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"TAIWAN AND MONGOLIA: INDUSTRIAL POLICY AND CONVERGENCE ANALYSIS"

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CONTENT

Abbreviation

R.O.C	Republic of China
MOFA	Ministry of Foreign Affairs
MOEA	Ministry of Economic Affairs
NCL	National Central Library
CCS	Center for Chinese Studies
TTERO	Taipei Trade and Economic Representative Office
NTUST	National Taiwan University of Science and Technology
NTU	National Taiwan University
CSIE	Center for the study of Innovation and Entrepreneurship
MUST	Mongolian University of Science and Technology
UNIDO	United Nations Industrial Development Organization
CAD	Comparative-Advantage-Defying
CAF	Comparative-Advantage- Following
ISI	Import-Substitution-Industrialization
EOI	Export- Orientation-Industrialization
S&T	Science and Technology
GDP	Gross Domestic Product
GNP	Gross National Product
GNI	Gross National Income
USD	United States Dollar
NTD	National Taiwan Dollar
MNT	Mongolian Tugriks
GCR	Global Competitiveness Report
GCI	Global Competitiveness Index
WEF	World Economic Forum
IMF	International Monetary Fund
WB	World Bank
WTO	World Trade Organization
CPI	Consumer Price Index
FDI	Foreign Direct Investments
R&D	Research and Development
ITRI	Industrial Technology Research Institute
PU	Polyurethane
ICT	Information and Communication Technology
LCD	Liquid-crystal Display
ECFA	Economic Cooperation Framework Agreement
ANZTEC	Agreement between New Zealand and Taiwan on Economic Cooperation
EPA	Environmental Protection Agency
ASTEP	Agreement between Singapore and Taiwan on Economic Partnership
IDB	Industrial Development Bureau
SMEs	Small and Medium Enterprises
OLED	Organic Light-Emitting Diode
AMOLED	Active-Matrix Organic Light-Emitting Diode
PECVD	Plasma-Enhanced Chemical Vapor Deposition
TFT-LCD	Thin-Film-Transistor LCD
USA	United States of America

EU	European Union
CIS	Commonwealth of Independent States
TFP	Total Factor Productivity
FADF	Fourier Augmented Dickey–Fuller
FADF–SB	Fourier ADF with structural breaks
WIOD	World Input-Output Database
HDI	Human Development Index
OECD	Organization of Economic Cooperation and Development
SAARC	South Asian Association for Regional Cooperation
MENA	Middle East and North Africa
NIEs	Newly Industrialized Economies
ASEAN	Association of Southeast Asian Nations
TW	Taiwan
MGL	Mongolia
NDA	National Development Agency, Mongolia
NSO	National Statistics Office
MASM	Mongolian Agency for Standardization and Metrology
GASR	General Authority for State Registration
WIPO	World Intellectual Property Organization
LLC	Limited Liability Company
JSC	Joint Stock Company
MSE	Mongolian Stock Exchange
GSP	Generalized System of Preferences
EPA	Economic Partnership Agreement
VAT	Value Added Tax

List of tables, figures

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INTRODUCTION

1.1. Research motivation

The Industry plays a significant role in the socio-economic development of any country. Competitiveness of a country depends, not only on population or territory size, and volume of natural resources, but also how countries use the resources effectively; well matching with their level of industrial development, and S&T achievements. Ever since, technological progress and innovation activities, which favor conversion of scientific knowledge into more productive consumption, have intensified, it brought totally new approaches to socio-economic and industrial development. In this regard, sound industrial policy plays significant role in a social and economic development of any country.

Mongolia is rich in natural resources, but level and capability of technological basis of the industry is still weak. For the past few years, Mongolian government has taken several steps towards developments of the Industry, S&T, and innovation. The Government proposed and approved several legal and policy documents, such as: "Law on support of SME development" "Law on Industrial and Technology Parks", "Law on Innovation", "Law on Science and Technology" and "Government Policy for Industrial Development" and related regulations. But, the implementation of these legislation is still insufficient. Also, despite the Mongolian Governments' efforts focused on industrial policy reforms, it is yet to reach satisfactory results.

In contrast, today's Taiwan, officially Republic of China (R.O.C), is one of the rapidly developing countries, which categorized in the advanced economies group by the International Monetary Fund (IMF), and by the World Bank, in the high-income economies group. Taiwan has been implementing several staged policies to develop industry and manufacturing of machinery and equipment and high-tech industry, and its industrial development has widely recognized as quite successful.

In the perspective of Industrial and economic development, both countries could combine their resources and competitive advantages to consummate industry convergence. However, in-depth investigation should be carried out in the field of defining opportunities and challenges of industry cooperation development and industry convergence.

1.2. Research goal and objectives

Main goal of the research work is to determine opportunities and challenges of development of industry cooperation between Mongolia and Taiwan, within the frame of industrial policies and their implementation achievements, analysis of industry convergence between two nations.

To reach this goal researcher puts following objectives:

- Investigate industrial policy and its achievements in Mongolia and Taiwan;
- Conduct analysis of industry convergence and to define possibility of industry cooperation between two countries;

1.3. Research methodology

In this study, the historical approach is used to identify how national strategies, policies, and practices have been implemented to support development of industry sector of the countries. The descriptive and comparative analysis methods are used for study of the R.O.C and Mongolian governments' perceptions, their industrial policy dimensions, main directions, and measures that have been applied up to date in order to prove that the both governments are consistent in the policy making and implementation towards sustainable development of the industry. Employed methods of statistical analysis and econometrics for industry convergence analysis.

The secondary data, utilized by researcher, is from the national and international data base, mainly from Industrial Development Bureau (IDB), MOEA of Taiwan and National Central Library, NTUST and NTU library and World Bank, World Economic Forum, International Monetary Fund, World Trade Organization, and Mongolian governmental and national statistical data base.

II. INDUSTRIAL POLICY IN TAIWAN AND MONGOLIA

2.1. Definition and role of industrial policy in economic development

Today, "industrial policy" still remains one of the emerging topics of economic development and academic debate. There are commonly used definitions, regarding meaning of this category:

-"An industrial policy of a country… is its official strategic effort to encourage the development and growth of all or part of the economy, often focused on all or part of the manufacturing sector" (Graham, 1994) [1].

- "Industrial policy is defined as the strategic effort by the state to encourage the development and growth of a sector of the economy. It refers to "any type of selective intervention or government policy that attempts to alter the structure of production toward sectors that are expected to offer better prospects for economic growth than would occur in the absence of such intervention" (Pack and Saggi, 2006) [2].

- "Industrial policy – understood as targeted efforts to change the production structure of an economy in order to accelerate economic development, so it should more accurately be called "production transformation policy" – is an "inner wheel" whose effects depend on "outer wheels" of macroeconomic conditions and underlying political settlements (Wade, 2013) [3].

- "Industrial policy is any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity towards sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention—that is, in the market equilibrium" (Warwick 2013) [4].

The following points explain the role of industrial policy in socio-economic development of a country:

- sound industrial policy promotes upgrading of industry development of not only industry sector, but also economy of a country;
- successful implementation of industrial policy encourages economic growth and helps to great jobs and reduce unemployment and poverty;
- development of the industry as a main result of implementation of industrial policy lead social-economic prosperity of a nation;

Study shows industrial policy has a several orientations, such as, import -substitution, export-orientation, innovation-driven, demand-driven and also, different implementation strategies, for instance, traditional strategy, "catch-up" (Kim, 1997, Mathews, 2006) [5, 6] comparative-advantage-defying (CAD), and the comparative-advantage- following (CAF) strategy [7] etc.

Industrial policy is usually seen as separate from broader macroeconomic policies, such as tightening credit and taxing capital gains. Many types of industrial policies contain common elements with other types of interventionist practices of a government, such as trade policy, small and medium enterprise development support policy, S&T and innovation policy, environmental sustainability policy, investment policy etc.

Traditional examples of industrial policy include subsidizing export industries and import-substitution-industrialization (ISI), where trade barriers are temporarily imposed on some key sectors, such as manufacturing [8]. By selectively protecting certain industries, these industries are given time to learn (learning by doing) and upgrade. Once competitive enough, these restrictions are lifted to expose the selected industries to the international market [9]. More contemporary industrial policies include measures such as support for linkages between firms and support for upstream technologies [10].

Methodological point of view, in the study of industrial policy, could be considered following items, such as:

- Goal and objectives of industrial policy;
- Strategy of implementation;
- Focuses and main directions of industrial development;
- Promotion activities and measures for industrial development;
- Achievements in industrial development as a results of policy implementation;

2.2. Industrial Policy in Taiwan and its implementation results and achievements

2.2.1 Brief introduction about the country

Today, Taiwan is rapidly developing country. The national economy of the country is the 7th largest economy in Asia, 34th largest economy in the world, by GDP- 602.7 bill. USD, GDP per capita, 25.534 USD for 2018 [11]. It ranked as 15th in the world by the Global Competitiveness Index (GCI) in Global Competitiveness Report (GCR) of World Economic

Forum (WEF) [12] and as 24th in nominal GDP of investment and foreign trade [13]. The country was included in the advanced economies group by the International Monetary Fund (IMF) [14] and gauged in the high-income economies group by the World Bank (WB) [15].

