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Israel's Ports Competition Reform: Research Dossier

1. Background & Reform Narrative

Israel's seaport sector has undergone a dramatic transformation from a state-owned duopoly plagued by inefficiency to a more competitive system with new private entrants. Historically, Israel relied on two main Mediterranean cargo ports – **Haifa** in the north and **Ashdod** in the south – both managed under a centralized Israel Port Authority until the early 2000s. Prior to reform, these ports suffered chronic labor disputes and low productivity: in the early 2000s, ships waited on average 17 hours to dock [1], and a government report found Israeli port work teams were **15–25% less productive** than Mediterranean peers [2]. Powerful unions of about 2,400 workers (earning roughly double the public-sector average) exerted outsized control [3] [4]. Strikes and slowdowns were common – for example, a 10-day union "go-slow" in April 2013 cost the economy an estimated ₪25 million in direct losses [5]. The unions "used their control of a key state property against the state," in the words of a chamber of commerce president [6]. Political leaders grew increasingly frustrated; then-Finance Minister Yair Lapid even declared "**Let there be war**" on port union intransigence [7].

First Phase (2003–2005): Institutional Restructuring. The seeds of reform were planted in the mid-2000s. In 2003, Israel embarked on a ports reform aimed at breaking the state monopoly. A new Ports and Shipping Law was enacted in 2004–2005, under which the Israel Ports Authority was **broken up into three independent government-owned port companies (Haifa, Ashdod, Eilat)** plus a landlord/regulatory body, the **Israel Ports Company (IPC)** [8] [9]. This corporatization took effect in February 2005, despite a month-long general strike by port workers protesting the change [9]. The intent was to **spur internal competition** between Haifa and Ashdod ports [10]. Service did improve modestly after 2005 – by 2012, average ship wait times fell to 3.7 hours at Haifa and 6.5 at Ashdod [11]. However, these wait times were still high by international standards ("in most world ports, *any* wait is unacceptable" noted an IPC official [12]). In essence, the 2005 restructuring curbed some inefficiencies but did not address the **core issue of a duopoly with strong unions and outdated infrastructure**.

Cost-of-Living Crisis and Renewed Reform Push (2011–2013). Widespread social protests in 2011 over Israel's high cost of living provided new impetus to tackle entrenched monopolies [13]. The government-appointed **Trajtenberg Committee (2011)** identified port inefficiency and lack of competition as major contributors to import costs [2]. The committee noted Israel's near-total dependence on seaports and that poor port performance imposed "very high economic costs" on importers via ship delays and high fees, especially due to elevated labor costs [14]. Trajtenberg recommended enabling *"effective intra-port competition"* by building new terminals at Haifa and Ashdod and expediting their statutory planning by end of 2012 [15]. In December 2011, the government formally adopted these recommendations and directed ministries to **accelerate the ports reform announced back in 2005**, with goals to *"open Israeli ports to competition, increase government revenues, and reduce the cost of living"* [16].

By 2013, political resolve to confront the unions had hardened. Prime Minister Benjamin Netanyahu, re-elected with a mandate to jumpstart growth, squarely blamed high consumer prices on monopolies and cartels, including the ports [13]. His transport minister Yisrael Katz vowed that *"opposite each port, a private competing pier must be built"* [17]. Despite union threats to "never let it happen" [18], the government approved plans in 2013–2014 for two new deep-water container terminals – one adjacent to Haifa (dubbed "Bayport") and one at Ashdod ("Southport") [19]. Each new terminal would be 800m long with 17.3m depth, able to berth 18,000–24,000 TEU mega-ships that previously could not dock in Israel [20]. Notably, at that time Haifa's old port could only handle ~15,000 TEU vessels [21], forcing some Israeli-bound cargo to be transshipped through foreign hubs at an annual cost of ~$30 million [22]. Thus, expanding capacity was both a competitive and infrastructural necessity.

Introduction of Private Competitors (2014–2022). Tenders to construct and operate the new terminals were issued in 2014. Few Western firms bid – the U.S. ambassador even tried (unsuccessfully) to recruit American companies [23]. Eventually, foreign operators from China and Europe stepped in. For Haifa's Bayport, **Shanghai International Port Group (SIPG)** was the sole bidder and won a 25-year operating franchise in 2015 [24] [25]. For Ashdod's Southport (Hebrew: נמל הדרום, also called the Hadarom terminal), the contract went to **Terminal Investment Ltd (TIL)** – an international port operator affiliated with Swiss-based MSC Shipping – also on a 25-year term [26] [27]. Chinese firms played a role in construction: e.g. China Harbour Engineering Co. built Ashdod's new terminal with a $894M Exim Bank loan [28] [29]. The foundations were laid in October 2014 with the Prime Minister in attendance [30]. After ~7 years of works (despite some local opposition and regulatory hurdles [31]), both new terminals came online around **late 2021**. **Haifa Bayport officially opened on 1 September 2021** [32] [25], marked by the arrival of a COSCO mega-ship and a modest COVID-era inauguration. Ashdod's Southport began partial operations in August 2021 and ramped up to full commercial service by late 2022 [33] [34]. On 24 November 2022, Southport hosted the *MSC Oscar*, the largest container ship to ever call in Israel up to that date [33], dramatizing the new ports' capabilities.

The entrance of these modern terminals **immediately shook up the sector's dynamics**. For the first time, Israeli port users had an alternative to the legacy ports, and they responded swiftly. Major shipping lines shifted their business to the new facilities to take advantage of greater efficiency and capacity. In Haifa, SIPG's Bayport quickly captured a dominant share of certain markets: by the end of 2022, Bayport handled **88% of Israel's transshipment traffic** (feedering containers between big and small ships) [35] [36]. The Chinese-operated terminal became a transshipment hub, benefitting from its deep water and state-of-the-art equipment. Meanwhile, Haifa's legacy port (the Haifa Port Company) saw container volumes plummet as shippers like COSCO, ZIM, MSC and Maersk migrated to Bayport [37] [38]. By Q2 2023, Bayport was handling ~80% of all container loading in Israel, while the "old" Haifa port's share shriveled to near-negligible levels [38]. Ashdod's experience was similar if less extreme: the new Southport (operated by TIL's subsidiary **Hadarom Container Terminal, HCT**) began attracting the business of MSC and others. The state-run Ashdod Port Company saw cargo throughput decline significantly in 2022, including a **24% drop in container volume vs. 2017** [39]. Together, the two new terminals added ~4 million TEU/year capacity (each up to ~2m TEU at full buildout) [40], loosening the bottleneck grip of the old ports. Competition also spurred the incumbents to upgrade: as part of the reform plan, Haifa and Ashdod's **existing quays were extended and deepened** to handle larger ships [41]. Ashdod Port Company, for instance, announced ₪1.5 billion of infrastructure investments (new cranes, automated systems, etc.) to raise its game [42] [43].

Privatization of Legacy Ports (2018–2023). In parallel, Israel moved to privatize the government-owned port companies to further boost efficiency. A small step came in 2013, when the minor Port of *Eilat* (Red Sea

port handling ~5% of trade) was sold to a private operator [44] [45]. The big prize was Haifa. After several false starts, the **Haifa Port Company** sale was launched in 2020 and successfully tendered by mid-2022 [46]. The winning consortium, **Adani Ports (India) and Gadot Group (Israel)**, agreed to pay **₪4.1 billion** (~$1.15b) [47]. The deal closed on **January 15, 2023** [48], marking one of Israel's largest privatizations in decades. The new owners took a 100% stake, with Adani holding 70% and Gadot 30% [49]. (Notably, the sale *excluded* the new Bayport terminal across the bay, which remains under SIPG's concession [47].) Finance Minister Bezalel Smotrich hailed the Haifa sale, commenting that *"it will enable [the port] to be competitive – competition is important for the economy"*, and expressed hope to "do the same in Ashdod" [50]. Indeed, **Ashdod Port Company** is now the sole major port still state-owned [51]. Plans for its privatization have been debated, but as of 2024 full privatization was **"off the agenda"** due to ministerial opposition [52]. Instead, a partial privatization via public share offering is considered – Ashdod Port already has 20% of shares listed on the Tel Aviv exchange [53]. In the meantime, Ashdod's management openly complains of an uneven playing field, even raising national security concerns about the Chinese-run rival in Haifa during the 2023 Gaza war [54] [55]. Such complaints likely reflect competitive tensions: the new entrants have eroded Ashdod's market share, pressuring the legacy port to reform or lose relevance [56].

Economic Logic of the Reforms. The overarching theory of change behind Israel's ports reform is that **introducing competition and private ownership would drive capital deepening (K/L) and labor productivity (LP) gains, ultimately lowering trade costs.** Under state monopoly, the ports suffered from under-investment in modern infrastructure and rigid labor practices. By **opening the sector** to new operators, the reform induced a *step change in capital intensity*: for example, the Bayport terminal brought in 8 super-post-Panamax cranes, automated yards, and digital systems enabling remote operation of equipment [57] [58] – technologies previously "unknown in Israel" [59]. Fewer workers are needed: by 2023 Bayport employed only ~150 local staff (plus ~20 expats) to handle ~1 million TEU/year [60], far outstripping the throughput per worker at the old ports. This **capital deepening** – more machinery and infrastructure per worker – is expected to raise **labor productivity**, measured in throughput (tons or TEUs) per employee-hour. Indeed, the new terminals boast faster turnaround and higher crane productivity, evidenced by Israel's improved standing in the World Bank's **Container Port Performance Index**. In 2021, prior to reform, Israel's ports ranked very poorly (Haifa was 196th globally), but after the new ports came online Haifa climbed to 56th in 2022 [61], reflecting huge efficiency gains. Meanwhile, the competitive pressure forced unionized port companies to streamline. The Haifa Port Company, now privatized, is contractually obliged to invest at least $290M in modernization [62] [63]. Even before privatization, both Haifa and Ashdod companies accelerated capital expenditures (e.g. Ashdod purchased advanced cranes and started a tech innovation hub) to try to narrow the gap [43]. Thus, **port competition → more capital per worker + better work practices → higher productivity**. This mechanism aligns with global experience: studies find that private or landlord ports tend to invest more in up-to-date equipment and achieve higher throughput efficiency [64] [65].

Finally, beyond microeconomic productivity, the reform aimed to **reduce import costs and improve service** for Israel's trade. By 2022–23 we observe outcomes consistent with this: shipping lines can now choose between multiple terminals, fostering **price competition** in fees and reducing delays. The costly *status quo ante* – with long queues (ship waiting times in Ashdod had ballooned to 123 hours for some cargos in 2021 [66]) and shipping surcharges passed onto consumers – has begun to recede. While comprehensive cost-of-trade data post-reform is not yet published, the government expects the increased port efficiency to lower Israel's supply chain costs and ultimately consumer prices [67]. In sum, Israel's port reform from 2003 to 2023 followed a **chronology** of corporatization (2005), introduction of private competition (tenders 2014, new ports 2021), and privatization of incumbents (Haifa 2023, Ashdod pending).

This multi-stage process illustrates an economic policy pathway wherein *structural reform triggers capital deepening which in turn drives productivity growth*. The following sections delve into literature, data, and methods to rigorously evaluate this pathway – comparing Israel's experience to global benchmarks and outlining an empirical strategy to quantify the **total, indirect (via K/L), and direct effects** of the port competition reform on productivity.

2. Literature Review — Israel-Specific Sources

(1) Trajtenberg Committee Report (2011) – *"Report of the Committee on Socioeconomic Change"* – **Quality: A (official government report)**. **Methods: Policy analysis & benchmarking.** This Hebrew report was a government-commissioned blueprint responding to 2011 social protests. It dedicates a section to **seaports**, noting Israel's *"almost complete dependence"* on them and diagnosing **inefficient port performance as a major cost driver** in the economy [68] [14]. The committee found that poor productivity at Haifa/Ashdod raised import costs through long ship wait times, unreliable service, and high user fees – all linked to **monopoly and labor power**. It highlighted that wage expenses at the ports were especially onerous, and there were no quick fixes in the short run [14]. Critically, Trajtenberg recommended enabling *effective intra-port competition* by building new terminals at each port, and fast-tracking their statutory planning by end-2012 [15]. The government formally adopted these recommendations in Dec 2011 [69]. **Design implications:** This report provides baseline evidence that **lack of competition was identified as the key structural failure** harming port efficiency. It justifies treating the 2021 opening of new terminals (and related decisions) as an exogenous *policy shock*. The report's quantified gap (15–25% productivity lag vs. peers [2]) offers a **benchmark for expected efficiency gains** from reform. We will use its findings to motivate our research question and to compare pre-reform performance with post-reform outcomes.

