IMPACT OF REGIONAL ECONOMIC INTEGRATION ON TAIWAN'S INDUSTRIAL SUPPLY CHAIN OF VEHICLES

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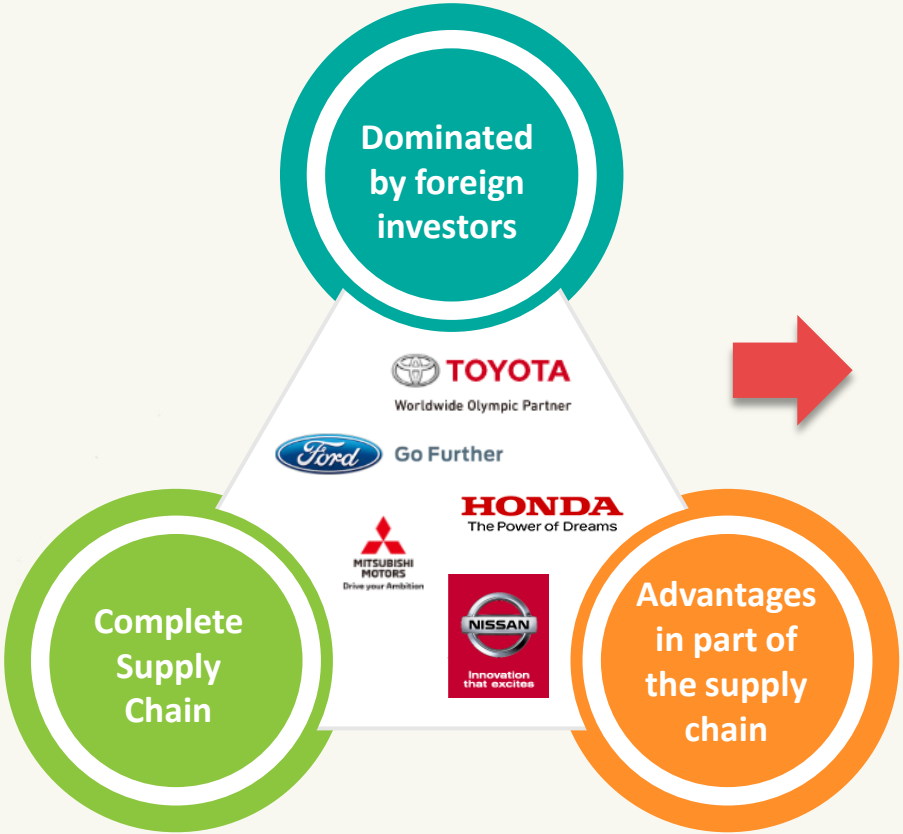
Purposes



What will be the impact on industry under the situations of regional economic integration and MNEs' adjustment of global supply chain?

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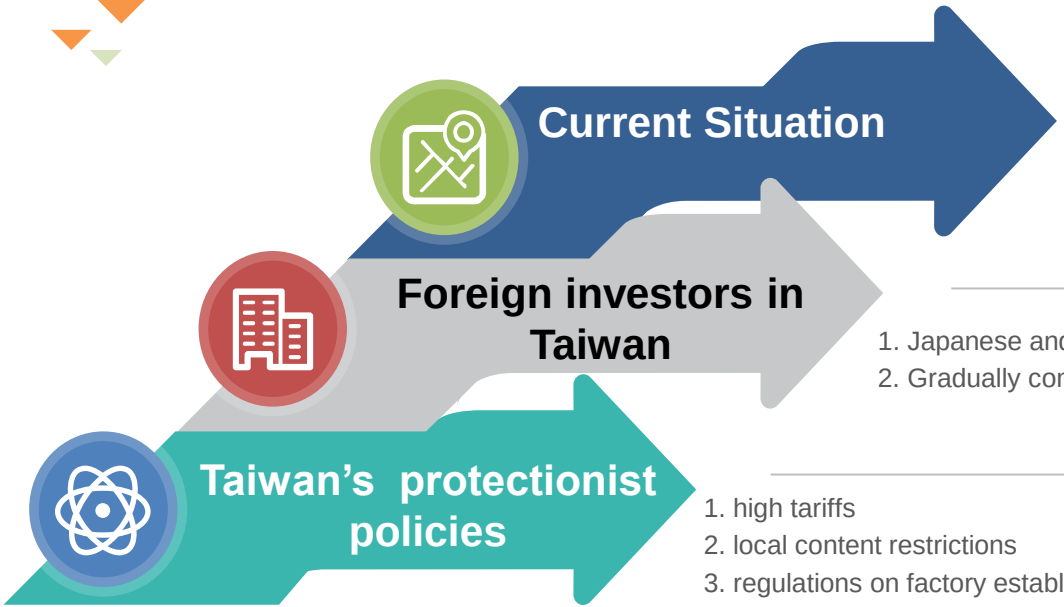
01 Background and Literature Review

