Shipping Risk and Financial Innovation

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Abstract

The majority of global trade is transported via container ships, with costs highly volatile. This paper studies how firms manage exposure to shipping risk and the role of financial innovation in mitigating it. We document large and persistent fluctuations in container freight rates that co-move with global uncertainty and trade disruptions. We analyze how mechanisms such as long-term contracts and freight derivatives can transfer risk between firms and financial intermediaries. To interpret these patterns, we develop a model in which importers face stochastic shipping costs and hedge through intermediaries with limited risk-bearing capacity. The model shows how financial markets for freight risk affect firms' pricing and inventory decisions, dampen the pass-through of shipping shocks to consumer prices, and explain the limited depth of these markets when coverage is incomplete or intermediary constraints bind.

JEL Codes: G10, F34, G21

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1 Introduction

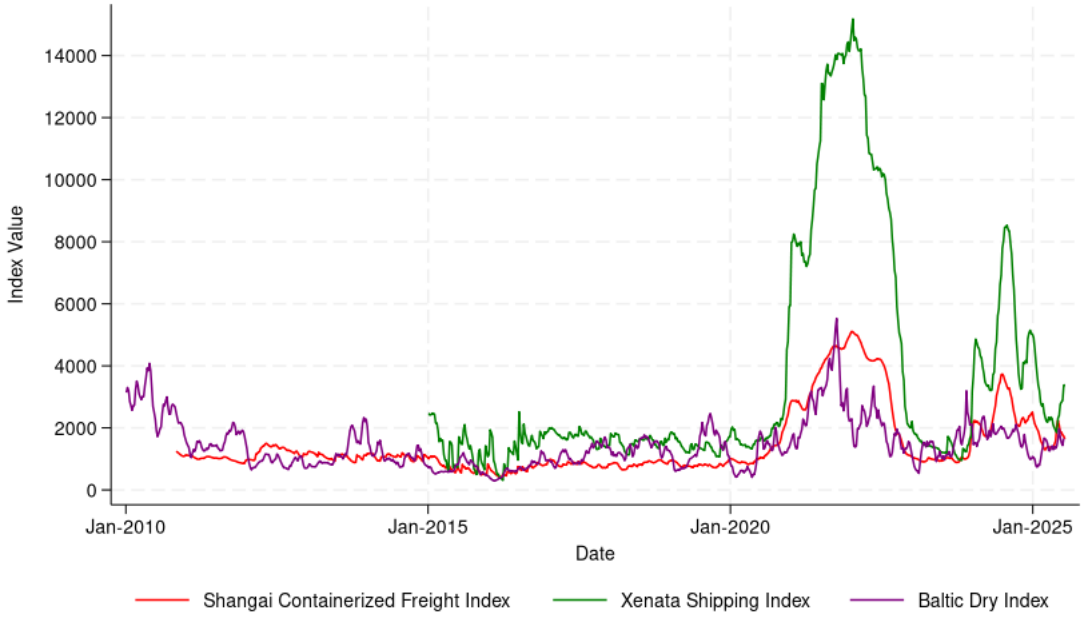
Container shipping moves nearly all goods traded across borders. Over the past decade, shipping costs and transit conditions have become increasingly volatile. Freight rates have swung sharply, ports have faced recurrent congestion, and global supply chains have been strained by the COVID-19 pandemic, conflict in the Red Sea, and rising geopolitical tensions. As shown in Figure 1, major shipping cost indices fluctuate widely, underscoring the growing uncertainty surrounding the cost and reliability of global trade. This paper studies the economic consequences of shipping-cost volatility and the potential for financial innovation to mitigate it.

Shipping cost volatility is a source of uncertainty for firms engaged in international trade, with the potential to shape how production, sourcing, and delivery decisions respond to shocks. Exporters and importers sign contracts over long horizons while facing uncertainty about both future freight costs and access to shipping capacity. When spot shipping rates surge or shipping capacity becomes scarce, firms may incur unhedged cost increases or delivery delays, transmitting volatility through supply chains and affecting prices and output. Recent works by Baslandze and Fuchs (2025) and Carreras-Valle and Ferrari (2025) quantify sizable welfare and productivity losses from such disruptions, underscoring the importance of understanding how firms manage exposure to shipping risk and the potential role of financial instruments in mitigating it.

In this paper we examine the mechanisms through which firms manage shipping risk and the limits of financial and contractual innovations in doing so. Firms can respond through internal adjustments, such as diversifying suppliers or holding inventories, or through external arrangements that transfer or share risk with other parties. We focus on the latter, including long-term contracts with shipping companies and financial instruments that hedge shipping-rate volatility, and analyze how financial innovation can complement or substitute for traditional contracting arrangements.

We study these questions through the lens of a recent financial innovation: the container freight futures market launched by the Shanghai International Energy Exchange (INE) in 2023. These cash-settled contracts, linked to the Shanghai Export Containerized Freight Index (SCFIS), allow firms to hedge shipping-cost risk on the Shanghai–Europe route. The introduction of this market provides a natural setting to examine how financial instruments

Figure 1: Global Shipping Cost Indices, 2010–2025



Notes: The Baltic Dry Index (BDI) reflects time-charter rates for bulk carriers. The Xenata Shipping Index (Far East–North Europe route) provides daily average short-term rates for a 40-foot container. The Shanghai Containerized Freight Index (SCFI) reports weekly spot rates for export containers departing Shanghai. Sources: Baltic Exchange, Xenata, and Shanghai Shipping Exchange.

can price and redistribute shipping risk.

We begin by documenting the volatility that motivates such instruments. Using data from the Shanghai Containerized Freight Index (SCFI), we show that container shipping costs fluctuate sharply over time in response to shipping-specific disruptions, while also being responsive to global uncertainty measures such as oil price volatility, geopolitical risk, and trade policy uncertainty. These patterns indicate that freight-rate risk is systematic rather than idiosyncratic and cannot be diversified away by individual firms. We then analyze the early behavior of the INE shipping freight futures market. Futures prices track spot rates closely, and the futures basis—defined as the difference between futures and spot prices—widens in periods of heightened uncertainty, consistent with a risk premium required by intermediaries to absorb freight risk. Open interest remains modest and peaks roughly three months before contract maturity, suggesting that firms hedge primarily over short horizons tied to physical shipment cycles. A simple comparison between outstanding futures positions and subsequent shipping volumes implies that only 5 to 30 percent of route-level exposure is hedged, underscoring the limited take-up of these markets despite high underlying

volatility.

These findings highlight both the promise and the limits of shipping freight futures. The contracts provide meaningful insurance against cost volatility, yet participation remains limited. To interpret this pattern, we build a model of importer behavior under shipping-cost risk and financial intermediary constraints. Importers face uncertainty in freight rates and can hedge through forward freight agreements with risk-averse financial intermediaries. In equilibrium, hedging demand and intermediary risk capacity jointly determine the forward price and the extent of insurance. The model shows that access to freight futures reduces the covariance between profits and freight rates, lowers profit variability, and thereby dampens the pass-through of shipping risk to consumer prices. However, because futures insure only price risk and not the risk of physical access to shipping capacity, the protection is incomplete. This partial insurance limits both hedging demand and market participation, helping explain the thin trading volumes observed in practice.

The framework can also be used to study other mechanisms through which firms and intermediaries share transportation risk. For example, one can extend the model to analyze contracts that reserve shipping capacity, instruments that link payments to realized delivery outcomes, or hybrid arrangements that combine financial and physical commitments. In this sense, the experience of the INE futures market provides a benchmark case for understanding how financial and contractual design shape the allocation of shipping risk and the depth of emerging freight markets.

Our paper contributes to three strands of research. First, we contribute to the literature on global supply chains and transportation risk by quantifying volatility in container shipping costs and linking it to global uncertainty measures. Second, we contribute to the study of financial innovation and risk sharing by examining the emergence of container freight futures as a new market for hedging shipping cost risk. We document how these contracts are structured, how they price risk, and how participation relates to firms' hedging incentives and intermediaries' risk-bearing capacity. Third, we develop a theoretical framework that connects freight risk, inventory behavior in international trade, and financial intermediation. The model helps explain why shipping futures markets may remain thin despite high underlying volatility in shipping costs and why other instruments, such as enforceable long-term or capacity contracts between firms and shipping companies, may play a larger role in mitigating exposure to shipping disruptions.

Section 2 documents the evolution and volatility of container shipping costs and their relationship to global uncertainty. Section 3 describes institutional and contractual responses to shipping risk, including focusing on the design and performance of the Shanghai INE freight futures. Section 4 presents a dynamic model of firm behavior under shipping-cost risk and analyzes the roles of price and access risk in shaping the demand for hedging. Section 5 discusses broader implications for financial innovation, market design, and international trade resilience and dynamics.

2 Shipping Risk

This section documents the magnitude and drivers of shipping-cost risk. We first describe how container freight rates are measured and show that alternative indices move closely together. We then quantify the volatility of shipping costs over time and relate these fluctuations to global uncertainty indicators. Together, these facts characterize the size and persistence of shipping-price risk and motivate our analysis of how firms and markets attempt to manage it.

