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ANALYZING OVERCAPACITY AND SUBSIDIES IN THE SHIPBUILDING SECTOR USING A GTAP MODEL

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APRIL 2025



OVERVIEW

- **Motivation**

- Hard data on industrial subsidies is scarce, especially implicit ones.
- “Other Transportation Equipment” (OTN) sector (e.g., shipbuilding, aerospace products, railroad equipment) exhibits signs of overcapacity.

- **Research Objectives**

- Use GTAP data to identify explicit and implicit subsidies.
- Examine the roles of high household savings and high investment in some countries due to a limited social safety net and restricted financial markets.

- **Methodology**

- Compare sectoral productivity growth in the sector to construct counterfactuals.
- Apply historical decomposition (Dixon & Rimmer, 2023) to estimate implied subsidies.

- **Expected Contribution**

- Demonstrate how to use the approach of historical decomposition in a GTAP framework to study the sources of overcapacity and industry policies (e.g, subsidies).
- Inform policy responses for industrial overcapacity and subsidy reform.



CONTEXT OF INDUSTRIAL POLICY

- Forms of government subsidies:
 - Production subsidies: such as, subsidized material inputs, export credits, and buyer financing.
 - Entry subsidies: such as, below-market-rate land prices, in combination with simplified licensing procedures.
 - Investment subsidies: such as, regional governments set up dedicated banks to provide shipyards with favorable financing terms.
- The combination of these policies in the 2000s was followed by a sharp expansion of production in some countries in other transportation equipment (e.g., shipbuilding production), market share, and capital accumulation.



OUTPUT AND MARKET SHARE OF THE 'OTHER TRANSPORTATION EQUIPMENT', 'OTN'

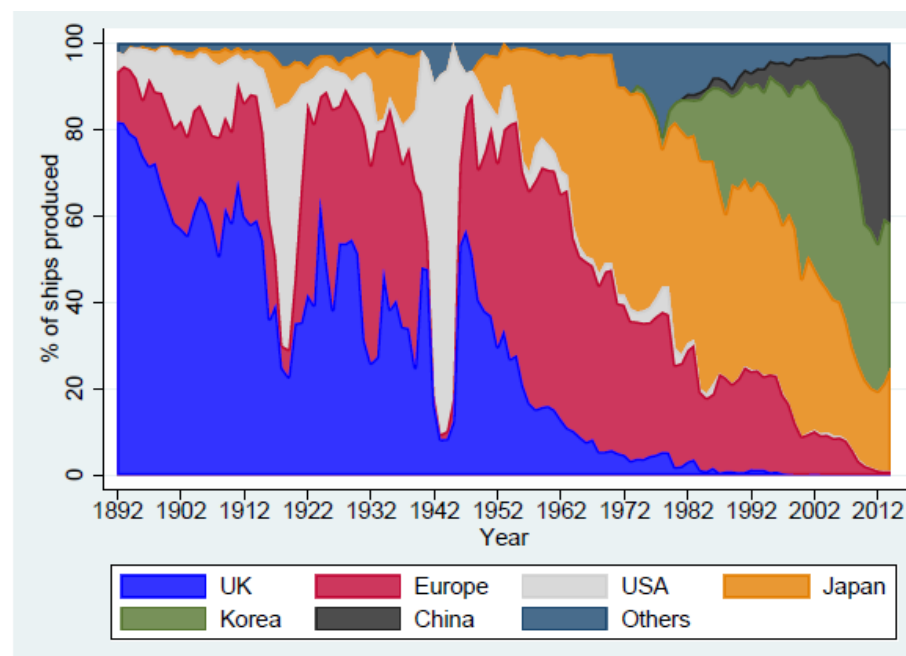
Output of other transportation in GTAP

US\$m	2004	2014	2004	2014
China	45,563	246,942	8%	21%
Japan	47,740	91,744	8%	8%
Korea	16,249	37,137	3%	3%
USA	177,715	196,036	31%	16%
UK	29,832	53,625	5%	5%
EU27	150,010	268,780	26%	23%
ROW	110,748	296,195	19%	25%
World	577,857	1,190,459	100%	100%

Source: Office of the Chief Economist, Global Affairs Canada.

LHS data: GTAP, RHS chart: Barwick et. Al (2024)

Share of commercial ships production



The market share of Chinese other transportation equipment increase substantially.

The RHS chart shows the ship building sector only, and the LHS table include shipbuilding, aerospace products and railroad equipment.



