

From Logs to Lumber: Product Upgrading in China's Wood Imports from ASEAN, 2010-2024

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Abstract

China's log imports from ASEAN collapsed from USD 1.93 billion in 2014 to USD 42 million in 2024, a fall of 97.8 percent that followed a wave of log export bans across mainland Southeast Asia. Whether this collapse represents a loss of trade or a change in its form has not been measured. Using UN Comtrade records of China's imports of logs, sawnwood, veneer and plywood from the ten ASEAN member states over 2010-2024, this paper constructs a substitution ratio that divides the rise in processed-wood imports by the fall in log imports, and evaluates it country by country. Two findings emerge. Compositional upgrading is real and robust: the log share of the four-product total fell from 48.7 percent in 2014 to 2.3 percent in 2024, and the upgrading index rose from 0.187 to 0.359. Nominal-value substitution is incomplete: the region-wide substitution ratio is -0.12 , and -0.26 once Thailand is excluded, meaning that processed-wood imports fell alongside logs rather than replacing them. The processed-wood total is dominated by Thai rubberwood sawnwood from a country with negligible log supply, while Laos, Cambodia and Malaysia recorded declines in processed wood as well. Myanmar is the only case of partial substitution among suppliers of consequence, at 0.20. Imports changed following the restrictions; these descriptive changes cannot establish policy effects or domestic processing capacity.

Keywords

Log Export Ban, Product Upgrading, China-ASEAN Trade, Wood Products, Substitution Ratio

1. Introduction

In 2014, China bought USD 1.93 billion of logs from the ten member states of ASEAN. In 2024, it bought USD 42 million, or 2.2 percent of that amount. The

fall was not gradual: Myanmar's export ban took effect in April 2014, Laos issued Order No. 15 in May 2016, and Cambodia intensified timber-export enforcement at its Vietnam border in the same year. Within a decade a trade that had organised the forest economies of mainland Southeast Asia around shipments to Chinese ports had almost disappeared. What that disappearance means is less obvious than it appears. A log ban is not designed to end trade; it is designed to move trade upstream, keeping the milling, drying and gluing at home and exporting boards instead of trees. If the policy works, the value that once left as logs should return as sawnwood, veneer and plywood. If it does not, the value simply leaves the bilateral relationship. Both outcomes produce the same collapse in the log series, and the log series alone cannot tell them apart. The existing literature on China-ASEAN timber trade, including our own earlier work, has concentrated on explaining why log imports fell (Guan & Zhang, 2023), and has therefore inherited this ambiguity rather than resolving it.

This paper resolves it by widening the product window. We assemble China's reported imports of four products, logs (HS 4403), sawnwood (HS 4407), veneer (HS 4408) and plywood (HS 4412), from each ASEAN member state for every year from 2010 to 2024, and ask how much of the fall in logs was recovered as processed wood. The instrument is a substitution ratio, the increase in processed-wood imports divided by the decrease in log imports over the same window. A ratio above one means the partner sent back more value in processed form than it lost in logs; a ratio between zero and one means partial recovery; a ratio at or below zero means the trade contracted outright. The answer separates cleanly into two parts. Compositional upgrading is genuine. The share of logs in the four-product total fell from 48.7 percent in 2014 to 2.3 percent in 2024, and an index weighting each product by processing depth rose from 0.187 to 0.359. On the composition margin the transformation is as complete as any in recent trade statistics. Nominal-value substitution remains incomplete. Aggregating the ten states, the substitution ratio is -0.12 , and excluding Thailand it is -0.26 . Processed-wood imports in 2024 stood at USD 1.80 billion against USD 2.03 billion in 2014, so the category that was supposed to absorb the displaced value shrank too.

