Enhancing e-Commerce Network Optimisation Through Navigating Trade Incentives Across Asia



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r 1. Project Description

The recent trend of e-commerce has led to a gradual change in the traditional sense of network optimisation. Amidst global competition, supply chain logistics providers face a rapidly changing e-commerce environment, with conflicting concepts of consolidation for economies of scale and deconsolidation for small volume online orders due to e-commerce increasing both supply chain complexity and overall cost. This project aims to explore tax incentives that e-commerce orders may benefit from, such as minimum quantity tax exemptions.

In most network modelling software, taxes and tariffs are often not well modelled. This project seeks to create a systematic approach to modelling taxes and tariffs to enhance network optimization routines, with e-commerce as the model problem.

Key Skillsets

Logistics Engineering & Supply Chain Modelling Application of supply chain concepts in network design

Operations Research

Applied understanding of OR techniques to develop tax routine

International Trade

Research and analysis on international trade regulations

Microsoft Excel VBA, Python

Cleaning of unstructured data and actual implementation of tax cost generation subroutine

2. Key Objectives

- To construct a generalized trade taxation structure that best represents those employed in most of Asia.
- To develop subroutine enhancement to the company's network design optimisation model, allowing Toll to provide network design advice that is well-founded in terms of tax and tariff considerations.
- To assess the significance of the tax and tariff components in influencing decision making in network design

4. Industry Research

Types of Taxes and Tariffs Cost, Insurance and Freight Value	Tax Components CIF Value of Product	 Free Trade Agreements Policies signed between two or more countries to boost trade Rule of Origin: conditions for imports/exports to be above some set percentage manufactured in participating country Preferential tariff rates to be applied for custom duties if
Goods are taxed according to Most Favored Nation (MFN) tariff rates. Rates differ from country to country, and depend on HS code classification.	Import/Export/Custom Duties	conditions are met
Indirect unit-based or percentage-value taxes are charged on the sale of certain products, usually for social and environmental reasons.	Excise Tax/Duties	 Duties and taxes are suspended for re-exported goods in designated storage areas or during period of temporary
A percentage value for a good/service is imposed. Many countries offer exemptions depending on the CIF value or customs duty imposed on the shipment or order.	Sales Tax/Value-Added Tax/Goods & Services Tax	 import schemes Goods are not taxable until they enter customs territory

3. Methodology

Understanding industry background	Held discussions with Toll and researched on supply chain network design
Research and analysis of regional tax and tariffs	Gathered information on tax types, exemptions and free-trade agreements & zones from online sources
•	
Development of generalized tax	into a suitable framework for
Structure	
Development of tax cost generation model	Developed using Python with tax reference generated using Microsoft Excel VBA
+	
Analysis and evaluation of impact of tax on costs	Assessed usefulness of model based on its impact on final costs and generated optimal network design
+	
Handover	Created handover documents to outline update procedures

Tax Incentives and Exemptions

Singapore: GST waived if CIF value < SGD \$400 (USD \$304) China: Tariffs waived if tax value < RMB \$50 (USD \$7.89) Japan: Customs duty & GST waived if tax value < \$10,000 yen (USD \$93.60) Korea: Customs duty and VAT waived if CIF value < KRW \$150,000 (USD \$141)

5. Tax Analysis

Generalised Tax Structure Free Trade Agreements **Taxes & Tariffs** Free Trade Zones (FTAs) (FTZs) Import/ **Countries** Countries **Customs Duties Rule of Origin Sales Tax Requirement (%) Excise Tax** New tariff rate

Investigating Tax Through Visualisation

- Dutiable goods are exempt from MFN-based customs duties if FTAs are in place
- Hence, only ad-valorem based excise taxes are considered in illustrations
- Illustrations aim to find out trade stance of countries and which ones are more likely to be favourable hub locations

Harmonised System (HS) Code

Classification system for tax purposes, where a commodity product group is represented using a number up to 10 digits