BACK OF THE ENVELOPE (BOTE) CALCULATION: THE PRODUCTION SUBSIDIES IN THE 'OTN' SECTOR IN CHINA

US\$m	Tax		Output		Tax / Output	
	2004	2014	2004	2014	2004	2014
China	2,299	3,571	45,563	246,942	5%	0%
Japan	3,322	8,709	47,740	91,744	7%	9%
Korea	624	1,449	16,249	37,137	4%	4%
USA	18,965	20,146	177,715	196,036	11%	10%
UK	3,207	4,321	29,832	53,625	11%	8%
EU27	15,553	25,580	150,010	268,780	10%	10%
ROW	8,001	17,468	110,748	296,195	7%	6%
World	51,972	81,243	577,857	1,190,459	9%	7%

Source: Office of the Chief Economist, Global Affairs Canada. GTAP

Taxation in the “OTN” sector in China did not grow proportionally with the sector’s size, causing the effective tax rate to fall from 5% to 0% of output between 2004 and 2014. If the 2004 tax rate (5%) had been applied in 2014, tax revenue would have been \$12.5bn (=247bn*5%). This suggests that the Chinese government effectively subsidized \$12.5 in this sector in 2014. Averaging this subsidy over the ten-year period from 2004 to 2014 gives an **annual subsidy of approximately \$6.3bn** (12.5bn ÷ 2), using the 2004 tax level as a benchmark.

If we benchmark **against the global average tax rate**, the estimated production subsidies provided by the Chinese government in this sector amount to about **\$9.3bn**.



BOTE CALCULATION: THE ENTRY AND INVESTMENT SUBSIDIES IS ABOUT \$20BN PER YEAR FROM 2004 TO 2014

US\$m	Payment to Capital		Output		Margin Rate (Rent / Output)	
	2004	2014	2004	2014	2004	2014
China	3,137	15,604	45,563	246,942	7%	6%
Japan	4,215	7,735	47,740	91,744	9%	8%
Korea	2,218	2,077	16,249	37,137	14%	6%
USA	10,335	30,430	177,715	196,036	6%	16%
UK	1,233	4,429	29,832	53,625	4%	8%
EU27	16,366	27,866	150,010	268,780	11%	10%
ROW	15,941	41,515	110,748	296,195	14%	14%
World	53,445	129,655	577,857	1,190,459	9%	11%

Source: Office of the Chief Economist, Global Affairs Canada. GTAP

The table indicates that **the “OTN” sector in China has a relatively low margin** compared to other regions. Globally, the margin rate is around 10%, while in China, it is approximately 7%. One possible reason for this is that government subsidies in China, such as those supporting market entry and investment, have boosted capital stocks.



LIMITATIONS OF THE BOTE CALCULATIONS

- Estimated Subsidies on 'OTN' Sector Provided by the Chinese Government from 2004 to 2014
 - Production subsidies: Approximately \$6.3 billion to \$9.3 billion per year.
 - Market entry and investment subsidies: we don't know, unless we know the rate of return on capital in this sector.
- Limitations of Our BOTE Calculations
 - Data accuracy: More precise data on the rate of return on capital is needed for more accurate estimates.
 - Additional influencing factors: Beyond government subsidies, other factors may contribute to the low return on capital and increased capital stock in China. For example, a restricted financial market and high savings rate could play a role. Consequently, households, along with the government, indirectly contribute to overcapacity in the sector. If that is the case, we might overestimate the entry and investment subsidies provided by the Chinese government.



ESTIMATING THE IMPLICIT SUBSIDIES BY HISTORICAL DECOMPOSITION

- Historical decomposition (Dixon & Rimmer, 2023) produces estimates of movement between 2004 and 2014 in:
 - **Technologies** disaggregated by industry, region and input; and
 - **Preferences** disaggregated by imported and domestic commodity, region and agent.
- These estimates are informed by data on movements between the two years in:
 - **real GDP, capital stock and employment** for each region, and employment disaggregated for selected regions into skilled and unskilled;
 - values in each region of **expenditures by households, governments and investors** disaggregated by commodity and source (imported or domestic);
 - values in each region of **expenditures on intermediate inputs** disaggregated by commodity and source;
 - values in each region of **expenditure on labour and on capital** aggregated over industries;
 - values of **exports** from each region disaggregated by commodity;
 - values of **margins** supplied from each region to facilitate international trade;
 - the **price index for investment** in each region;
 - **quantities of world output** for 35 out of the 57 GTAP commodities; and
 - **taxes and subsidies** (including tariffs) in production, consumption and trade.



