMF food CPI, series unspecified	Annual percentage	Higher values indicate faster food price increases	Retained as missing	0 of 240
Shipping disruption intensity	Independent variable	Disruption severity measured through maritime transit constraints	Maritime or canal authority records, series unspecified	Source dependent	Higher values intended to represent greater disruption	Retained as missing	0 of 240
Chokepoint exposure	Independent variable dimension	Economy exposure to affected maritime corridors	Shipping route records, series unspecified	Intended annual share	Higher values indicate greater exposure	Retained as missing	0 of 240
Food import dependence	Independent variable dimension	Food imports as a share of merchandise	World Bank, TM.VAL.FOOD.ZS.UN	Annual percentage	Higher values indicate a greater food share of	Retained as missing	0 of 240

		imports			merchandise imports		
Consumer price inflation	Potential control	Annual change in the overall consumer price index	World Bank, FP.CPI.TOTL.ZG	Annual percentage	Higher values indicate greater headline inflation	Retained as missing	0 of 240
Merchandise imports	Potential control	Total value of merchandise imports	World Bank, TM.VAL.MRCH.CD.WT	Current USD, annual	Higher values indicate greater import value	Retained as missing	0 of 240
Official exchange rate	Potential control	Local currency units per United States dollar	World Bank, PA.NUS.FCRF	Annual period average	Higher values indicate more local currency units per dollar	Retained as missing	0 of 240
Food import value	Derived indicator	Merchandise imports multiplied by the food import share expressed as a proportion	Derived from World Bank indicators	Current USD, annual	Higher values indicate greater nominal food import value	Not calculated when components are missing	0 of 240

The variable dictionary separates directly observed indicators, proposed measures and calculated quantities. This distinction prevents conceptual constructs from being presented as validated empirical indices. Shipping disruption intensity and chokepoint exposure remain undefined at the operational series level because the workbook does not identify verified observations, source specific measurement units or aggregation procedures.

No descriptive statistics for economic variables can be calculated from the supplied numerical fields. The available information establishes 20 economies, 12 annual periods and 240 structurally defined records, but no valid numerical counts, means, standard deviations, medians or ranges for the substantive variables. Measurement reliability, cross source agreement and sensitivity to alternative constructions therefore cannot be reported as completed empirical assessments.

3.4 Analytical Framework, Identification, and Reproducibility:

The research question concerns whether shipping chokepoint disruptions are associated with changes in domestic food prices across importing economies. The intended analytical perspective is associational because the supplied material does not establish an exogenous disruption assignment, an identification strategy or another design capable of supporting causal interpretation.

The country and year structure provides a potential basis for panel analysis. However, the available workbook does not contain a complete dependent variable, an observed shipping disruption measure or the numerical controls necessary to estimate their relationship. Consequently, no baseline regression, fixed effects specification, dynamic model or statistical inference procedure has been implemented or validated.

The available data do not support coefficient estimation, statistical significance testing, interaction effects, model diagnostics or robustness comparisons. Specifying these procedures as completed would misrepresent the empirical evidence. Likewise, annual observation records alone cannot establish the temporal ordering of disruptions and domestic price responses, particularly when transport events and price adjustments may occur within the same calendar year.

The workbook documents its country identifiers, annual periods, intended variable definitions, indicator codes and official data access endpoints. These elements provide a reproducible framework for organizing subsequent source observations. Nevertheless, the absence of verified numerical measurements prevents reproduction of empirical estimates or validation of the proposed hypotheses.

The data structure therefore establishes the geographical and temporal boundaries of the analysis but not an estimable relationship between shipping disruptions and domestic food inflation. The distinction between constructed observations and verified measurements preserves the integrity of the empirical framework and prevents unsupported conclusions about international food price transmission.

4. Methods:

4.1 Research Design and Analytical Scope:

The study adopts a descriptive secondary-data design to assess whether vessel movements and transported cargo provide equivalent information about maritime activity. This distinction matters because identifying trade flows exposed to a chokepoint differs from establishing the consequences of interrupted passage (Wellesley et al., 2017). The analysis compares the direction and proportional magnitude of changes in two maritime indicators without interpreting those changes as identified effects on domestic food prices.

The numerical analysis uses four annual Panama Canal observations covering 2017 to 2020. The unit of analysis is the canal reporting year. Useful variation arises from changes in transit counts and cargo volumes within the same corridor. The country-year frame described in the Data section defines the broader research scope but does not constitute the estimation sample for these calculations.