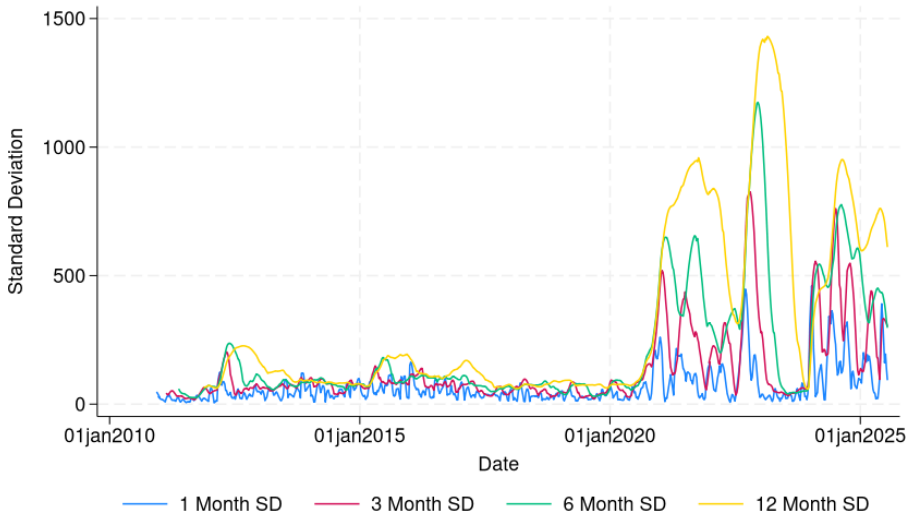
Global freight rates are tracked through several widely used indices that move closely together over time, as shown earlier in Figure 1. Among these, we focus on the Shanghai Containerized Freight Index (SCFI), which reflects spot rates for Shanghai's export container transport market. The SCFI is calculated as the average final price (weighted by volume) of space booked on the spot market by common container shippers across 13 shipping routes. The port of departure is Shanghai, with destinations including Hamburg, Rotterdam, and Le Havre in Europe, and Los Angeles, Long Beach, and Oakland in the United States (Shanghai Shipping Exchange, 2025).[1]

2.1 Volatility of Shipping Costs

To quantify the magnitude of shipping-price risk, we construct backward-looking measures of volatility in the weekly SCFI series using rolling windows of 1, 3, 6, and 12 months. For each week from 2010 to 2025, we calculate the standard deviation of weekly SCFI observations over the preceding window. This provides a simple, backward-looking measure of the variation in freight rates that a firm involved in international trade might consider when contracting shipments several months in advance.

[1]For details on the SCFI and its construction, see Section A.1.

Figure 2: Backward-Looking Rolling Volatility of the SCFI Series: 1-, 3-, 6-, and 12-Month Windows



Notes: Volatility is the rolling standard deviation of the weekly SCFI over 1-, 3-, 6-, and 12-month windows. Data start in November 2010. Source: Authors' computations using Shanghai Shipping Exchange data

Figure 2 compares volatility across the four window lengths. Volatility in shipping costs increased sharply in the post-pandemic period, with other spikes appearing to follow seasonal patterns. These increases in both the level and the variability of shipping costs correspond to well-documented rises in shipping times during the pandemic, some of which are reflected in global supply-chain pressure measures.[2] Compared with the pre-pandemic period, the issue of shipping cost variation clearly has risen importance from the perspective of firms involved in international trade.

2.2 Seasonality and Persistent Risk

We assess systematic seasonal patterns in shipping costs and volatility by estimating regressions of the form

$$\log(SCFIMeasure_t) = \alpha + \gamma_{m(t)} + \varepsilon_t,$$

where $SCFIMeasure_t$ is the logarithm of either the raw SCFI or its 3-month backward-looking standard deviation. t indexes weeks and $\gamma_{m(t)}$ denotes month fixed effects. We estimate this specification over the full sample (November 2010–May 2025), over a pre-pandemic subsample (ending January 2020), and over a post pandemic subsample.

[2]See Benigno, di Giovanni, Groen, and Noble (2022).

Table 1: Estimates of Month Fixed Effects for the SCFI Series and Its 3-Month Rolling Standard Deviation

	(1)	(2)	(3)	(4)	(5)	(6)
	Log SCFI	Log SCFI	Log SCFI	Log SCFI SD	Log SCFI SD	Log SCFI SD
Feb	-0.162**	-0.063	-0.338*	-0.152	-0.087	-0.298
	(0.076)	(0.058)	(0.184)	(0.124)	(0.098)	(0.280)
Mar	-0.244***	-0.154***	-0.412**	-0.138	0.102	-0.565**
	(0.071)	(0.054)	(0.174)	(0.115)	(0.090)	(0.265)
Apr	-0.195***	-0.133**	-0.311*	-0.152	0.205**	-0.728***
	(0.071)	(0.055)	(0.173)	(0.116)	(0.092)	(0.263)
May	-0.176**	-0.091*	-0.330*	-0.338***	0.005	-0.916***
	(0.071)	(0.055)	(0.174)	(0.116)	(0.091)	(0.265)
Jun	-0.146**	-0.111**	-0.221	-0.372***	-0.238***	-0.625**
	(0.072)	(0.055)	(0.177)	(0.117)	(0.091)	(0.271)
Jul	-0.082	-0.085	-0.102	-0.505***	-0.436***	-0.656**
	(0.071)	(0.055)	(0.173)	(0.116)	(0.091)	(0.263)
Aug	-0.053	-0.044	-0.077	-0.464***	-0.414***	-0.555**
	(0.072)	(0.054)	(0.181)	(0.117)	(0.090)	(0.276)
Sep	-0.148**	-0.110**	-0.228	-0.343***	-0.360***	-0.327
	(0.072)	(0.055)	(0.179)	(0.117)	(0.091)	(0.273)
Oct	-0.153**	-0.144**	-0.187	-0.131	-0.109	-0.202
	(0.077)	(0.059)	(0.189)	(0.126)	(0.099)	(0.288)
Nov	-0.131*	-0.081	-0.236	-0.204*	-0.142	-0.321
	(0.071)	(0.053)	(0.181)	(0.117)	(0.091)	(0.276)
Dec	-0.132*	-0.105**	-0.193	-0.290**	-0.179*	-0.504*
	(0.071)	(0.053)	(0.177)	(0.117)	(0.091)	(0.271)
Post P	0.794***			1.046***		
	(0.031)			(0.049)		
Constant	6.932***	6.891***	7.812***	4.372***	4.249***	5.651***
	(0.052)	(0.038)	(0.130)	(0.086)	(0.065)	(0.198)
Starting Month	Nov 2010	Nov 2010	Feb 2020	Nov 2010	Nov 2010	Feb 2020
Ending Month	July 2025	Jan 2020	July 2025	July 2025	Jan 2020	July 2025
N obs	736	466	270	722	452	270
R2	0.486	0.029	0.039	0.408	0.198	0.072
Adj R2	0.477	0.005	-0.002	0.398	0.178	0.032

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Base month = January. Columns (1) and (4) use the full sample (Nov 2010–Jul 2025); Columns (2) and (5) end before Jan 2020; Columns (3) and (6) start after Feb 2020. *Log SCFI SD* is the log of the backward-looking 3-month standard deviation of the weekly SCFI. *Post P* equals 1 if the observation occurs after January 2020. Source: Authors' computations using Shanghai Shipping Exchange data.

The results (Table 1) show the evolution in seasonality in both the level and the volatility of shipping costs. The constant term captures a gradual upward trend in both shipping cost and volatility series, while the month fixed effects indicate that some months exhibit systematically lower freight rates and volatility. In the pre-pandemic sample, shipping costs were typically lower in March, April, June, September, and October relative to January, and summer months displayed lower volatility. These seasonal patterns likely reflect regular demand cycles and weather effects, while the overall upward trend points to a persistent and growing component of risk in global shipping markets. The strength of the seasonal components changes substantively pre- and post-pandemic period.

2.3 Shipping Risk and Global Uncertainty

We next relate movements in shipping costs to broader measures of uncertainty to assess whether freight risk co-moves with global financial and geopolitical risk. Specifically, we estimate regressions of the form

$$\log(SCFIMeasure_t) = \alpha + \log(Uncertainty\ Measure_t) + \gamma_{m(t)} + \varepsilon_t,$$

where the uncertainty measure is one of the CBOE Volatility Index (VIX), the Oil Price Uncertainty Index (OPU), the Geopolitical Risk Index (GPR), the Trade Policy Uncertainty Index (TPU), or the Economic Policy Uncertainty Index (EPU) (Figure A1).[3] In characterizing evolution over time, we additionally test for changing importance of risk measures for shipping cost levels and shipping risk in the pre- and post-pandemic periods.

Risk measures add substantial explanatory power to containing shipping cost series, even in specifications that control for monthly seasonality. Movements in the SCFI are strongly correlated with each of these global uncertainty measures. The magnitude of effects of higher market (VIX), geopolitical risk, trade policy uncertainty and economic policy uncertainty change across the pre- and post COVID periods, but add significant incremental explanatory power to specifications focused on (log) levels of container-shipping costs.

The relationship between shipping price volatility and risk changes over time. Baseline specifications pick up higher levels of volatility post pandemic, consistent with the visualizations. These higher levels are generally associated with nexus of trade policy uncertainty and economic policy uncertainty, with levels that evolved substantially over time. These

[3]Sources include Caldara and Iacoviello (2022); Abiad and Qureshi (2023); Caldara et al. (2020); Baker, Bloom, and Davis (2016).

relationships hold even after controlling for seasonality via month fixed effects.