- Background
- Literature Review

Background



1. Most automobiles manufactured in Taiwan are Japanese brands and sold domestically
2. Production arrangements and sales are mostly managed by the parent company in Japan.
3. Some companies show high competitiveness in auto parts especially in aftermarket (AM).

1. Japanese and American automobile manufacturers invested to produce in Taiwan.
2. Gradually completed the supply chain for Taiwan's automobile industry.

1. high tariffs
2. local content restrictions
3. regulations on factory establishment

- Shih et al., 2016
  - The automobile industry will face severe impact when Taiwan participates in regional economic integration, while Japan will have the greatest impact on Taiwan's finished vehicle industry.
  - Reasons:
    - Taiwan's finished vehicles are mainly sold in the domestic market
    - production and marketing are arranged by the parent company (mainly Japanese automobile manufacturers).

Literature Review

- **International Trade and Price Elasticity of Imports**
  - Effect of trade policy on macro economy
    - ✓ Sharma (2002): imports of the U.S. bring negative impact on its domestic employment
    - ✓ Aiello et al. (2015): globalization decrease the effect of currency depreciation on export
  - Estimate the elasticity of imports for different industries
    - ✓ Colak et al. (2014): the elasticity of import demand varied significantly in different industries in Turkey.
    - ✓ Felettigh and Federico (2010): the price and income elasticity in its main export market was lower for the vehicles and transportation equipment imported from Italy than those from France and Germany.
    - ✓ Imbs and Mejean (2017): trade elasticity of different industries in 28 developing different countries were estimated, then the different trade elasticity between countries with different degrees of development were discussed.
  - Only a few studies analyzed the effect of opening markets on the domestic production/sales of a specific industry.

Literature Review

Supply Chain of Automobile

Types and Characteristics of Automobile Supply Chain

- ✓ Gereffi (1994, 1999) : Multinational manufacturers with core technologies tend to have strong control power over their upstream suppliers and downstream wholesalers and retailers. (automobile, aerospace, semiconductor, pharmaceuticals, and equipment manufacturing)
- ✓ Gereffi, et al. (2005): When knowledge and information have high codifiability and product portfolios are complex, but suppliers have relatively weak ability, the governance of GVC would tend to the captive type.
- ✓ Shih et al. (2014): Automobile production were close to markets, resulting in a relatively clear division between regions; top ten automobile brands in the global market accounted for 70% market share.

Global supply chain of automobile

- ✓ Cross-border automobile supply chains can be divided into three main regions: E.U. and Turkey; North America; East Asia
- ✓ Taiwan has no connection with the main cross-border supply chain.

Literature Review

- **Effect of regional economic integration**
  - Effects of regional economic integration on international trade
    - ✓ Thronton and Goglio (2002) and Clarete et al. (2003) : preferential trade agreement (PTA) between two countries significantly increases exports between the two countries.
    - ✓ Nguyen (2014): the lower of Japan's tariffs or the more of Japan's outflow investments, the higher of the probability that the counterparts export to Japan after the agreement come into force.
    - ✓ Marmolejo (2011): higher tariffs would give trading counterparts greater incentive to transfer the effects of currency depreciation to product prices, causing import prices more sensitive to the change of exchange rate.
  - Effect of trade agreements on the automobile industry
    - ✓ Goldberg (1995): The automobile industry is an oligopoly market which dominated by multinational automobile manufacturers; small Japanese and Germany vehicles have different price elasticities in the U.S. automobile market. Thus signing trade agreements with Japan and Germany may cause different result to US automobile industry.