The analysis distinguishes transport activity from transport constraints. Delivery time has an economic value in international trade, but traffic counts and cargo quantities do not directly measure that cost (Hummels &Schaur, 2013). Consequently, the analytical target is the correspondence between observed maritime indicators rather than a causal price-transmission parameter.

4.2 Measurement and Analytical Specification:

Annual transit counts measure the frequency of vessel passage, while cargo volumes measure transported quantities in million long tons. These indicators remain separate because their units and substantive meanings differ. Percentage changes place their movements on a common proportional scale without combining them into an unvalidated disruption index. Annual percentage changes are calculated as:

$$g_{k,t} = 100\left(\frac{X_{k,t} - X_{k,t-1}}{X_{k,t-1}}\right)$$

Here, $g_{k,t}$ denotes the annual percentage change in indicator k during reporting year $t, X_{k,t}$denotes its observed value, and $X_{k,t-1}$denotes its value in the preceding reporting year. The index kdistinguishes transit counts from cargo volumes. The preceding observation provides the comparison base rather than a lagged explanatory variable. Cumulative change across the available observation window is calculated as:

$$G_k = 100\left(\frac{X_{k,2020} - X_{k,2017}}{X_{k,2017}}\right)$$

Here, G_k denotes the percentage change in indicator kbetween the first and last available reporting years. Equation 2 measures endpoint change rather than an average annual growth rate. Both equations describe observed maritime movements; neither estimates disruption severity or domestic price transmission.

4.3 Observation Alignment and Analytical Procedures:

The sample construction table and variable dictionary in the Data section distinguish the country-year observation frame from populated numerical records. The maritime calculations use the annual transit and cargo observations reported in the Findings section. Canal-level observations are not duplicated across importing economies because such replication would introduce no additional country-specific information.

The observations are arranged chronologically while retaining their reported units and reporting-year labels. Annual changes use consecutive observations from the same indicator. Calculations use the reported levels, with percentage changes rounded to two decimal places for presentation. No weighting, interpolation, imputation, currency conversion, or composite-index construction is applied. Blank economic fields remain missing and do not enter the calculations.

The comparison evaluates the direction and proportional magnitude of changes in transit counts and cargo volumes. Movements in opposite directions establish divergence between traffic frequency and transported quantities. Movements in the same direction establish directional agreement without implying equal proportional change. This procedure preserves the distinction between transport activity and route-specific exposure emphasized by Wellesley et al. (2017).

4.4 Analytical Validation and Interpretive Limits:

Arithmetic validation reconciles the reported percentage changes with their underlying annual observations using Equations 1 and 2. Annual and cumulative comparisons remain separate because they describe different time horizons. The calculations are deterministic summaries of the supplied records; regression diagnostics, statistical significance tests, and confidence intervals are not applicable to these arithmetic comparisons.

Interpretation remains confined to the information conveyed by the indicators. Divergence between transit counts and cargo volumes demonstrates that the measures are not interchangeable descriptions of maritime activity. It does not establish whether changes arose from vessel capacity, cargo composition, trade demand, or operational constraints. Although transportation time can influence trade costs, that mechanism cannot be inferred from traffic quantities alone (Hummels & Schaur, 2013).

Replication requires the annual observations, their measurement units, their reporting-year labels, and the two calculation rules. The methodological contribution is transparent measurement alignment: conclusions follow from what the observed indicators represent, without attributing unmeasured transport costs or consumer price effects to changes in maritime activity.

5. Findings:

This analysis evaluates the empirical evidence concerning shipping chokepoint disruptions and food price transmission across 20 importing economies during 2010 to 2021. It examines the observation structure, maritime transport indicators, and the availability of measurements required to test the proposed relationships. The findings distinguish verified numerical patterns from theoretical expectations that cannot be statistically established using the available data.

5.1 Sample Characteristics and Descriptive Findings:

The research dataset comprises 240 country and year records covering 20 importing economies over 12 consecutive years. The observation structure is balanced, with each economy represented annually. However, the

numerical fields for shipping disruption intensity, chokepoint exposure, food import dependence, and domestic food price inflation remain unpopulated. Consequently, the constructed panel does not provide a complete estimation sample.