Table 2: Log SCFI Regressed on Log Uncertainty Measures

	(1) Log SCFI	(2) Log SCFI	(3) Log SCFI	(4) Log SCFI	(5) Log SCFI	(6) Log SCFI	(7) Log SCFI	(8) Log SCFI	(9) Log SCFI	(10) Log SCFI
Post P	1.598***	1.498***	-0.175	-0.212	-2.195**	-2.562***	0.569***	0.553***	4.128***	4.125***
	(0.442)	(0.444)	(0.486)	(0.534)	(0.793)	(0.740)	(0.128)	(0.127)	(0.403)	(0.427)
Log VIX	0.085*	0.086*								
	(0.044)	(0.046)								
Post P × Log VIX	-0.276*	-0.241								
	(0.151)	(0.152)								
Log OPU			-0.021	-0.012						
			(0.025)	(0.037)						
Post P × Log OPU			0.211*	0.220*						
			(0.108)	(0.119)						
Log GPR					-0.431***	-0.472***				
					(0.072)	(0.068)				
Post P × Log GPR					0.649***	0.730***				
					(0.163)	(0.151)				
Log TPU							-0.129***	-0.132***		
							(0.016)	(0.016)		
Post P × Log TPU							0.066**	0.071**		
							(0.029)	(0.029)		
Log EPU									0.287***	0.278***
									(0.036)	(0.038)
Post P × Log EPU									-0.689***	-0.687***
									(0.080)	(0.085)
Constant	6.565***	6.562***	6.891***	6.850***	8.755***	8.942***	7.296***	7.305***	5.502***	5.542***
	(0.127)	(0.128)	(0.123)	(0.162)	(0.317)	(0.303)	(0.054)	(0.066)	(0.164)	(0.172)
Month FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	736	736	729	729	736	736	736	736	736	736
R2	0.478	0.490	0.484	0.499	0.492	0.510	0.497	0.510	0.542	0.551
Adj R2	0.476	0.480	0.482	0.489	0.490	0.500	0.495	0.501	0.541	0.542

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample = Nov 2010–Jul 2025. *Post P* equals 1 if the observation occurs after January 2020. Standard errors clustered by month. Source: Authors' computations using Shanghai Shipping Exchange data and uncertainty measures.

Overall, the evidence shows that shipping-cost risk is large, persistent, higher in the post-pandemic period, and correlated with global uncertainty. Shipping freight rates spike especially during periods of geopolitical tension and trade policy uncertainty, pulling up shipping price volatility. These patterns imply that firms engaged in international trade face non-diversifiable exposure to shipping-cost fluctuations that move with macroeconomic risk factors.[4] In the next section, we turn to how firms attempt to manage these risks through

[4]We have not quantified the level of exposure that firms face with respect to actual access to container ship space, which in some cases is tied to the spot price of shipping and in other cases to route disruptions. The context for this type of risk is discussed in Section 3.

contractual and financial mechanisms.

Table 3: 3-Month Rolling Standard Deviation of SCFI Regressed on Log Uncertainty Measures

	(1) SCFI SD	(2) SCFI SD	(3) SCFI SD	(4) SCFI SD	(5) SCFI SD	(6) SCFI SD	(7) SCFI SD	(8) SCFI SD	(9) SCFI SD	(10) SCFI SD
Post P	2.687*	2.397	3.567**	3.680**	-1.751	-1.097	-0.560	-0.541	0.385	-0.015
	(1.466)	(1.438)	(1.233)	(1.266)	(1.506)	(1.602)	(0.374)	(0.384)	(0.626)	(0.617)
Log VIX	-0.101	-0.190								
	(0.127)	(0.125)								
Post P × Log VIX	-0.534	-0.430								
	(0.512)	(0.502)								
Log OPU			0.085	0.085*						
			(0.048)	(0.043)						
Post P × Log OPU			-0.545*	-0.569*						
			(0.276)	(0.282)						
Log GPR					0.083	0.209				
					(0.221)	(0.230)				
Post P × Log GPR					0.592*	0.449				
					(0.316)	(0.336)				
Log TPU							-0.161***	-0.156***		
							(0.034)	(0.035)		
Post P × Log TPU							0.385***	0.381***		
							(0.084)	(0.086)		
Log EPU									-0.485***	-0.558***
									(0.121)	(0.125)
Post P × Log EPU									0.183	0.270*
									(0.127)	(0.124)
Constant	4.387***	4.634***	3.721***	3.723***	3.729***	3.157**	4.730***	4.710***	6.301***	6.628***
	(0.331)	(0.324)	(0.182)	(0.164)	(0.965)	(1.045)	(0.142)	(0.137)	(0.530)	(0.570)
Month FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	722	722	722	722	722	722	722	722	722	722
R^2	0.394	0.425	0.397	0.429	0.401	0.431	0.405	0.435	0.407	0.443

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample = Nov 2010–Jul 2025. *SCFI SD* is the log of the 3-month rolling standard deviation of the SCFI. *Post P* equals 1 if the observation occurs after January 2020. Uncertainty measures are averaged over matching weeks; OPU, GPR, TPU, and EPU are monthly. Standard errors clustered by month. Source: Authors' computations using Shanghai Shipping Exchange data and uncertainty measures.

3 Managing Shipping Risk

Having established that shipping costs are highly volatile and correlated with global uncertainty, we now examine how firms and markets attempt to manage this risk. Firms can mitigate exposure through contractual arrangements with carriers or through financial in-

struments that allow them to hedge shipping freight-price risk. This section describes both approaches. We first discuss traditional contracting between shippers and liners and its limitations. We then analyze the emergence of freight derivatives, specifically the container freight futures introduced by the Shanghai International Energy Exchange (INE) in 2023, as a new instrument for managing shipping-cost risk.

3.1 Contracting with Shipping Companies

A long-standing way to manage shipping risk is via direct contracting between firms and container shipping companies. Such contracts can, in principle, lock in container shipping rates or capacity on actual container ships, and reduce firm exposure to volatile spot prices. In practice, however, these agreements are often difficult to enforce and frequently break down during periods of large price swings.

Available reports emphasize the fragility of these arrangements, particularly the lack of commitment between liners and shippers when spot prices diverge from contracted levels (Song, 2021). Some contracts include minimum quantity commitments (MQCs) that specify the total volume to be shipped over the contract horizon. Yet they often omit details about shipment timing or vessel allocation (New York Shipping Exchange, 2022). Industry reports suggest that, without clear enforcement mechanisms, it can be difficult to establish fault or impose penalties for non-performance (The Maritime Executive, 2022). As a result, the container shipping industry has long tolerated a practice of no penalty for either party in the event of a no-show or rollover. When spot shipping rates rise, carriers may favor higher-paying spot shipments or may impose additional surcharges to recover costs (Freightos, 2024). When rates fall, shippers may fail to deliver contracted volumes.[5] Conversely, when spot prices fell sharply in 2022 and 2023, more than 80 percent of BCOs renegotiated existing contracts and nearly half switched carriers or reverted to spot bookings (Freightos, 2024). (Tirschwell, 2017) reports that industry executives at Maersk and Hapag-Lloyd estimate that roughly one quarter of bookings fail to show even in normal times.

During system-wide disruptions such as the COVID-19 pandemic, some firms sought legal remedies to enforce contracts. The U.S. Federal Maritime Commission (FMC) reaffirmed in 2020 the common carrier obligation, which prevents liners from unreasonably refusing to

[5]For example, when freight rates spiked in December 2020, CMA CGM rolled over roughly 51 percent of its contracted cargo (Leonard, 2021). Similarly, a Freightos survey found that 35 percent of beneficial cargo owners (BCOs) experienced rollovers during 2020 and 2021 (Freightos, 2021).

deal with exporters or importers (Ludwikowski, Williams, and Alghazali, 2024). Nonetheless, carriers were permitted to introduce emergency surcharges and, during the 2024 Red Sea disruptions, obtained waivers to raise rates without the usual 30-day notice period.

To improve reliability, several institutional innovations have emerged in contracting in some locations. The New York Shipping Exchange (NYSHEX) offers commitment contracts that include third-party dispute resolution, producing fulfillment rates of 99 percent compared with an industry average of 67 percent (Gore, 2021). Major carriers such as Maersk have moved toward similar enforceable agreements (Johnson, 2019). Another development is the rise of long-term, index-linked contracts in which prices adjust automatically with a benchmark index, allowing shippers and carriers to share risk more symmetrically (Hennessey, 2024). Industry consolidation has also raised switching costs for shippers who break contracts, which strengthens incentives to comply (Miller, 2022).

Finally, some large importers manage risk by adjusting shipment timing rather than relying on formal hedges. When geopolitical shocks caused freight-rate spikes such as the 2024 Red Sea attacks, firms including Walmart temporarily delayed shipments in anticipation of falling rates (Baertlein, 2024). These behaviors illustrate that, even without complex financial tools, firms may attempt to actively manage shipping risk through timing, contracting, and renegotiation.

3.2 Financial Instruments to Manage Shipping-Cost Risk

A second way to manage freight risk operates through financial markets. Derivative instruments such as forward freight agreements (FFAs) and freight-index-based futures allow market participants to hedge against future shipping-cost fluctuations. FFAs are traded over the counter and settled at maturity, exposing counterparties to potential default risk, whereas futures are exchange-traded and marked to market daily, which reduces counterparty risk (CME Group, 2025). Both mechanisms provide a means to lock in freight costs and transfer risk to financial intermediaries.

In 2023, the Shanghai International Energy Exchange (INE) introduced a new class of container freight futures contracts, known as the EC series, designed to help shippers and carriers hedge shipping-cost risk. These contracts are cash-settled against the Shanghai Export Containerized Freight Index based on Settled Rates (SCFIS), which measures realized

freight prices for voyages departing Shanghai to Europe.[6] A new contract matures every other even month, and the final settlement price equals the average of the last three weekly SCFIS readings in the delivery month (Shanghai International Energy Exchange, 2025). Daily settlement prices reflect the volume-weighted average of trades executed that day. The INE futures therefore provide a transparent, exchange-traded mechanism for hedging freight-rate risk on the Shanghai–Europe route.