(2) State Comptroller's Report (2024) – *"Ports Sector in Israel and Service at Ashdod Port"* – **Quality: A (official audit)**. **Methods: Descriptive statistics & performance audit.** The State Comptroller (מבקר המדינה) investigated Israeli port performance from 2017–2022, providing valuable Hebrew-source data on operational efficiency. The report found that **all key service metrics worsened from 2018 to 2021** at Haifa and Ashdod: average ship waiting time more than tripled, and average ship **dwell time** (port time) roughly doubled [70] [71]. For example, by 2021 a bulk cargo vessel waited **313 hours** to start work at Ashdod (vs 49 hours in 2017) [66]. These declines began *before* COVID-19, indicating structural issues (e.g. capacity bottlenecks and labor inefficiencies) [72]. The Comptroller also documented **falling productivity per work hour**. At Ashdod, container handling productivity dropped ~10% (from 43.3 to 39.1 containers/hour 2017–2021) and general cargo tons/hour fell 14% [73] [74]. Haifa saw a similar ~20% decline in container moves/hour (58.6 to 46.6) [75]. Additionally, the **"responsiveness"** of ports in providing labor teams when needed deteriorated by 24–70%, implying labor rigidities [76]. Interestingly, by 2022 – after the new terminals opened – wait times *decreased* compared to 2021, except for a slight uptick for general cargo at Ashdod [77]. This suggests early relief of congestion due to increased capacity. **Design implications:** The Comptroller's data underscore **why reform was needed** and provide **pre-treatment baseline trends**. The steep pre-2021 decline in service could complicate identifying reform effects (trend breaks must be distinguished from continuation of pre-existing decline). However, the report's 2022 improvement in wait times is preliminary evidence correlating with the reform. We will use these detailed metrics (wait, dwell, output/hour) as **outcome variables** in our analysis. The audit also alerts us to control for exogenous shocks (e.g. COVID) and to consider **parallel trends**: performance was worsening in both ports before the reform, which our Difference-in-Differences design must account for.

(3) Reuters News (May 2013) – *"Seaport battle looms as Israel plans new competition"* – Quality: B (high-quality journalism). **Methods: Investigative reporting, interviews.** This English article captures the policy turning point when Israel's government decided to break the Ashdod and Haifa duopoly by licensing private piers [78]. It provides quotes from key actors that illustrate the stakes: Port unions (through Histadrut) vowed to resist any competing ports, while Finance Minister Lapid signaled readiness for a showdown [7] [79]. The piece confirms that in 2013 the cabinet authorized the new terminals, each costing ~₪4 billion, with investors to be found internationally [80]. It also quantifies union power and inefficiency: 2,400 workers, double public-sector pay, causing slowdowns that cost tens of millions [4] [5]. Notably, it reports that **Netanyahu's 2005 reform (corporatization) was "only the first step toward total privatization"** and reduced average ship wait from 17.4 to 3–6 hours by 2012 [9] [11]. Yet even ~3–6 hours was considered excessive globally [12]. The article also mentions the 2013 privatization of Eilat Port and the idea of worker equity participation as a compromise, which was floated but not adopted [44] [18]. **Design implications:** This source gives **contextual qualitative evidence** for our narrative and helps identify *treatment timing*. It indicates that the **policy "shock" can be dated to 2013–2014** when tenders were issued – suggesting we might treat those years (or the actual opening in 2021) as the intervention point. The data on wait times and losses provide **impact measures** to validate against our quantitative findings. Furthermore, the article underscores that other reforms (e.g. Open Skies in aviation) were happening concurrently [81]. We should ensure to isolate port reform effects from such contemporaneous liberalizations in our design (e.g. by controlling for overall trade growth or other policy changes).

(4) Government Press Release (Jan 2023) – *"Completion of Haifa Port privatization"* – Quality: A (official statement). **Methods: Announcement with policy rationale.** The Israeli Government Companies Authority announced the closing of Haifa Port's sale to Adani–Gadot for ₪4.1B [82] [49]. In Hebrew, it emphasized that this **privatization is part of a broader seaports reform begun in 2003**, aimed at **increasing competition and efficiency** [83]. The statement highlighted that the Haifa tender drew robust global interest (five bidding groups) and that the new owners must invest at least ₪1B in the port's development [62] [63]. Officials touted the deal as a historic success that will *"ensure the port's ability to compete and thrive for decades"*, and noted it *"paves the way for similar moves at Ashdod"* [50]. This source confirms that by policy design, **privatization and competition go hand-in-hand** – with competition from the new Bayport balanced by bringing in a private operator for the old Haifa port, and an expectation to do likewise at Ashdod [84]. **Design implications:** The press release (along with local Hebrew media reports of the same [85] [86]) provides **clear official framing** of the reform's intended effect – i.e. competition is expected to *"improve port efficiency through significant investments"* [67]. For our study, this implies **two distinct reform components**: (a) **infrastructure competition** (new terminals in 2021) and (b) **ownership change** (privatization in 2023). We may need to treat these as separate events or instruments in our identification strategy. The investment obligations mentioned guide us to examine **capital expenditure data post-privatization** as evidence of capital deepening.

(5) Calcalist News (Hebrew, July 2022) – *"Gadot–Adani win Haifa Port tender for ₪4.1b"* – Quality: B (respected business media). **Methods: News report with financial data.** This article (in Hebrew) reported the privatization outcome and included **financial and operational stats for Ashdod Port Company**, providing a rare public glimpse into port company performance. It noted that after Haifa's sale, *"Ashdod will remain Israel's only government-owned port"*. Ashdod's **2021 revenues were ₪845M with ₪271M net profit** [86], indicating a healthy ~32% profit margin pre-competition. It broke down Ashdod's revenue sources: 77% from containers, 12% general cargo (including cement), 4% vehicle imports, and 3% transshipment [86]. This shows that transshipment was negligible at Ashdod (only 3% of sales) – a telling contrast to Haifa which historically did more transshipment and saw it nearly all captured by Bayport in 2022 [36]. **Design**

implications: The financial figures establish a **pre-treatment baseline** for Ashdod Port's profitability and volume mix. Post-reform, we anticipate these numbers to shift (e.g. container revenue likely fell as throughput moved to Southport, and profit margins may erode under competition). We can use such data to compute **labor productivity in monetary terms** (revenue or profit per employee) if employment numbers are known. Also, the breakdown reinforces that our analysis should focus primarily on **container throughput and efficiency**, since that is the dominant revenue driver and the segment directly targeted by competition (the new terminals are container terminals). It also suggests using **transshipment volume** as an outcome or mechanism variable, as Haifa's big gain in transshipment share is a direct effect of improved capacity.

(6) Jewish Policy Center/INSS (Winter 2022) – *"Bayport Terminal: The View from Israel"* – **Quality: A (think-tank analysis)**. **Methods: Case study, secondary data.** Written by Orion & Lavi (analysts at INSS) shortly after Bayport's opening, this English article provides a comprehensive narrative of the reform's motivations and expected impacts. It cites the 2011 Trajtenberg findings that Israeli container teams were **15–25% less productive** than foreign counterparts and that lack of competition and strong unions were the root cause [2]. It then describes the government's response: adopting the committee's recommendation, accelerating the port reform that *"was announced back in 2005"* [69]. The article explains in detail how outdated infrastructure (shallower berths) forced Israel to rely on foreign hubs for the largest ships, adding time and cost [87] [22]. It then outlines the **new ports plan** (Bayport and Southport each 800m/17m depth) and the intended outcomes: more capacity, ability to handle 24k TEU megaships, reduced need for transshipment abroad, and overall efficiency gains saving time and money [19] [88]. It concludes that *"operation of the two new ports is essential for solving the problems at Israel's ports…increase competition… encourage greater efficiency in the existing ports"* [89]. **Design implications:** This source effectively summarizes the **theory of change** we seek to test: competition via new terminals should lead to **service improvements and cost reductions**. It also provides **quantitative targets** – e.g. each new port can eventually handle ~2 million TEU [40], versus the ~3 million TEU total the old ports handled together pre-reform [40]. These figures help us set up a **capacity utilization analysis**: one could track how utilization at the old ports changed once an extra ~66% capacity came online. The text also alerts us to **national security and geopolitical factors** (Chinese operator concerns [90]), which, while tangential to productivity, might influence political support and are a reminder to consider external shocks (like war) in our robustness checks. Overall, this analysis from INSS will be cited for the rationale and expected mechanism of reform, strengthening the qualitative validity of our study design.

(7) Ynet/Calcalist (Nov 2023) – *"China halts shipments…hurting its own port"* – **Quality: B (media, translated)**. **Methods: Descriptive stats, natural experiment observation.** This Hebrew-origin news piece (English Ynet version) reported on how the October 2023 Hamas–Israel war and subsequent halt of COSCO shipping lines to Israel impacted Haifa's Bayport. Before that shock, the article recounts Bayport's **meteoric rise**: from first opening in Aug–Sept 2021 to capturing **88% of Israel's transshipment market by end-2022** [35]. It provides concrete numbers demonstrating **productivity and share shifts**: by Q2 2022, Bayport handled 9,600 containers vs 7,400 at old Haifa port [37]; by Q2 2023, Bayport handled ~30k containers (80% of national total) while old Haifa did only 340 [91]. It also notes Zim (Israel's largest shipping company) moved to Bayport, and by Q1 2023 Bayport was loading *10 times* more containers than old Haifa [38]. Following the war outbreak, COSCO's exit then caused Bayport's transshipment volumes to dip sharply, an ironic self-inflicted setback [92]. **Design implications:** The pre-war data here vividly illustrate the **competitive outcome** of the reform: the new port achieved far greater throughput with far fewer workers (Bayport ~150 workers vs Haifa Port ~1,300 workers pre-privatization, implied by labor cuts) – a near-instant productivity leap. We will use these figures as **evidence of impact** (e.g., difference-in-differences in volume

between Haifa and Ashdod, where Haifa's change was more dramatic due to Bayport's success). The COSCO episode also suggests using **transshipment TEUs** as a performance indicator and possibly an instrument: COSCO's move could be seen as an exogenous driver of Bayport's volume. While war effects are beyond our evaluation scope, this highlights the importance of controlling for **external demand shocks** in our analysis. This source will be cited to corroborate the magnitude of shift in container flows attributable to the new competitor.

(8) Globes (Hebrew, Sept 2023) – *"New regulation for Israel's ports underway"* – **Quality: B (industry news)**. **Methods: Policy update.** This piece (referenced via Jerusalem Post) discussed a 2023 regulatory initiative in Israel's port sector. It noted that Israel's ports reform "began twenty years ago" with the goal of improving goods flow efficiency [93]. It revealed that **full privatization of Ashdod Port had fallen off the agenda** due to political opposition [52]. Instead, attention turned to regulatory adjustments and possibly partial listing of shares. The article underscores that since Haifa's privatization, Ashdod remains the sole government-held port, and its status is a matter of debate [52]. **Design implications:** This source reminds us that **Ashdod Port is effectively our "control" case** of a state-run incumbent facing competition without having been privatized (yet). It suggests examining differential outcomes between Haifa (treatment: competition + privatization by 2023) and Ashdod (competition only). We can leverage this in an event-study framework around the Haifa privatization in early 2023. If Haifa's performance post-2023 diverges from Ashdod's (beyond what competition alone caused), that difference could represent the added impact of privatization. This highlights a potential **two-tier analysis**: competition effect vs. ownership effect. It also alerts us to any regulatory changes in 2023–24 that may need to be factored in (the piece implies new port sector regulations being signed by ministers, which could affect operations or pricing).

In summary, Israeli sources consistently portray the port reform as a response to inefficiency caused by monopoly and labor issues, with the remedy being competition and privatization to spur investment and productivity. They provide both **qualitative expectations** (competition improves efficiency) and **quantitative benchmarks** (e.g. wait times, productivity indices) that our study will build upon. These sources strengthen the case for treating the reform as an exogenous intervention and guide the specific outcomes and mechanisms we will measure (wait times, throughput per worker, etc.). They also ensure our design is grounded in the institutional reality (timing of events, union actions, etc.), improving internal validity when we execute the empirical analysis.

3. Literature Review — International & Conceptual Sources

(1) Cheon, Dowall & Song (2010) – *"Impacts of Institutional Reforms on Port Efficiency: Ownership, Corporate Structure, and TFP of World Ports"* – **Quality: A (peer-reviewed, Transport Research E)**. **Methods: Panel data econometric analysis (TFP, fixed-effects).** This influential study evaluates how changes in port governance affect efficiency globally [94]. Using a panel of international container ports, the authors compute Total Factor Productivity and test the impact of **ownership** (public vs private/landlord) and **corporatization** reforms on productivity growth [94] [95]. A key finding is that **privatization alone only partially improves efficiency** – gains are realized when accompanied by competitive pressure and managerial autonomy [96] [64]. Cheon et al. note that private participation often brings *"competitive stimulus, stronger management control (less political interference), and new investment in infrastructure and equipment"*, which together drive productivity improvements [97]. In particular, they highlight that **technological progress tends to follow the transfer of operations to private hands**, resulting in capital injection and better technology adoption [64] [98]. For example, in landlord ports, after privatization of terminals, ports saw significant efficiency jumps from updated equipment and processes [99]. The study's quantitative result

was that ports with reforms had higher TFP growth (on average ~1.5–2 percentage points higher) compared to unreformed ports, controlling for other factors [100] [101]. **Relevance to design:** This paper provides a **conceptual framework** linking our variables of interest: it explicitly demonstrates that *ownership structure and competition are drivers of port productivity*. We will use its insight that **reform benefits come via technology and capital investment** as support for our mediation hypothesis (K/L as the channel). Methodologically, Cheon et al. use panel **fixed-effects regressions on port throughput and efficiency metrics** – a strategy we can emulate with our Israel port panel (albeit with fewer units). They also suggest treating reform not as a binary but examining *which aspects* (ownership, corporate structure, market structure) matter – informing our plan to decompose competition vs privatization effects. This source strengthens the external validity of our study: if Israel's results align with global patterns identified by Cheon et al., our conclusions will be more credible.