The reconciliation of these two facts is the paper's contribution. Compositional upgrading is arithmetically compatible with aggregate contraction whenever the numerator falls more slowly than the denominator, and that is what occurred. Moreover, the processed-wood total is dominated by Thailand. Thailand supplied USD 1.28 billion of processed wood in 2024, seventy-one percent of ASEAN's processed-wood exports to China, almost all of it rubberwood sawnwood from plantations established for latex; Thailand shipped USD 2.0 million of logs in 2014 and has never been a log supplier of consequence. Remove Thailand and Laos, Cambodia and Malaysia show falling processed-wood exports alongside their vanished log exports. Only Myanmar converted part of its lost log trade into processed form, and only one fifth of it. Three contributions follow. First, we supply the measurement that the log-focused literature left open, extending the analysis

from a single tariff line to the first four stages of the wood value chain. Second, we propose the substitution ratio as a transparent statistic for the question of changes in bilateral trade value around restrictions, and we document how sharply it depends on the base period chosen, an exercise that is usually left implicit. Third, we show that the aggregate figure conceals a composition effect strong enough to reverse its sign, which is a caution for any regional study of export restrictions that works with totals. The rest of the paper is organised as follows. Section 2 reviews the policy background and the relevant literature. Section 3 describes the data and defines the measures. Section 4 reports the results. Section 5 concludes.

2. Background and Literature

2.1. Log Export Restrictions in ASEAN

Restrictions differ in scope. Myanmar's Notification No. 26/2013, dated 5 April 2013, prohibits nationwide HS 4403 exports from 1 April 2014 ([Ministry of Environmental Conservation and Forestry, 2013](#)). Laos's Order No. 15/PM, dated 13 May 2016, covers natural-forest logs and unfinished timber, including sawnwood, and illegal transit ([Government of Lao PDR, 2016](#)). Cambodia's Sub-Decree No. 131, dated 28 November 2006, prohibits logs, rough-sawn timber and oversized squared timber; its 2016 episode concerns enforcement at the Vietnam border, not a new nationwide ban ([Royal Government of Cambodia, 2006](#); [Pheap, 2016](#)). Sabah's log-export restriction began on 23 May 2018 and applies only within that Malaysian state ([DIDR, 2019](#)).

2.2. Export Restrictions and Downstream Processing

The theoretical argument for restricting raw-material exports is straightforward. A binding export ban depresses the domestic price of the raw material below the world price, which is equivalent to an implicit subsidy to domestic processors that use it as an input. If processors respond by expanding, the country exports processed goods instead of raw ones and retains the processing margin. The same logic underlies resource-nationalist policies in mining, where governments restrict ore exports to induce domestic smelting ([Östensson, 2019](#)). The empirical record is considerably less encouraging than the theory. [Resosudarmo and Yusuf \(2006\)](#) reviewed two decades of debate on Indonesia's log export ban and concluded that the evidence largely demonstrates the perversity of such policies, even as governments continue to adopt them. [Amoah et al. \(2009\)](#) reached similar conclusions for Ghana, and [Tachibana \(2000\)](#) showed that Southeast Asian log export restrictions were transmitted to the Japanese plywood market rather than absorbed by new domestic processing. More recent cross-country work is more favourable but also more qualified. [Marchand and Zerbo \(2023\)](#) examined whether log export bans raise the production and export of sawn timber and veneer, distinguishing a simpler from a more complex processing stage, and [Marchand and Zerbo \(2025\)](#) found that ban adoption raised total employment in wood-processing firms across 74 developing countries. The common thread is that the pol-

icy can work, but that its effect operates through firms that must already exist and be able to expand. What has not been done, to our knowledge, is a systematic accounting of how much of the lost raw-material trade returned in processed form for a group of countries subject to comparable restrictions and shipping to a common destination. That is the gap this paper addresses.

2.3. China as the Destination Market

China's position gives the question its scale. China is the world's largest importer of industrial roundwood and the largest exporter of finished wood products, a combination that makes its import composition a sensitive indicator of upstream conditions in supplier countries (Zhang & Gan, 2007). Guan and Zhang (2023) estimated a gravity model of log export restrictions in 38 countries and found that exporter forest endowment and WTO membership, alongside the restrictions themselves, shape China's log imports. Chinese demand also shifted for reasons unrelated to ASEAN policy over our sample period. Zhang and Chen (2021) used a triple-difference design to show that China's logging ban in natural forests changed wood trade responses across product categories, and Zhang et al. (2023) examined its effect on the stability of the timber import trade network. The Russian export tax regime and later the 2022 sanctions environment altered the relative attractiveness of northern suppliers over the same period. These parallel shifts mean that a fall in ASEAN log shipments cannot be read as a pure policy response, a limitation we return to in Section 5.