The introduction of this market is intended to represents a major step toward the financialization of shipping freight risk. Until recently, hedging instruments were primarily available for bulk shipping, with limited access for containerized trade. By tying the futures contract to the SCFIS index, the INE created the first liquid vehicle directly linked to container freight rates, enabling both shippers and carriers to manage cost volatility in a standardized, regulated market. The timing of this launch followed several years of historically high volatility and tight capacity, which likely increased the demand for mechanisms to insure against shipping-cost risk.

3.2.1 Pricing and Market Activity

Consider next the pricing dynamics and participation in the INE EC contracts. The key object of interest is the *basis*, defined as the logarithmic ratio between the futures settlement price and the underlying spot index:

$$\text{Basis}_t \equiv \log\left(\frac{\text{Settle}_t}{\text{SCFIS}_t}\right)$$

A positive Basis_t means that the futures price Settle_t exceeds the current spot rate SCFIS_t. This can reflect either expectations of higher future freight costs or, more generally, a *risk premium* paid by importers to hedge against such increases. In the absence of risk premia– if futures prices simply mirrored expected future spot rates– the average basis would be close to zero. Systematically positive values therefore indicate that market participants are willing to pay a premium today to insure against future shipping-cost volatility, consistent with the idea that the INE freight futures market primarily serves as a vehicle for risk transfer rather than speculation.

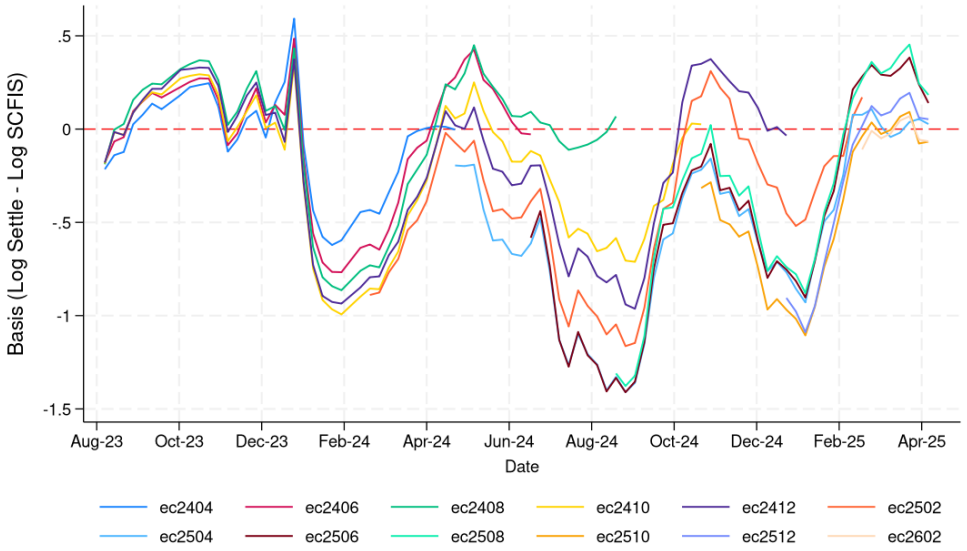
[6] See Appendix A.1 for a detailed description of the SCFIS index, the structure of INE EC futures contracts, and examples of how firms use these instruments to hedge freight exposure. Each contract represents 50 Yuan per index point. For example, when the SCFIS equals 1,943, a single contract corresponds to 97,150 Yuan.

The basis comoves strongly across contracts (Figure 3), which suggests that common shocks such as changes in expected demand, global fuel prices, or uncertainty shift all maturities in similar ways rather than producing maturity-specific patterns. This pattern is consistent with a single underlying factor driving expectations about future freight conditions. In contrast, if the bases moved independently across maturities, it would indicate that contract pricing reflects maturity-specific influences such as differences in liquidity, storage costs, or financing conditions rather than a common set of fundamentals. The observed comovement therefore points to a dominant global component in freight risk that affects both short- and long-dated contracts simultaneously. Using regression analysis, we find that the basis is higher when contracts are close to maturity and during periods of elevated uncertainty. The positive relationship between the basis and uncertainty indicates that futures prices rise above spot rates when trade or geopolitical risks intensify, consistent with market participants paying a premium to lock in shipping costs in advance.

In contrast, market participation, measured by open interest, exhibits a clear maturity profile. Figures 4 and 5 show that positions concentrate in contracts within roughly three months of expiry, which is consistent with hedging horizons that match near-term shipping activity. Open interest rises sharply as contracts approach delivery and then drops upon expiration, while cross-contract comovement is limited. This concentration near maturity suggests that firms use these contracts primarily to manage short-term exposure rather than to speculate on longer-term movements in shipping rates. Neither open interest nor volume exhibits a systematic relationship with uncertainty, in contrast to the strong sensitivity of prices and the basis. This evidence indicates that participation and trading activity are driven primarily by operational hedging needs that align with physical shipment schedules rather than by speculative demand or shifts in market-wide risk appetite.

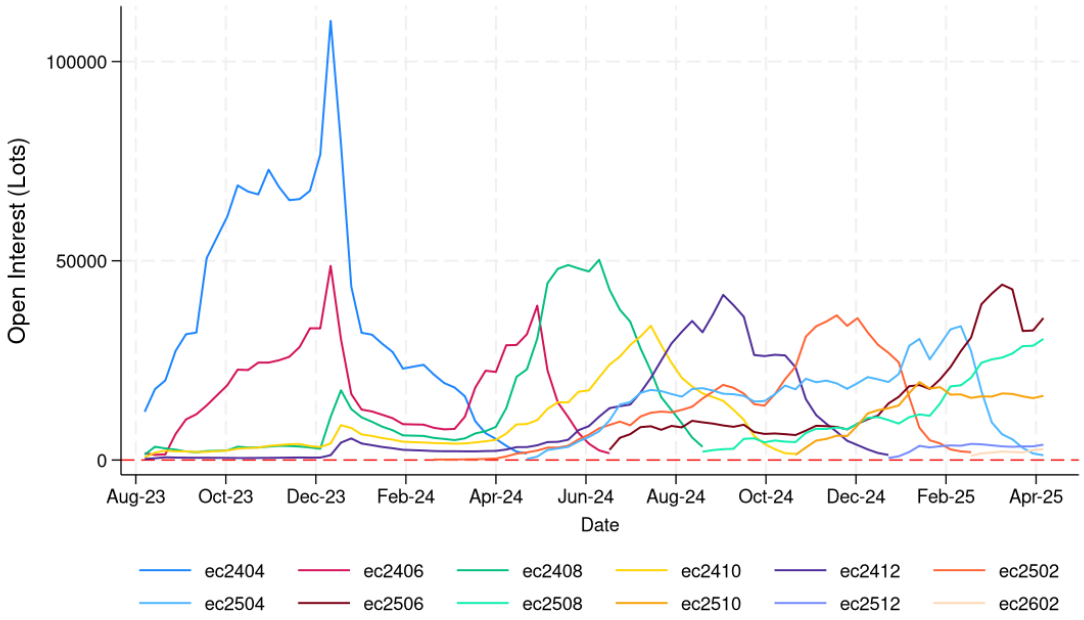
Overall, the evidence points to a market that primarily serves short-horizon shipping cost hedging needs rather than speculative or portfolio demand. The positive correlation between the basis and uncertainty reflects a risk premium akin to that observed in commodity and energy futures markets, where hedgers pay intermediaries to bear price risk.

Figure 3: Basis (Log Settle - Log SCFIS) Across INE EC Contracts (2023-2025)



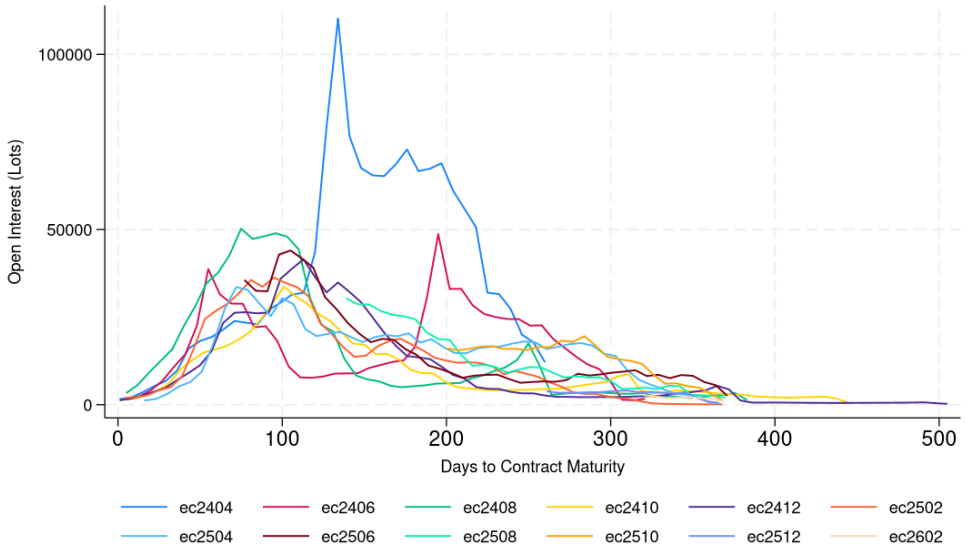
Settle is constructed as a weekly mean of each contract's daily settlement price. Source: Authors' computations using Shanghai Shipping Exchange data.

Figure 4: Open Interest Across INE EC Contracts (2023-2025)



Open Interest is calculated as the weekly mean of the number of outstanding contracts. Source: Authors' computations using Shanghai Shipping Exchange data.

Figure 5: Open Interest by Days to Maturity



Notes: The sample period covers August 2023 to April 2025. *Open Interest* is calculated as the weekly mean of the number of outstanding contracts. Source: Authors' computations using Shanghai Shipping Exchange data.