Literature Review

- Only a few studies analyzed the effect of opening the market on the domestic production and sales for a specific industry.
- Studies that did focus on the automobile industry mainly focused on major European and American automobile brands.
- Properties of automobile industry in Taiwan:
  - OEMs with complete supply chains for multinational automobile manufacturers;
  - For satisfying the local demand;
  - A small economy aiming to participate in regional economic integration with complete automobile industry supply chain but is dominated by parent companies from other countries(especially Japanese brands).

Methodology

GMM estimation proposed by Lewbel (2012) with supply-demand model to estimate the price elasticity of finished vehicles in Taiwan

The pricing strategy of dealerships if the tariff on automobile are reduced

- The rationality of the empirical results and its implications
- The effect of participating in the regional economic integration and tariff elimination on vehicles and auto parts.

02

Overview of Taiwan’s and Japan's Automobile Industry Development

- Automobile industry of Japan
- Automobile industry of Taiwan
- Bilateral trade between Taiwan and Japan

Automobile industry of Japan

1.Strong finished vehicles and key components

The average export amount: US$156.90b in 2015-2017
1st : finished vehicles (US$97.53 b)
2nd:chassis and transmission parts (US$26.95b)
3rd: engines (US$10.84 b)

2.High portion of vehicles produced abroad

In 2017, the amount of finished vehicle production in Japan was 9.69 million, while overseas production was 19.741 million.

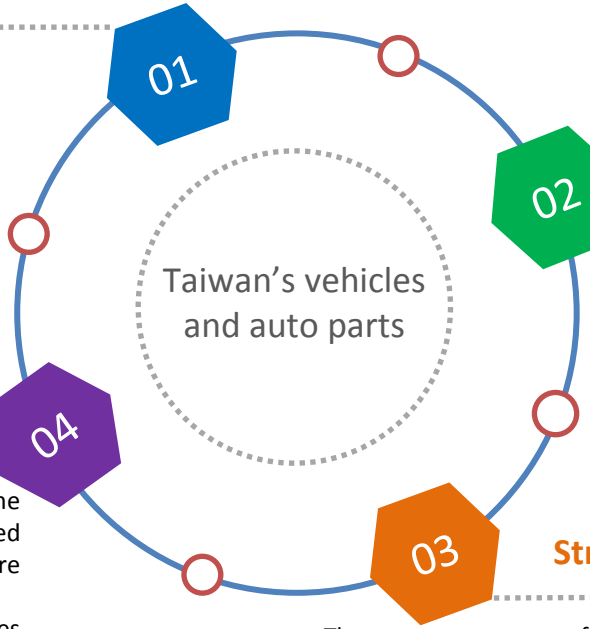
3.Revitalizing domestically produced vehicle

Japanese automobile manufacturers subsequently moved the production of some models back to Japan and then exported.

Automobile industry of Taiwan

Dominated by Japanese brands

- Vehicles of Japanese brands accounted for 70% of the total registered vehicles in Taiwan.
- About 74% of Japanese brand vehicles was produced in Taiwan and 23% was produced in Japan and then exported to Taiwan.



Shrinking local production

- The average number of vehicles sold in Taiwan in 2013-2017 was 421 thousand.
- Market demand shows slightly growth, but the market share of domestically produced vehicles declined from 69.61% in 2013 to 57.33% in 2017.

Keen competition in the market of 2,000 cc and under vehicles

- 2,000 cc and under vehicles are the main product of domestically produced vehicles, and engage in the most severe competition with imported vehicles.
- Number of 2,000cc and under vehicles sold in Taiwan is twice as many as ones over 2000cc
- Growth rate of 2,000cc and under vehicles sold in Taiwan was greater than those over 2,000cc every year after 2011.