GDP annual growth rate in Taiwan averaged 6.8% from 1962 until 2018, reaching an all-time high of 17.1% in the third quarter of 1978 and a record low of -8.12 percent in the first quarter of 2009. For the whole 2018, the GDP advanced 2.6%**,** below 3.08% in 2017, for 2019, it is projected to grow by 2.3% [16]**.** GDP composition by sector- 69.2% is Service, 29.2% is Industry, only 1.6% is Agriculture. An average inflation (CPI-Consumer Price Index) rate was 1.06% for 2007-2017 [16].

The economy of the country is being driven largely by industrial manufacturing, and especially exports of electronics, machinery, and petrochemicals [16] and if compared with other major economies in the region, is "at a crossroads" [17]. It is facing economic marginalization in the world economy [18] and businesses in Taiwan suffer most from being the size of Small and Medium Enterprises only with weaker-than-expected revenue of its hectic business operation for any consideration of further expansion, and overall impedes any attempts at economic transformation of Taiwan from the Taiwanese government [19].

Economic Development of Taiwan features a collection of papers by many researchers, their analyses on Taiwan's pre-war and post-war early economic history debunk the myth of the country's post-war rags to riches story and revalue the myth of "wise" government policy [20]. But, no doubt, about that, Taiwanese experiences of industrial development can be valuable paradigms for emerging economies of Asian, African and Latin American countries in this age of globalization [20].

Today, industrial development of Taiwan has been widely regarded as quite successful. Many scholars attribute this success to the country’s policies, especially its industrial policy [20, 21, and 22].

Since 1950s, over a period of several decades, industry of Taiwan has already established solid foundations, and has become an important part of the global economy [23].

2.2.2 Industrial policy of the country: Specifications and achievements

Industrial policy of the country has specific features over past decades (Table 1.). It could be indicated, that past decades main direction of industry policy and strategic orientation of the industry development have been changed by 10 years.

If, in 1950s, in the industrial policy was dominated “Import –substitution”, in 1960s it evolved into “Export-orientation”, in 1970s, main focus had given to “Infrastructure improvement”, 1980s, prioritized “Liberalization of national economy”, in 1990s, implemented strong “Industry Upgrading”, which encouraged development of high-technologies, 2000s, started initiation of Knowledge-based economy development plan, and industrial policy was directed to “Global deployment”, 2010s, innovation-driving policy took-

off and key measures had taken to enhance country's "Participation in regional economic integration".

As a result of the steady development of Taiwanese industry over the period, Taiwan's per capita gross national product (GNP) has risen from less than USD200 in 1951 to USD22540 in 2016, which is more than 100 times [23].

Over the same period, the industrial sector's output value share of gross domestic product (GDP) had increased from USD260 million in 1951 to USD184.4 billion in 2016[16, 23].

According to researches on East Asian industrial policy [25, 26], main features of Taiwanese industrial policy over time could be summarized as following (Table 1):

- Taiwanese government intervened to direct the sectoral evolution of manufacturing, accelerating growth by the shifting from import-substitution to export promoting policies in 1960s.

- FDI played a major role in the export expansion of the country, mainly concentrating in export-processing-zones, and the state invested heavily in capital-intensive sectors and infrastructure.

- Trade protection, fiscal incentives and selective credit were available to the promoted sectors according to the government's shifting industrial policy priorities. The use of tariff and non-tariff barriers has been significant. Low-interest loans were granted to exporting firms, and since the 70s to public utilities and heavy industries. Many state-owned enterprises were created in heavy and petrochemical sectors to provide intermediate goods for the export industries and played an important role in industry development.

- Orientation of industrial policy changed during the 80s, toward information and other high-tech sectors such as biotechnology and the advance of high-tech sectors has been supported by the creation of two major public projects, the Industrial Technology Research Institute and the Hsinchu Science Park. The government has offered direct grants and subsidies to finance private R&D efforts in high-tech sectors and has promoted venture capital funds.

- During the 1990s the government has considerably lowered trade barriers in manufacturing.

- Public research institutions played a greater role in promoting diffusion of new technologies and coordinating industry-specific R&D, such as Industrial Technology Research Institute (ITRI), which helped spin-off a successful semiconductor sector.

Table 1. Strategic directions and main Achaemenes of Taiwan's industrial policy and development

№	Period & development strategy	Main strategic direction and Key measures	Main achievements in Industry development	Industry sector GDP (US$ 100 mil.) & Per Capita GDP(US$)
1	*2*	*3*	*4*	*5*
1	1950s Import Substitution	**Import- Substitution/ Labor- Intensive Industry development** 1951- Land reforms implemented; 1953-Economic development plan launched; 1960- Investment incentive regulations implemented	**Raped development of Consumer Goods industry**: Textile and food industry technology upgrading, Improving quality, New product development;	1.77→2.76 (+56%) & 137→172 (+25%)
2	1960s Export Expansion	**Export – Expansion/ Light Industry development** 1966- Export processing zone established	**Raped Growth of Light Industry, Establishment of Machinery production**: Bicycle manufacturing turned to the international market. Raise of the export.	3.28→14.32 (+4.4 times) & 143→320 (+2.2 times)
3	1970s Infrastructure Improvement	**Import- Substitution/ Heavy Industry development** 1971 Ten Major Construction Projects launched; 1974- ITRI established; 1979- Science and Technology Development Plan initiated; 1980- Science-based industrial park set up	**Development of Capital & Technology Intensive Industry**: Taiwan produced 50% of the world's PU synthetic leather, Established computer and electronics industry.	16.54→119.26 (+7.2 times) & 360→1758 (+4.9 times)
4	1980s Economic Liberalization	**Industry Upgrade / Strategy Industry development** 1982- Strategic industries promoted; 1985- Economic liberalization promoted; 1987-Environmental Protection Administration established	**Promotion of High-Tech Industry**: ICT and electronics sector had been developed intensively.	149.15→515.35 (+3.5 times) & 2189→7097 (+3.2 times)
5	1990s Industry Upgrading	**Industrial Restructuring / High-Tech Industry/** 1991- Statute for Upgrading Industries implemented; 1991 Six-year National Development Plan launched; 1993 Restrictions on indirect investment in mainland China relaxed	**Implementation of Industrial Restructuring and Development of High-Tech Industry**: Country became the world's notebook computer manufacturing base	533.49→717.61 (+34.5%) & 7556→12324 (+63%)

1	*2*	*3*	*4*	*5*
6	2000s Global Deployment	**Knowledge-based Economy /Creative R&D Industry** 2000- Knowledge-based Economy Development Plan initiated 2002- "Challenge 2008" National Development Plan launched 2006- Big Investment, Great Warmth" industry development plan implemented; 2008- E-Taiwan 12 infrastructure projects launched 2009- Development of six key emerging industries promoted	**Development of Knowledge Industries:** ICT, biotechnology, e-Taiwan project: in 5 major areas: government, life, business, transport, and broadband. Country became a leader in the world by semiconductor, LCD production.	763.24→936.99 (+23%) & 13299→14271 (+7%)
7	2010s Participation in regional economic integration	**Innovation-driven/ Smart Industry** 2010-Statute for Industrial Innovation implemented; Cross-strait ECFA signed; Development of 10 key service industries and 4 emerging smart industries promoted; 2013- Taiwan-New Zealand ECA (ANZTEC); Taiwan-Singapore EPA (ASTEP); 2014-Industry Upgrading and Transformation Action Plan launched; 2015-Productivity 4.0 project; 2016- Promoting the development of the "5 Innovative Industries"; 2017-Promoting international linkage and Forward-looking Infrastructure Development Program	**Development of the Innovative Industries:** Smart machinery, Asian Silicon Valley, Biotech & pharmaceutical industry, Green energy, National defense; New materials and circular economy" Taiwan is 16th place in university-industry collaboration in R&D, 10th place in company spending on R&D, and 22nd place in capacity for innovation.	1119.55→1588 (+42%) 2010→2016 & 19278→22540 (+17%) 2010→2016

Source: *2017 Industrial Development in Taiwan, R.O.C, Industrial Development Bureau (IDB), Ministry of Economic Affairs (MOEA)*

Furthermore, an interesting study, in which research had conducted with aim to examine and analyze Taiwanese industrial policy, focusing on the policy measures implemented by the government over the years, should be noted here (Day-Yang Liu, Lin Abe C, Tseng Kuo-An) [28]. Through interviews with domestic scholars and experts in the industry, public officials, academics, and research institutions, evaluated the effectiveness of the Taiwanese industrial policy measures on three perspectives: level of importance, level of assistance and level of applicability. Day-Yang et.al. had defined 6 categories of industrial policy measures, such as subsidies on scientific and technology development, industry parks, assistance on talent education and training, tax and financial aid, industry rules and regulations and industry activity information and subdivided into 32 items. In this study, the researchers evaluated that, Dual-use technology projects, Government funding support, Overseas trade promotions had relatively poor effect; Industrial district 006688 programs, SMEs R&D alliance subsidies and Assistance for enterprises to raise funds from the open market had insufficient effect; Financing and Loans, Financing and trade promotion, SMEs R&D alliance subsidies were not effective enough. SMEs and non-high-tech industries generally thought to have unfulfilled demand in budgets and talents for science professions. The overall financial and economic policies and moderation of the relative rules and regulations affected the development environment of the industries.