The concentration of open interest in near-term contracts further underscores that these markets are tightly linked to real shipping activity rather than to financial trading motives. To gauge the economic significance of the INE freight futures market, we compare the notional exposure represented by outstanding contracts to realized shipping volumes on the Far East–Europe route using data from Container Trade Statistics (CTS). The notional exposure measures the total value of freight-rate risk covered by open futures positions.[7] We focus on contracts expiring three months ahead, the horizon where open interest peaks (Figure 5). Because the contracts are cash-settled, this comparison provides an upper bound on the share of trade value along the Shanghai route that is hedged using the futures market.[8]

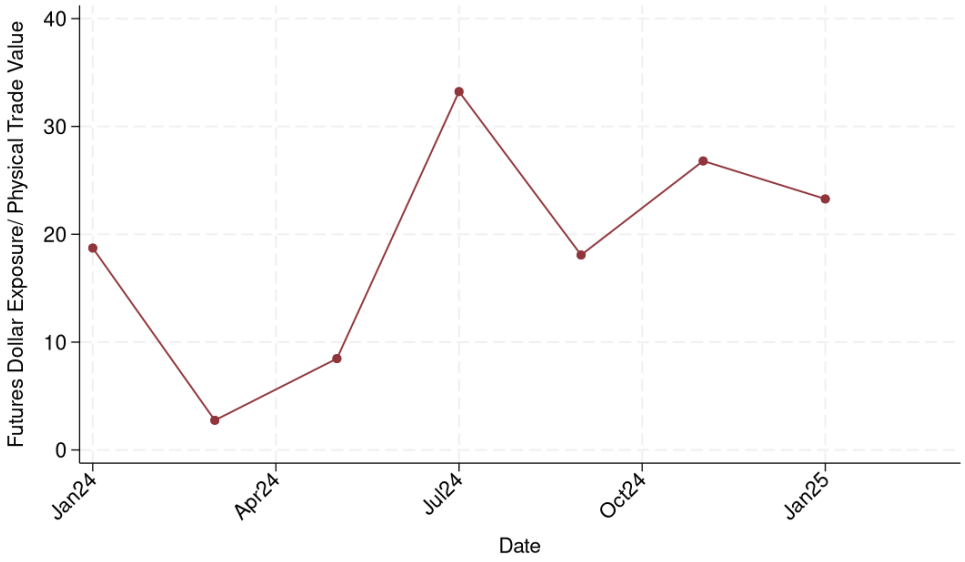
[7]The notional exposure is computed as the product of the contract multiplier (50 Yuan per index point) and the index level.

[8]We calculate the share of hedged shipping-cost exposure as

$$\text{Hedged Shipping Cost Risk}_t = \frac{(\text{OI}_t \times 50 \times \text{SCFIS}_t)/\text{FX}_t^{\text{CNY/USD}}}{\text{SCFIS}_{t+3} \times \text{Far East–Europe TEU}_{t+3}}, \tag{1}$$

where the numerator converts open interest into its U.S. dollar notional equivalent and the denominator approximates the dollar value of physical shipments three months later.

Figure 6: Hedging in INE EC Futures Relative to Realized Shipping Activity (Three-Month Horizon)



Notes: The figure plots Equation 1 for the seven contracts that expired between August 2023 and April 2025. Monthly averages are used since CTS data are monthly. Source: Authors' computations using data on Container Trade Statistics, Shanghai Shipping Exchange, and other series.

The notional value of outstanding futures positions corresponds to between five and thirty percent of subsequent route-level shipping activity (Figure 6). This range indicates that while use of this financial innovation to manage container shipping risk is still limited in absolute terms, the INE futures market already intermediates a meaningful share of freight-rate exposure. The scale of hedging relative to underlying trade volumes is comparable to that observed in the early stages of other commodity and freight derivatives markets. The partial nature of this coverage, however, highlights an important finding: a substantial portion of shipping-cost risk remains unhedged. Understanding this gap between potential and realized demand for insurance against freight risk motivates the model developed in the next section, which examines how intermediary constraints and incomplete coverage shape equilibrium participation in these markets.

4 Model - Preliminary and Incomplete

The evidence points to large and persistent shipping-cost risk, systematic variation in the futures–spot basis, and limited market participation using a financial instrument to manage shipping cost risk. In this section, we set up a two-period model to study how importers

choose shipments and inventories when facing stochastic shipping freight costs, how financial hedging modifies those allocations, and how intermediary constraints shape the equilibrium price of risk and the extent of participation in the financial instrument. An importing firm decides how to allocate its imports over time in the presence of uncertain shipping costs and possible shipment shortfalls. The firm can import in both periods, store goods between periods at a cost, and hedge part of its exposure to future freight-rate risk using forward freight agreements (FFAs).

4.1 Firm Problem

The firm operates over two periods, $t \in \{0, 1\}$. It imports a homogeneous good from the world market at a constant unit price P and sells it to final consumers at a retail price P_t^c in each period. Imports incur a per-unit shipping cost R_t, which is known at $t = 0$ and stochastic at $t = 1$. The period-1 shipping cost R_1 is a random variable with known distribution at $t = 0$, and ω indexes its realized value at $t = 1$.

The firm sells the good to final consumers in each period. Let S_t denote the quantity sold at retail price P_t^c. In each period $t \in \{0, 1\}$, the firm faces a downward-sloping demand curve:

$$S_t = \left(\frac{P_t^c}{A_t}\right)^{-\epsilon}, \quad \epsilon > 1,$$

where A_t is a demand shifter and ϵ is the elasticity of substitution. The firm takes A_t and ϵ as given and chooses S_t and P_t^c subject to this constraint.

At $t = 0$, the firm chooses how much to import, M_0, and how much to carry into the next period as inventory, I_1. Goods not sold in period 0 can be stored, depreciating at rate $\delta \in (0, 1)$ and incurring a per-unit holding cost c_I. Inventories evolve according to

$$I_1 = (1 - \delta)I_0 + M_0 - S_0,$$

where I_0 is given and S_0 denotes period-0 sales.

At $t = 1$, the firm chooses imports $M_1(\omega)$ and sales $S_1(\omega)$ contingent on the realized shipping cost $R_1(\omega)$. Only a share of import orders actually arrive, which we denote by $\theta(R_1)$. This share depends negatively on the realized shipping cost:

$$\theta(R_1) = \theta_0 + \theta_1\big(R_1 - \mathbb{E}[R_1]\big), \quad \theta_0 \in (0, 1], \quad \theta_1 < 0.$$

A higher shipping cost therefore implies a smaller share of imports arriving, capturing con-

gestion or limited shipping capacity when freight rates rise. The firm's sales constraint becomes

$$S_1(\omega) \leq (1-\delta)I_1 + \theta(R_1(\omega))M_1(\omega).$$

The firm does not carry inventories beyond $t = 1$, and any unsold goods are discarded without value.

At $t = 0$, the firm can trade an FFA that settles in cash at $t = 1$ against the realized shipping cost R_1. The FFA is priced at F and delivers a payoff of $(R_1 - F)$ per unit. By taking a long position $h \geq 0$ in the FFA, the firm earns $h(R_1 - F)$ in cash at $t = 1$. A hedge position of $h = M_1$ would fully offset the price component of the firm's shipping-cost exposure but would not insure against the loss of goods that fail to arrive.

Profits in period 0 are deterministic and equal to

$$\Pi_0 = P_0^c S_0 - (P + R_0)M_0 - c_I I_0 - hF.$$

Profits in period 1 depend on the realization of R_1 and the share of imports that arrive:

$$\Pi_1(\omega) = P_1^c(\omega)S_1(\omega) - (P + R_1(\omega))M_1(\omega) + h(R_1(\omega) - F).$$

The firm maximizes a mean–variance objective over lifetime profits:

$$\max_{\substack{M_0, S_0, I_1, h \\ \{M_1(\omega), S_1(\omega)\}}} \quad \Pi_0 + \mathbb{E}_\omega[\Pi_1(\omega)] - \frac{\phi}{2}\,\mathrm{Var}_\omega[\Pi_1(\omega)]$$

subject to

$$\begin{aligned}
&I_1 = (1-\delta)I_0 + M_0 - S_0, \\
&S_1(\omega) \leq (1-\delta)I_1 + \theta(R_1(\omega))M_1(\omega), \quad \forall\omega, \\
&S_t = \left(\frac{P_t^c}{A_t}\right)^{-\epsilon}, \quad t \in \{0,1\}, \\
&M_0, M_1(\omega), S_0, S_1(\omega), I_1, h \geq 0, \quad \forall\omega.
\end{aligned}$$

When $\theta_1 < 0$, a higher R_1 both raises shipping costs and reduces the volume of goods received, amplifying the importer's exposure to freight risk. Futures contracts provide insurance against the price component of this risk but cannot hedge the shipment shortfall, implying that hedging offers only partial protection.

4.2 Speculators

A representative financial intermediary (or "speculator") participates in the FFA market. Speculators do not engage in physical imports or hold inventories. Their role is to provide risk-bearing capacity to firms that seek to hedge freight-cost risk. Whenever an importer takes a long position in the FFA market, it contracts with a speculator who takes the opposite side of the trade and absorbs freight risk in exchange for an expected return. In practice, such counterparties may include financial intermediaries, brokers, or shipping companies that use these instruments to hedge their own freight revenues or to take speculative positions on freight rates.

The total supply of FFA contracts is in zero net supply: every unit of hedging demand must be matched by an equal and opposite speculative position. Speculators require compensation for bearing this risk, especially when their capital constraints are tight. In equilibrium, the forward price F adjusts to clear the market. If importer hedging demand is strong and speculator risk-bearing capacity is limited, the forward price F must rise above the expected future spot rate $\mathbb{E}[R_1]$ to compensate speculators for bearing risk. The resulting wedge $F > \mathbb{E}[R_1]$ reflects a freight risk premium paid by hedgers to speculators.