(2) Estache, González & Trujillo (2002) – *"Efficiency Gains from Port Reform: Lessons from Mexico"* – **Quality: A (World Bank/World Development)**. **Methods: Quasi-experimental efficiency measurement (Malmquist DEA).** This paper analyzes Mexico's 1993 port privatization and decentralization, drawing parallels to Israel's case. Mexico broke up a federal port monopoly into independent regional port authorities and introduced private terminal concessions [102]. Estache et al. measure port efficiency before vs. after using Data Envelopment Analysis and find **significant short-term efficiency gains post-reform** [102] [103]. Specifically, Mexican ports' average efficiency scores improved immediately following privatization, indicating that the **combination of privatization + increased competition led to productivity jumps** [102] [104]. They also discuss *yardstick competition*: comparing performance across ports spurred improvements. The decomposition in a follow-up 2004 paper shows these gains came from *"technological change"* (frontier shift) and *"catch-up"* (efficiency catch-up) [105] [106]. In other words, some gains were from new investments (shifting the production frontier) and some from better utilization of existing resources due to competitive pressure. **Relevance to design:** This study provides **evidence that port reform can causally increase efficiency**, using one country's natural experiment. For our purposes, Mexico's experience offers a template: a **Difference-in-Differences** can compare port performance pre- vs post-reform. The authors effectively treat 1993 as a break point and use DEA indices to quantify changes – we can similarly use productivity indices or output per worker for Israel. The finding that improvements happened quickly ("short-term improvement" [102]) suggests our study should look for an **immediate jump post-2021** in Israel's data. Additionally, their mention of *yardstick competition* implies we might compare Haifa vs Ashdod outcomes as a form of internal benchmark – though in Israel both got reform, one after the other's effect might serve as a comparison. This source bolsters our confidence in expecting measurable efficiency effects and guides us to analyze **Malmquist index or TFP** changes to complement simple output per labor metrics.

(3) González & Trujillo (2009) – *"Reforms and Efficiency in Spain's Container Ports"* – **Quality: B (journal article)**. **Methods: Stochastic frontier analysis (SFA).** This study examines the impact of gradual liberalization in Spanish ports during the 1990s–2000s. It finds that increased intra-port competition (through multiple terminal operators in one port) and partial privatization improved efficiency over time, but the effects were heterogeneous. Notably, ports that implemented **more extensive reforms saw greater productivity gains** [94] [95]. However, the authors caution that entrenched labor arrangements can dampen the gains. For example, in some Spanish ports where unions retained hiring monopolies (despite private operators), efficiency gains were limited. This resonates with Israel's scenario, where union labor remained in the legacy ports even as new competitors emerged. **Relevance:** This underscores the importance of **labor reforms alongside capital investment**. In our design, we will consider whether labor practices changed (e.g. voluntary retirement plans or new work rules in privatized Haifa) as part of the **direct effect** not captured by capital deepening. It also suggests an analysis of **efficiency dispersion** – not

every port or terminal may respond equally, which in Israel could mean Bayport vs Southport vs old ports had different performance trajectories. We might incorporate port fixed effects and allow treatment effects to vary by port.

(4) Cullinane, Ji & Wang (2005) – *"The Relationship between Privatization and Port Efficiency"* – **Quality: A (Maritime Policy & Management)**. **Methods: Data Envelopment Analysis (DEA) with Tobit regressions.** This paper empirically tests whether privately-operated ports are more efficient than public ones across a sample of international ports. The results are nuanced: **full privatization is not necessary for efficiency – landlord ports with private operators can be just as efficient** [107] [108]. They find that *competition* (number of competing terminals or ports in vicinity) is a more decisive factor than ownership per se [108]. Public ports in a competitive environment often outperform private monopolies. Cullinane et al. conclude that **introduction of competition has a significantly positive effect on port efficiency**, whereas privatization's effect is positive but smaller and sometimes statistically insignificant (unless accompanied by competition) [107] [109]. **Relevance:** This is directly applicable to the Israel case where we have a mix: new terminals are privately operated (landlord model), but initially the old ports remained government-run. The literature suggests that **the competition element will be the key driver of productivity**, more than ownership change. We will reflect this in our identification by prioritizing the "competition shock" (new port opening) as our main treatment, and consider privatization as an ancillary or secondary treatment. It also justifies using **competition metrics** (like Herfindahl index of port market share, or count of operators) as independent variables in our regressions. We may also explore if *effective competition* (e.g. Haifa faced both Bayport and Israel Shipyards, Ashdod faced Southport) led to differential outcomes – consistent with Cullinane's point that not all competition is equal in intensity.

(5) PPIAF/World Bank (2007) – *"Port Reform Toolkit"* – **Quality: B (industry toolkit, compilation)**. **Methods: Case studies and best practices.** While not a research paper, this toolkit synthesizes global experiences of port privatization and competition. It emphasizes that **labor reform (reducing over-manning, improving work rules) and investment in modern equipment are the two pillars of successful port reform**. It documents cases from e.g. Rotterdam, Singapore, etc., where mechanization dramatically boosted berth productivity (often measured in crane moves per hour or ship turnaround time). The toolkit also warns of transition issues: incumbent labor often resists reform, requiring compensation or phased transitions – a dynamic we see in Israel (the government had to negotiate terms with port workers and even offered them shares or benefits in some proposals [18]). **Relevance:** This compilation will help us in framing the **mechanisms qualitatively** – for instance, it provides examples of **capital deepening** like introducing gantry cranes that doubled productivity. We can use such examples to contextualize Israel's data on crane additions and yard automation. It also can guide our identification strategy in terms of timeline: often there is an **adjustment period** after reform. For Israel, we might expect a year or two of ramp-up (training on new systems, initial labor disputes in reaction, etc.), so we should check for a gradual trend rather than an instantaneous jump in some metrics. The toolkit's global perspective reinforces using **international benchmarks** in our analysis – e.g. comparing Israel's TEU per crane or per berth hour to OECD averages to gauge how far the reform closed the gap.

(6) Suárez-Alemán et al. (2016) – *"Port Management Reforms in Developing Countries"* – **Quality: A (Policy research working paper)**. **Methods: Meta-analysis & panel data.** This study looks at port reforms in lower-income countries (which may be more analogous to Israel's developing-stage challenges in the 90s/2000s). It finds that **investments in port infrastructure and superstructure (cranes, IT systems) have the highest payoff in terms of efficiency improvements**, especially when coupled with regulatory reforms that allow competition [110] [111]. The authors stress that simply transferring ownership without new

investment yields modest results. They also highlight **diminishing returns**: the first major reform jump yields big gains, but subsequent improvements are incremental. **Relevance:** This suggests that in Israel we should expect **a one-time big jump around 2021–2023**, and after that productivity growth might plateau once the new capacity is absorbed. It informs our plan to use an **event-study model** to capture the dynamic pattern: a sharp change at treatment and then leveling. Also, Suárez-Alemán's emphasis on infrastructure investment aligns with using **capital stock measures** (e.g. number of cranes, berth length, etc.) as an explanatory variable. If possible, we will compile such measures for Haifa/Ashdod over time. Their findings will also support our argument that capital deepening (K/L increase) is the critical mediator for efficiency – a core hypothesis of our project.

(7) Imai et al. (2010) – *"Causal Mediation Analysis"* – **Quality: A (Journal of Royal Statistical Society)**. **Methods: Statistical theory (mediation formulas).** This paper isn't port-specific but provides the formal framework for **mediation analysis** in causality. It distinguishes the **total effect** of a treatment from the **indirect effect** (mediated by a variable) and **direct effect** (through other channels). It introduces methods to estimate these, originally in an experimental or observational setting with strong assumptions. For our context, the "treatment" is port reform, the mediator is K/L (capital per labor), and the outcome is labor productivity. Standard mediation analysis would require no unmeasured confounders between mediator and outcome – likely violated here. However, Imai et al.'s formulas and approach inspire our use of **IV-mediated analysis** to identify those effects. **Relevance:** We will adapt these concepts by using **instrumental variables** for the mediator (K/L) to isolate the indirect path. The terminology and notation from this source will ensure we precisely define *Total Effect (TE), Natural Indirect Effect (NIE), and Natural Direct Effect (NDE)* in our design. This raises our methodological rigor, guiding how we structure the equations in Section 5. For example, we will use a two-stage approach: first stage (reform → K/L) and second stage (productivity on instrumented K/L) to estimate the indirect effect. Imai et al.'s work will be cited to justify that approach and to interpret the results (e.g. proportion of total effect mediated by K/L).

(8) Dippel, Gold & Heblich (2018) – *"Instrumental Variables and Causal Mechanisms: Unpacking Trade's Effects"* – **Quality: A (NBER Working Paper)**. **Methods: IV decomposition, applied economics**. This study is a practical example of using IVs to **unpack the channels** through which a treatment (trade shocks) affects outcomes (worker earnings, voting). They develop an approach to estimate how much of the total effect of increased import competition on voting behavior was mediated by labor market changes, by using an instrument (China's WTO entry) for the trade shock [112]. They find, for instance, that the majority of the effect on voting was via unemployment (the mediator) rather than other channels. **Relevance:** This provides a blueprint for our IV-mediation strategy. We will similarly use a **reform instrument** (e.g. timing of Bayport opening or delivery of new cranes) to isolate the effect of reform on capital deepening, and then link that to productivity. Dippel et al. also discuss the assumptions needed (exclusion restriction, sequential exogeneity) in an IV-mediation context [113]. We will mirror their approach in constructing our estimation equations and interpreting the coefficients – e.g., "X% of the reform's impact on productivity is mediated through increased capital per worker." This source essentially validates that doing a mediation analysis with IV is feasible and meaningful in economic research.

(9) Tongzon & Heng (2005) – *"Port Privatization, Efficiency and Competitiveness: Empirical Evidence"* – **Quality: B (Journal of Transportation Research-A)**. **Methods: Cross-sectional regression, efficiency ranking.** This paper studies 25 ports and finds that **privatization alone does not guarantee efficiency unless accompanied by competition and sound regulation** [107]. They rank ports by efficiency and note many top-performing ports are landlord ports (e.g. Hong Kong, Antwerp) with private operators and significant competition, rather than fully privatized monopolies. They caution that poorly implemented

privatization (e.g. transferring public monopoly to private monopoly) can even worsen performance due to higher tariffs without service improvement. **Relevance:** For Israel, this underscores why the government pursued a multi-pronged approach: not just selling the ports, but simultaneously introducing new competitors. It suggests our evaluation should consider **price effects** as well (if data allow) – did port handling fees drop with competition? Even if outside our main scope, it's a dimension of competitiveness. Also, Tongzon & Heng's methodology of **comparing efficiency rankings** before and after reforms could inspire a simple check using e.g. the World Bank's CPPI ranking: Israel's jump from 3rd quartile to 2nd quartile in 2022 [61] is a qualitative indicator consistent with their findings. We will use their work to back our argument that competition was the crucial element – echoing their conclusion that *"competition, not privatization per se, is the key"*.

(10) OECD (2011) – *"Competition in Ports and Port Services" (OECD Policy Roundtable) – **Quality: A (OECD report)**. **Methods: Synthesis of country submissions, comparative analysis.** This report gathers evidence from many OECD countries on how competition (both **inter-port** and **intra-port**) affects performance. It notes that ports with **intra-port competition** (multiple terminal operators) tend to have higher productivity and lower costs for users [114]. For example, the UK's experience post-privatization showed enormous productivity gains at previously strike-plagued ports like Felixstowe, once multiple operators and new labor contracts were in place. It also highlights regulatory challenges, such as preventing collusion among port operators and ensuring fair access. **Relevance:** The OECD findings help situate Israel among its OECD peers. Many OECD countries have moved to the landlord model with private operators; Israel was late to this but now has essentially followed suit. We can use OECD data on **average crane productivity** or **turnaround times** as a comparison: e.g., top OECD ports operate ~30+ crane moves/hour; Israeli ports pre-reform were around 20–25 moves/hour on average [115] [75]. By documenting improvements, we can compare if Israel is catching up to OECD norms. Also, the policy discussions in OECD's report might inform our **risk analysis** – for instance, ensuring competition doesn't lead to labor shedding that causes political backlash, or addressing potential duopoly of two operators (SIPG and TIL) instead of one monopoly. This broad perspective will enrich the discussion of **risks and diagnostics** in section 7.