The researchers recommended to government agencies, to take responsible and concerned attitude to strive to involve and intervene in order to achieve correction and adjustment purposes, and to continually promote the execution under the existing structure, to make the most of the industrial policy measures, to conduct comprehensive and diversified thinking in considering the direction of the industry policies, in order to satisfy the needs of different types of industries, and also to possess the ability of pre-warning and planning [28].

Today, in response to the rise of the knowledge economy, the country devotes its' efforts to the promotion of a technology and innovation- driven industrial development policy to secure Taiwan's competitive position in the new century and lay a stable foundation for the country's industrial growth [16, 23].

The government of Taiwan is implementing seven interrelated policies, including industrial development policy, in economic development [16]:

- "Technology and Innovation driven" industrial development policy;
- "Market Diversification and Global Deployment" trade policy;
- "Simultaneous Enterprise Creation and Development" Small and Medium Enterprise (SME) policy;
- "Economic Development and Environmental Sustainability" state-owned enterprises policy;
- "Knowledge Innovation and High Quality Life" service industry policy;
- "Efficiency, Reform, and Serving Business and the Public" investment policy;

For successful implementation of "Technology and Innovation driven" industrial development policy, in order to accelerate industrial upgrading and transformation, Executive Yuan approved the "Industry Upgrading and Transformation Action Plan" on 13 Oct. 2014[16].

According to this plan, there were defined 3 main axes and 4 main strategies for industry development and as well as various policy tools and accompanying measures. Its main aim is to encourage and assist the enterprises in upgrading and transforming into smarter, greener facilitation, subsequently culture & creativity development of the country.

Three main axes for Taiwan's Industry Upgrading and Transformation:

1. "Revitalizing traditional industries"
2. "Consolidating main-strength industries"
3. "Cultivating emerging industries"

Four main strategies for Taiwan's Industry Upgrading and Transformation:

1. "Raising product levels and product added value"
2. "Setting up complete industry supply chain systems"
3. "Establishing systems solutions project competency"
4. "Accelerating the development of emerging industries"

"Revitalizing traditional industries" axis means, enterprises in Taiwan's traditional sectors are numerous and small in scale and despite abated growth as well as limited increases in technology levels and product grades in recent years, these businesses still serve as an important force for stable industry and employment opportunities [6]. According to "2018 White Paper on Small and Medium Enterprises in Taiwan", the number of SMEs reached 1.437.616 and accounted for 97.7% of total number of enterprises in the country. The number of employed persons in SMEs is 8.904.000 and represented 78.4% of all employed persons in Taiwan. The annual sales of SMEs in 2017 came to NTD 12,139.5 billion up 3.19 percent from 2016, accounting for 30.2% percent of the total annual sales of all enterprises of the country. With regard to industrial structure in Taiwan, the number of SMEs is mostly concentrated in the Service sector, with the proportion being 79.58%, 47.93% of SMEs are in Wholesale and Retail Trade, followed by Accommodation and Food Services industry (10.95%), and Manufacturing (9.98 %). In 2017, total of 101556 SMEs were newly created [24].

Therefore, the MOEA has chosen "***raising product levels and product added value***" as a main strategy to transform traditional industries. The aim of this strategy is to penetrate high-end product application fields, to master key technologies in the entire value chain, and raise industry's added value through key measures promoting the development of high value-added R&D, the formation of up, mid and downstream industry R&D alliances, the integration of testing and certification, the establishment of global logistics centers, and other [16, 23, 24].

For "***Consolidating main-strength industries***", the MOEA will begin with "***establishing complete industry supply chain systems***" strategy, a goal of "to establish complete industry chains and autonomous production capacity domestically for key materials (such as for OLED[1] panel packaging), components (such as for machine tool

[1] **Note**: OLED- Organic light-emitting diode, AMOLED- Active-matrix organic light-emitting diode, PECVD- Plasma-enhanced chemical vapor deposition.

controllers and electronic speed control for bicycles), and equipment (such as AMOLED[1] and PECVD[1]), by key measures of promoting the formation of autonomous systems by R&D alliances, the inventory of industry deficiencies, the application of themed R&D advisory capacity, cross-disciplinary cooperation to expand application fields". Also, will implemented strategy for "***establishing systems solutions project competency***", its key measures will include:

- striving to tap global business opportunities, forming systems integration alliances, establishing flagship teams to enhance export strength;
- setting up a financial support mechanism;
- expanding turnkey project solution competency to bring about growth in exports;
- integrating intelligent automation to enhance hardware and software integration, and boosting systems solution project competency in order to expand the value chain";
- raising above sectors' ability to manufacture key materials, equipment and components domestically and to expand turnkey project solution competency and boost related export performances [16, 23, 24].

For the axis of "***Cultivating emerging industries***", the MOEA, will implement "***accelerating the development of emerging industries***" strategy, in its promotion of emerging industries, with priority placed on cross-disciplinary and cross-sector innovation, not only will aim to inject new growth momentum into the manufacturing sector but also to bring about service sector development. Besides, actively developing the next generation of main-stream emerging industries, inter-disciplinary new application markets need to be developed, as the line dividing the manufacturing, service, and other industries becomes increasingly blurry, in order to grasp future global trends and emerging business opportunities [16, 23, 24].

From 2010s, for the successful implementation of the industrial policy, government focused on following objectives [16]:

1. **Providing Taiwan's world-leading position in technology and innovation.** In its most recent report, the World Economic Forum (WEF) ranked Taiwan globally at 15th in terms of growth competitiveness, 4th on the innovation capability, 11th on the innovation ecosystem, underscoring the strength of Taiwan's innovative R&D.

2. **Providing a strong support for industrial growth by developing R&D, spending 3% of GDP.** In order to develop Taiwan as the most attractive base for innovative R&D in Asia, the government aims to increase R&D spending to 3% of GDP by 2006, putting Taiwan on par with developed countries. In 2004, the government implemented the Advanced Technology Programs to increase R&D spending by nearly 11% compared to 2003s level, thereby helping Taiwan to strengthen innovative and forward-looking R&D and industrial results. According to data from

OECD, Taiwan's spending on R&D, adjusted for purchasing power parity (PPP), totaled US$33.7 billion, 3.1 percent of GDP in 2015, the 9th highest among 42 countries and economies worldwide [25].

3. **Solidifying Taiwan's leading position in high-tech industry by the "Two-Trillion and Twin-Star Industries".** MOEA designates semiconductor industry and color-image display industry as the "Two-Trillion" industries; digital content industry and biotechnology industry as the "Twin-Star" industries. They are the new niche for Taiwan's industrial development. It was estimated that by 2006, Taiwan to become an important location for 12-inch wafer fabrication plants and the biggest supplier of TFT-LCD panels in the world. At the same time, Taiwan aimed to be the pioneer of design and application of digital content and biotechnology in the Asia-Pacific region. Besides, through the strategy of "mobile services, mobile life, and mobile learning", the production value of broadband and wireless communication industry planned to exceed NTD1 trillion in 2008, enabling the industry to become the third "Trillion" industry. Today, the following export product groups, such as Electrical machinery, equipment: USD144.3 billion (43% of total exports), Optical, technical, medical apparatus: $16.1 billion (4.8%), Organic chemicals: $11.5 billion (3.4%) represent the highest dollar value in Taiwanese global shipments during 2018 [23].

4. **Promoting Taiwan as a significant R&D center based on its high-tech advantages.** Based on Taiwan's economic and strategic location and its advantages in R&D, the government is proactively encouraging domestic and overseas enterprises to set up R&D centers in Taiwan. With advantages in high-tech industry, Taiwan is introducing in overseas R&D talent, technology, resources and systems, expecting to create a better niche. It is anticipated that 40 transnational companies planned to establish their regional R&D centers and 100 domestic enterprises should establish R&D centers in Taiwan by 2007. As a result, today in Taiwan, industry clusters have developed in and around those enterprises, and also individual regions within Taiwan developing S&T parks and R&D centers that reflect their own particular sources of comparative advantages. There are 13 science parks, such as Hsinchi science park, Taichung precision machinery science and technology innovation park, Central Taiwan science park, Nankang software park, 10 export processing zones, 62 IDB- designated industrial zones, 17 Local government designated industrial zones, 94 privately developed industrial zones and 2 industrial parks [23].