At $t = 0$, the speculator chooses a position h^s in the FFA contract. This position is settled in cash at $t = 1$ based on the difference between the realized shipping cost R_1 and the contracted forward rate F. The speculator takes prices as given and chooses h^s to trade off expected returns against the cost of risk exposure. Since the FFA is in zero net supply, the speculator's position must offset the importer's hedge demand in equilibrium.

Following Acharya, Lochstoer, and Ramadorai (2013), financial intermediaries face constraints that limit their ability to take on risk. We represent these constraints by a quadratic penalty on the variance of the FFA payoff. Let $\phi_S > 0$ denote the tightness of the constraint. The speculator chooses

$$\max_{h^s} \quad \mathbb{E}[h^s(R_1 - F)] - \frac{\phi_S}{2} \operatorname{Var}[h^s(R_1 - F)].$$

A higher ϕ_S implies tighter constraints and lower willingness to absorb freight risk, leading to a higher forward premium.

4.3 Equilibrium

A competitive equilibrium is a collection of allocations $\{M_0, M_1(\omega), S_0, S_1(\omega), I_1, h, h^s\}$, prices $\{P_0^c, P_1^c(\omega), F\}$, and profit realizations $\{\Pi_0, \Pi_1(\omega)\}$ such that:

1. The firm maximizes its mean–variance objective given I_0, the prices $\{P_0^c, P_1^c(\omega), F\}$, and the distribution of R_1, subject to all constraints, including the arrival share $\theta(R_1)$.

2. The speculator chooses its FFA position h^s to maximize expected payoff, taking F and the distribution of R_1 as given.

3. The FFA market clears: $h = h^s$.

5 Implications of the Model

This section characterizes the main implications of the model. We begin by analyzing a benchmark version of the economy in which all import orders arrive, corresponding to $\theta_0 = 1$ and $\theta_1 = 0$. This baseline preserves the core features of shipping-cost risk while abstracting from shipment shortfalls, allowing us to isolate the effects of financial hedging through forward freight agreements (FFAs) on prices, quantities, and inventories. We then reintroduce the possibility that only a share of imports arrive, as captured by $\theta_1 < 0$, to study how this additional source of uncertainty limits the degree of insurance provided by FFAs and helps explain the limited participation observed in the data.

5.1 Key Equilibrium Objects

The model yields two central equilibrium variables, the forward rate F and the importer's hedge position h, which together determine how freight risk is priced and shared between importers and intermediaries.

The forward rate is given by

$$F = \mathbb{E}[R_1] - \frac{\phi\,\phi_S}{\phi + \phi_S}\,\mathrm{Cov}\big(\Pi_1^0, R_1\big),$$

where Π_1^0 denotes the importer's operating profit before any hedging payoff, $\phi > 0$ measures the importer's aversion to profit risk, and $\phi_S > 0$ captures the tightness of intermediary risk-bearing constraints. The covariance term $\mathrm{Cov}(\Pi_1^0, R_1)$ captures the importer's exposure to freight risk by measuring how profits co-move with shipping costs. When importer profits and shipping costs move in opposite directions, as in periods when high freight rates coincide

with low sales, $\text{Cov}(\Pi_1^0, R_1) < 0$. In this case, the forward rate exceeds the expected spot rate, $F > \mathbb{E}[R_1]$, because importers are willing to pay a premium to hedge against high future freight costs. The term $\frac{\phi\phi_S}{\phi+\phi_S}$ determines how this premium depends on risk sharing: when either the importer or the intermediary is nearly risk neutral, the premium is small; when both are risk averse or constrained, the premium is larger.

The importer's optimal hedge position is

$$h = -\frac{\phi}{\phi + \phi_S} \frac{\text{Cov}\big(\Pi_1^0, R_1\big)}{\text{Var}(R_1)}.$$

This expression shows that the hedge is proportional to the importer's underlying exposure $\text{Cov}(\Pi_1^0, R_1)$ and inversely related to the variance of shipping costs $\text{Var}(R_1)$. A stronger negative covariance, meaning higher sensitivity of profits to freight costs, leads the importer to take a larger hedge. Greater volatility of R_1 reduces the size of the hedge, as each contract introduces more profit variability for a given expected return. Tighter intermediary constraints (higher ϕ_S) make hedging more expensive and therefore reduce the equilibrium hedge position.

The relationship between the forward and spot rates defines the *basis*,

$$\text{Basis} \equiv \log\left(\frac{F}{R_0}\right).$$

Using the equilibrium condition

$$F = \mathbb{E}[R_1] - \frac{\phi\,\phi_S}{\phi + \phi_S} \text{Cov}\big(\Pi_1^0, R_1\big),$$

the basis can be written exactly as

$$\text{Basis} = \log\left(\frac{\mathbb{E}[R_1]}{R_0}\right) + \log\left(1 - \frac{\phi\,\phi_S}{\phi + \phi_S} \frac{\text{Cov}(\Pi_1^0, R_1)}{\mathbb{E}[R_1]}\right).$$

The first term, $\log(\mathbb{E}[R_1]/R_0)$, reflects expected growth in freight rates. The second term captures the risk premium paid by importers to transfer freight risk to intermediaries. This premium is positive when $\text{Cov}(\Pi_1^0, R_1) < 0$—that is, when importer profits are low in high-freight states—and increases with both the magnitude of this covariance and the tightness of intermediary constraints, $\frac{\phi\,\phi_S}{\phi+\phi_S}$. Stronger exposure or tighter financial capacity therefore widen the basis, linking the theoretical expression directly to the empirical patterns.

These equilibrium expressions together illustrate the economic forces shaping freight-risk pricing. The forward rate captures both expected shipping costs and the price of risk, the hedge ratio determines how that risk is shared, and the basis measures the resulting premium

in equilibrium. When shipping costs are volatile or intermediaries are constrained, the model predicts a larger basis and smaller hedge positions. These patterns correspond closely to the evidence documented in Section 3: futures prices tend to lie above expected spot rates in periods of high uncertainty, while trading volumes remain limited because intermediaries have limited capacity to absorb risk.

5.2 Effect of Futures Access on Consumer Prices

Access to FFAs alters how shipping-cost risk affects consumer prices by changing the covariance structure of profits and shipping costs. The key mechanism operates through the importer's pricing rule,

$$P_1^c(\omega) = \frac{\epsilon}{\epsilon - 1} \frac{P + R_1(\omega)}{1 - \phi(\Pi_1(\omega) - \mathbb{E}[\Pi_1])}.$$

Futures do not change the marginal cost $P + R_1(\omega)$ but affect how profits $\Pi_1(\omega)$ respond to shocks in $R_1(\omega)$, and therefore how the markup term in the denominator varies across states.

When the importer can hedge, the equilibrium hedge position is

$$h = -\frac{\phi}{\phi + \phi_S} \frac{\mathrm{Cov}\big(\Pi_1^0, R_1\big)}{\mathrm{Var}(R_1)}.$$

This hedge weakens the co-movement of profits with shipping costs:

$$\mathrm{Cov}(\Pi_1, R_1) = \frac{\phi_S}{\phi + \phi_S} \mathrm{Cov}(\Pi_1^0, R_1),$$

so that access to FFAs proportionally attenuates the covariance between profits and freight rates by the factor $\phi_S/(\phi + \phi_S) \in (0, 1)$ and lowers the variance of profits.

Because the markup adjustment in prices depends on the dispersion of profits, lower profit variance translates into more stable prices. In the limiting case where either the importer is risk neutral ($\phi = 0$) or hedging fully eliminates risk, the expected consumer price equals the constant-markup benchmark,

$$\mathbb{E}[P_1^c] = \frac{\epsilon}{\epsilon - 1}\big(P + \mathbb{E}[R_1]\big).$$

With partial hedging and positive risk aversion, average prices deviate upward from this benchmark and become state-dependent, reflecting the residual risk in profits.

Hence, FFAs dampen both the sensitivity of prices to freight shocks and the dispersion of markups across states. The strength of this effect depends on intermediary capacity: when intermediaries are well capitalized (low ϕ_S), hedging absorbs a greater share of risk,

producing more stable prices and smaller deviations from constant markups.

5.3 Quantities and Inventories

We focus on the benchmark case in which all booked imports arrive in period 1, $\theta_0 = 1$ and $\theta_1 = 0$. The intertemporal condition that governs the timing of imports and the desired inventory stock equates the marginal cost of importing today to the expected discounted marginal cost of having the unit available tomorrow:

$$P + R_0 \;=\; (1-\delta)\left(P + \mathbb{E}[R_1]\right) \;-\; c_I.$$

This Euler condition pins down front-loading versus postponement. When $(1-\delta)\big(P + \mathbb{E}[R_1]\big) - c_I > P + R_0$, the firm imports more in period 0 and raises I_1; when the inequality reverses, it shifts imports to period 1.

In this benchmark, the Euler condition depends on expected future costs but not on their variance, and it is not altered by the hedge h because futures do not change physical marginal costs. The effect of FFA access on quantities and inventories operates through prices and therefore through sales. Let $S_1(\omega) = (1-\delta)I_1 + M_1(\omega)$ denote the period-1 resource constraint and let $P_1^c(\omega)$ follow the pricing rule in the previous subsection. By stabilizing profits, hedging compresses markups and stabilizes $P_1^c(\omega)$, which reduces the need to buffer demand with physical stocks. In equilibrium,

$$M_0^{(h>0)} \;<\; M_0^{(h=0)}, \qquad I_1^{(h>0)} \;<\; I_1^{(h=0)},$$

and the sensitivity of both M_0 and I_1 to $\mathrm{Var}(R_1)$ is lower when FFAs are available. Thus, with $\theta_0 = 1$ and $\theta_1 = 0$, futures do not alter the physical marginal-cost trade-off in the Euler condition, but by stabilizing prices they reduce precautionary front-loading and lower average inventories.