RELIABILITY OF TAX AND TARIFF DATA IN GTAP

- **Tariffs**
 - Based on **MAcMap** – dependable if MAcMap is accurate.
- **Export Taxes**
 - Sourced from **WTO notifications** – considered reliable.
- **Sales Taxes/Subsidies (Manufacturing & Services)**
 - Based on **country-specific IO tables** – less reliable.
 - IO tables have one row of indirect taxes proportionally shared across flows.
- **Income and Factor Taxes**
 - Taken from **IMF data**.
 - Applied like tariffs by backing out rates from initial gross factor flows.
- **Domestic Support (Agricultural Subsidies)**
 - **Country-level rates**: aligned with **OECD PSE** data – reliable.
 - **Sectoral rates**: less accurate due to distribution assumptions across sectors.
- **Output Taxes**
 - Based on original **IO table rates**, unless the sector receives domestic support.
 - In those sectors, IO tax rates replaced by **domestic support rates**.



CHINA'S LOW SPENDING AND HIGH INVESTMENT, HIGH ESTIMATED PRODUCTIVITY GROWTH IN THE 'OTN' SECTOR

	Consumption out of GDP		Gov't Spending out of GDP		Investment out of GDP		All-input productivity of 'OTN', 2004-2014
	2004	2014	2004	2014	2004	2014	
USA	68%	70%	15%	15%	22%	20%	-0.5
Canada	57%	58%	20%	21%	22%	25%	-3.0
Mexico	67%	69%	11%	12%	21%	21%	-2.1
China	40%	38%	14%	14%	40%	44%	23.9
Japan	57%	58%	18%	20%	22%	21%	-11.1
SKorea	48%	52%	15%	16%	31%	27%	5.4
India	61%	61%	11%	12%	30%	33%	-0.7
France	56%	57%	23%	25%	22%	22%	-5.9
Germany	58%	55%	19%	20%	19%	20%	-0.9
UK	66%	67%	20%	20%	18%	17%	7.0
RoEU	57%	58%	21%	22%	23%	20%	1.5
SaudiArabia	32%	31%	24%	25%	20%	24%	-2.9
RoW	60%	59%	15%	16%	21%	24%	15.3
World	60%	58%	17%	17%	23%	25%	2.0

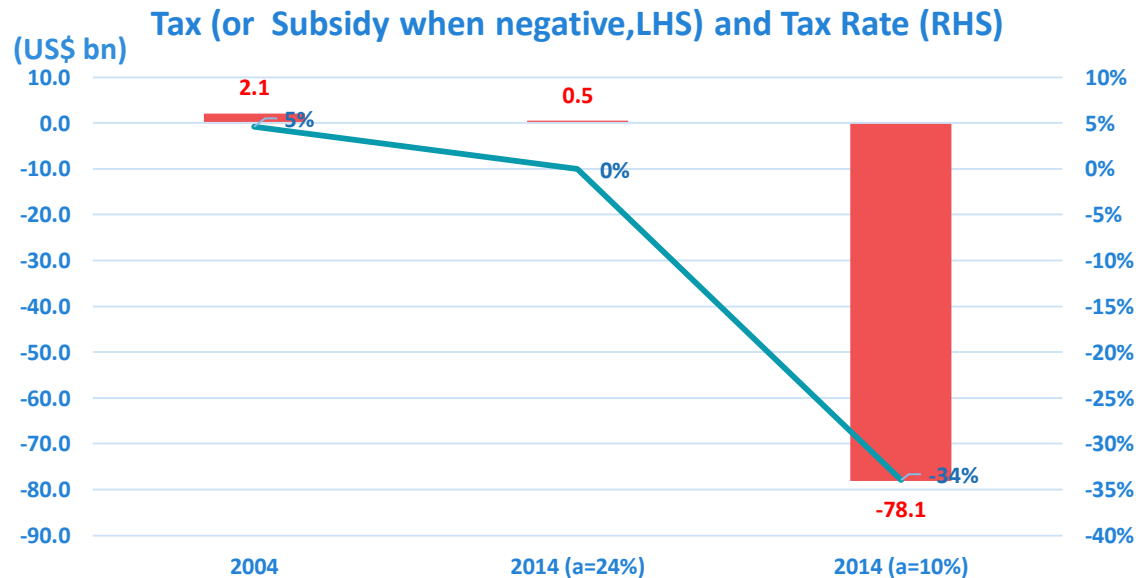
Source: Office of the Chief Economist, Global Affairs Canada. GTAP

The estimated all-input productivity growth in 'OTN' sector in china is 23.9%, much higher than the world average (2%). Is that plausible?