Strong auto parts in AM

The export amount of Taiwan's automobile industry was US$8.77 billion in average(2015-2017), while 91% of the exports are auto parts

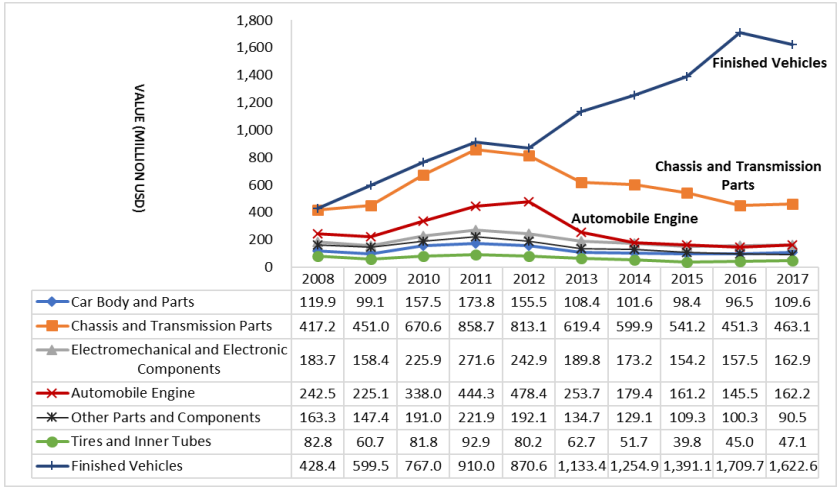
1st: car body and parts (US$2.26 b)

2nd: electromechanical and electronic components (US$1.99 b)

3rd: other parts and components (US$1.82 b).

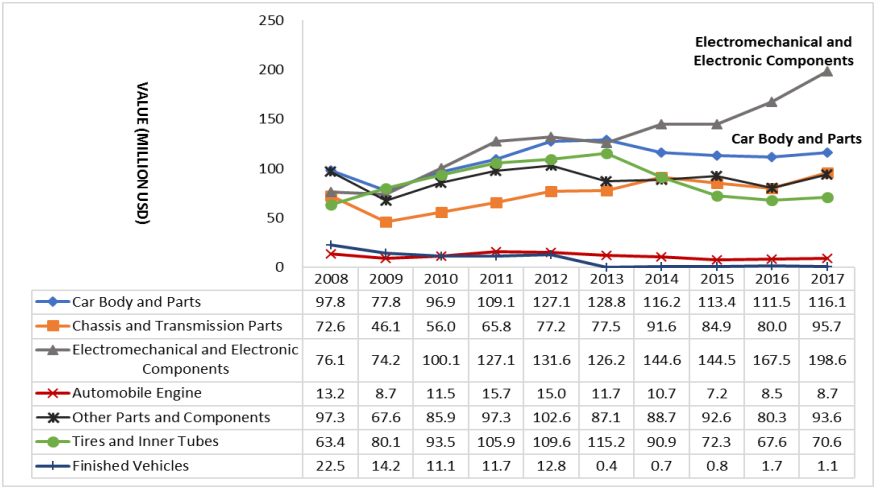
Bilateral trade between Taiwan and Japan

Exports of Japan to Taiwan



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Car Body and Parts	119.9	99.1	157.5	173.8	155.5	108.4	101.6	98.4	96.5	109.6
Chassis and Transmission Parts	417.2	451.0	670.6	858.7	813.1	619.4	599.9	541.2	451.3	463.1
Electromechanical and Electronic Components	183.7	158.4	225.9	271.6	242.9	189.8	173.2	154.2	157.5	162.9
Automobile Engine	242.5	225.1	338.0	444.3	478.4	253.7	179.4	161.2	145.5	162.2
Other Parts and Components	163.3	147.4	191.0	221.9	192.1	134.7	129.1	109.3	100.3	90.5
Tires and Inner Tubes	82.8	60.7	81.8	92.9	80.2	62.7	51.7	39.8	45.0	47.1
Finished Vehicles	428.4	599.5	767.0	910.0	870.6	1,133.4	1,254.9	1,391.1	1,709.7	1,622.6