3. Data and Measurement

3.1. Data Sources

Trade data are taken from the United Nations Comtrade database. The reporter is China, the flow is imports, the partners are the ten ASEAN member states (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam), the frequency is annual and the period is 2010 to 2024. Four commodity codes constitute the core sample: HS 4403 wood in the rough, HS 4407 wood sawn lengthwise, HS 4408 sheets for veneering, and HS 4412 plywood. Four additional codes, HS 4409, HS 4410, HS 4411 and HS 9403, are used in a robustness check that widens the definition of processed wood. Values are import values in current US dollars on a CIF basis; quantities are net weight in kilograms. The core sample is a balanced grid of ten partners, fifteen years and four products, that is 600 cells, of which 511 record positive imports; the remaining cells are true zeros rather than missing values. All files were downloaded directly from the source, and the complete set of query parameters and download timestamps is retained alongside the raw JSON responses so that every figure in this paper can be traced back to its request.

Table 1 summarises the variables and their sources.

Two data issues require disclosure. First, the Comtrade preview interface returns records disaggregated by second partner for some years, so that naive sum-

mation double-counts; we retain the aggregate record where one exists and sum the disaggregated records only where it does not. Second, net weight is missing for most log records in 2016, so that year's weight coverage, measured by value, is 81.8 percent; unit values are reported as not available wherever weight coverage for a year-product cell falls below 95 percent, rather than computed from partial coverage. The 2016 veneer unit value, which passes that threshold but is an order of magnitude above adjacent years, should also be treated with caution.

Table 1. Variables and data sources.

Variable	Definition	Unit	Source and coverage
Import value	China's imports of a product from a partner	USD, CIF	UN Comtrade, reporter China (156), flow imports, annual, 2010-2024
Net weight	Quantity of the same flow	kg	UN Comtrade; missing for most 2016 log records
Logs	HS 4403, wood in the rough	—	HS four-digit heading
Sawnwood	HS 4407, wood sawn lengthwise	—	HS four-digit heading
Veneer	HS 4408, sheets for veneering	—	HS four-digit heading
Plywood	HS 4412, plywood and laminated wood	—	HS four-digit heading
Extended set	HS 4409, 4410, 4411, 9403	—	Robustness check only
Partners	Ten ASEAN member states	—	Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam
Policy dates	Restriction or enforcement episodes	—	Policy instruments and official administrative records; Myanmar 2014, Laos/Cambodia 2016, Sabah 2018; see Section 2.1
Processed share	Non-log products as a share of the four-product total	%	Computed
Upgrading index	Value-weighted processing depth, weights 0, 1/3, 2/3, 1	0 - 1	Computed
Nominal-value substitution ratio	Processed-value change/log-value decline	ratio	Computed
Concentration	Largest-supplier share and Herfindahl-Hirschman index	%, points	Computed on the four-product total
Unit value	Import value divided by net weight	USD/kg	Computed; not reported where weight coverage is below 95 percent

3.2. Measures

Let $V(c, p, t)$ denote the value of China's imports of product p from country c in year t , where p runs over logs, sawnwood, veneer and plywood. Processed wood is the sum of the three non-log categories. The processed share is the share of processed wood in the four-product total, computed for the region or for a single partner. The upgrading index weights each product by its position in the processing chain, assigning weights of 0 to logs, 1/3 to sawnwood, 2/3 to veneer and 1 to plywood, and takes the value-weighted average. It ranges from 0, when imports are entirely logs, to 1, when imports are entirely plywood. The device is deliberately simple. Trade-based measures of sophistication and upgrading are well established (Lall et al., 2006; Schott, 2007), and Kaplinsky (2005) discussed at length what can and cannot be inferred about upgrading in the wood furniture sector from trade statistics alone; our index inherits those limits and is offered as a compact summary of composition rather than as a welfare measure. Policy-context suppliers have a documented restriction/enforcement episode in Section 2.1 and three complete pre- and post-event years: Myanmar, Laos, Cambodia and Malaysia. Malaysia is a national proxy for Sabah; Cambodia represents border enforcement. Membership is independent of subsequent imports. ASEAN-10 remains the regional description; ASEAN excluding Thailand is only a composition sensitivity check, not the policy sample.