In summary, the international literature confirms a consistent narrative: **port reforms generally improve productivity, primarily via capital investment and competition, while the role of privatization is supportive but not sufficient alone** [108] [96]. Empirical cases from various countries (Mexico, Spain, global panels) show measurable gains in efficiency (TFP, throughput, turnaround time) after reforms [102] [100]. These studies guide our methodological choices (panel DiD, Malmquist index, IV mediation) and help us anticipate magnitudes. For instance, a 10–20% jump in productivity is plausible given the 15–25% initial gap identified in Israel [2] and experiences elsewhere. The conceptual literature on mediation and IV gives us tools to dissect **how much of the reform's effect works through K/L** – a question that standard analyses often leave unanswered. Leveraging these sources, our study will be designed to contribute to this literature by providing a detailed case of Israel's reform, quantifying both the direct and indirect (capital-mediated) productivity gains, and thereby addressing an evidence gap on the mechanism of port competition reforms.

4. Data Inventory

To empirically analyze Israel's port reform, we compile a range of datasets from Israeli official statistics, port authorities, international databases, and company reports. **Table 1** below summarizes key data sources,

including their contents, coverage, and how we plan to use them. We also identify any anticipated **MISSING-DATA** issues and suggest substitutes.

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
Central Bureau of Statistics (CBS) – *Annual Transport Statistics* [116] [117]	- **Port throughput by port** (tons and TEU, by Haifa/ Ashdod/Eilat) [117] - **Ships arrived** (count by port, by vessel type) - **Labor**: number of port workers (if available, possibly in CBS labor force by industry) - **Trade by port**: imports/ exports by port (tons)	**2000–2024** (annual). Some series also quarterly or monthly (CBS trade reports).	*Merge keys:* Port name (Haifa, Ashdod, Eilat), Year/ Month. *Access:* CBS publishes an annual *Statistical Abstract*. Table likely titled "Seaborne Cargo by Port". Data can be scraped from PDF or via CBS API (if available) in Hebrew. Also, the **World Bank** uses CBS data for country TEU (see WB data [116]).	*Import stub (Python/Pandas):* `import pd` `df = pd.read_csv('CBS_port_throughput df.pivot(index='Year', columns=' values='TEU')` . *Note:* Verify units (tons, TEU). Possibly digitize from PDF if A

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
Israel Ports Company (IPC) – *Annual Reports / Stats* [118] [119]	- **Port performance indicators**: e.g. average ship wait time, berth utilization (%), crane productivity (moves/hour). (IPC often compiles sector-wide stats.) - **Infrastructure inventory**: number of berths, cranes, yard area at each port (before/after expansion). - **Financials**: aggregated revenue of port sector (if reported).	**2010–2022** (annual). IPC was established 2005; key stats likely from ~2010 onward.	*Merge keys:* Year, Port (sometimes aggregated). *Access:* IPC's Hebrew site (israports.co.il) has sections on *Port Development* and *Statistics*. Some pages (e.g. *"Israeli Port Industry Overview"*) are available [118] . Alternatively, **Ministry of Transport – Shipping & Ports Administration** publishes an annual report (the State Comptroller cites data from there [120]). Data may need manual extraction from PDFs or requests to IPC.	*Usage:* These indicators will allow us to co **outcome variables**: e.g. wait_time_avg (moves_per_hour, etc. *Import stub:* Us or Camelot to extract tables from IPC PD E.g., `import camelot` `table camelot.read_pdf('IPC_Annual_Rep pages='10')` . Check output and cl

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
Bank of Israel (BoI) – *Annual Reports (esp. Chapter on Infrastructure)*	- **Qualitative data on port delays & costs**: BoI reports often discuss port congestion, e.g. backlog of ships and impact on import prices. - **Macroeconomic data**: GDP, import volumes (to correlate port throughput with broader trends). - Possibly **BoI port index**: In 2021–22, BoI tracked supply-chain indicators, might include port throughput or waiting ships.	**2015–2023** (annual text, quarterly data in some cases).	*Merge keys:* Year/ Quarter (not port-specific typically). *Access:* BoI Annual Report (Hebrew and English) PDFs available on boi.org.il. For example, 2021 report discussed port issues (the **INSS 2022** piece cites BoI/ CBS data on share of maritime trade [121]). We will manually glean numerical references (e.g. "X days of waiting" or cost estimates).	BoI data is mostly narrative; any numeric index of port utilization) would be manua *Example:* BoI 2022 might state "Port increased by Y% after Bayport opened" – that as a datapoint or cross-check for ou

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
Company Reports – Haifa & Ashdod Port Companies [122] [86]	- **Financials**: revenue, profit, operating costs (annual). [86] - **Volume**: TEU throughput, bulk tonnage, car units (detailed breakdown per company). - **Employees**: number of employees, labor costs (these firms often report headcount and sometimes productivity metrics like revenue per employee). - **Capital expenditures**: investments made each year (could track K increases).	**2012–2022** (annual reports). Haifa Port Co. (now privatized) and Ashdod Port Co. both had to publish financials while state-owned.	*Merge keys:* Year, Company (Haifa/ Ashdod). *Access:* **Ashdod Port Co.** posts ESG and annual reports on its website (Heb/Eng). The 2021 ESG report (Hebrew) contains data on new cranes and tech [43] . **Haifa Port Co.** (pre-2023) had data via Gov't Companies Authority or Dun's100 profile [122] . Some data (revenue 2021, etc.) we got via Calcalist [86] . We may need to submit a FOIA or use archived reports for full details.	These reports are key for **K/L measurem** assets value or # of cranes (K proxy) and *Import stub:* If we obtain data in PDF or OCR. For example, from Ashdod 2021 "employees: 1,300; handling volume: 1.5r invest: ₪X". We would assemble a small C like: `Year, Port, Employees, T` import with pandas.

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
World Bank – Container Port Performance Index (CPPI) [61]	- **Efficiency rank and score** for major world ports (index based on ship turn-around times, etc.). Haifa and Ashdod have scores/ranks in 2021, 2022, 2023 reports. [61] - **Country aggregate port traffic** (TEU, via WB Development Indicators) [116] .	**2020–2023** (annual CPPI reports). WB port traffic from 2000s–2022 (annual).	*Merge keys:* Port name or Country name, Year. *Access:* CPPI reports (2021, 2022) are available on World Bank website. The **2022 CPPI** shows Haifa's jump to rank 56 (score ~68) from 2021 rank 196 [61] . Raw scores can be extracted from report appendix (PDF or Excel). The **WB WDI** has "Container port traffic (TEU)" by country [116] accessible via API (indicator `IS.SHP.GOOD.TU`).	CPPI ranking is an independent **outcom** performance improvement. We will use i as a dependent var in regression due to l points). *Import stub:* e.g., using WB A Python: `import wbdata` `data` `wbdata.get_dataframe({'IS.SHP.GO` `country='ISR', data_date='2000')` Israel total TEU per year [116]).

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
OECD Structural Analysis (STAN) & Productivity Database	- **Value-added, Employment, Capital stock** for sectors like “Transportation and Storage” or specifically “Water transport” or “Port and Warehousing”. - **Labor productivity** (VA per worker) by industry – if available, port operations likely fall under ISIC code 522 “Support activities for transportation”. - **International comparison data**: e.g., average productivity growth in transport sector in OECD countries post-privatization.	**2000–2021** (annual). OECD data may not isolate ports perfectly, but from 2015–2021 could reflect changes.	*Merge keys:* Country (ISR), Year, Industry code. *Access:* OECD.stat interface. We will look for **ISIC Rev.4 code H52** (“Warehousing and support activities for transportation”) which includes cargo handling and ports. The OECD Productivity Database might have labor productivity indices for this subsector. If data for Israel is missing, this is **MISSING-DATA** flagged.	This is potentially **MISSING-DATA**: Israel’s stock by subsector may not be in STAN. I use Israel’s national accounts to get Gros employees in “Transportation & storage” share based on throughput. **Substitute** *ILO* data for similar countries’ port labor benchmark. *Import stub:* Use OECD A CSV from OECD.stat after selecting Israel `pd.read_csv('oecd_ports.csv')`.

Dataset & Source	Variables & Description	Years & Freq.	Merge keys & Access	Usage Notes & Import Stub
Ministry of Transport – Shipping & Ports Administration (מינהל הספנות והנמלים) – *Annual data tables*	- **Throughput by cargo type** (containers, general, bulk) per port, monthly/annual. (Comptroller used this: e.g. 100k TEU transshipped in 2020 [22], grain imports by port [123]. - **Port service metrics**: average waiting/dwell times per cargo type (as in Comptroller report) [124]. - **Operational workforce deployment**: e.g. number of gangs (work teams) requested vs supplied, by shift [120] [39]. - **Safety/Incidents** (likely not needed for our study).	**2017–2022** (monthly or quarterly internal data, aggregated annually). Possibly older data available internally.	*Merge keys:* Port, Year, Cargo type. *Access:* These detailed stats are not published openly but may be obtained via the Ministry. The State Comptroller's report includes specific figures (we have those excerpts [66] [115]). We could attempt to request anonymized data. **Alternatively, the ministry might publish port statistics in a yearly report or on data.gov.il.**	We will use the **published figures from** points. For instance, we have waiting tim by port and cargo [66] [125]. We can incorp manually. These metrics help create **perf charts** and to validate our regression res estimated reform effect on wait time alig from 2021 to 2022). *Import stub:* Cre Comptroller's table, then read with pand visualization.

Notes on Missing Data & Substitutes: Some granular data might be missing or hard to obtain:

- **Capital Stock at Port-Level (MISSING-DATA):** We lack a direct series for "capital employed" in Haifa or Ashdod port operations. *Substitute 1:* use **number of ship-to-shore cranes** and **yard equipment count** as proxies for capital. For example, Bayport started with 8 new STS cranes [126]; Ashdod old port had e.g. 12 cranes in 2017, etc. We can gather such info from company reports or media. *Substitute 2:* use **fixed assets book value** from port company financials as a capital measure (if disclosed). Ashdod Port Company's balance sheet might show PPE (property, plant, equipment) value – which, adjusted for inflation, can indicate capital growth.

- **Labor Hours (MISSING-DATA):** We have number of employees, but not total labor hours or effort. We assume full-time employment counts; if needed, *substitute:* use headcount * average hours (from labor agreements or typical full-time hours) to estimate labor input. Alternatively, we use number of shifts operated per day as a proxy for labor utilization (the Comptroller gave insight on shifts manned vs needed [76]).

- **Port User Tariffs (MISSING-DATA):** Data on port fees and shipping costs pre/post reform are not readily available. While not central to our analysis, this would measure consumer benefit. If needed, *substitute:* use World Bank's Logistics Performance Index or anecdotal evidence from freight forwarders on cost changes, or use CPI of imported goods as an indirect indicator.

Each dataset will be integrated to construct a panel at the **port-year (or port-quarter)** level for Haifa and Ashdod, plus potentially a national aggregate series. We will derive key variables: **Labor Productivity (LP)** (e.g. TEU per worker per year), **Capital-Labor ratio (K/L)** (e.g. cranes per 100 workers, or capital value per worker), and performance metrics like average wait hours (could be outcome or control if it affects throughput).

Example data merge: We'll assign Bayport's opening (2021-Q4) as a treatment indicator for Haifa, Southport's opening (2022) for Ashdod, and Haifa's privatization (2023) as another treatment. Using the data above, we can create a table like:

Port	Year	TEU	Employees	Cranes	WaitTime_avg	Privatised	NewTerminal_active
Haifa	2020	1.46M [127]	~1000 (est.)	15	17.4 hrs [128]	0	0
Haifa	2022	1.0M (old port) + 0.9M (Bayport)	900 (old) + 150 (new)	15+8	4.0 hrs (improved)	0	1
Ashdod	2020	1.53M [122]	~1300	13	8.8 hrs [73]	0	0
Ashdod	2022	1.2M (old) + 0.5M (new)	1200 + ~100	13+5	6.0 hrs	0	1

(Numbers illustrative; actual data will be used in analysis.)

By merging and analyzing these datasets, we will create a **robust, reproducible data foundation** for our study. Data access has been verified for most sources (CBS, WB, company financials via media). Potential missing elements (capital stock) will be addressed with proxies as described. The import stubs above indicate we are prepared to ingest and process the data programmatically, ensuring efficient updates and reproducibility.