5. **Fostering excellence to fully support industrial development.** By establishing industrial colleges and extensively recruiting overseas high-tech talents, MOEA is enhancing the quality of talents in IC design and digital content industry. Nurturing large quantity of professionals, who meet the needs of enterprises definitely will support Taiwan's industrial development. Today, MOEA is encouraging research institutes and the private sector to invest in the incubation sector, and has drawn up strategies to integrate the different resources and strengths of those incubation centers run by universities, those established by research institutes, those administered by the government and those set up by private companies. Currently, there are around 140 incubators operating through-out Taiwan. Majority of them, 102 SME incubators, are affiliated to

universities. Another 4 incubation centers are supported by SME Development Fund, Nankang Software Incubator, SME Incubator at Tainan Science Park and Nankang Biotech Incubation Center. And the rest are incubation centers set up by other government agencies or by the private sector. Details of core areas and their main orientations are shown below [23]:

Core areas of incubation:

- *Local Cultural Characteristics (10 incubation centers)***:** They incubate industries with local characteristics, with "local" pertaining primarily to the countryside, towns and cities. A characteristic industry refers to a local industry with historic, cultural or other distinctive or unique qualities. Consult industries with local characteristics in terms of their community or organization on enhancement of space design, landscape design and planning and organizational management as well as assistance with product package design, product R&D and manufacturing technology.
- *Strategic Knowledge Services (26 incubation centers)***:** The majority of incubated companies are in financial service, logistics and transportation service, telecommunications and media service, health and personal care service, human resource training service, manpower allocation and property management service, tourism, sports and recreational service, cultural and creative service, design service, information service, R&D service, environmental protection service and engineering consulting service sectors.
- *Innovative Traditional Industries (13 incubation centers):* Mostly incubated companies are all non-tech or low-tech industries. For example: agriculture, forestry, animal husbandry, mining and quarrying, textiles, chemicals, food, beverage processing, food and beverages, metal and electrical industries, construction, shoe-making and related industries, glass and ceramics, paper making and printing transportation and warehousing.
- *Advanced science and Technology Industries (36 incubation centers)***:** The incubated companies are those in digital 3C, precision electronic components, precision machinery, aerospace, bio-medical and special chemicals, green technologies and high-end materials.
- *Multi-incubation (55 incubation centers):* The incubated companies are in a wide range of fields.

Main orientations of incubation centers:

- 27.94%- ICT industry: IT and electronic (22. 08%,) multimedia & broadcasting (4.47%), telecommunications (1.39%);
- 22.37%- Biotechnology & Chemistry: biotechnology (16.67%), medical industry (4.77%), chemical and petrifaction (0.93%)
- 15.71%-Tourism & Education, Culture: tourism and recreation (8.91%), education and culture art (6.80%);
- 12.80%- Environmental Protection, Livelihood Industry & Architecture: environmental protection industry (4.90%), livelihood industry (3.93%), raw material (2.83%), architecture (1.14%);

- 11.32%- Machinery & Aerospace: machinery and electric machinery (10.09%), planning and aerospace (0.42%);
- 1.22%- Distribution & Logistics (1.22%)
- 9.46%- Others (9.46%)

Starting from 2016, the Taiwanese government has launched a new industrial development policy based around promoting the development of the "Five Innovative Industries" – Smart machinery, Asian Silicon Valley, Biotech & pharmaceutical industry, Green energy, and National defense – along with "New materials and circular economy" and "New agriculture," with the aim of bringing about a wholesale transformation of Taiwanese industry. In 2017 several major new initiatives are launched, including the Forward-looking Infrastructure Development Program, to enhance the overall industrial environment in Taiwan [16, 23].

Conclusion

1. Over a period of more than last 60 years, Taiwan has succeeded in transforming itself from an agricultural society into an industrialized society, had shown "economic miracle", through the combined effects of industrial policy, collaboration between industry and universities, continued promotion of innovative new business models, and the tireless efforts of both the public and private sectors. Today, the country is one of the rapidly developing countries, the 7th largest economy in Asia, 34th largest economy in the world, grouped in the advanced economies and high-income economies groups.
2. With the Taiwanese economy now entering a new stage of innovation-driven development, Taiwan will be committing itself to ongoing innovation, working with potential partner countries to explore new models for collaboration, thereby helping to meet the challenges of the constantly-changing global economy. In the future, Taiwan will be making use of this solid foundations that it has built up in the past to strengthen communication and exchange with the countries targeted by the New Southbound Policy, sharing Taiwan's development experience and exploring new opportunities for collaboration; Taiwan will be working together with these countries to create a new era of growth characterized by mutual benefit and shared prosperity.
3. International experiences indicate that in order to promote development successfully industrial policy has to be tailored to the specific context or institutions of a country. From this perspective, the case of Taiwan's industrial policy adoption and implementation demonstrate, political stability, adequate government intervention, fruitful partnership with business and effective private sector involvement, research –based concept and actions. It was encouraged by key role of industrial policy research institutions and resultative implementation of projects, based on sound and accurate feasibility studies, instead of just political consideration.
4. Industrial policy of the country is based on new technologies and innovation and supports society's long-term targets. During the period of implementation of Taiwan's industrial policy, various strategies were effectively used, government interventions and regulations regarding country's social- economic conditions and development challenges. Taiwan's industrial policy and its implementations are widely recognized as successful and valuable examples for other countries, specially, developing ones.

2.3. Industrial Policy in Mongolian: Strategic directions and main achievements

2.3.1 Brief introduction about Mongolia

Mongolia is located in East Asia, between Russia and China. Its territory is 1.5 million sq. km, 18th largest country in the world, and the most sparsely populated country with a population of 3.5 million. Ulaanbaatar, the largest city and the capital, is a home to half of the country's entire population. Currently, approximately 30% of the population sustains traditional way of nomadic lifestyle to certain degrees. In 20th century, Mongolia had gone through several political and socio-economic changes, starting with a declaration of independence of The Bogd Khanate of Mongolia, in 1911. In 1924, following the Soviet Union, Mongolia became a socialist country and Mongolian People's Republic was founded. Democracy movements begun around early 1990s led to peaceful democratic revolution and with the new Constitution of 1992, transitioned into a market economy.

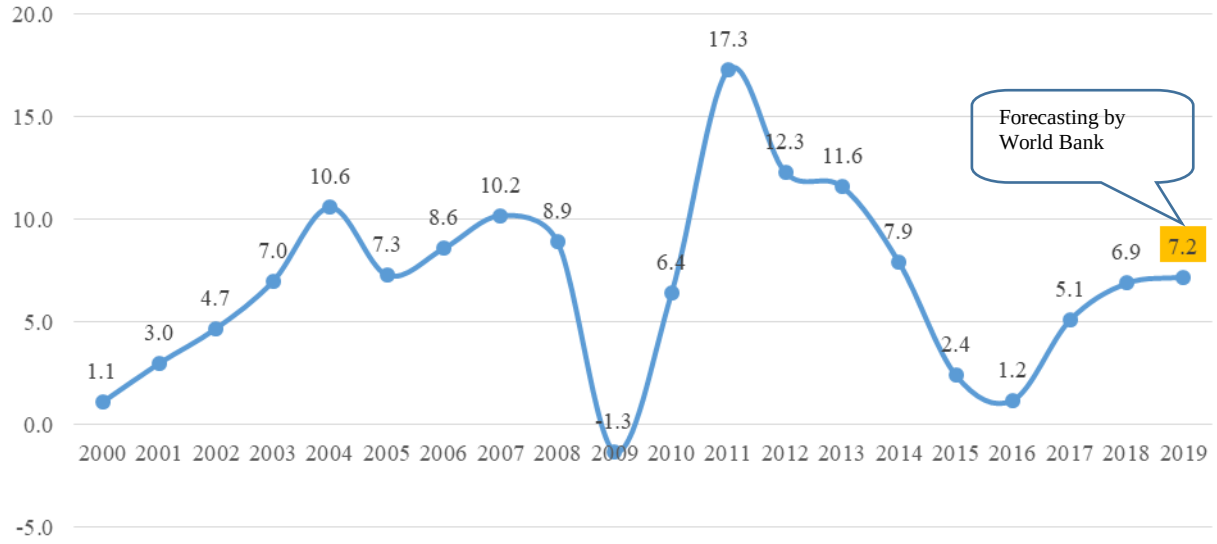
Since 1990s, transition to the market economy, major socio-economic changes have taken place, and the foundation for a new socio-economic system based on market relations had established in the country. Special attention was paid to the establishment of a legal basis for the market economy and many legal acts had developed and approved. The privatization of state and cooperatives' properties had created a private sector and is rapidly developing [29, 30]. According to statistical data, in 1989, the private sector accounted for only 3.3% of GDP, while in 2007 it reached 68.0% and in 2017 it reached 78.7% [31, 32].