Write $L(c, t)$ for country c 's log exports to China in year t and $P(c, t)$ for the sum of its three processed-wood categories. The nominal-value substitution ratio σ compares the change in the second with the change in the first between a base period t_0 and an end period t_1 :

$$\sigma_c = \frac{P(c, t_1) - P(c, t_0)}{L(c, t_0) - L(c, t_1)}$$

The denominator is the fall in log imports and is positive whenever log imports declined. A ratio greater than one indicates that the rise in processed wood more than offset the lost log trade; a ratio between zero and one indicates partial substitution; a ratio at or below zero indicates that processed-wood imports fell as well, so that the bilateral trade contracted in both categories. The ratio is undefined where log imports did not fall, which is the case for Thailand.

Because σ compares two endpoints, it inherits whatever is idiosyncratic about them. Section 4.3 therefore reports it under four base-period definitions rather than defending a single choice. For a deflated counterpart, replace each annual value V by $V \times I(2014)/I(t)$, using the World Bank's annual Timber price index (2010 = 100; World Bank, 2025). This common hardwood log/sawnwood benchmark is a price sensitivity check, not a product-specific volume measure. Two further descriptive measures are used. Supplier concentration is summarised by the share of the largest supplier and by the Herfindahl-Hirschman index computed over partner shares of the four-product total. Unit values, in dollars per kilogram, are reported where weight coverage permits.

4. Results

4.1. The Composition of Imports Has Been Transformed

Table 2 reports the annual structure of China's wood imports from ASEAN. **Figure 1** presents the same information graphically.

Table 2. China's wood imports from ASEAN-10 by product, 2010-2024 (million USD).

Year	Logs	Sawnwood	Veneer	Plywood	Total	Log share (%)	Upgrading index
2010	459.4	886.5	13.9	80.5	1440.2	31.9	0.267
2011	841.1	1131.2	23.1	79.2	2074.7	40.5	0.227
2012	669.8	1167.5	29.6	76.5	1943.5	34.5	0.250
2013	1166.7	1493.5	50.0	54.0	2764.2	42.2	0.212
2014	1926.9	1893.4	75.7	59.3	3955.3	48.7	0.187
2015	608.6	1661.7	79.0	52.7	2402.0	25.3	0.274
2016	448.9	1893.6	61.9	53.1	2457.5	18.3	0.295
2017	291.0	2222.3	57.5	44.5	2615.2	11.1	0.315
2018	246.1	1995.1	73.8	34.2	2349.1	10.5	0.319
2019	174.1	1434.0	81.7	26.2	1716.1	10.1	0.326
2020	62.3	1250.0	104.2	25.3	1441.8	4.3	0.355
2021	124.6	1293.4	211.0	21.3	1650.4	7.5	0.359
2022	77.9	1288.4	125.2	19.3	1510.8	5.2	0.352
2023	64.5	1490.4	122.4	13.4	1690.8	3.8	0.350
2024	42.4	1628.6	155.8	15.5	1842.3	2.3	0.359

Source: UN Comtrade, China-reported imports, CIF values. Upgrading index weights logs 0, sawnwood 1/3, veneer 2/3, plywood 1.

The compositional change is unambiguous. Logs accounted for 48.7 percent of the four-product total at the 2014 peak and 2.3 percent in 2024. The upgrading index, which had actually fallen during the log boom of 2011-2014 as raw material crowded out processed goods, rose from 0.187 in 2014 to 0.359 in 2024 and has been flat since 2021, suggesting the transition has run its course. On this margin the trade relationship has been remade. Two features of **Table 2** qualify any celebratory reading. The 2014 peak is an outlier rather than a plateau: log imports rose by two thirds between 2013 and 2014 and then fell by roughly the same proportion in a single year, a spike driven mainly by Laos, whose shipments rose from USD 309 million in 2013 to USD 784 million in 2014 ahead of the restrictions that followed. Any comparison anchored on 2014 therefore measures partly against an anomaly. More importantly, the four-product total in 2024, at USD 1.84 billion, is less than half the 2014 peak, having recovered only to about a quarter above its 2010 nominal level while its composition changed completely. The composition improved far faster than the volume of business recovered.