5. Design & Identification Strategy

We aim to estimate the **causal impact** of Israel's ports competition reform on productivity, and decompose that impact into an **indirect effect via capital deepening (K/L)** and a **direct effect (other channels)**. Our design leverages both **Difference-in-Differences (DiD)** for the policy shock and an **Instrumental Variables (IV) mediation approach** for the mechanism.

5.1 Causal Effects Framework: Let *Treatment* (T) be the introduction of port competition (the reform), *Mediator* (M) be capital per labor (K/L), and *Outcome* (Y) be labor productivity (output per worker, or similar). We define: - **Total Effect (TE):** Effect of the reform on productivity (with all channels). - **Indirect Effect (IE):** Effect of reform on productivity that operates through raising K/L. - **Direct Effect (DE):** Effect of reform on productivity through all other channels (e.g. operational efficiency, labor effort, competition pressure) not via K/L.

Formally, $TE = \frac{dY}{dT}$, $IE = \frac{dY}{dM} \times \frac{dM}{dT}$, and $DE = TE - IE$. We anticipate $TE > 0$ (reform increases productivity), with $IE>0$ (because reform → new investment → higher output per worker) and possibly a smaller positive direct effect (e.g. from work rule changes or better management post-privatization). Our goal is to quantify these.

5.2 First Stage (Reform → K/L): For identification, we exploit the staggered timing and scope of the reform: - **Competition Shock Timing:** *Haifa* experienced a major shock in **Q4 2021** (Bayport opening 1-Sep-2021 [32]) and a second shock in **Jan 2023** (privatization complete [82]). *Ashdod* got competition in a more gradual way (Southport partial Aug 2021, ramping in 2022), and has not (yet) been privatized. *Eilat* (small port) was privatized in 2013 but is minor. We will focus on Haifa and Ashdod as the main treated units. - **DiD Setup:** We treat the **new terminals' commencement** as the primary treatment event. Haifa's treatment date ~2021Q4, Ashdod's ~2022 (we can use 2022Q4 as the effective date when HCT was fully operational). Pre-treatment period is pre-2021 for both. Both ports serve as "controls" for each other in a staggered DiD: Haifa got the shock slightly earlier than Ashdod, which allows leveraging *Goodman–Bacon decomposition* of DiD [9]: - Haifa's early post period (2021Q4–2022) vs Ashdod as control. - Ashdod's later post period (2022) vs Haifa (which was already treated, so in Bacon decomposition this becomes a type of comparison as well). - We will use **Sun & Abraham (2020)** or **Goodman-Bacon (2021)** methods to properly weight these comparisons and avoid bias from treatment effect heterogeneity. - **Regression Spec (First Stage DiD):** $$K/L_{pt} = \alpha + \beta_1 \textit{Comp}*{pt} + *beta_2 \textit{Priv}*,$$ where $p \in {\text{Haifa, Ashdod}}$, t is year-quarter. $\textit{Comp}} + \gamma_p + \lambda_t + \epsilon_{pt*{pt}$ is an indicator =1 if port p at time t faces new competition (post reform). $\textit{Priv}$ =1 if port is privatized by time t. γ_p are port fixed effects, λ_t are time dummies capturing common shocks (e.g. global trade swings, Covid).

We expect $\hat\beta_1 > 0$, i.e. competition significantly raises K/L. For Haifa, this captures the huge capital infusion at Bayport (and possibly reactive investments at the old port). For Ashdod, β_1 will capture the addition of Southport's capital (cranes, etc.) relative to labor.

Goodman–Bacon weights: In our case, one port's treatment can act as control for the other's later treatment. We will apply the Goodman-Bacon decomposition to check for any **negative weight issues** (e.g. if treatment timing differs, some DiD estimators might give weird weights). Using the more robust **two-way fixed effects (TWFE) with Sun-Abraham correction** will avoid bias if treatment effects change over time. In Stata, we can use `estat bacon` after a TWFE to inspect weights, or use user-written `did_multipleGT` for the SA method.

Code stub (Stata, First Stage DiD/Event Study):

```
xtset PortID Quarter
* Interaction for event study relative to Q3 2021 for Haifa:
```

```
gen treat_Haifa = PortID=="Haifa"
gen post_Haifa = (quarter >= tq(2021q4))
gen treat_Ashdod = PortID=="Ashdod"
gen post_Ashdod = (quarter >= tq(2022q4))
* TWFE with dummies:
xtreg K_L i.treat_Haifa#i.post_Haifa i.treat_Ashdod#i.post_Ashdod i.quarter, fe
cluster(PortID)
estat bacon
```

This will decompose the β_1 effect. Alternatively, we might do:

```
reghdfe K_L Comp Priv, absorb(PortID Quarter) cluster(PortID)
```

since we have few panels.

- **Continuous instrument:** Instead of a simple dummy, we can refine $M_{pt} = K/L$: For instrumenting in second stage, we may use a continuous instrument like **number of new cranes delivered** or **capacity added**. For example, we know Bayport added 8 cranes in 2021 [126] and Ashdod HCT ~5 cranes by 2022. We can construct Z_{pt} = cumulative new cranes at port p (exogenous, determined by reform schedule). Then first stage becomes $K/L_{pt} = \pi_0 + \pi_1 Z_{pt} + \gamma_p + \lambda_t + \nu_{pt}$. This treats the actual capital injection as an instrument (plausibly exogenous timing, since crane deliveries were scheduled by the project, not by port productivity – e.g., if COVID delayed crane deliveries to Ashdod until 2022, that's exogenous from port performance). We anticipate $\pi_1>0$ (more cranes -> higher K/L obviously). This IV first stage gives us a **strong instrument** (e.g., Bayport's 8 cranes massively increased national crane count).

5.3 Second Stage (K/L → Productivity, using IV-Mediation): To estimate the indirect effect via capital deepening, we use an **instrumental variable for K/L**: - The instrument will be the reform indicator or related measure from first stage (e.g. $\textit{Comp}*{pt}$ or number of new cranes Z*). This instrument affects productivity *only* through its effect on K/L, under our assumption that any direct effect (labor practices, etc.) we will capture separately or assume minimal during the short horizon. This exclusion restriction might not strictly hold (competition can also directly push workers to be more efficient), but we will account for that by estimating direct effect in the structural equations. - **IV regression (Second stage):** $$\textit{Productivity}*{pt} = \delta_0 + \delta_1 \widehat{K/L}* + \delta_2 \textit{Priv}*{pt} + \gamma'_p + \lambda'_t + u$$ Here $\widehat{K/L}*{pt}$ *is the predicted capital per labor from first stage (fitted using competition/crane instrument).* δ_1 *estimates the effect of K/L on productivity that is causally attributable to the reform-induced variation in K/L – essentially the* ***mediated effect****. We also include* $\textit{Priv}*$ (privatization dummy) to soak up direct changes due to privatization (as a control or an additional "treatment" – we could instrument that too via a dummy for 2023 for Haifa, though with only one treated unit it's tricky, so likely just treat it as control dummy).

We expect $\hat{\delta}_1 > 0$, meaning higher K/L (due to reform) leads to higher productivity. For example, if $\delta_1=0.5$, then a 10% increase in K/L yields 5% increase in output per worker. Combined with first stage β_1, we can calculate $IE = \beta_1 * \delta_1$ in effect-size terms.

Meanwhile, the **direct effect** of reform can be inferred by any residual impact of $\textit{Comp}*{pt}$ not explained by K/L. In practice, we can estimate an alternative reduced-form: $$\textit{Productivity}* = \kappa_0 + \kappa_1 \textit{Comp}*{pt} + *kappa_2 \textit{Priv}* + \gamma''*p + *lambda''*t + *e*.$$ Here κ_1 is total effect of competition on productivity. And if we multiply first stage and second stage: $\beta_1 * \delta_1$ should equal the **indirect effect** portion. We can compare κ_1 vs. $\beta_1 * \delta_1$. The difference (if any) would be the direct effect portion $\kappa_1 - (\beta_1 \delta_1)$. We can formally test significance of direct effect by including both $\widehat{K/L}$ and the treatment dummy in the second stage: if the treatment dummy still has a significant coefficient after controlling for instrumented K/L, that suggests a direct effect (e.g. improved labor effort or reduced idle time due to competition).

Code stub (Stata IV mediation):

```
* First stage:
ivregress 2sls Productivity (K_L = Comp cranes) Priv i.PortID i.Quarter,
cluster(PortID)
```

Or using Stata's `ivmediate` command (if installed) for formal mediation:

```
ivmediate Productivity Priv (Comp -> K_L), treat(Comp) med(K_L) iv(Comp)
```

This would compute mediated effects if assumptions hold [129] . But likely simpler is to do it manually.

- We will also consider **alternative designs** for robustness:
- **Synthetic Control (SCM):** Construct a synthetic "no-reform" scenario for Israel's ports using other Mediterranean ports' data (e.g. combine trends from, say, Cyprus, Malta, or other small countries without reform to match Israel's pre-2011 productivity, then see post-2021 divergence). This could provide a visual confirmation of reform impact. Given limited comparable cases, SCM might be of limited power, but we may attempt it for overall throughput or wait times.
- **Matched DiD:** We could match subsets of data where, for instance, Ashdod pre-reform is matched to Haifa pre-reform on performance metrics, then see post differences. With only two major ports, matching is trivial (they'll be both used anyway).
- **Inter-port vs Intra-port analysis:** Another angle is to use **within Haifa** data: Haifa port company vs Bayport as two units from 2022 onward, where Bayport (private, new) vs Haifa (old, now private after 2023) could be compared. But Bayport didn't exist before, so that's like a post-only comparison; not suitable for DiD but can illustrate productivity differences (Bayport's productivity in 2022 vs old Haifa's in 2020, for example).
- **Event study for outcomes:** We will plot event-study coefficients for key outcomes (e.g. throughput per worker, wait time) relative to reform time. This will check **parallel trends** pre-reform and capture any anticipation effects or gradual build-up.

5.4 Addressing Key Identification Challenges: - **Parallel Trends:** We only have 2 treated units and essentially no pure control unit (since both main ports eventually got treated). This is a limitation – however, in the staggered design, when Haifa is treated in late 2021, Ashdod in early 2022 was not fully treated, so Ashdod serves as a short-run control for Haifa's immediate jump. We will verify pre-2021 that Haifa and Ashdod productivity trends were similar (Comptroller data indicates both were declining similarly [72]). - **Contemporaneous shocks:** COVID-19 (2020–21) and the global shipping surge could confound results. We

include time fixed effects λ_t (quarter or year) to net out any common shocks. Also, 2023 war impact (Q4 2023) might distort late data (COSCO withdrawal hit Haifa's volumes [130]). We might censor Q4 2023 or control for war period with a dummy. - **Unit-level heterogeneity:** Port fixed effects γ_p handle baseline differences (Ashdod was larger volume, etc.). - **Goodman-Bacon weights:** As noted, standard TWFE can mix in negative weights if treatment timing effects vary. The Sun-Abraham approach (an event-study with interactions by cohort) will be implemented. E.g., we'll include leads/lags of treatment for Haifa and Ashdod separately. Since timing is very close, this is mostly to ensure we correctly attribute effects: - Actually, a simpler approach: treat the **reform as simultaneous in 2022** (since by 2022 both new ports are operational) and do a classic DiD with both ports vs some control. But we lack a third port as control (Eilat is too small and also changed in 2013). Could use *synthetic control* as pseudo-control as mentioned.

5.5 Mechanism identification: By using IV, we assume: - Instrument (competition introduction) is **as good as random** with respect to potential productivity outcomes, except through K/L. This is plausible since new ports' opening dates were scheduled long in advance, driven by construction timelines, not by a sudden need from port performance (if anything, delays in opening due to local politics [31] means the timing wasn't endogenously chosen to coincide with a productivity dip or peak). - No **spillovers**: Actually, here is a concern – the new port in Haifa obviously directly affected the old Haifa port's output (some share shift). Our analysis sees that as part of the treatment effect. There's also a spillover to Ashdod? Possibly some cargo or ships may shift between Haifa and Ashdod due to competition (e.g., if Haifa becomes more efficient, shippers might route more via Haifa than Ashdod). Indeed, Ynet suggests some ships that would go to Ashdod diverted to Haifa during war [131] (different scenario, but conceptually possible in normal times too). We will acknowledge this: our port-level approach captures combined effect on each port. A national-level analysis (summing both) will capture net efficiency (which likely rose overall). We might do a **national time-series DiD** (treat "Israel's port sector" as treated in 2021 vs perhaps another country as control). Another approach: include port*post interaction and interpret coefficients carefully.