0101.21.00.10 Internationa



r6. Implementation

Referencing three-echelon supply chain	Considerations	File Structure	Inp	uts	Outputs	Program UI			
Objective Function:Variables: $\sum_i \sum_j \sum_k (transWC_{i,j,k} + whVar_{i,k})d_{j,k}Y_{i,j,k} + l$ Plant $\sum_l \sum_i \sum_k (transPW_{l,i,k} + pVar_{l,k})Z_{l,i,k} + j$ Customer $\sum_i \sum_w whFix_{i,w}X_{i,w}$ wWarehouse Type	 Managing complexity and efficiency vs. effectiveness of 	<mark>Orders</mark> Order No., Product Mix, Destination	Products SKU, HS Code, Origin, Sales Price	Sales Tax Destination, Tax Cost	Order-level Tax Cost Order No., Total CIF Value, Destination, Sales & Customs Tax for	Terriff Cest Generator Tariff Cost Generator input_files/orders.csv not found, nput_files/arders.csv not found, nput_files/arders.cs	✔ Twilf Cest Generator – □ × TOLL LOGISTICS Tariff Cost Generator All files are found. Click on "Create Oulput Files" button.	Teriff Cott Generator	✓ Tariff Cost Generator ■ X TOLL LOGISTICS Tariff Cost Generator Output files written successfully! Time Elesped: 667.65
$transWC_{i,j,k}$ Transport Costs from Warehouse i to Customer j for Product k $whVar_{i,k}$ Warehouse i variable cost for Product k $d_{j,k}$ Demand by Customer j for Product k $Y_{i,j,k}$ Indicator variable if Warehouse i serves Customer j Product k $transPW_{l,i,k}$ Transport Costs from Plant l to Warehouse i for Product k	 model MIP assumptions on additivity and proportionality 	<u>Tariffs</u> Destination, HS Code, Tax/Unit	Excise Tax Destination, HS Code, Tax/Unit	FTZs Destination	Origin and Destination <u>Product-level Tax Cost</u> SKU, Unit tax cost at	There are mosing life' Floats and them to be 'input life' folder and restart the program.	Create Output Files	Create Output Files	Create Output Files
$pVar_{l,k}$ Plant l variable cost for Product k $Z_{l,i,k}$ Amount of Product k flowing from Plant l to Warehouse i $whVar_{i,w}$ Warehouse i variable cost for Product k $X_{i,w}$ Indicator variable if Warehouse i opened with option w	 Difficult to capture tax cost penalties as indexes 	<u>Exemptions</u> Destination, Type (CIF Value, Tax Value), Value	FTAs Origin, Destination, HS Code, Type (New value/% change), Value		origin for imports and re-exports, Unit tax cost at destination for imports and re-exports	Check for input files	Prompt to start cost calculation	Processing output files	Prompt on completion

crunsi vilik	Transport costs from Franci to Warehouse From Froudet
pVar _{l,k}	Plant <i>I</i> variable cost for Product <i>k</i>
$Z_{l,i,k}$	Amount of Product k flowing from Plant l to Warehouse
whVar _{i.w}	Warehouse <i>i</i> variable cost for Product <i>k</i>
X	Indicator variable if Warehouse <i>i</i> opened with option w

	proportionanty	
•	Difficult to capture	E TO
	tax cost penalties as	Destinat
	indexes	Value, Tax



r 7. Results and Analysis

Case Study

- Product data from Client H, a health products marketplace operator from the US, is used to run the tax calculation model
- Client H previously decided to locate its hub in South Korea, even though Toll had advised H that Singapore is the best hub location choice.
- H might not have sufficiently understood tax costs in Singapore, and hence was hesitant to take the risk of incurring additional costs from tax and tariffs from Singapore's GST rates.

Illustration of Results Cost reduction vs. next best 1% South Korea hub choice China **Cost difference** considering tax 0.6% (Hong Kong) & tariffs



1200 0 Without tax costs: KOR optimal With tax costs: SGP optimal

Analysis

- Generally low tax impact on cost by re-export goods compared to warehousing and transport costs due to waivers from Free Trade Zones and Temporary Import Schemes
- Tax and tariff costs are relatively consistent between hub choices, hence they have little impact on optimality
- However, for products that face high tariffs in certain countries due to protectionist trade policies (refer to illustration in Section 5), impact on total costs become more significant and can affect relative hub optimality
- Client H is worse off to choose other hubs from Singapore because of tax risk concerns
 - Being informed on tax impact can help Client H avoid incurring more cost unnecessarily

8. Future Work

- Incorporating tax and tariff calculations into the optimisation algorithm
- Automate the updating of sources of tax information and FTAs
- Dynamic scenario modelling to allow customers to look at revenue structure and management
- Investigate into areas with greatest potential for cost improvement
- Investigate into scenarios involving complex product compositions affecting **Rule-of-Origin**
- Include more detailed FTZ considerations