As the market economy is a completely new socio-economic situation in the country, the lack of knowledge and experience in market relations throughout the country, especially at the government level, led to the failure of state-owned enterprises in the early years and put them in the state of bankruptcy. Even the privatized manufacturing enterprises could not operate properly due to the owner's inability to adapt into market economy, closed one after another. The closure continued for about a decade, led to major setback in the development of national industry. The share of industry in GDP fell from 35.5 percent in 1990 to 19.3 percent in 1999 [33]. However, during this time many private enterprises were established and developed.

Today, Mongolia is ranked as a lower-middle-income economy by the World Bank. In 2018[2], GDP was 13,010 million USD, GDP per capita was 4,104 USD, exceeded previous year by 432 USD [34]. Mongolia had never been listed among the emerging market countries until 2011, when Citi group analysts determined Mongolia to be one of the 3G- "global growth generating" countries, which possess promising growth prospect for 2010–2050 [35].

GDP annual growth rate was averaged 3.8% from 1994 to 1999, 5.5% from 2000 to 2009, 8.0%- from 2010 to 2017, 6.9% - between 2000 and 2017, reached an all-time high of 17.3% in 2011 and recorded low of -1.3% in 2009. (Figure 1). In 2018, the GDP annual growth rate was 6.9% and for 2019, it is projected to grow by 7.2%[3] [31, 33, 34].

[2] https://data.worldbank.org/country/mongolia?view=chart
[3] https://data.worldbank.org/country/mongolia?view=chart



Source: Mongolian Statistical Year book, 2005-2018, NSO [31], https://data.worldbank.org/country/mongolia?view=chart [34]

Figure 1. Mongolian GDP annual growth rate, 2000-2019, %

In 2018, GDP composition by sector is: Service - 47.4%, Industry - 41.9%, Agriculture - only 10.7% and, it has relatively changed from 2001 (Service -51.7%, Industry – 23.4%, Agriculture – 24.9%). An average inflation (CPI) rate was 10.1% for 2007-2018 [33].

Economic activity of the country has long been based on agriculture, although development of extensive mining of copper, coal, gold, and other minerals has emerged as a key drive of the industrial production (Table 2).

Table 2.Structural changes in the Economy of Mongolia, % in GDP

№	Sectors	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Industry	23.4	22.1	25.4	29.9	30.2	37.7	35.7	36.3	36.1
2	Agriculture	24.9	20.7	20.1	20.9	21.7	19.5	20.6	18.8	15.2
3	Service	51.7	57.2	54.5	49.2	48.1	42.8	43.7	44.9	48.6
Sectors		**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1	Industry	36	35.9	34.6	34.4	34.7	33.7	36.4	41.4	41.9
2	Agriculture	11.6	10.2	11.2	13.4	13.3	13.3	11.5	10.1	10.7
3	Service	52.3	53.9	54.2	52.3	52	53.1	52.1	48.5	47.4

Source: www.1212.mn, National Statistics, Mongolia [32]

Also, the quaternary economic sector, such as Information and Communication Technology (ICT), is rapidly developing. In between 2000 and 2005, the number of cellular phone users had grown by 7.6 times, from 75.1 thousand users to 570.9 thousand, and the number of Internet users increased by 2.2 times. According to national statistics, in 2018, the number of cellular phone users reached 4222.1 thousand, nearly tripled that of 2009, and the number of Internet provider subscription was 4295.4 thousand, which is 40.5 times increase from that of 2009[4] [36].

Mongolia is rich in natural resources. Minerals such as coal, copper, gold and agricultural raw materials, mostly from animal husbandry. Number of livestock has reached 66.5 million in 2018,

composed as 30.6 million sheep, 27.1 million goats, 4.4 million cows, 3.9 million horses, and 0.5 million camels[5] [32].

Currently, there are 49 coal mining companies with 37.4 billion tons of coal resource[6], about 2000 tons of gold resource. In 2017, there were about 500 licenses for mining gold and about 150 enterprises sent their plan of gold quarrying to the Ministry of mining and heavy industry. Erdenet and Oyu-Tolgoi hold quite amount of share in the world market of copper and molybdenum mining and quarrying industries and their estimated resources believed to be 8091,4 million tons[7]. Gold mining yield was 2.9 tons, copper mining - 445.4 thousand tons, coal mining - 15883.6 thousand tons in the first quartile of 2018 [32, 33, 37, 38]. Today, Mongolia possesses major reserves of 80 different minerals including copper, gold, coking coal, iron ore, fluorspar, molybdenum, and crude oil. In particularly, the Oyu-Tolgoi mine, located near the southern border, is potentially one of the world largest copper mine.

However, some historical and geographical features cause level of problems. The vastness of the territory, with many inaccessible parts, and scattered population give it an extremely high land/labor ratio, make transport cost as a significant element in manufacturing costs. In addition, its land-locked location presents a major barrier to foreign trade. Once bridging the East and the West, now facing difficulty in logistic cost, due to aged railroad network system, seriously need costly upgrade. And the high transport cost, even by the standards of other Central Asian land-locked economies, provide natural protection for producers selling in the small domestic market, but at the same time make it more difficult to export, particularly goods with low value-to-weight ratios [39].

Thus, for Mongolian development, the key policy challenge is to revitalize and modernize industry, especially manufacturing and to diversify the economy more generally to allow it to reach a more stable growth.

2.3.2 Industrial Policy in Mongolia: Strategic directions and implementation results

The modern Mongolian Industrial development policy has long history, progressed from the government of Bogd Khanate Mongolia, and can be divided into the three phases, as following (Table 3):

- Phase 1: Industrial Development Policy of Mongolia ruled by Bogd Khan (1911-1921)
- Phase 2: Policy and implementation of industrial development during the centrally-planned economic system (1921-1990)
- Phase 3: Mongolian Industrial Development Policy of the Market Economy (since 1990) and Its Implementation Status

[4] http://www.crc.gov.mn/k/2ZV
[5] www.1212.mn
[6] https://mrpam.gov.mn/article/99/
[7] http://www.mongolianminingjournal.com/a/45701

Industrial development policy of Mongolia ruled by Bogd Khan (1911-1921)

The modern industrial development history is considered to have started from 1911, after the declaration of national independence. From then on, some major reformations had begun to ensure socio-economic independence. The government of Bogd Khanate Mongolia had started implementing policies and measures to optimize the use of natural resources, to increase the state treasury. Russian researcher M. Mayski estimated that, in today's money value of the Mongolian national treasure was around 250 million rubles during the period of 1916 to 1919. At that time, several foreign companies were required to carry gold in the Mongolian territory and provide an appropriate proportion of gold mined to Mongolia. In Nalaikh, now on of the 9th districts of Ulaanbaatar city, a small coal mine was established in 1915. Also, some business enterprises, such as logging, public housing, an electric station and a brick factory, started to operate. M. Mayski and other researchers summarized that Mongolia had good opportunities to develop its mining industry, light industry, food industry and processing industry for agricultural raw material. At the threshold of Mongolian revolution of 1921, Mongolian national income had reached to 51,033.0 thousand tugrugs (no inflation adjustment) and the construction sector contribution was estimated to be 3% (1,578.0 thousand tugrugs). In 1918, the population was 648.1 thousand and the number of households was 93.7 thousand. In 1924, the total number of livestock was 13,764.0 thousand [29, 30].

The government of Bogd Khanate Mongolia had made certain measures, such as literacy promotion, supporting manufacturers of wool and carpet, engraving and sculpture, to seize the opportunities mentioned above for the economic and industrial development, until 1921. The economic and industrial development policies of this period was mainly aimed to strengthen the economy and to raise the national treasury by ensuring independent economic activities, and tax policy. However, the political and social situation just after the independence wasn't stable, which affected the results of those policies, negatively.

Industrial policy and its implementation during the Centrally-planned economic system (1921-1990)

With the victory of the Mongolian Revolution of 1921, the goals of the development of a new Mongolian national economy were realized – industrialization. During this period, major political and social changes had happened, industrialization became intense and had a considerable progress. It was started with implementing policies to develop light and food industry, at that time mostly consisted of small handicraft factories, owned by foreign nationals. Some new firms were established, those existing factories were transferred to the Department of Finance's supervising, and later in 1924, transferred to the Ministry of Industrial Affairs. In 1922, "Basic Economic Policy" with 18 articles, was on effect and was the first legal act of Mongolian industrial concept. It declared the main direction of economic development: mining and mineral production and animal-derived raw material processing. To achieve the aimed level this policy initiated agricultural cooperatives throughout the country for better management of raw material harvesting, started education and trainings of skillful workers by sending them abroad and also establishing public schools. These activities had ignited the great potential of industrial

development, introduced new culture, advanced science and technology and education [29, 30].