5.6 Alternative/Additional Analyses: - **Goodman–Bacon Decomposition for Wait Time:** We will replicate a diff-in-diff on average wait time (which dramatically fell by 2022 according to data [77]) to see if it aligns with competition timing. This is an outcome directly tied to capacity. - **Difference-in-Difference-in-Differences (DDD):** Possibly, we could exploit difference by cargo type. The new terminals focused on containers. Bulk cargo didn't get a new terminal (they still rely on old ports, aside from maybe new general cargo quay usage permission [132]). So we could do a DDD: compare change in container productivity (treated cargo) vs change in, say, bulk cargo productivity (untreated cargo) at the same ports, pre vs post. This helps cancel out general trends. E.g. labor productivity for bulk handling might not improve (no new bulk terminals), whereas for containers it should. A DDD regression: $$Y_{p,c,t} = \alpha + \theta (TreatCargo_c \times PostReform_t \times Haifa_p) + ...$$ including all lower interactions. θ would capture if containers in Haifa improved relative to bulk in Haifa and relative to containers in Ashdod, etc. This triple diff could strengthen identification if data permits (the Comptroller gives some breakdown by cargo [73] [75]).

5.7 Embedding Code and Statistical Tests: We will implement our analysis likely in R or Stata. We'll include code stubs in the final paper for transparency. For example, using R with **fixest** package:

```
library(fixest)
# First stage DiD with Sun-Abraham method:
```

```
es <- feols(K_L ~ sunab(cohort_qtr, quarter) + Priv | Port + quarter,
data=panel)
summary(es)
iplot(es)  # plot event-study coefficients
# IV second stage:
iv_res <- feols(Productivity ~ Priv + 1 | Port + quarter | K_L ~ Comp,
data=panel)
summary(iv_res)
```

This would yield the IV estimate δ_1. We'll test instrument strength (F-stat for β_1) and use robust clustered errors by port (with 2 clusters it's borderline, but since we have time variation and maybe using monthly data yields more clusters). If monthly data is used, we have more periods and can cluster by port.

We will also consider using **Goodman-Bacon decomposition directly** via the `bacondecomp` package in R or `did` in Stata to report how much each timing contributes to the DiD estimate, ensuring no pathological weights.

5.8 Summary of Identification: - The **policy variation** (timing of Bayport/Southport opening, plus Haifa privatization) provides our source of exogenous variation. - **DiD/Event study** captures the **total effect** on outcomes like productivity. - **IV mediation** (using that variation to instrument K/L) isolates the **mechanism effect**. - We thereby measure: - κ_1: total reform effect on productivity. - β_1: effect on K/L. - δ_1: effect of K/L on productivity (causal path). - And confirm $\kappa_1 \approx \beta_1 \delta_1 + \text{(direct effect)}$.

This strategy allows us to answer: *Did the reform significantly increase productivity?* (yes/no from DiD), *How much of that increase was due to increased capital per worker?* (from IV estimates), and *What is the residual direct effect?* (inferred if any).

We will complement this with **robustness checks** (synthetic control, DDD by cargo) as described. This mixed-method approach strengthens credibility in the results, mitigating the pitfalls of each single method. By triangulating evidence (DiD, IV, etc.), we'll provide a compelling identification of both the existence and the source of productivity gains from Israel's port reforms.

6. Implementation Plans

To ensure timely progress, we outline concrete implementation steps with checkpoints at 48 hours, 7 days, and 14 days:

Within 48 Hours: Initial Setup & Data Acquisition
- **Data Collection Kickoff:** Download readily available datasets: - CBS Statistical Abstract tables for port throughput (verify TEU/tonnage by port/year) [116] . - World Bank WDI data for Israel's container traffic [116] . - Retrieve Haifa/Ashdod Port Company reports or data (from Calcalist, Globes, etc.) for financials and workforce (e.g. Ashdod 2021 revenue & employees) [86] . - Request or scrape Ministry of Transport port stats (if online) – if not, plan Freedom-of-Info request (though likely too slow; will rely on Comptroller's published figures). - **Data Cleaning Scripts:** Set up Python notebooks to parse any PDFs (using Camelot for tables like

Comptroller's stats [124]). Initialize a master CSV for port-quarter data, with columns for output, labor, etc. - **Preliminary EDA:** Plot baseline trends (2010–2020) for Haifa vs Ashdod throughput and productivity (approx TEU/employee if we have rough employee counts). Check if trends diverging pre-reform (parallel trend assumption). - **Analysis Skeleton:** Write outline of analysis code (placeholders for DiD model, IV model). E.g., create panel structure and dummy variables for treatment timing. - **Literature Integration:** Compile key parameter expectations from lit (e.g. expected 10-20% efficiency gain). Draft a reference table mapping lit findings to what we plan to test (to keep focus). - **Meeting Prep:** If working with an advisor, prepare a one-page summary of design for quick feedback within 48h.

By Day 7: Core Analysis & Results Drafting

- **Estimate DiD Models:** Run the difference-in-differences regression for **first stage** (reform → K/L). Check instrument strength (F-stat). Then run **reduced form** (reform → productivity). Then the **IV second stage** (productivity on instrumented K/L). - Compute point estimates for total, indirect, direct effects. For example, if TEU/employee increased by 20% in Haifa vs Ashdod by 2022, how does that break down via crane additions? - **Event Study Visualization:** Produce an event study plot for productivity around Q4 2021 (Haifa) and Q4 2022 (Ashdod) to visually inspect assumptions. Also plot K/L similarly. - **Synthetic Control (if feasible):** Using, say, Italy or OECD average as a control, create a synthetic Israel port productivity trend for no-reform scenario. Compare actual vs synthetic post-2021. - **Robustness Checks:** Run a triple-diff (container vs bulk) if data permits, and/or exclude wartime 2023 data to see if results hold. - **Diagnostics:** Check for parallel pre-trends (statistically, test leads of treatment in event study – they should be ~0). Use `estat placebo` in Stata or equivalent. - **Power Calculation:** Perform an ex-post power check: with 2 ports and ~40 quarters, what effect size could we detect? (Likely we have >80% power to detect large changes like 15% productivity jump, given low noise in aggregated data). - **Draft Results Section:** Summarize preliminary findings in text: e.g. "By end-2022, Haifa's labor productivity (TEU/worker) rose ~50%, whereas Ashdod's rose ~10%; DiD estimate of competition effect is a **+30%** (±X%) significant at 5%." Indicate how much of that corresponded with capital increases (like crane count up 60% in Haifa, etc.). - **Design Refinement:** Based on results, adjust model if needed (e.g. include an interaction if Ashdod's effect smaller, meaning heterogeneity). - **Begin Drafting Graphs/Tables:** Prepare draft versions of key tables: (1) DiD regression outputs, (2) IV regression output, (3) descriptive stats (before vs after for each port), and figures (trend lines, event study plot). - **Coding the Proposal Insert:** Start assembling the 3-page proposal (Sec 10) content from the above sections, focusing by Day 7 on clearly stating the research question and approach (Page 1) and summarizing lit gap (Page 2). - **Advisor Check-in:** Have a midpoint meeting with advisor (if applicable) to discuss any identification concerns or data issues uncovered.

By Day 14: Full Draft Completion & Reproducibility

- **Finalize Analysis:** Incorporate any new data that became available (e.g. if a FOIA request surprisingly yielded something, or updated 2023 data from BoI on port activity). Finalize numbers and ensure consistency. - **Stress Tests:** Do a **placebo test** – pretend reform happened 2 years earlier (apply DiD on 2016–2019 as "fake reform") to ensure no significant effect when there should be none. Also test alternative definitions (use monthly data if available to increase observations). - **Documentation:** Clean up code and comment thoroughly. Ensure the pipeline from raw data to final results is fully reproducible (set random seeds if any sampling). - **Prepare Appendices:** Draft appendix sections for data dictionary, additional robustness results, and any calculation details (like how we estimated capital stock proxy). - **Write Results & Discussion:** Integrate analysis findings into the dossier narrative. Interpret coefficients: e.g. "Our IV estimate implies ~70% of the productivity gain came via capital deepening, suggesting the reform's primary impact was through new equipment rather than solely labor practice changes." Discuss how this compares to expectations (maybe we expected, say, 50/50 from literature, so if 70% we note that). - **Risks &**

Diagnostics Section: Write Section 7 reflecting on issues encountered: e.g., maybe parallel trends held reasonably, but we note limitation of small sample (we'll mention that inference is based on effectively N=2 ports, so results should be taken with caution). - **Policy Implications:** Briefly note in discussion if results suggest anything for future reforms (e.g. need to address remaining direct inefficiencies at Ashdod since direct effect was small meaning mostly capital – thus privatization's direct effect maybe yet to be realized). - **Complete Section 10 (Proposal Insert):** Finalize all three pages, making sure it complies with Econ H191 spec (likely format and content). - **Final Proofreading:** Check all citations (ensure all 【†】 links resolve and are relevant). Verify that Hebrew source info is translated or explained in English in text. - **Assemble Manifest:** Create a file manifest listing all data files (with source URLs) and code files, as required by Sec. 8 (Reproducibility). - **Submission Prep:** Ensure the document meets all formatting (headings, lists, etc.) and length requirements for each section. All sections (1–10) should be within specified word ranges.

By following this timeline, we will produce a comprehensive, high-quality analysis on schedule, with interim results to guide any course corrections early and a fully polished dossier by the end of week 2.

7. Risks, Diagnostics, Power/MDE

Every research design has risks. We address the key threats to validity, how to diagnose them, and considerations of statistical power:

Internal Validity Risks: - **Confounding events:** The reform did not happen in isolation. *Diagnostic:* We include time fixed effects to absorb any common shocks (e.g. global shipping boom in 2021, war in 2023). We will also run placebo tests: for instance, assume the reform "happened" two years earlier – we expect no effect then, confirming no spurious trend. Additionally, we compare container sector (treated) vs bulk cargo (untreated) to differ out economy-wide effects. - **Non-parallel pre-trends:** With only two main units, parallel trends assumption is hard to verify. However, we will use the **event study lead coefficients** as a diagnostic: if in 2019–2020 Haifa vs Ashdod had diverging trends already, the leads of treatment in our event study would be significantly non-zero [72]. If that occurs, we may adjust by modeling the pre-trend (include a port-specific time trend term). Fortunately, data show both ports were similarly stagnating/declining pre-2021 [73] [75]. We'll formally test H_0: pre-period $\kappa_{lead}=0$ (no difference-in-trend) and report that. - **Anticipation effects:** Ports and shippers might have changed behavior in anticipation of the new terminals (e.g. some efficiency moves knowing competition is coming). This could muddy timing. *Diagnostic:* If anticipation occurred, we'd see productivity upticks in Haifa *before* Q4 2021. The event study can catch this (any rise in early 2021). If found, we might treat the announcement (2013/2014 or 2018 concession signing [62]) as a gradual treatment. However, given union resistance, it's likely little changed until the competitor was actually operational. - **Spillovers between units:** As noted, improved performance at one port could draw business from the other (especially Haifa might steal share from Ashdod). This violates the stable unit treatment value assumption (SUTVA). It means our port-level DiD might *underestimate* the total national benefit (Ashdod's performance might drop partly because Haifa improved). To diagnose, we will look at **national aggregate productivity** (combined throughput divided by combined labor). If national productivity also rises post-reform even as Ashdod falls behind, that confirms net positive effect. If needed, we will complement with a **nation-level synthetic control** as discussed. We'll acknowledge that at port-level our estimate is conservative due to competition effects across ports. - **Weak Instrument or Exclusion Restriction:** If our IV (competition dummy or new cranes) is weak, coefficients will be unreliable. But first-stage F-stat is likely huge (Bayport literally doubled crane count in Haifa). We will report the F-stat; anything >10 is generally fine (we expect F >> 10). Exclusion assumption (instrument affects output only via K/L) could be violated if, say, the new port also reduced union strikes at the old port (a direct effect not via capital).

That would bias IV. We can partially test this by checking if $\textit{Priv}_{pt}$ (which captures some direct effect like labor changes) soaks up residual effect. Ultimately, we'll discuss that IV-mediation gives an upper-bound estimate of indirect effect assuming minimal direct effect via instrument.

Model Diagnostics & Robustness: - We will examine **residual plots** from regressions to ensure no obvious outliers (maybe war quarter might be an outlier – if so, we will exclude Q4 2023 as robustness). - Use **cluster-robust SEs** (but note only 2 clusters – a known issue. We might use Newey-West with lag for time series or the **wild bootstrap** for inference given few clusters). - **Goodman-Bacon decomposition:** If TWFE DiD is biased by heterogeneous effects, we will rely on event-study or explicit cohort modeling. We will report if any negative weighting occurred (small sample, but we'll check).

External Validity & Generalizability: - Israel's case is somewhat unique (concentrated trade in few ports, strong unions). The magnitude of effect might differ elsewhere. We'll note that but highlight commonalities (e.g., many countries see ~20-30% efficiency jump from introducing competition [2]). - Also, the war in 2023 is an extreme event that may temporarily reverse gains (COSCO's exit hurt Bayport's utilization [92]). Our analysis up to 2023Q3 may show a dip; we'll clarify that's temporary (and indeed outside normal conditions). It's a risk to interpretation if someone looked at late-2023 data without context.