5.4 Partial Insurance and Limited Participation

We now extend the analysis to the case in which only a share of imports arrive in the second period. Let the share be $\theta(R_1) = \theta_0 + \theta_1(R_1 - \mathbb{E}[R_1])$ with $\theta_1 < 0$. When shipping costs rise, a smaller fraction of booked imports is delivered. This modification does not alter the structure of the equilibrium but changes the importer's exposure to shipping risk. High R_1 now reduces profits through two channels: higher per-unit cost and lower quantity received. Because FFAs pay only on the price component R_1, they do not insure the quantity shortfall.

The partial-insurance nature of the hedge has three main implications. First, the covariance $\mathrm{Cov}(\Pi_1^0, R_1)$ becomes more negative, so the equilibrium risk premium $F - \mathbb{E}[R_1]$ increases. Second, the optimal hedge position h falls because a smaller fraction of total risk is hedgeable. Third, importers rely more on physical adjustment—by front-loading imports and holding larger inventories—to manage the remaining unhedgeable risk. Futures markets therefore coexist with, but do not replace, traditional real-buffer mechanisms.

This extension provides a simple explanation for the limited participation observed in freight-futures markets. When a significant part of shipping risk arises from uncertainty about access to capacity, rather than from freight prices alone, the benefits of hedging through FFAs diminish. In equilibrium, the market remains active enough to price the insurable component of risk, generating a positive basis, but participation is limited because the instrument covers only part of total exposure. Empirically, routes characterized by congestion and capacity bottlenecks—settings corresponding to larger $|\theta_1|$—should exhibit both a higher basis and lower open interest, consistent with the evidence documented earlier.

Summary. The model shows that financial hedging instruments can substantially reduce exposure to shipping-cost volatility and stabilize prices and quantities, but their insurance is incomplete when shipment shortfalls are correlated with freight rates. This partial coverage explains the coexistence of a large, positive basis with limited participation in freight-futures markets observed in the data.

6 Concluding Remarks - Incomplete

This paper analyzes how firms manage exposure to shipping-cost risk and the role of financial innovation in reallocating that risk across markets. Container freight rates display large and persistent volatility, closely linked to global uncertainty and trade disruptions. The introduction of container freight futures provides a mechanism to insure against such volatility, yet participation remains limited.

The framework developed here highlights why these markets remain thin. Freight futures insure against price fluctuations but not against the risk of limited shipping capacity or delivery shortfalls. As a result, firms continue to rely on inventories and contractual arrangements to buffer against uninsurable shocks. Together, the evidence and the model underscore that expanding the financial sector's risk-bearing capacity and developing instru-

ments that address both price and access risk are essential for strengthening the resilience of international trade to disruptions in global shipping.

References

Abiad, Abdul, and Irfan A. Qureshi. 2023. "The macroeconomic effects of oil price uncertainty." *Energy Economics* 125 106839.

Acharya, Viral V, Lars A Lochstoer, and Tarun Ramadorai. 2013. "Limits to arbitrage and hedging: Evidence from commodity markets." *Journal of Financial Economics* 109 (2): 441–465.

Baertlein, Lisa. 2024. "US container shippers slow walk new contracts, eye easing of Red Sea rate hikes, analysts say." *Reuters*, https://www.reuters.com/world/middle-east/us-container-shippers-slow-walk-new-contracts-eye-easing-red-sea-rate-hikes-2024-03-06/.

Baker, Scott R., Nicholas Bloom, and Steven J. Davis. 2016. "Measuring Economic Policy Uncertainty." *The Quarterly Journal of Economics* 131 (4): 1593–1636.

Baslandze, Salomé, and Simon Fuchs. 2025. "The Price of Delay: Supply Chain Disruptions and Pricing Dynamics." Working Paper 2025-8, Federal Reserve Bank of Atlanta.

Benigno, Gianluca, Julian di Giovanni, Jan J.J. Groen, and Adam I. Noble. 2022. "The GSCPI: A New Barometer of Global Supply Chain Pressures." Staff Report 1017, Federal Reserve Bank of New York.

Caldara, Dario, and Matteo Iacoviello. 2022. "Measuring Geopolitical Risk." *American Economic Review* 112 (4): 1194–1225.

Caldara, Dario, Matteo Iacoviello, Patrick Molligo, Andrea Prestipino, and Andrea Raffo. 2020. "The Economic Effects of Trade Policy Uncertainty." *Journal of Monetary Economics* 109 38–59.

Carreras-Valle, Maria-Jose, and Alessandro Ferrari. 2025. "The Cost of Delivery Delays." *AEA Papers and Proceedings* 115 618–23.

CME Group. 2025. "Futurization: Futures vs. Forwards." https://www.cmegroup.com/articles/2025/futurization-futures-vs-forwards.html.

Freightos. 2021. "Negotiations and Uncertainty Ocean Contracts During Corona." https://www.freightos.com/resources/negotiations-and-uncertainty-ocean-contracts-during-corona/.

Freightos. 2024. "Ocean Contracts in the Digital Age." https://www.freightos.com/logistics-technology-insights/logistics-technology/ocean-contracts-in-the-digital-age/.

Gore, Matthew. 2021. "Lack of enforceability: a freight-ening prospect." *Holman Fenwick Willan LP*, https://www.hfw.com/insights/lack-of-enforceability-a-freight-ening-prospect/.

Hennessey, Philip. 2024. "Beware a potential flaw in index-linked ocean container shipping contracts, which could cost millions of dollars." https://www.xeneta.com/blog/beware-a-potential-flaw-in-index-linked-ocean-container-shipping-contracts-which-could-cost-millions-of-dollars.

Johnson, Eric. 2019. "Maersk revives no-show fees for bookings." *S&P Global Journal of Commerce*, https://www.joc.com/maritime-news/container-lines/maersk-line/maersk-revives-no-show-fees-bookings_20190625.html.

Leonard, Matt. 2021. "A tumultuous year of ocean shipping prompts a rethink of contracts." *Supply Chain Dive*, https://www.supplychaindive.com/news/ocean-shipping-contract-carrier-capacity-rate-nvocc-drewry-nyshex/596178/.

Ludwikowski, Mark, Kevin Williams, and Sally Alghazali. 2024. "The Red Sea shipping crisis: lessons for importers." *Reuters*, https://www.reuters.com/legal/legalindustry/red-sea-shipping-crisis-lessons-importers-2024-02-21/.

Miller, Greg. 2022. "Back to the futures: New era of container freight hedging begins." *Freight Waves*, https://www.freightwaves.com/news/back-to-the-futures-new-era-of-container-freight-hedging-begins.

New York Shipping Exchange. 2022. "Not All "Contracts" Are Contracts – And That's a Good Thing." https://nyshex.com/blog/not-all-contracts-are-contracts-and-thats-a-good-thing.

Shanghai International Energy Exchange. 2025. "Containerized Freight Index (Europe service) Futures Trading Handbook." https://www.ine.cn/eng/market/futures/index/ec/manual/202308/W020250812582460747914.pdf.

Shanghai Shipping Exchange. 2025. "About SCFI." https://en.sse.net.cn/indices/scfinew.jsp.

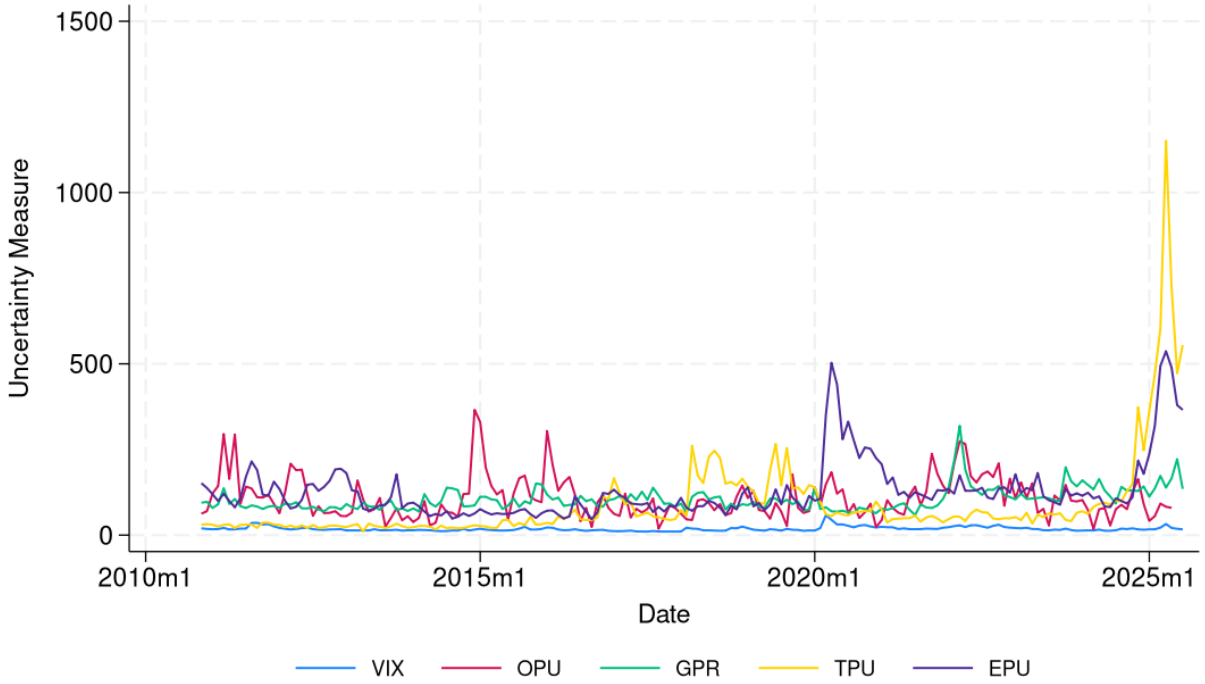
Song, Dongping. 2021. "A literature review, container shipping supply chain: Planning problems and research opportunities." *Logistics* 5 (2): 41.