The first modern factory, equipped with machinery, was established in 1922. In 1932, the technologically integrated Industrial Complex for producing end products of animal origin, started to operate in Ulaanbaatar. This complex was consisted of primary processing plants for sheep wool, animal skin and cashmere, factories for producing yarn, textiles and processed leather, and also, factories producing end-products, such as carpet, knit/ woven goods and leather shoes. A breach of World War II impeded Mongolian economic and industrial development, but industrialization was continuing. In the 1940s, the major transportation and logistics system took shape as laying railways, major roads, and it was a decade of rapid industrial development. In 1947, there were about 500 factories, of which 280 were related to food processing. From 1950 to 1960, a large leather factory was expanded to make value added products such as leather jackets and coats [29, 30].

A glue factory (1972) and a leather factory (1976) were established by Polish aid. In 1978, Japanese government built the "Gobi" cashmere factory in Ulaanbaatar as part of its World War II reparations, equipped with modern machineries and had production capacity of producing over 1 million cashmere goods. The "Erdenet" Russian-Mongolian joint venture factory (now Erdenet Mining Corporation), one of the 10 largest copper-molybdenum mines at that time, was established in 1978, was a big push forward for the sector and the country's economy [29, 30].

By the time of 1989, Mongolia had succeeded in developing and modernizing its major industrial sectors, which were the key drivers of the economic development. At that time, the industrial sector's output had reached 9,181.9 million tugrugs (as constant price of 1986), accounted for 48.6 percent of GDP, and it was 78.8 times increase from 1940. The employment reached 119.6 thousand people, accounting for 18.9 percent of total employees. And Mongolia's GDP per capita of 1989 was 6,165.6 USD, and it ranked at 115th in the world, which left Philippines, India, Vietnam, China and Indonesia behind [29, 30].

However, the internal forces and opportunities of the socialist economic system and mechanisms were depleted over the years, and in the late 1980s it was no longer possible to survive. The entire socio-economic reforms in the centrally-planned economy had been primarily focused on the creation of a socialist society and the state policy for industrial development had been the main goal of building industrialization intensively in the country and building and strengthening the modern industry.

Mongolian industrial development policy in period of the Market economy (since 1990)

The social shift into market economy in the 1990s, demanded an establishment of new socio-economic system, development policies and activities, and most urgently to lay legal basis for market relations. Ever since, many legal documents had come into action to regulate new socio-economic relations.

The legal documents that are comprising the State Policy and Legal Basis for the Mongolian

Industrial Sector vary as law, development concept, policy, program, master plan and action plans.

For example, in 1992, newly declared Constitution allowed citizens to own properties and granted a voluntary business, production and entrepreneurial right. Furthermore, the Law on Taxation (1993), the Corporate Law (1993), the Law on Environmental Protection (1995), the Law on Technology Transfer (1998), the National Security Law (2001), the Law on Science and Technology (2006), the Patent Law (2006), the Law on SMEs (2007), the Law on Property Assessments (2010), the Company Law (2011), the Law on Innovation (2012) and the Law on Development Policy Planning (2015) were passed. In addition, Mongolia's National Development Concept (1996), Regional Development Concept (2001), Millennium Development Goals (2005), Comprehensive National Development Policy based on Millennium Development Goals (2008), National Security Concept (2010) and The Sustainable Development Concepts-2030 (2016) provide some insights for Industry development [42, 43].

And here are the development policies, directly related to the Industry:

- Mongolia's heavy industrial development policy, 2006
- Government policy on High technology, 2010
- Government policy on Mineral sector, 2014
- State policy on Industry, 2015 etc.

Since the 1990s, within the framework of implementation of the industrial development policy, a number of programs had been carried out. For example, Gold program (1991), National Program to Support SME Development (1996), National Poverty Alleviation Program (1996-2000), The Development of the 21st Century Sustainable Development Program (1998), the Biotechnology Development Program (1998), the Export Production Support Program (1998), the Cashmere Program (2000), the Wool Program (2001), the Leather program (2001), National Food Supply, Safety and Nutrition program (2001), Garments Production (2003), National Program to Support SME Development (2005), Investment Program of Mongolia: 2013-2017 (2012), The Action Plan of the Government of Mongolia for 2016-2020 (2016), Gold-2 program (2017), "Industrialization 21:100" National program (2018), 2018-2021 Investment Program of Mongolia (2018) etc. Mongolia also made some efforts for sustainable development, by supporting innovation oriented, environmentally friendly industries, under the several policies: The Green Development Policy (2014), the Government Policy on Science and Technology (2017), the Government Policy on Innovation (2018), the Three-Pillars Development Policy (2018).

The focus of these industrial development policies, could be categorized as following:

- Development of Heavy industry;
- Fevelopment of Light industry;
- Development of Small and Medium Enterprises (SMEs);
- Development of Industrial parks, Free economic zones;
- Export promotion and import substitution;

Above all, the most important policy that should be thoroughly analyzed, is the "State Policy on Industry" approved by Ulsyn Ikh Khural (Mongolian Parliament- the top of both legislative and oversighting power in Mongolia) in 2015. The main purpose is to create and develop prioritized industries and services that employ advanced means and high technology, contributing to the sustainable development of Mongolia and raise country's competitiveness. Main objectives and implementing activities are as following:

1. Improve the legislation of the industrial sector and to create an optimal conditions for manufacturing;
2. Determine the industrial development regions, calibrated with the policy of ecosystem, population density and settlement, natural resources and infrastructure, develop the "General industrial plan map of Mongolia";
3. Determine the prioritizing industry, form manufacturing clusters, economic free zones, establish industrial and/or technology parks, and integrate transportation and logistics network;
4. Support efficient collaboration between state, science and business within the industrial sector;
5. Support social-entrepreneurship and efficient production (innovative, high-tech, low-emission etc.) in manufacturing, recycling and creative industries by investment and financial policy;
6. Support development of creative industry
7. Capacity building of skilled human resources;
8. Create optimal conditions for foreign trade and vary the export;

And the principles of the policy are:

- Manage healthy, safe and environment friendly manufacturing;
- Support manufacturing of the export-oriented, import-substitutive and competitive products that assured the national and international standards;
- Develop efficient manufacturing based on the advanced techniques, high technology and innovation;
- Be based on effective state, science and business collaboration;
- Provide equality and fair competition within the industrial sectors.

Current industrial policy will be implemented in 3 main stages:

I stage. 2015-2020: Implement an Industrial policy to protect the national production, to process raw materials domestically, to apply new technologies, to support export and to substitute imports;

II stage. 2020-2025: Establish export-dominated industrial structure and to create high-tech, mechanical, and chemical manufacturing;

II stage. 2025-2030: Develop knowledge-based industry and to initiate technological exports;

Government defines top priorities of industry:

- **Heavy industry:** Oil production; Coal chemical production; Coke chemical production; Copper smelting; Steel production; Cement industry;
- **Light industry:** Leather and hide production; Cashmere production; Wool

production; Wood production;

- **SME sector:** Dairy production; Construction material production; Food production; Bio preparations; Information technology;

It could be said that significant progress has been made in the economic and industrial development of Mongolia, as result of the implementation of the above-mentioned development policies and programs. For instance, referring to the share of value added mining and quarrying in the Industrial sector, in between 1990 and 2018, it hit all time low in 1990 of 35.2 percent, and the highest in 2006 of 77.9 percent. And, the share of manufacturing sector was the lowest in 2006 of 14.9 percent, the highest in 1990-1994 of 57.4 percent, while the lowest share of electric, thermal energy and water supply industry was in 2014 of 5.2 percent, and the highest in 1998 of 17.2 percent [33].

The contributive share of Industry in GDP of 2017 was 32.7 percent, 2.8 points lower than that of 1990 and 1.9 points lower compared to 1995. But in 2018, the share in GDP reached 41.9 percent. In the perspective of the Industry structure of 2017, the mining and quarrying sector covered 57.4 percent, was 10.2 points of increase, compared to 2001 (47.2%). In the contrast, processing industry sector was 33.3 percent and 1.6 points of decrease compared to 2001 (34.9%), as well 2.1 points decrease (17.9%) from 2001 in the electric, thermal energy and water supply industry, which was 15.8 percent [31, 40, 41, 42].

In 2018, the share of value added mining and quarrying in the Industrial sector was 67.6 percent, of manufacturing sector was 26.4 percent, electric and thermal energy was 4.8 percent, and water supply, waste water treatment, waste management was 1.2 percent [33].