Power and Sample Size: Our sample (2 ports, ~15–20 years of annual or ~60 quarters of data) is relatively small. However, the **effect sizes are large** (we anticipate changes on the order of 20-50%). Thus, even with few units, the DiD should detect such a big shift. We can bolster power by using **monthly data** if available (e.g. TEU per month) which would give ~2 *(years*12) observations – possibly ~2 *(15*12)=360 port-month observations. That would allow more precise estimates and better clustering (since cluster=2 is problematic, cluster by port*year perhaps or use wild cluster bootstrap). - We will calculate the Minimum Detectable Effect (MDE)**: Given 2 clusters, it's tricky, but treating it as a time-series (T=60) with AR1 errors, we can estimate needed effect. Roughly, if standard deviation of productivity is say 10% and autocorrelation is high, detecting a 15% jump might still be feasible at 5% significance using a Prais-Winsten or similar approach. - We can also leverage the fact that within each port we have many observations over time, so effectively the power comes from time-series change which is easier to detect given the dramatic nature (e.g., Haifa's throughput per worker probably jumped by >2 SD). - If needed, we combine datasets to increase N: e.g., include Eilat or split Haifa into "Haifa old vs new" as separate series (though new had no pre-period, so not straightforward).

Potential "Null" scenarios and our response: - If we find no significant improvement in productivity, that would be surprising given qualitative evidence. Possible reasons: maybe labor hoarding at old ports kept productivity low despite new capital. Or measurement error in K/L. If this occurs: - We'd double-check measurement (maybe output per worker didn't rise because they didn't reduce workforce initially – indeed Ashdod's union might keep staff despite volume drop, so short-run productivity might dip at Ashdod). - We'd consider longer horizon (maybe need more years for adjustments or retirement of excess labor). - We would report a null finding and explore if perhaps direct effect manifested negatively (e.g., union backlash offset gains initially). - Given external data (CPPI rank improved), a null on our specific metric might suggest mis-specification, so we'd try alternative metrics (e.g. vessel wait time definitely improved, which is another productivity aspect). - Another risk: **Overstatement of K/L role** – if our IV is invalid, we might attribute too much to K/L. We'll be cautious interpreting mediated effect, and perhaps bound it: use **Lewbel's method** (using higher moments as IV) or just discuss qualitatively if direct effect is plausible (e.g., if union labor still causing slowdowns, then not all gains are from machines).

Diagnostic Summary: We will include an appendix table with checks: parallel trend test p-value, instrument F-stat, etc., to demonstrate robustness. We will also likely run a **wild bootstrap** for our main IV result to ensure significance is reliable with few clusters.

Ethical and Practical Considerations: No human subjects issues here; we use aggregate data. One risk is misinterpreting short-term war disruptions as reform failures – we will explicitly isolate those (maybe exclude late-2023 in main analysis). Also, the Chinese involvement controversy is outside our scope but we should acknowledge it's not part of our productivity analysis.

In conclusion, while our design has challenges (small N, staggered treatment), we mitigate them via careful modeling, robustness tests, and triangulating multiple data points (operational metrics and financial metrics). Our diagnostics will transparently show the reader that the results are driven by the reform and not an artifact of some hidden bias. Additionally, the magnitude of observed changes provides a sort of "sanity check" – e.g. a doubling of throughput per crane at Haifa is hard to attribute to anything but the new terminal, lending credibility to our causal inference.

8. Reproducibility

To ensure reproducibility, we will provide a **complete research compendium** with data and code. Below is the file manifest and data dictionary for the project:

File Manifest: - `data/` (folder containing raw and processed data) - `data/cbs_ports.csv` – CSV extracted from CBS, listing yearly throughput (tons, TEU) and ship calls by port (Haifa, Ashdod, Eilat) from 2000–2022. **Source:** CBS Statistical Abstract tables [116]. - `data/port_company_financials.xlsx` – Excel file compiling Haifa & Ashdod Port Company stats (revenues, profits, employees, etc.) for 2010–2021. **Sources:** Gov.il privatization reports, Calcalist, Dun's 100 [86]. - `data/comptroller_port_stats.pdf` – Excerpt of State Comptroller 2024 report (in English) with tables for wait times, productivity 2017–2022 [124]. (Also stored as CSV `comptroller_clean.csv` after manual entry). - `data/world_bank_teu.csv` – Country-level TEU throughput for Israel 2008–2022 (from WB WDI) [116]. - `data/CPPI_port_rankings.csv` – Rankings and scores of Haifa and Ashdod from WB CPPI 2021 & 2022 [61]. - `data/ports_panel_quarterly.csv` – **Master panel dataset** constructed for analysis, with each row = port-quarter. Variables: - `Port` (Haifa/Ashdod), - `Year, Quarter`, - `TEU` (thousands of TEU handled in that quarter), - `Employees` (headcount, approximate, either quarterly or interpolated from annual reports), - `Cranes` (number of STS cranes operational), - `K_L` (calculated capital-labor ratio index, e.g. cranes per 100 workers or normalized PPE per worker), - `Prod` (productivity metric, e.g. TEU per worker per quarter), - `WaitTime` (avg hours wait, if quarterly data available or NA otherwise), - `NewComp` (dummy =1 if new competitor terminal active), - `Privatized` (dummy =1 if port privatized by then). - `code/` (folder for analysis code) - `code/01_data_cleaning.ipynb` – Jupyter Notebook cleaning and merging raw data into `ports_panel_quarterly.csv`. Includes steps like: parsing PDF tables, converting annual to quarterly (e.g. distributing annual TEU evenly or by known seasonality), and creating dummies for reform timing. - `code/02_analysis.do` – Stata do-file (or R script `02_analysis.R`) performing the statistical analyses: - Reads `ports_panel_quarterly.csv`, - Runs descriptive stats, - Executes DiD regressions, IV regressions, event studies, - Saves outputs (tables, figures). - `code/figures_tables.do` – (if using Stata) Script to format regression tables (using `esttab` or similar) and produce publication-ready figures (event study plots, etc.). This will output figures to `outputs/`. - `outputs/` (folder for generated results) - `outputs/descriptive_table.pdf` – Table of summary stats (mean TEU, employees, etc. pre vs

post). - `outputs/did_regression.txt` – Regression results of DiD and IV models. - `outputs/event_study_plot.png` – Plot of productivity vs time with reform event marked. - `outputs/synthetic_control.png` – Plot of actual vs synthetic national TEU per worker. - `outputs/proposal_insert.pdf` – The 3-page proposal (section 10) formatted as required for submission. - `README.md` – Instructions to replicate analysis: software requirements (Stata 17 or R 4.2, Python 3.9), step-by-step to run code, expected run time. - `LICENSE` – Open-source license for our code (MIT or CC-BY for data, except where data is proprietary to sources).

Data Dictionary (selected variables): - **Port:** Categorical (Haifa, Ashdod). - **Year, Quarter:** Time period (e.g. 2021Q4). - **Throughput_TEU:** Numeric. Container throughput in TEUs for that period. *Source:* IPC/CBS [117]. - **Throughput_tons:** Numeric. Total cargo tons (includes bulk/general). *Source:* CBS. - **Employees:** Numeric. Number of employees at port company. For Bayport (Haifa new terminal), added to Haifa's count post-2021. *Source:* Company reports (e.g. Haifa ~1000 pre-privatization, Bayport 150 in 2023 [60]). - **Cranes:** Numeric. Count of ship-to-shore container cranes. Haifa old ~12, Bayport +8 in 2021, Ashdod old ~13, Southport +5. *Compiled from sources like Port Company data and media*. - **K_index:** Numeric. An index of capital stock – e.g. (Cranes + other equipment weighted) or PPE (in constant NIS). Normalized to 1.0 in base year 2010 for each port. - **Labor_prod:** Numeric. Our main productivity metric – e.g. TEU per employee per quarter (or per year in annual context). Computed as Throughput_TEU / Employees. - **WaitTime:** Numeric (hours). Average ship waiting time for a container ship. (If quarterly unavailable, annual values assigned to all quarters of that year). *Source:* Shipping & Ports Administration via Comptroller [73] [128]. - **NewComp (Competition):** Dummy. =1 if a new private competitor terminal is operational. (Haifa: =1 from 2021Q4 onward; Ashdod: from 2022Q4). - **Privatized:** Dummy. =1 if port company has been privatized. (Haifa: =1 from 2023Q1; Ashdod: 0 throughout our period). - **Post2021:** Dummy (for synthetic control maybe) =1 from 2022 onward for Israel as a whole.

All data transformations and assumptions (e.g. linear interpolation of employees between known years, or assumption that Bayport's labor is separate) will be documented in the code and README. For instance, *"Employees_Haifa includes Bayport workers post-2021. We added 150 from 2022 as Bayport staff (per news [60]) – sensitivity check: if we exclude those (assuming they are separate), productivity calc changes slightly, see appendix."*

The reproducibility package will allow anyone to **re-run the analysis** end-to-end. By following the README, one can fetch the data (we'll include data where allowed, or code to fetch from original sources like WB API or references to manually download if license issues). The code will then generate all results used in the report.

Finally, our writing will cite the sources of data for transparency. For example, if we state "Haifa's throughput was 1.46M TEU in 2018", our source is wiki/IPC [127]; all such factual claims in the dossier are traceable to the connected references, reinforcing reproducibility of the evidence base.

9. Next-Step Task List

Building on this proposal and preliminary analysis, the following next steps are recommended:

1. **Obtain Granular Operations Data:** Request monthly operational stats from the Shipping & Ports Administration (through data request or scraping MoT site) to refine our analysis frequency (e.g.

monthly TEU, wait times). Higher frequency will improve estimation precision and allow detecting short-term dynamics (e.g. immediate post-reform adjustment period).

2. **Conduct Interviews/Field Inquiry:** To enrich the quantitative analysis, interview port officials or industry experts. Topics: actual changes in work practices post-competition, unrecorded investments (IT systems, training), and how labor unions adapted. This qualitative info can explain mechanisms behind any direct effects we find and validate assumptions (e.g. did privatization lead to layoffs or new labor agreements?).
3. **Extend Comparison to International Benchmarks:** Gather data from similar mid-sized ports in OECD (e.g. Greek or Italian ports without recent reform) to serve as additional controls or benchmark trends. This will strengthen our synthetic control or at least contextualize Israel's post-reform performance relative to others.
4. **Incorporate Cost-Benefit Analysis:** Using data on port tariffs and efficiencies, attempt an economic evaluation: e.g. estimate savings in shipping costs due to reduced wait times and larger ships docking (100k TEU transshipment avoidance saved ~$30M [22]). This will translate productivity gains into monetary terms and address welfare implications (important for policy conclusions).
5. **Examine Distributional Impact on Labor:** Analyze how reform affected port workers: track employment levels, average wages before vs after, and any early retirement schemes. If data are sparse, use proxies (e.g. total wage bill from company reports). This addresses whether productivity gains came at the expense of labor downsizing or through win-win skill improvements.
6. **Robustness to Definition of K/L:** Explore alternative measures of capital deepening – e.g. use **automation index** (perhaps Bayport's yard is fully automated vs old ports manual). If we find a measure of automation (yes/no, or % of moves automated), include it to refine the mediator. This also helps separate pure capital quantity from technology quality in productivity gains.
7. **Follow-up as Data Extends:** Plan to update the analysis as more post-reform data become available (2024–2025), especially given the wartime disruptions in late 2023. A longer run analysis can see if Ashdod Port eventually improves or if initial losses persist, and whether Haifa's gains are sustained after shock events. We should schedule a revisit of data extraction in a year.
8. **Prepare Policy Brief & Presentation:** Synthesize findings into a brief targeted at Israeli policymakers (Ministry of Transport, Finance). Emphasize evidence that competition raised productivity and highlight any remaining gaps (e.g. Ashdod's need for privatization or labor reform to fully catch up). Also prepare an academic presentation (slides, charts) for the Econ H191 seminar, ensuring clarity of identification strategy and results.

By following these next steps, we will deepen the analysis, future-proof it with upcoming data, and ensure the research has practical impact and scholarly contribution. Each task aligns with moving from proposal to execution to dissemination, rounding out the project's lifecycle.

10. Appendix: V1 Proposal Insert (3 pages)

Page 1: Research Question, Design, and Data Sources

Research Question: *How has the introduction of private competition in Israel's seaport sector affected port productivity, and through what mechanisms (specifically, capital deepening versus other factors)?* In particular, we ask if the 2021–2023 ports reform – featuring new privately-operated terminals at Haifa and Ashdod and the privatization of Haifa Port – led to increases in labor productivity (output per worker) at Israel's ports, and to what extent these gains were mediated by increased capital intensity (equipment and infrastructure per worker).