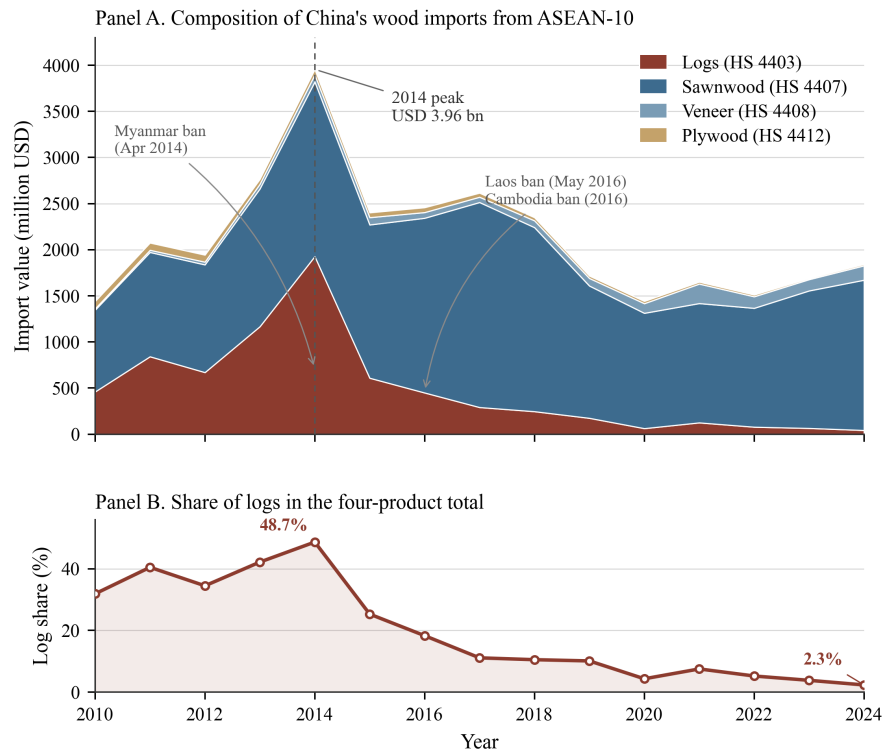


Figure 1. Composition of China's wood imports from ASEAN-10, 2010-2024.

4.2. Substitution Fails at the Regional Level

Table 3 decomposes the change between the 2014 peak and 2024 by partner and reports the substitution ratio.

Table 3. Substitution of processed wood for logs (million USD). (a) By partner, 2014-2024; (b) Region-wide ratio under alternative base periods.

(a)							
Country	Logs 2014	Logs 2024	Δ Logs	Processed 2014	Processed 2024	Δ Processed	σ (nominal)
Laos	783.7	26.9	-756.8	248.3	29.9	-218.3	-0.29
Myanmar	619.3	0.1	-619.2	42.5	169.3	+126.8	+0.20
Vietnam	241.8	2.4	-239.4	165.0	164.9	-0.0	-0.00
Malaysia	127.9	3.9	-123.9	188.6	59.7	-129.0	-1.04
Cambodia	125.2	3.7	-121.5	14.7	0.4	-14.3	-0.12
Indonesia	20.8	0.7	-20.1	259.3	50.0	-209.2	-10.41
Philippines	4.7	0.0	-4.7	92.3	46.2	-46.1	-9.76
Thailand	2.0	4.4	+2.3	1017.8	1279.3	+261.6	n.a.
ASEAN-10 total	1926.9	42.4	-1884.5	2028.4	1799.9	-228.6	-0.12
Excluding Thailand	1924.9	38.1	-1886.8	1010.6	520.5	-490.1	-0.26