By the time of 2018, Mongolian GDP reached 13.01 billion USD, 5.1 times increase compared to 1990 (2.561 billion USD), GDP per capita reached 4,103.7 USD, increased 2.5 times compared to 1990 [31].

Conclusion

- Modern industry development of Mongolia had progressed after the declaration of national independence in 1911. Several important economic reforms had begun, to ensure socio-economic independence of the country. The economic and industrial development policy of the Government of Bogd Khanate Mongolia was projected to strengthen the economy and to raise the national treasury by upgrading financial and tax system, improving usage of natural resources, and ensuring economic independent. Mongolia's economy at the time was dominated by nomadic pastoralism, with exception of small coal mines, logging farms, publishing houses, power plants, and brick factories. In addition, due to the unstable socio-political situation in the country, weak economic base, and lack of national treasury, the policy of economic and industrial development of Mongolia, just came independent, had not been implemented effectively.

- In 1921, following the victory of the People's Revolution, Mongolia began to pursue the path of socialism. Since then, certain policies and activities to develop the country's economy and

lay the foundation for a modern industrial sector began to be implemented intensively. "The Basic Economic Policy", adopted by the government in 1922, set goals for the country's industrialization, primarily in mining, quarrying, and the processing of animal-sourced raw materials. The opening of the Industrial Complex in Ulaanbaatar in 1932 laid a solid foundation for the emergence and development of a modern industrial sector. During this period, a large number of factories and enterprises were established, and completely new industries (light and food industry, construction, energy, mining, etc.) emerged. By 1989, industry was a key sector of the Mongolian economy, accounting for almost 50 percent of GDP.

- After 1990s, with transition to market economy Mongolia experienced a radical change in its socio-economic development. This involved the rapid opening-up of the economy to foreign trade and the privatization of most of the big industrial enterprises. It was demanded to establish a new socio-economic system, to develop policies and activities, and to lay legal basis for the market relations.

- Even though, Mongolia is one of the richest countries in natural resources, faces critical policy challenges. It seems that plenteous mineral reserves pose the potential to grow rapidly and raise living standards significantly. But international experience shows the otherwise, which is economic diversification that allows the industry and manufacturing sector to prosper, and should be the important policy objective.

- Main focuses of industrial development policy could be categorized as development of Heavy and Light industry, and SMEs, establishment of Industrial parks, free economic zones, Export promotion and Import substitution. And there are three broad options for the intervention: Development of the mineral sector; Modernization of traditional activities; development of new activities.

- To successfully implement the Industrial policy, the Mongolian government should play an important role in creating a favorable business environment with reliable financial system and less bureaucracy. Also, adhering to basic principles, such as sustaining green manufacturing; endorsing up to or over the standard, export-oriented, import-substitutive, and competitive products; encouraging efficient manufacturing based on the advanced, high- tech and/or innovation; promoting effective public-private-partnership in science and business; providing equality and fair competition within the industrial sectors, could help significantly.

Table 3. Mongolian industrial policy and development: Main directions and achievements

№	Timeline of development strategy	Main strategic direction and Key measures	Main achievements in Industry development	Some main indicators
1	1911- 1921 Period of National Independence	Major reforms to ensure socio-economic independence of the country: - Raising state treasury - Natural resources usage optimization - Establishment and promotion of national production- mining industry (coal, gold etc.) light industry, food industry, processing industry for agricultural raw material etc. - Promotion of foreign and domestic trades - Reforms on public financing and banking system, customs.	- The Government of Bogd Khanate Mongolia, organized special research unit, consisted with leading specialists and foreign experts, to determine the economic situation, capacity, natural resources, agriculture, and hunting resources of Mongolia. - Nalaikh coal mining reserve (1915) - New agreement with "Mongolor" International joint venture in Mining - Promotion of Handcraft - Business enterprises, such as logging, public housing, an electric station, and a brick factory etc.	By 1921, Mongolian national income had reached to 51,033.0 thousand tugriks*. (No statistical data on overall industry sector)
2	1921-1990 Period of Centrally-Planned Economy	The main goal of economic development was set as Industrialization, -1922, "Basic Economic Policy": mining and mineral exploitation and animal-originated raw material processing - 1946, First "5-year plan of National economic and cultural development": enhance industry sector, increase production	1922, the first modern factory, equipped with machinery was established; 1932, technologically integrated Industrial Complex, processed from primary to end products of animal-originated materials. By 1947, the number of factories were 500. 1978, "Gobi" cashmere factory (production capacity of over 1 mill. cashmere goods) 1978, "Erdenet mining" Russian-Mongolian joint factory (now Erdenet Mining Corporation), one of the 10 largest copper-molybdenum mines By 1989, the Modern Industry sector had formed completely.	By 1989, Industrial sector's output was accounted as 48.6% of GDP, and it was 78.8 times increase from 1940. Per Capita GDP 6,165.6 USD, the employment of the industry reached 119.6 thousand, accounting for 18.9 percent of total employees.
3	After 1990s Period of Market Economy	Transition to market economy, establishment of new socio-economic system, and laying legal basis for market relations. - 1992, new Constitution allowed property rights to citizens, granted a voluntary business, production and entrepreneurial right; - Implemented privatization and took measures	1990, Metallurgical plant in Darkhan (1200 employees) Timeline of Private companies: 1990, Monos Cosmetics LLC (now Monos group-1700 employees) 1993, Mongol Gold LLC (1600 employees) 1993, MCS group LLC (engineering, production of	Mongolia- one of the 3G-countries, with the most promising growth prospects for 2010–2050; 2017, share of Private sector in GDP increased 23.8 times

№	Timeline of development strategy	Main strategic direction and Key measures	Main achievements in Industry development	Some main indicators
3	After 1990s Period of Market Economy	to strengthen the private sector; - Numerous policies on economic and industrial recovery (Policy on Sustainable, Green development, S&T, Innovation, Industry development and so on), National programs (Gold-1,2, Wool, Cashmere, Leather, Food supply, Export production and SME support, Industrialization, etc.); - Main directions of Industry development: ▪ Development of Heavy industry; ▪ Development of Light industry; ▪ Development of Small and Medium Enterprises (SMEs); ▪ Development of Industrial parks, Free economic zones; ▪ Export-promotion and import-substitution;	beverages and furniture, 9000 employees) 2003, TESO group (Food production, 1500 employees) 2005, Energy resource LLC (Coal flotation, 1500 employees) 2009-2010, Agreement and Beginning construction of Oyu Tolgoi mine, Mongolia's largest copper and gold mining company with 14000 employees and 100 year of deposit; included in TOP-5 Copper-Gold mines worldwide; 2010, Erdenes-Tavan tolgoi (Coal mining, Annual coal washing capacity – 10 mill. tons, 800 employees) By 2018, Cashmere sector grew into one of the main industry, producing 40% of World raw cashmere, annual cashmere washing production capacity of 9100 tons, 2.8 mill. pieces of end products and 100 factories, app. 200 workshops; Wool sector producing 37000 tons of washed wool, 934000 pieces of knitted goods, 492000 m. woven material, 116 mln.m^2 carpet, and 804000 m^2 construction materials; in Food industry sector operated 1914 factories and employed 12925 people.	from 1989 (3.3% in 1989, 78.7% in 2017); 2018, share of Industry in GDP composition was 41.9%, and GDP reached 13.010 bill. USD, increase of 5.1 times compared to 1990, GDP per capita was 4103.7 USD, increase of 2.5 times that of 1990. Employees in Industry - 270.6 thousand people, 23% of Total employees.

Note: *by the author (L. Oyuntsetseg, 2019) based on information of economic development and industrial policy of Mongolia*

III. ANALYSIS OF THE INDUSTRIAL CONVERGENCE AND DEVELOPMENT OPPORTUNITIES OF THE INDUSTRIAL COOPERATION BETWEEN TAIWAN AND MONGOLIA

3.1. Methodology of convergence analysis in industry

3.1.1 Basic understanding and definition of convergence

In last few decades, interest in issues of economic convergence between different countries became popular among economists and researchers. The process of globalization has accompanied with convergence, which refers to the conjugation of economic growth with the social and institutional convergence of countries with different levels of economic and social development. From this perspective, the theory of convergence is the basis for determining the degree of convergence between different economies. The term ‘‘convergence’’ basically means “getting similar” or “getting closer” and the opposite meaning is “divergence”, which means “getting different” or “moving apart” [73]. From the perspective of economic theory, convergence is assumed that countries could get closer by level of development. This term in scientific research was considered for certain indicators of economic development in the 1960s. On the other hand, convergence was interpreted as a joint movement towards each other from both the countries of socialist system and developed industrial countries (capitalist countries) [44, 67]. It was postulated that the Soviet Union borrowed the concept of profitability from capitalism, while capitalist countries, including the United States, borrowed from the experience of state planning. But, after 1990s the convergence theory in this interpretation had been lost its relevance in connection with the disappearance of the antagonistic struggle between the two systems - capitalism and socialism [67].