Context & Motivation: Israel's ports historically suffered from low productivity due to a monopoly structure and powerful unions [2]. The government implemented a major reform: building new deep-water terminals operated by international firms (operational 2021–22) [19], and selling the state-run Haifa Port Company to a private consortium (completed Jan 2023) [82]. This injected modern technology and competitive pressure. We want to rigorously evaluate the outcome. Understanding the mechanism is crucial: if productivity gains came mostly from **capital deepening (K/L)** – e.g., new cranes and automation – it validates theories that competition spurs investment. If significant gains also came from **direct effects** (like improved work practices or better management), that highlights the role of incentives beyond just new equipment. The findings will inform privatization and port management policies in other countries by illustrating what drives efficiency in port operations.

Empirical Design: We will use a **Difference-in-Differences (DiD)** approach, exploiting the timing of reforms. Haifa experienced competition earlier (new Bayport terminal from Sep 2021) [32] and privatization in 2023 [82], whereas Ashdod's new terminal ramped up during 2022 and remains state-run. This staggered rollout allows us to compare productivity changes at Haifa vs Ashdod over time. The identification assumption is that, absent reform, productivity trends at Haifa and Ashdod would have been similar (supported by parallel pre-2018 trends in performance metrics [72]). We will check this via pre-reform data and adjust if needed (e.g. include port-specific trends).

To dissect mechanisms, we employ an **IV-mediation strategy**. The reform provides an instrument for capital deepening: essentially a shock that increased capital inputs (cranes, etc.) exogenously. We instrument the port's capital-labor ratio (K/L) with an indicator for reform exposure. Intuitively, we ask: did ports that got the reform invest more in capital, and did those investments translate into higher output per worker? Using two-stage least squares, we can estimate the portion of the reform's effect that works via K/L. The remaining unexplained portion would be attributed to other factors (direct effects like better labor efficiency or competition-driven optimization).

Data Sources & Availability: We have identified the following data to execute this design (all **confirmed available** or accessible): - **Port Throughput & Employment:** Annual and quarterly data on cargo volumes (TEU, tons) and number of employees for Haifa and Ashdod ports. *Sources:* Israel's CBS publishes port throughput [116]; port companies report workforce and financials (e.g., Ashdod Port had ~1,300 workers and handled 1.525M TEU in 2017 [122]). We have 2010–2022 figures from reports and news (Haifa ~1,000 workers pre-privatization; Bayport added ~150 workers) [60]. - **Capital Inputs:** Data on port infrastructure/capital: number of cranes, berth length, etc. *Sources:* Israel Ports Company and news releases (Bayport brought 8 new STS cranes [57]; Ashdod's new terminal ~5 cranes; existing port crane counts from IPC). Also, fixed asset values from port financial statements (if available) will proxy capital stock. - **Operational Performance Metrics:** Average ship waiting time, berth utilization, etc., by port and year. *Source:* Ministry of Transport's Shipping & Ports Administration provides these (the 2024 State Comptroller report includes 2017–2022 stats [66]). We have data showing, for example, average wait for container ships in Haifa dropped from ~17 hours in 2017 to ~4 hours in 2022 [75] [77] after Bayport opened. - **Macro Controls:** Overall trade volumes (so we control for booming trade in 2021) from CBS trade data, and possibly GDP or industrial production indexes from the Bank of Israel (to net out general economic trends).

All these data are either publicly available online or have been obtained from official publications. We have verified key numbers (e.g. TEU throughput by year, see Section 4 data inventory). Data will be structured as a panel (port-quarter level).

Data Availability Verification: As a check, we already pulled World Bank data showing Israel's total container traffic was ~3.08M TEU in 2021 and ~2.95M in 2022 [116]. We also have Haifa Port's privatization documents confirming required investment amounts [62] (to gauge capital increases) and labor agreements status. Thus, we are confident the needed data exist. For any variables not directly observed (like precise quarterly employees), we can interpolate or use proxies (and conduct sensitivity analysis).

In summary, the research design leverages a natural experiment-like reform implementation, and we have the data to measure its effects. Next, we highlight relevant literature and the gap our study will fill.

Page 2: Literature Review and Evidence Gap

Literature Review: Two strands of literature inform this study: (1) research on **port privatization/ competition and productivity**, and (2) methods for **causal mediation/IV analysis**.

On ports, numerous studies document efficiency gains from reforms: - *Global studies:* Cullinane & Song (2002) found privatization only modestly improves efficiency unless accompanied by competition [107]. Cheon et al. (2010) showed that transferring operations to private entities and introducing competition significantly increased TFP at container ports worldwide [94] [98]. These indicate our expected direction of effect – competition should raise productivity – and emphasize looking at competition *versus* privatization. - *Case studies:* Estache et al. (2002) on Mexico's ports reform found a short-term efficiency jump (~15% increase in productivity) after privatization and decentralization [102]. Gonzalez & Trujillo (2009) showed Spanish ports that fostered intra-port competition (multiple terminal operators) achieved higher efficiency gains than those that didn't. These contextualize our scenario: Israel's reform is akin to introducing intra-port competition (Bayport vs Haifa Port, etc.). Our study will add a new case, using recent data from Israel which has not yet been examined in academic literature, especially given the reform is very recent (2021–23). - *Mechanism insights:* Notteboom & Rodrigue (2012) discuss how investments in port infrastructure (larger cranes, deeper berths) are crucial for handling mega-ships and that often such investments come with private involvement. Empirically, Tongzon & Heng (2005) found that efficiency differences correlate strongly with capital investment and technology adoption post-reform, rather than just change of ownership. This suggests measuring K/L is key – which we do.

On methodology, our approach draws on: - *Causal Mediation Literature:* Imai et al. (2010) formalized methods to estimate mediation effects and introduced the concept of natural direct/indirect effects. They typically require strong assumptions, but the idea of quantifying how much of an effect is mediated by a variable is directly relevant. Economists Dippel et al. (2018) applied IV to mediation, effectively decomposing the effect of a trade shock on outcomes via a particular channel (labor markets). Their approach gives precedent to our IV mediation strategy: use reform as an instrument to isolate the mediated pathway (capital deepening). There is an evidence gap in applying such methods to infrastructure reforms – we aim to fill that.

Contribution and Gap: Despite abundant literature on port reforms, **Israel's ports reform has not been studied econometrically** yet (to our knowledge). Most prior studies cover reforms in the 1990s–2000s. Israel's reform is a 2020s case with modern features (e.g., Chinese state-operator involvement, immediate technology leap to semi-automation). This offers a fresh data point for the ongoing debate about privatization vs competition: Israel essentially created competition first (new terminals) and privatized second (Haifa port sale). Our analysis can distinguish their effects, which is rarely done. For example, in

many cases privatization and competition come together, so separating them is hard; here Ashdod allows a comparison (competition without full privatization).

Moreover, our focus on **quantifying the mechanism** (capital deepening) addresses a gap. Studies often conclude "efficiency improved" but not *how* or *why*. By measuring K/L changes and using IV, we will provide evidence on whether it was the infusion of new capital that mattered or if simply the presence of a competitor made labor work harder (a direct effect). If we find, say, 80% of productivity gains were due to higher K/L, that reinforces theories that infrastructure investment is key. If instead a large part is unexplained by K/L, that might suggest managerial efficiency or labor reorganization played a bigger role – an insight valuable for policy (as it might mean similar results could be achieved by better management even without huge capital spend, or vice versa).

Additionally, this study is essentially a **microcosm of the broader infrastructure productivity question**: public vs private efficiency. Israel's experience will contribute to that literature with hard data. Given the politically sensitive nature (unions claimed privatization would hurt workers; government claimed it would cut costs [85] [133]), an objective analysis is needed. Our results can inform if similar reforms (e.g., privatizing Ashdod, or in other sectors like rail or electricity) are likely to yield productivity improvements.

In summary, the literature suggests we should expect positive effects from the port reform, but it hasn't quantified Israel's case or the mediation via capital. We fill this gap by applying modern causal inference tools to new data. This will enrich both the empirical record on port reforms (with a contemporary case) and demonstrate an approach to disentangle channels of effect, which can be applied to other infrastructure reforms.

Page 3: Why Our Approach is Better

Our approach offers several advantages and improvements over both status quo understanding and potential alternative methods:

1. Causal Clarity through Research Design: By using the staggered introduction of competition and privatization, we move beyond simple before-after comparisons (which could be biased by unrelated trends). A naïve analysis might note that productivity improved after 2021 and attribute it to the reform, but we establish causality by comparing against the appropriate counterfactual (Ashdod's slightly later reform timeline, plus pre-reform baseline). This DiD setup with careful attention to parallel trends and potential spillovers yields **more credible causal inference** than, say, correlating privatization with performance (which could be endogenous – better-performing ports might be privatized first, etc.). In Israel's case, Haifa was privatized not because it was efficient (arguably the opposite, it was sold to *make it* efficient), supporting our treatment exogeneity, but our design will explicitly test and confirm that.

2. Mechanism Identification (IV-Mediation): Many evaluations stop at "reform = productivity gain" without explaining the mechanism. Our approach, by instrumenting K/L with the reform, **directly quantifies the role of capital deepening**. This is a methodological improvement, allowing us to answer not just "did it work?" but "*how* did it work?". For policymakers, this is crucial. If we find that nearly all gains came from new equipment (and not from, e.g., cutting labor or improving incentives), it implies that replicating such success elsewhere needs capital investment. If we find a large direct effect, it implies managerial autonomy or competition pressure itself yielded efficiencies (e.g., reducing idle times, better

scheduling) beyond what new cranes alone would do. This nuanced insight is only possible with our IV-mediation strategy, which is novel in this context.

3. Data Granularity and Dual-language Sources: We leverage detailed operational data (wait times, etc.) from Hebrew sources that international studies might overlook. For example, OECD reports wouldn't have Israel's internal wait-time stats that we obtained [66]. By incorporating these, our analysis is **more comprehensive** and fine-grained. We can corroborate productivity findings with parallel evidence (reduced wait times, increased ship size handling) to strengthen causality. Our multilingual research (using Hebrew Ministry reports and English sources) ensures no stone is unturned data-wise – something a non-local researcher might miss. This thorough data inclusion makes our results more robust and tailored to the Israeli context.

4. Comparative Angle – separating competition vs. privatization: Our approach implicitly separates the effects of introducing a competitor (which happened while the port was still public) from the effect of later changing ownership. Many studies conflate these. We will be able to say, for instance, "the competition itself raised productivity by X%, and the subsequent privatization added an additional Y%." If Y is small, it suggests that the heavy lift was done by competition and that privatization mainly serves other goals (perhaps long-term investment or relieving state finances). If Y is large, it means there were inefficiencies only resolvable by removing the port from government ownership (like streamlined procurement or labor flexibility). This is directly policy-relevant: it informs whether a government could achieve most benefits by simply introducing competition (and could even retain ownership under regulation) or if full privatization is necessary to reap the gains. Our design, thanks to the timing difference at Haifa vs Ashdod and pre/post privatization at Haifa, is uniquely suited to tease this out. That makes our approach superior to one that would treat the reform as one monolithic block or examine just one aspect.

5. Counterfactual Construction: We plan to bolster our DiD with synthetic control for national-level impact. While DiD handles port-level, a synthetic control using other countries' trends will address the question: what if Israel had not reformed at all? Preliminary thought: without reform, Israel's congestion would have worsened (indeed wait times were on a worsening trajectory pre-2021 [134]). We'll quantitatively show how far off the path Israel veered due to reform (e.g., climbing in global port rankings from 3rd percentile to 20th percentile [61]). Alternative approaches might not incorporate such a broad perspective. By doing so, we strengthen external validity (comparing to global benchmarks) and show that our findings aren't Israel-specific quirks but align with economic intuition.

6. Reproducibility and Transparency: Our approach emphasizes a fully reproducible workflow (detailed in Section 8). While not a theoretical improvement, it is a practical one: it means our results can be trusted and verified by others. This contrasts with some past studies on port reforms that might use proprietary efficiency scores or opaque data. We compile data from public sources and will share the code, enhancing the credibility and allowing future researchers to update the analysis as more data come in (e.g., including 2024, 2025 outcomes).

Why better than alternative methods? One might consider an **aggregate time-series** approach (e.g., ARIMA on productivity with an intervention dummy in 2021). That would suffer from one data point of intervention and many confounders (global shipping crisis, etc.). Our panel DiD approach is more robust, using the within-country control (Ashdod) and controlling for time effects. Another method could be a **frontier analysis (DEA/efficiency scores)** comparing before vs after. While useful, DEA would show improvement but not causally attribute it or break down the cause. Our econometric approach directly

attributes cause and effect with statistical significance and confidence intervals. Finally, by explicitly modeling the mediator, we improve upon a pure structural production function approach (which might estimate elasticities of capital and labor but not connect them to the reform policy).

In summary, our approach is tailored to leverage Israel's reform as a natural experiment, and goes a step further to unpack the causal chain. It is both rigorously causal and rich in detail. This will yield insights not just on whether the reform "worked", but *why* it worked, providing a better evidence base for decisions on port sector reforms in Israel and abroad.

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