WE MIGHT OVERESTIMATE THE GROWTH IN PRODUCTIVITY AND UNDERESTIMATE PRODUCTION SUBSIDIES IN THE 'OTN' SECTOR

- Barwick et al. (2024) argue that China's production process in shipbuilding sector is not characterized by significant technological advances, and product differentiation is very limited. On the other hand, the production subsidies in China play bigger role in helping lower the cost and expand the output.
- What if we assume the growth in productivity in 'OTN' sector in China is the twice as South Korea between 2004-2014? The subsidies required to support the growth of the level of production in 2014 is about US\$78bn (about US\$39bn/year from 2004-2014).



Source: Office of the Chief Economist, Global Affairs Canada. GTAP



DECOMPOSING THE CONTRIBUTION OF FACTORS TO PRODUCTION IN 'OTN' SECTOR



Source: Office of the Chief Economist, Global Affairs Canada. GTAP

- If China followed the global ratio of household consumption and government spending to GDP, production in the 'OTN' sector would fall by US\$45.8bn (about 18% drop from the initial level).
- If China invested at the same proportion of GDP as the world, 'OTN' production would drop by US\$9.8bn (4% of the initial level).
- Adding back the production tax (7%) to the 'OTN' sector in China, production would decline by US\$17.4bn. If removing the implicit subsidy, the production would drop US\$46.9bn (19%).
- Combining the effects of high saving, high investment, missing tax and implicit subsidies, the counterfactual output of the 'OTN' sector in 2014 would have been US\$127.2bn, rather than US\$246.7bn.



WHAT WOULD HAPPEN TO THE OUTPUT AND MARKET SHARE OF 'OTN' SECTOR IN THE GLOBE IN THE COUNTERFACTUAL SCENARIO

(US\$m)	Counterfactual			Counterfactual	
	2014 level	level	% change	2014 level	level
USA	323,363	356,308	10%	25%	28%
Canada	28,461	30,234	6%	2%	2%
Mexico	12,196	11,938	-2%	1%	1%
China	246,942	127,156	-49%	19%	10%
Japan	56,204	61,112	9%	4%	5%
SKorea	36,114	41,182	14%	3%	3%
India	41,609	43,912	6%	3%	3%
France	92,354	109,011	18%	7%	9%
Germany	100,491	116,098	16%	8%	9%
UK	51,720	56,347	9%	4%	4%
RoEU	77,689	82,434	6%	6%	6%
SaudiArabia	3,508	3,480	-1%	0%	0%
RoW	215,883	233,463	8%	17%	18%
Total	1,286,534	1,272,676	-1%	100%	100%

Source: Office of the Chief Economist, Global Affairs Canada. GTAP



PROS AND CONS OF THIS APPROACH

- **Pros:**

- We use **historical decomposition** to estimate implicit subsidies driving overcapacity in Other Transportation Equipment (OTN) sector (2004–2014).
- The method **separates the effects of the macro factors**, such as, high savings and investment rates, from the effects of industrial policy (e.g, subsidies).
- This approach can be **extended to other sectors** (e.g., steel, aluminum, cement).

- **Cons:**

- **The quality of the sector-specific tax data** in GTAP is generally lower than that of tariff data.
- The GTAP model **lacks sector-specific capital dynamics**. CHINA-GEM or other country-specific CGE models may be better suited.
- Assuming **10% productivity growth** in 'OTN' sector in China (about twice as Korea's) during 2004-2014 is a simplification. More accurate productivity data would improve the credibility of our subsidy estimates.



POLICY IMPLICATIONS: ADDRESSING OVERCAPACITY IN OTN SECTOR

- **Recognize the Scale of Subsidy-Driven Growth**
 - Estimated subsidies in the OTN sector (including shipbuilding) in some countries are substantial
 - Growth in output may reflect **policy-driven capital deepening**, not productivity gains.
- **Re-evaluate Industrial Policy Tools**
 - Entry, investment, and production subsidies may create **long-run inefficiencies** if not paired with innovation or competitiveness goals.
 - Overcapacity poses risks of global price suppression and trade tensions.
- **Consider Broader Macro-Structural Factors**
 - High household savings and financial repression may be **amplifying capital misallocation**.
 - Structural reforms in financial markets may be needed alongside industrial policy adjustments.
- **Global Coordination Matters**
 - Subsidy-driven overcapacity can have **spillover effects** on international markets.
- **Recommendation**
 - Shift from broad-based subsidies to **targeted, performance-based support** (e.g., tied to productivity, decarbonization, or export quality standards).



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THANKS!
Q&A