Continued

(b)				
Base and end period	Sample	Δ Logs	Δ Processed	σ (nominal)
2014 peak to 2024	ASEAN-10	-1884.5	-228.6	-0.12
2014 peak to 2024	Excl. Thailand	-1886.8	-490.1	-0.26
2010 to 2024	ASEAN-10	-416.9	+819.1	+1.96
2010 to 2024	Excl. Thailand	-419.2	+42.0	+0.10
2010-2012 avg to 2022-2024 avg	ASEAN-10	-595.2	+457.0	+0.77
2010-2012 avg to 2022-2024 avg	Excl. Thailand	-602.1	-89.8	-0.15
2012-2014 avg to 2022-2024 avg	ASEAN-10	-1192.9	-13.5	-0.01
2012-2014 avg to 2022-2024 avg	Excl. Thailand	-1200.4	-297.7	-0.25

Source: (a) UN Comtrade. Brunei and Singapore omitted (negligible values). σ is undefined for Thailand because its log imports rose; (b) UN Comtrade. Three-year averages reduce sensitivity to single-year spikes.

The regional substitution ratio is -0.12. Processed-wood imports did not rise to meet the shortfall in logs; they fell by USD 229 million while logs fell by USD 1.88 billion. Excluding Thailand the ratio falls to -0.26, and the processed-wood total halves from USD 1.01 billion to USD 521 million. For 2014-2024, policy-context ratios are -0.14 (nominal) and -0.09 (deflated). Deflated ASEAN-10 and ASEAN excluding Thailand ratios are +0.18 and -0.17. The country pattern explains why. Laos lost USD 757 million of log exports to China, by far the largest absolute loss, and lost a further USD 218 million of processed-wood exports on top of it, giving the most negative ratio among the states with substantial log trade. Cambodia followed the same path on a smaller scale. Vietnam's processed-wood exports to China were unchanged to the nearest million while its log exports vanished, a ratio indistinguishable from zero. [Iwanaga et al. \(2020\)](#) documented how plantation expansion and the natural-forest logging ban reshaped raw-material procurement among Vietnamese sawmills, while [Meyfroidt and Lambin \(2009\)](#) showed that Vietnam's forest recovery was accompanied by displaced extraction abroad, making the country a substantial importer of wood in its own right. Malaysia's ratio of -1.04 reflects a decline in processed exports slightly larger than the fall in logs. Indonesia and the Philippines register extreme negative ratios, but these are artefacts of small denominators: both had already banned log exports before 2014, so their log trade with China was negligible at the base date and any fall in processed wood divides by a very small number. Those two ratios should not be interpreted. Myanmar is the single case of genuine partial substitution. Log exports to China fell from USD 619 million to USD 0.1 million, effectively to zero, while processed-wood exports rose from USD 42 million to USD 169 million, recovering about one fifth of the lost value. [Dong and He \(2018\)](#) documented the cross-border timber trade from Myanmar to China around the ban, and [Rand et al. \(2023\)](#) examined economic and environmental upgrading in the Myanmar tim-

ber value chain after policy reform, finding that legality-verification mechanisms did not always match the conditions facing local firms.

Figure 2 compares the changes in log and processed-wood imports across ASEAN suppliers between 2014 and 2024. Thailand accounts for the divergence between the two aggregate rows. Its processed-wood exports to China rose by USD 262 million to reach USD 1.28 billion in 2024, seventy-one percent of ASEAN's total processed-wood exports to China. The material is overwhelmingly rubberwood sawnwood, a by-product of replanting cycles in latex plantations; Shigematsu et al. (2011) identified rubberwood as central to the wood exports of both Thailand and Malaysia. Thailand shipped USD 2.0 million of logs to China in 2014 and had little log trade at the base date. Its contribution explains the sensitivity check; it does not determine policy-sample membership.