Table 3: Sample Characteristics and Measurement Coverage

Indicator	Verified Result
Importing economies	20
Observation period	2010 to 2021
Annual periods	12

The absence of complete observations prevents calculation of descriptive statistics for the substantive research variables. This limitation is important because transportation costs and international price transmission vary across economies and trade relationships. Hummels and Schaur, 2013, establish the economic importance of transportation time, while Gopinath et al., 2010, demonstrate that international price transmission depends partly on invoicing currency. These findings provide relevant comparative evidence but do not establish empirical relationships within the present sample.

5.2 Maritime Transport Findings:

The available historical Panama Canal observations provide limited evidence on changes in maritime transport activity. Annual transits increased from 13,548 in 2017 to 13,795 in 2018, before declining to 13,785 in 2019 and 13,369 in 2020. Cargo volumes increased from 241.0 million long tons in 2017 to 255.8 million long tons in 2020.

Table 4: Panama Canal Transit and Cargo Statistics

Year	Annual Transits	Cargo Volume, Million Long Tons
2017	13,548	241.0
2018	13,795	255.1
2019	13,785	253.0
2020	13,369	255.8

The number of transits increased by 1.82 percent between 2017 and 2018, declined by 0.07 percent between 2018 and 2019, and decreased by 3.02 percent between 2019 and 2020. Across the reported period, cargo volume increased by approximately 6.14 percent despite a 1.32 percent reduction in transit counts.

These results establish that transit frequency and transported cargo volumes followed different patterns.

However, the observations cannot independently identify shipping disruption intensity because vessel capacity, trade demand and operational changes may also influence canal activity. Hummels and Schaur, 2013, demonstrate that transport time affects trade costs, but the available canal statistics do not measure transit delays or their transmission into domestic food prices.

6. Discussion:

The central challenge in understanding international food price transmission is distinguishing disruptions to maritime transport activity from disruptions that materially affect the cost and availability of imported food. The evidence presented in Table 2 demonstrates that shipping transit frequency and cargo volumes can move in different directions, indicating that vessel movements alone cannot reliably represent the intensity of transport constraints. This distinction is consistent with the maritime network analysis of Ducruet and Notteboom (2012), which emphasizes the structural organization of global shipping networks, and the examination of transport costs by Behar and Venables (2011). The analytical contribution lies in identifying a measurement distinction that matters for research on shipping chokepoints: changes in traffic volumes cannot automatically be interpreted as changes in disruption intensity. However, Table 3 contains no estimated coefficients or correlations linking maritime activity to domestic food inflation. Consequently, the analysis does not establish a new structural relationship or demonstrate that shipping disruptions increase consumer food prices. Its contribution at this stage is to clarify the empirical conditions required to distinguish maritime activity from economically meaningful disruptions.

The transmission of maritime transport constraints into domestic food prices depends on several mechanisms that cannot be inferred from shipping activity alone. Transportation costs, import procurement conditions, inventory adjustments and domestic distribution arrangements may influence whether international disruptions reach consumers. Anderson and van Wincoop (2010) establish the importance of trade costs in shaping international economic integration, while Head and Mayer (2014) demonstrate how trade frictions influence bilateral economic relationships. These theoretical insights suggest that shipping disruptions may affect domestic food prices through changes in delivered import costs, but they do not establish the relative importance of individual transmission channels. Table 3 does not contain mediation estimates, and no corresponding mediation equation has been estimated. Therefore, the analysis cannot distinguish direct from indirect effects or classify any mechanism as partial or full mediation. This distinction advances the interpretation of the research question by separating theoretically plausible transmission pathways from

empirically identified mechanisms, preventing the attribution of domestic price changes to maritime disruptions without evidence connecting the relevant stages of transmission.

The relative contribution of different transmission channels remains central to explaining why importing economies may respond differently to common maritime constraints. Food import dependence, exposure to particular shipping corridors and domestic market adjustment capacity represent distinct dimensions of potential vulnerability. Arvis et al. (2018) demonstrate that international logistics performance differs across economies, suggesting that transport and trade infrastructure can shape the conditions under which external pressures are absorbed. Similarly, Limão and Venables (2010) identify the importance of infrastructure and transport costs in international trade. These findings provide a basis for examining whether geographical exposure and import composition influence domestic price responses. Nevertheless, Table 1 establishes that the available country panel lacks the numerical observations required to decompose these mechanisms, while Table 3 confirms that their statistical relationships remain unestimated. No transmission channel can therefore be identified as dominant. The theoretical implication is that geographical exposure, shipping disruption intensity and food import dependence should remain analytically distinct rather than being combined into an unvalidated measure of external vulnerability.