The Maritime Executive. 2022. "Why Shippers Can Renegotiate Some Long-Term Contracts But Not Others." https://maritime-executive.com/article/why-shippers-can-renegotiate-some-long-term-contracts-but-not-others.

Tirschwell, P. 2017. "Fewer 'No Shows' Key to Service Contract Evolution." *S&P Global Journal of Commerce*, https://www.joc.com/maritime-news/container-lines/predictability-cargo-flows-vital-cost-savings_20170508.html.

Appendix

Figure A1: Global Uncertainty Indices, 2010-2025



VIX is collapsed to its monthly mean. OPU, GPR, TPI, and EPU reported monthly. Source: Authors' computations using data on uncertainty indices.

A.1 Shipping Prices: Data Description

There are two relevant indices that track shipping freight rates from Shanghai to Europe: the Shanghai Containerized Freight Index (SCFI) and the Shanghai Export Containerized Freight Index based on Settled Rates (SCFIS). Both indices are published by the Shanghai Shipping Exchange (SSE) and measure container freight rates on routes departing from Shanghai. The SCFI is a forward-looking index that tracks spot market booking rates, representing what shippers expect to pay for immediate vessel space before departure. The SCFIS is a backward-looking index that reflects the settled rates that were paid after the ships have departed (Shanghai Shipping Exchange, 2025). The INE EC futures contracts are a set of contracts that track the SCFIS (Europe) index and mature on the last Monday of every other month.

The SCFI

- **Description:** The SCFI reflects the spot rates of Shanghai's export container transport market. It includes the freight rates of 13 individual shipping routes. The port of departure is Shanghai, and the destination ports include Hamburg, Rotterdam, and Le Havre in Europe, and Los Angeles, Long Beach, and Oakland in America (Shanghai Shipping Exchange, 2025).

- **Type of Price:** The rates measured by the SCFI are the average final prices (weighted

by volume) of space booked on the spot market by common shippers. The units are USD / TEU (twenty-foot equivalent unit). The container type is a general dry cargo container.

- **Composite Index:** The basis composite index is 1,000 points and the base period is specified on October 16, 2009. The SCFI is updated and published weekly, typically on Fridays at 15:00 Beijing time.

- **Information Collection:** The freight information for SCFI compilation is reported by a panel of liner companies and shipper/freight forwarders (intermediaries between shippers and various transportation services). At present, 22 liner companies and 26 shippers/freight forwarders provide the freight rate information.

- **Calculation:** First, the average weekly freight rate of each shipping route is calculated as the arithmetic mean of all freight rates on that route from Monday to Sunday. This result is divided by the average freight rate of that shipping route in the base period (2009). To construct the final index, each route-specific average is multiplied by a weighting term for that route, and then summed together to obtain the final total.

- **Coverage Period and Data Availability:** The SCFI was officially launched in October, 2009.

The SCFIS

- **Description:** The SCFIS captures changes in the settled rates of Shanghai's spot export container transport market. The port of departure is Shanghai, and the ports of destination on the Europe service are Hamburg, Rotterdam, Le Havre, Antwerp, and Felixstowe (Shanghai Shipping Exchange, 2025).[9]

- **Type of Price:** The SCFIS measures the prepayment of freight (USD) for voyages that departed between Monday and Sunday on the Shanghai-Europe service. The freight rate (USD / TEU or FEU) includes basic ocean freight and surcharges per unit. The container type is a dry cargo container (specifically 20-feet general purpose (GP) containers, 40-feet GP containers, and 40-feet high cube (HQ) containers).

- **Composite Index:** The basis composite index is 1,000 points and the base period is specified on June 1, 2020. The index is published weekly on Mondays, with information on voyages that departed in the prior week.

- **Information Collection:** The freight information for the SCFIS (Europe service) is reported by a panel of 10 liner companies and 4 shipper/freight forwarders.

- **Calculation:** The average freight rates by container type (20GP, 40GP, and 40HQ) are calculated by dividing the total freight rates paid by the total quantity transported for each container type. Each average by container type is then divided by the

[9] In addition to the Europe service, the SCFIS is also calculated for the American West Coast service (ports of destination include Los Angeles, Long Beach, and Oakland). We do not have data on the American West Coast service SCFIS.

corresponding value in the base period and multiplied by 1000. The SCFIS is then calculated as a weighted sum over the different container types.

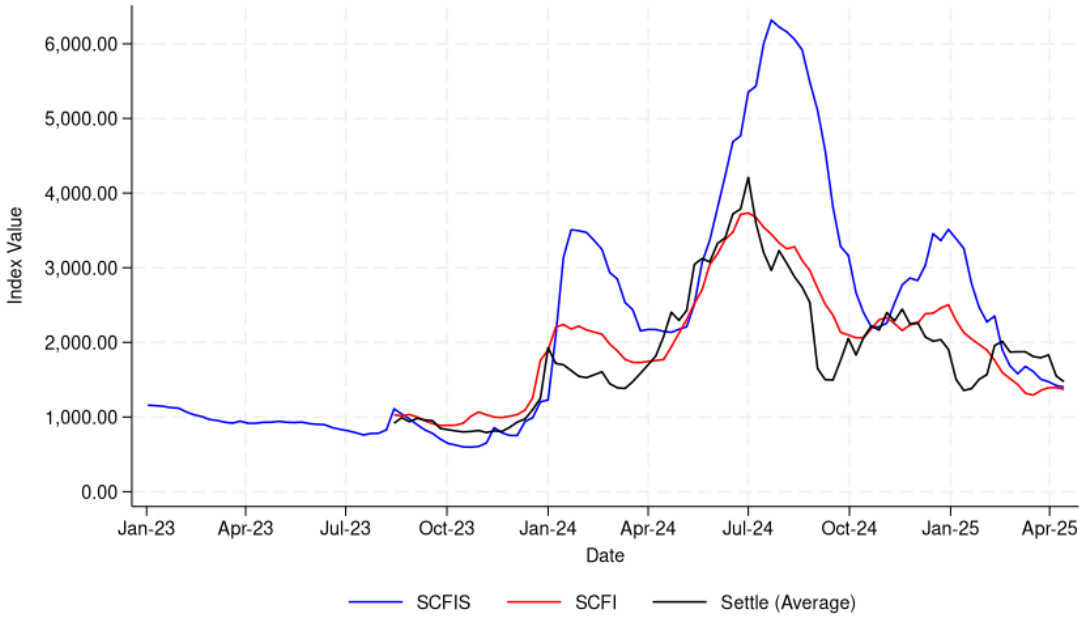
- **Coverage Period and Data Availability:** The SCFIS was officially launched in November, 2020 and was developed specifically to support the futures market as an underlying index.

The INE EC Future Contracts

- **Description:** The INE EC contract is a future that is based on the SCFIS index. Importantly, it is cash-settled, meaning that buyers will not receive any freight space.
- **Final Settlement Price:** As an index-based future, the final settlement price of an INE EC contract is the average of the last 3 weekly releases of the SCFIS in the contract's delivery month.
- **Daily Settlement Price:** The daily settlement price of an INE EC contract is the volume weighted average price of all trades in that contract executed on that trading day.
- **Listed Contracts:** A new set of futures contracts matures every other (even) month (e.g., February, April, etc). Contracts are listed approximately a year in advance. For a given contract, a new position cannot be opened in the last three days of trading.
- **Coverage Period and Data Availability:** The INE EC contracts were launched in August 2023. Daily data was aggregated to a weekly level to match the frequency of the SCFIS index publication.
- **Contract Units:** The INE EC contract is traded in terms of lots, where 1 lot is worth the index multiplied by 50 Yuan (Shanghai International Energy Exchange, 2025).
- **Key Variables of the INE EC Futures Data:**
  - Delivery Month (YY-MM): The year and month that a specific INE EC contract will expire in (on the last Monday).
  - Settle: Weekly mean of the daily settlement prices of a specific INE EC contract (measured in RMB).
  - High: Maximum price (RMB) that the EC contract traded at in a given week.
  - Low: Minimum price (RMB) that the EC traded at in a given week.
  - Open: The opening price that a EC contract trades at the start of a week (RMB).
  - Close: The closing price that a EC contract trades at the end of the week (RMB).
  - Open Interest (OI): Open interest refers to the total number of outstanding future contracts at the end of the trading day (measured in terms of lots). This number is a weekly mean.
  - Volume: The total number of futures contracts transacted during a week (measured in terms of lots).

The SCFI, the SCFIS, and the INE EC weekly average settlement price exhibit strong co-movement during the post-2023 period in which they overlap (Figure A2). With its longer time series, the SCFI captures important historical trends in freight rates, such as the post COVID-19 increase in rates. Moreover, the SCFI tends to have a lower magnitude than the SCFIS, reflecting its earlier base period.

Figure A2: Shipping Price Measures Since 2023



Notes: The settlement price is the average of the weekly settlement prices of all actively traded contracts. Data availability begins for the SCFI series in November 2010; for the SCFIS series in January 2023; and for the Settle price in August 2023. Source: Shanghai Shipping Exchange.