Exports of Taiwan to Japan



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Car Body and Parts	97.8	77.8	96.9	109.1	127.1	128.8	116.2	113.4	111.5	116.1
Chassis and Transmission Parts	72.6	46.1	56.0	65.8	77.2	77.5	91.6	84.9	80.0	95.7
Electromechanical and Electronic Components	76.1	74.2	100.1	127.1	131.6	126.2	144.6	144.5	167.5	198.6
Automobile Engine	13.2	8.7	11.5	15.7	15.0	11.7	10.7	7.2	8.5	8.7
Other Parts and Components	97.3	67.6	85.9	97.3	102.6	87.1	88.7	92.6	80.3	93.6
Tires and Inner Tubes	63.4	80.1	93.5	105.9	109.6	115.2	90.9	72.3	67.6	70.6
Finished Vehicles	22.5	14.2	11.1	11.7	12.8	0.4	0.7	0.8	1.7	1.1

Source: Compiled by this study from the Taiwan customs statistics of World Trade Atlas.

- Taiwan's automobile industry has a trade deficit with Japan, especially in the finished vehicles, chassis and transmission parts, and automobile engine.
- Even though Taiwan imposes an average tariff of 19.66% on finished vehicles, and most assembly plants in Taiwan are OEMs for Japanese automobile manufacturers for local demand, the amount of finished vehicles produced in Japan and then exported to Taiwan is still growing rapidly.

03 Empirical Models

- Model specifications
- Statistics of variables and Data Sources

Model Specifications

Single equation

$$d\ln Q_{dom,t} = \beta_0 + \beta_1 d\ln P_{dom,t} + \beta_2 d\ln P_{JP,t} + \beta_3 d\ln P_{other,t} + \beta_4 d\ln EX_{US,t} + \beta_5 d\ln EX_{JP,t} + \beta_6 d\ln EX_{EU,t} + \beta_7 dY_t + f(dummy_m) + v_t$$

Simultaneous equations

$$\begin{cases} Demand: \\ d\ln Q_{dom,t} = \beta_0 + \beta_1 d\ln P_{dom,t} + \beta_2 d\ln P_{JP,t} + \beta_3 d\ln P_{other,t} + \beta_4 d\ln EX_{US,t} \\ \qquad + \beta_5 d\ln EX_{JP,t} + \beta_6 d\ln EX_{EU,t} + \beta_7 dY_t + \beta_8 t + f(dummy_m) + u_{1t} \\ Supply: \\ d\ln Q_{dom,t} = \gamma_0 + \gamma_1 d\ln P_{dom,t} + \gamma_2 d\ln P_{JP,t} + \gamma_3 d\ln P_{other,t} + \gamma_4 d\ln EX_{US,t} \\ \qquad + \gamma_5 d\ln EX_{JP,t} + \gamma_6 d\ln EX_{EU,t} + \gamma_7 dY_t + f(dummy_m) + u_{2t} \end{cases}$$

Statistics of variables and Data Sources (2000cc and under)

Variables	Description	Source	unit	Average	Std.	Min.	Max.
Q_{dom}	Registered vehicles produced in Taiwan	Statistics of vehicles registered	vehicle	16,523.28	6,103.00	4,577.00	43,750.00
P_{dom}	Price of registered vehicles produced in Taiwan	Taiwan Insurance Institute	NT$10,000	71.57	4.92	59.64	83.72
Q_{jp}	Registered vehicles imported from JP	Statistics of vehicles registered	vehicle	1,088.28	1,445.00	55.00	6,694.00
P_{jp}	Price of registered vehicles imported from JP	Taiwan Insurance Institute	NT$10,000	95.92	23.05	66.95	160.83
Q_{other}	Registered vehicles imported from other countries	Statistics of vehicles registered	vehicle	2,667.72	1,546.00	618.00	7,191.00
P_{other}	Price of registered vehicles imported from other countries	Taiwan Insurance Institute	NT$10,000	151.89	26.90	107.33	203.12
EX_{us}	Exchange rate between NTD and USD (NTD/USD)	Statistics of the Central Bank		32.03	1.62	28.81	35.07
EX_{jp}	Exchange rate between NTD and JP yen (NTD/JP yen)	Statistics of the Central Bank		0.30	0.04	0.25	0.39
EX_{eu}	Exchange rate between NTD and EUR (NTD/EUR)	Statistics of the Central Bank		38.53	5.11	27.20	48.23
industry	Industrial production index	Directorate-General of Budget, Accounting and Statistics		83.27	18.49	46.01	113.37