The available evidence also identifies an important methodological challenge in international maritime research: aggregate shipping indicators may conceal differences in cargo composition, vessel capacity and country exposure. Table 2 shows that changes in Panama Canal cargo volumes do not consistently follow changes in transit counts. This divergence limits the interpretation of shipping traffic as a direct measure of operational disruption. UNCTAD (2021) documents the importance of maritime transport for international trade and the sensitivity of shipping systems to changes in demand, capacity and logistical conditions. The World Bank (2018) similarly identifies differences in logistics performance across national trading systems. These institutional findings indicate that maritime activity reflects several interacting economic and operational processes. The present evidence does not identify regulatory failures, infrastructure deficiencies or institutional inefficiencies within the selected economies. Instead, it establishes that aggregate canal statistics cannot independently explain national food price outcomes. This measurement limitation is substantively important because attributing price movements to chokepoint disruptions without country specific exposure information risks confusing general maritime activity with actual supply constraints.

The international relevance of the analysis arises from the possibility that similar maritime constraints may produce different economic outcomes across importing economies. Research by Bekkers et al. (2017) demonstrates the importance of international trade relationships in transmitting economic disturbances, while the Food and Agriculture Organization of the United Nations (2011) documents the significance of international food price volatility for food security and market stability. These contributions support the broader argument that international supply conditions and domestic market structures jointly influence economic vulnerability. However, the available observations do not permit comparisons between advanced and emerging economies or establish differences in food price transmission across geographical regions. Table 1 identifies the geographical scope of the constructed panel, but the absence of matched economic measurements prevents comparative estimation. The analysis therefore does not overturn existing evidence on international price transmission. Rather, it clarifies that meaningful cross country comparisons require consistent measures of transport disruptions, route exposure and domestic food prices. This distinction matters for global research because international comparisons based on inconsistent maritime indicators may generate misleading conclusions about the distribution of external economic risks.

The practical implication is that maritime transport monitoring and food price surveillance should be analytically connected through verified measures of route exposure and import dependence before policy responses are attributed to shipping disruptions. Table 2 demonstrates the limitations of relying exclusively on aggregate shipping traffic, while Table 3 establishes that the three proposed hypotheses cannot be statistically resolved using the available observations. Policymakers should therefore distinguish observed transport activity from documented supply interruptions and evaluate food price developments using country specific import and consumer price information. The theoretical framework can be strengthened by treating shipping disruption intensity as an external logistical condition, chokepoint exposure as a potential source of heterogeneous transmission and food import dependence as a measure of trade composition rather than domestic consumption dependence. Future empirical research should determine whether verified route disruptions are associated with subsequent food inflation, whether these relationships vary with import exposure and whether domestic market adjustment weakens transmission. These questions extend the analytical framework without attributing causal mechanisms or policy effects to relationships that have not been estimated.

7. Conclusion and Implications:

Global food security depends on what shipping movements conceal as much as on what they reveal. The available maritime observations show that vessel traffic and cargo volumes can move in different directions, making transport activity an insufficient standalone indicator of supply interruption. The study's contribution is an analytical distinction between observed shipping movements and the constraints capable of transmitting costs

into domestic food markets. This distinction sharpens the application of trade cost reasoning by separating logistical activity from economically consequential disruption, while preserving the importance of routing and import structures in interpreting potential exposure. Rather than establishing a causal price relationship, the analysis identifies why maritime monitoring must connect operational conditions with the food flows and markets actually affected. For managers, this supports combining shipment tracking with delivery reliability, procurement costs, and supplier alternatives when allocating contingency resources. For policymakers, it supports coordinating transport surveillance and food market monitoring before selecting interventions. Operationally, consistent records of delays, cargo composition, and delivery costs would make disruption assessments more informative. The broader social relevance lies in improving the evidence used to protect food affordability: distinguishing transport fluctuations from supply constraints can help institutions target preparedness without treating every decline in vessel movements as an equivalent threat to consumers.

The constructed country-year frame provides a foundation for extending the analysis through matched observations of shipping conditions and consumer food prices. Monthly shipment and price records would improve temporal alignment and reveal adjustment patterns obscured by annual aggregation. Commodity-specific routing information would distinguish affected imports from unrelated trade flows, while consumption-based measures would clarify domestic reliance on external food supplies. Documented interruptions combined with credible comparison groups could support stronger identification of price effects. Cross-country extensions could then test whether procurement flexibility, inventories, and domestic distribution arrangements alter transmission, establishing which mechanisms transfer across institutional and economic settings.

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