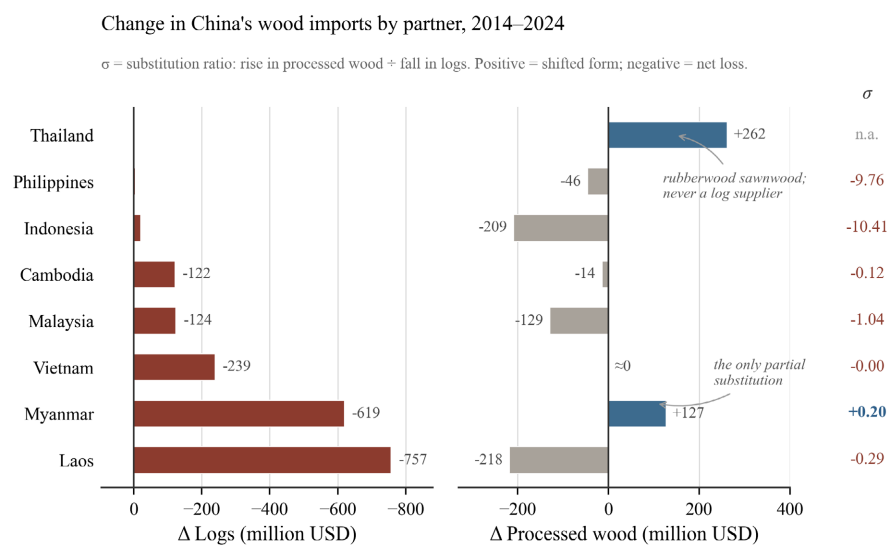


Figure 2. Change in China's wood imports by partner, 2014–2024.

4.3. The Substitution Ratio Depends on the Base Period

Because σ is computed from two endpoints, and because 2014 was an exceptional year, the choice of base period deserves explicit treatment rather than a footnote. Panel B of **Table 3** recomputes the regional ratio under four definitions. The range is wide: from -0.26 to $+1.96$. Two regularities cut through it. First, every specification that excludes Thailand returns a ratio at or near zero, between -0.26 and $+0.10$, and three of the four are negative. Second, the two specifications that yield apparent substitution both include Thailand, and the higher of them uses a 2010 base that predates most of Thailand's sawnwood expansion, so that Thailand's growth changes the regional ratio. Averaging over three years narrows the spread but does not change the conclusion once Thailand is removed. These comparisons describe endpoint and supplier composition sensitivity, not policy effectiveness.

4.4. Around the Bans

Table 3 compares endpoints ten years apart. We also describe three-year averages

before and after the four episodes, excluding the event year; neither comparison isolates policy effects. Log imports fell in the three mainland comparisons. Myanmar's annual average fell from USD 331 million in 2011-2013 to USD 121 million in 2015-2017, a decline of 64 percent; Laos fell from USD 477 million in 2013-2015 to USD 129 million in 2017-2019, or 73 percent; Cambodia fell from USD 68 million to USD 11 million over the same windows, or 84 percent. Processed-wood imports fell alongside them, by 40 percent for Myanmar (USD 55 million to USD 33 million), 60 percent for Laos (USD 166 million to USD 67 million) and 36 percent for Cambodia (USD 15 million to USD 9 million). The processed share of each country's shipments did rise, from 14 to 21 percent for Myanmar, 26 to 34 percent for Laos and 18 to 46 percent for Cambodia, but this reflects the collapse of the denominator rather than growth in the numerator. Both China-bound categories declined in these windows. Myanmar's later recovery, from USD 33 million in 2015-2017 to USD 169 million by 2024, describes later China-bound growth, not a processing-capacity response. For the 2018 Sabah episode, Malaysia's national averages fell from USD 40.5 million to USD 2.8 million for logs (2015-2017 versus 2019-2021), and USD 145.2 million to USD 75.0 million for processed wood. These are national comparisons, not Sabah estimates. The Philippines is omitted from this comparison: its 2011 ban leaves only one pre-ban year inside the sample, and its log trade with China was already negligible, so the implied changes rest on very small values.