04 Regression Results and Implications

- Regression Results
- Implications

Regression Results

△ln Q_{dom}	Single equation		Simultaneous equations	
	Specification 1	Specification 2	Specification 3	Specification 4
Intercept	0.457*** (0.048)	0.392*** (0.055)	0.617*** (0.129)	0.538*** (0.127)
△ln P_{dom}	-0.981** (0.451)	-1.32** (0.507)	-12.706*** (1.25)	-12.381*** (1.177)
△ln P_{JP}	0.247 (0.154)	0.218 (0.176)	0.457* (0.233)	0.569*** (0.189)
△ln P_{other}	-0.246 (0.282)	-0.021 (0.359)	0.544 (0.505)	0.367 (0.506)
△ln EX_{US}	-0.25 (1.1)	-0.893 (1.236)	0.978 (1.732)	1.846 (1.588)
△ln EX_{JP}	0.412 (0.562)	0.616 (0.634)	0.326 (0.832)	1.247* (0.742)
△ln EX_{EU}	0.021 (0.291)	0.069 (0.314)	0.703* (0.416)	0.721** (0.339)
△ln industry	0.774*** (0.264)	0.433 (0.301)	1.238*** (0.477)	2.008*** (0.435)

Regression Results

$\triangle \ln Q_{dom}$	Single equation		Simultaneous equations	
	Specification 1	Specification 2	Specification 3	Specification 4
dummy2	-0.967*** (0.068)	-0.983*** (0.078)	-1.123*** (0.167)	-0.974*** (0.166)
dummy3	-0.537*** (0.104)	-0.352*** (0.12)	-0.459*** (0.158)	-0.584*** (0.136)
dummy4	-0.461*** (0.085)	-0.457*** (0.098)	-0.831*** (0.163)	-0.794*** (0.167)
dummy5	-0.626*** (0.084)	-0.513*** (0.102)	-0.633*** (0.15)	-0.508*** (0.139)
dummy6	-0.205*** (0.065)	-0.112 (0.081)	-0.396*** (0.127)	-0.42*** (0.145)
dummy7	-0.198*** (0.065)	-0.133 (0.08)	-0.338** (0.14)	-0.339** (0.134)
dummy8	-0.929*** (0.067)	-0.913*** (0.081)	-1.041*** (0.139)	-1.007*** (0.132)
dummy9	-0.503*** (0.077)	-0.4*** (0.093)	-0.415*** (0.149)	-0.42*** (0.142)
dummy10	-0.47*** (0.082)	-0.414*** (0.095)	-0.807*** (0.146)	-0.84*** (0.156)
dummy11	-0.461*** (0.075)	-0.393*** (0.087)	-0.414*** (0.152)	-0.178 (0.155)
dummy12	-0.253*** (0.063)	-0.151** (0.071)	-0.333*** (0.125)	-0.417*** (0.148)
Lag-period variables, time trend	-	-	-	-
p-value of Ljung-Box Q(12) test	0.3162	0.6413	0.9978	0.9980
R^2	0.831	0.874	0.745	0.749
Adjusted R^2	0.813	0.826	0.711	0.708

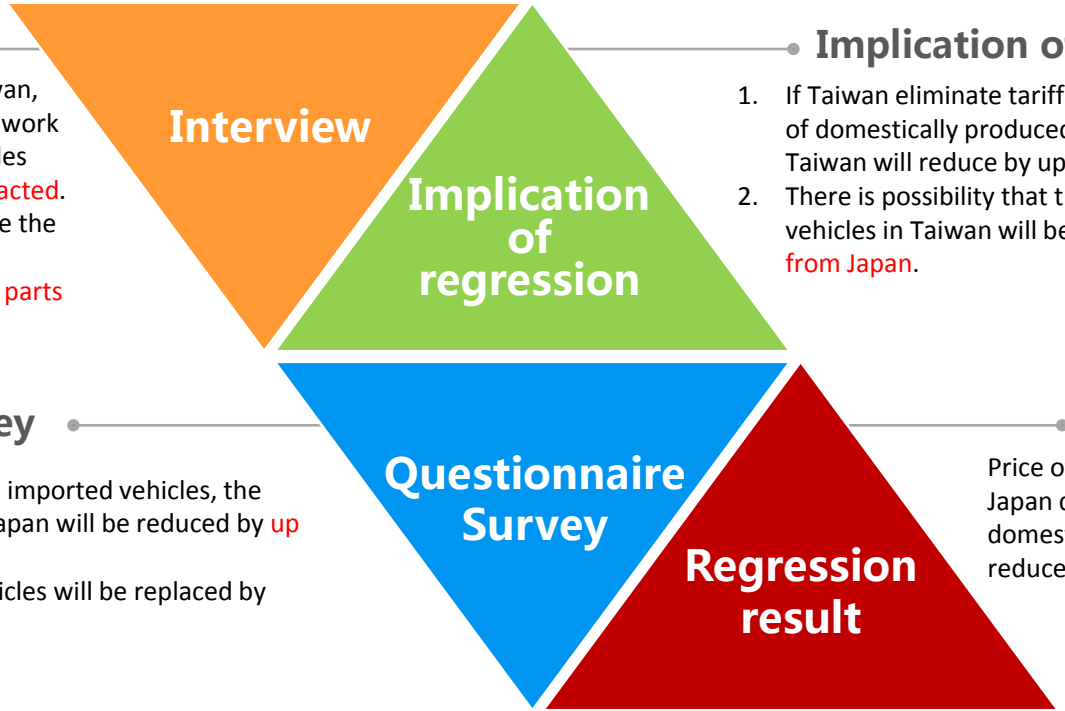
Implications

Interview

1. With the 70% local content in Taiwan, the auto parts manufacturers that work together with those finished vehicles manufactures will be severely impacted.
2. Lacking of the platform to integrate the auto parts, it may even affect the technologies development of auto parts in Taiwan.

Implication of regression

1. If Taiwan eliminate tariffs on vehicles, number of domestically produced vehicles registered in Taiwan will reduce by up to 4-6%.
2. There is possibility that the production of vehicles in Taiwan will be replaced by imports from Japan.



Questionnaire Survey

1. Once Taiwan eliminates tariffs on imported vehicles, the price of vehicles imported from Japan will be reduced by up to 10%.
2. Some domestically produced vehicles will be replaced by imported vehicles.

Regression result

Price of vehicles imported from Japan decreases 1%, the domestically produced vehicles reduce by 0.4-0.6%

05 Concluding Remarks

- Effect of opening automobile market
- Opportunities and challenges of Taiwan's automobile industry
- Future Research

Effect of opening automobile market

Effect on finished vehicles

- Decreasing the price of vehicles imported from Japan by 1% will cause the number of domestically produced vehicles decrease about 0.4-0.6%;
- Appreciation of TWD against JPY or EUR in a long term trend will increase citizens' tendency to purchase imported vehicles
- Eliminating tariffs on automobiles will reduce the price of vehicles imported from Japan by up to 10%; and domestically produced vehicles will be replaced by imported ones.

Effect on auto parts

- Auto parts manufacturers that work with Taiwan's assembly plants will be seriously impacted if Taiwan opens its market, especially to Japan.
- Because finished vehicles are needed for developing new products, auto parts manufacturers with high competitiveness will be affected and gradually lost their advantage if the vehicles are no longer produced in Taiwan.

Opportunities and Challenges of Taiwan's Automobile Industry

- Complete industrial supply chain and high efficient production;
- High potential for developing, producing, and integrating the electronic components;
- Have successfully worked closely with Tesla, such as TPK, Chroma, and Kaori Heat Treatment.

Opportunities

- Lack the ability to free from the control of parent companies, and have little incentive to invest in R&D;
- Fall behind in joining regional economic integration;
- Difficult to integrate the enterprises of finished vehicles, auto parts, and electronic components;
- Slowly developed infrastructure;
- Small market to attract investors.

Challenges

Future Research

New trend of vehicles

With the development of new types of vehicles and restructuring of supply chains, what will be the effect of regional economic integration on the automobile industry's cross-border supply chain?

International cooperation

How to strengthen the connection with cross-border supply chains by participating in regional economic integration, and work with the international automobile manufacturers to boost the mutual development of new types of vehicles?

THANK YOU