4.5. Concentration and Unit Values

Two further measures support the same reading. Supplier concentration in the four-product total rose substantially: the largest supplier's share increased from 35.0 percent in 2010 to 69.7 percent in 2024, and the Herfindahl-Hirschman index rose from 2195 to 5058. Thailand was the largest supplier in both years, but its share almost exactly doubled, from 35.0 to 69.7 percent, as the mainland log suppliers dropped away. China's wood trade with ASEAN is now, in effect, a trade with Thailand plus a residual. Unit values indicate that the composition shift did not raise average prices as the upgrading narrative would suggest. Sawnwood fell from USD 0.415 per kilogram in 2010 to USD 0.363 in 2024, and veneer from USD 0.327 to USD 0.169. Only plywood rose, from USD 0.728 to USD 1.176. Meanwhile the unit value of the residual log trade doubled, from USD 0.310 to USD 0.622 per kilogram, consistent with the remaining shipments being small volumes of high-value species rather than bulk industrial roundwood. The processed material entering China from ASEAN is thus not, on average, more valuable per unit than it was; the upgrading is in product category rather than in price. The 2016 log unit value is not reported because net weight is missing for most log records in that year.

4.6. Robustness

Widening the definition of processed wood to include shaped wood (HS 4409),

particle board (HS 4410), fibreboard (HS 4411) and wooden furniture (HS 9403) raises the 2024 total from USD 1.84 billion to USD 2.07 billion and the processed share from 97.7 to 98.0 percent, leaving every conclusion intact. The additional categories are small in the ASEAN-China relationship.

5. Conclusions

China's wood imports from ASEAN changed form completely between 2010 and 2024. Logs fell from 48.7 percent of the four-product total at the 2014 peak to 2.3 percent in 2024, and an index of processing depth rose from 0.187 to 0.359. Imports changed following the restrictions; attribution to the bans is unsupported. The substitution ratio for the region is -0.12 , and -0.26 excluding Thailand: processed-wood imports fell alongside logs instead of replacing them. Several suppliers recorded declines in both China-bound categories. Laos lost USD 757 million of log trade and USD 218 million of processed trade on top of it. Cambodia lost both. Vietnam's log trade vanished while its processed exports to China stood still, without evidence here about other markets. Only Myanmar converted part of its lost log trade into processed form, and only about one fifth of it. The apparent regional success visible under some specifications rests on Thai rubberwood sawnwood, which alone accounted for 71 percent of ASEAN's processed-wood exports to China in 2024.

The evidence concerns China-bound trade, not national processing capacity or exports to third markets. Related governance research includes [Ramcilovic-Suominen et al. \(2019\)](#) mapping the concentration of power in Laos's timber legality negotiations and [Milne \(2015\)](#) documenting the persistence of illicit extraction in Cambodia alongside formal restrictions. Legality requirements are already reshaping tropical timber flows: [Masiero et al. \(2015\)](#) argued that they are producing a dual market in tropical timber products, [Kim et al. \(2024\)](#) analysed their effect on tropical sawnwood trade, and [Nathan et al. \(2018\)](#) examined how Chinese wood enterprises respond to international legality verification.

Three limitations bound these conclusions. First, the analysis is descriptive: the substitution ratio measures what happened around the bans, not what would have happened without them, and the four policy-context reporting partners are too few and too heterogeneous for a credible counterfactual. Chinese demand shifted over the same period for domestic reasons, including the 2017 extension of the natural forest logging ban, and the observed changes may reflect those shifts and global supply conditions. Second, we observe only bilateral trade with China; a supplier that redirected processed exports to third markets would appear here as a failure of substitution when it is in fact a redirection. Third, the common Timber deflator cannot capture product- or supplier-specific prices; neither ratio measures physical quantities. The natural extension is to widen the destination set. Measuring each ASEAN supplier's processed-wood exports to all destinations would separate the countries that failed to build processing capacity from those that built it and sold elsewhere, a distinction this paper's bilateral design cannot draw and one

that matters for the policy verdict.

Author Contributions

Conceptualization, K.N. and Z.G.; methodology, K.N.; software, K.N.; validation, K.N. and Z.G.; formal analysis, K.N.; investigation, K.N.; data curation, K.N.; writing—original draft preparation, K.N.; writing—review and editing, K.N. and Z.G.; visualization, K.N.; supervision, Z.G.; project administration, Z.G. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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