Starting from I980s, economists began to pay big attention to this issue, and according to X. Sala-i-Martin by two reasons. First is that, “the existence of convergence across economies was proposed as the main test of the validity of' modern theories of economic growth” and, second, “a data set on internationally comparable GDP levels for a large number of countries became available in the mid-1980s”, which allowed to conduct empirical studies on “comparison of GDP levels across a large number of countries, and to look at the evolution of these levels over time, a necessary feature for the study of the convergence hypothesis” [54].

Generally, convergence is interpreted in three main ways:

- ***absolute convergence***, if all countries accomplish the same level of long-term income growth and it also suggests that the less developed countries grow more rapidly than developed countries resulting in catching up by poorest countries [44, 52, 54];
- ***conditional or unconditional convergence***, first suggests that a country or a region will converge to its own steady state as every country or region has its own distinguished set of endowments, while the unconditional convergence implies that all countries or regions are converging to a common steady state [44, 52, 54, 64];
- ***convergence club*** means the existence of multiple, locally stable, steady-state equilibrium to which economies with similar characteristics converge [45], in other words, groups of

countries that have the same level of industrialization, and the same level of economic development [46];

In applied economic researches were used several hypothesis with aim of testing above mentioned types of convergence, which is divided into four main categories, according to Veli Yilanci, Ercan Saridoğan, Okşan Artar (2014) [70]:

1. **Sigma convergence** (σ - convergence): According to Barro and Sala-i-Martin (1995) it concerns the measure of cross-sectional dispersion. If the dispersion measured by the standard deviation of the logarithm of per capita income or product across a group of countries or regions declines over time, convergence occurs [52, 70].
2. **Absolute (unconditional) beta convergence** (β-convergence): applies if a poor economy – defined without the conditioning of any other economic characteristics – tends to grow faster than a rich one, so that the poor country tends to catch up to the rich country in terms of levels of per capita income or product [52, 70];
3. **Conditional beta convergence** (β-convergence): occurs when all the economies do not share the same parameters, and therefore, differ in terms of their steady state positions. If the steady states are different, an economy grows faster the further it evolves from its own steady state [52,70];
4. **Stochastic convergence**, which does not require each country to converge to the same steady state, is applicable when per capita income disparities between countries follow a mean-stationary process, i.e., relative per capita income shocks lead only to transitory deviations from any tendency toward convergence [70].

3.1.2 Literature review on convergence analysis

Over the last few decades, several studies have attempted to analyze the convergence from diverse economic aspects in different countries or regions and sectors. From the literature review could be highlighted following works.

J. Baumol (1986) conducted empirical analysis of the convergence using Maddison's (1982)[8] dataset, which consists from data of 16 industrialized countries, covers time period of 1870-1979 and estimated a simple regression equation to show the strong inverse association among the growth rate of GDP and its preliminary value [45]. S. Dowrick and T. Nguyen (1989) discovered the existence of income convergence for developed OECD countries by using parameter stability test [46].

R. Barro and X. Sala-i-Martin had conducted several studies. They (1990) studied absolute convergence across the States of USA [4] R. Barro (1991) tested the convergence hypothesis for a dataset consisting of 98 countries and rejected the absolute convergence hypothesis [48]. R. Barro and X. Sala-i-Martin (1991) examined the growth and dispersion of personal income since 1880 and the evolution of gross state product of U.S. states since 1963. They applied the same framework to patterns of convergence across 73 regions of Western Europe since 1950. This study showed that, the process of convergence within the European countries is similar to that of

[8] *Madison (1982) conducted analysis using long-run (1870-1979) national income and aggregate productivity data for 16 successful capitalist nations.*

the United States and in particular, the rate of convergence is again about 2 percent a year [49]. In the other study, R. Barro and X. Sala-i-Martin (1992) studied convergence across the 48 U.S. states using data on personal income since 1840 and on gross state product since 1963 based on the neoclassical growth model [50]. In the work "Technological diffusion, convergence, and growth" R. Barro and X. Sala-i-Martin (1995) constructed a model which combines of endogenous growth with the convergence implication of the neoclassical growth model and the results exhibited a form of conditional convergence, a property found in the cross-country data on economic growth [51]. In other work X. Sala-i-Martin (1996) considered the concepts of σ-convergence, absolute β-convergence and conditional β-convergence and applied to a variety of data sets that include a large cross-section of 110 countries, the sub-sample of OECD countries, the states within the United States, the prefectures of Japan, and regions within several European countries and all data sets displayed strong evidence of σ-convergence and absolute β-convergence, the cross-section of countries exhibits σ -divergence and conditional β-convergence, the speed of conditional convergence, which was very similar across data sets, is close to 2 % per year [52].

D. Quah (1990) considered methodology of convergence analysis and shown that the widely-used initial level regressions, in fact, shed no light on convergence and a negative cross-section regression coefficient on initial levels was consistent with absence of convergence [53]. D. Quah (1996) proposed the nonparametric methodology and conducted research on regional convergence clusters across the Europe [54, 55]. S. Durlauf, D. Quah (1998) considered in their work, an overview of empirical research on patterns of cross-country growth and convergence analysis [56].

N. Apergis, C. Christou, S. Miller (2010) investigated industry convergence of equity markets from perspective of club convergence, clustering using the panel convergence methodology developed by Phillips and Sul (2007) based on data of the 42 countries. Empirical results suggested that the equity markets of 35 of the 42 counties in the sample formed a unified convergence club and also showed more numerous stock-price convergence clubs in certain industries [65].

T. Ito (2010) conducted research on productivity convergence between Mexico and the US and introduced improved procedures for generating total factor productivity (TFP) data and applied new and more appropriate econometric methods [66].

D. Tsyrkunov (2010) investigated the processes of economic convergence in Central and Eastern Europe based on sigma – convergence approach, which shows the degree of variation in income levels per capita and human development index (HDI) among the countries. Results showed the absence of the effect of reducing divergence in the region and the differentiation of income between countries [67].

M. Andreano, L. Laureti, P. Postiglione (2013) evaluated the economic growth of the Middle East and North Africa (MENA) countries based on conditional β-convergence approach, using a set of state, environmental, and economic covariates as conditioning variables of the model. The data set constituted by 26 countries, and ranges from 1950 to 2007 [68].

I. Corazziari, G. Gabrielli, A. Paterno and S. Salvini (2014) conducted analysis the trends of specific demographic parameters regarding mortality and fertility rates, jointly with some socio-economic characteristics (living condition, socio-sanitary situation) of more than 100 DCs, to assess if convergence patterns in demographic behaviors prevail or if marked differences persist [69].

In the Asia, several researchers have been conducted convergence studies in field of economies, regions, sectors, like industry, and agriculture. Sh. Fukuda, H. Toya (1995) investigated a tendency to convergence in East Asian countries, in particularly, the Asian newly industrialized economies (NIEs), the ASEAN countries, and Japan. Study showed, per capita growth rates in East Asian countries have little correlation with the starting level of per capita product even if it allowed for the difference in the level of human capital and given the export-GDP ratios, subsequent growth rates in East Asian countries were negatively related to the initial level of per capita GDP [57].

L. Lim and M. McAleer (2000) tested the existence of a convergence club for ASEAN-5, as well as ASEAN-5 plus the USA and found evidence of several convergence clubs, in which per capita incomes have converged for selected groupings of countries and regions and concluded that, the catching up hypothesis states that the lagging country, with low initial income and productivity levels, will tend to grow more rapidly by copying the technology of the leader country, without having to bear the associated costs of research and development (R&D) [58].

J. Kim (2001) tested the 0-hypothesis of endogenous growth theories applied for 17 Asian countries and NIEs, including Taiwan, with panel data and results showed the conditional convergence of the exogenous growth model against the endogenous growth model [59].

A. Joian (2002) presented econometrics model by using panel data from the East Asia and other part of the world with aim to find convergence rate between East Asian and some advanced economies, and to show convergence rate within the region [60].

G. Arrighi, B. Silver, and B. Brewer (2003) demonstrated empirically widespread convergence in the degree of industrialization between former First and Third World countries over the past four decades and concluded that may destabilize not only the “globalization project,” but also the global hierarchy of wealth that has characterized historical capitalism [61].

M. Nair and M. Kuppusamy (2004) investigated trends of convergence and divergence in the information economy for selected developed and developing countries. Results from the empirical analysis showed countries that if invested heavily into ICT infrastructure, human capital and innovation tend to have higher productivity levels. The empirical evidence also showed that the gap between the developed and developing countries have increased over the seven years from 1995 to 2001. This study also examined the type of policies pertaining to the above-mentioned factors in the more developed and highly competitive economies [62].

E. Barrios (2007) studied convergence in agricultural sector of some Asian countries and proposed an agricultural growth model is to verify the agricultural convergence hypothesis following the method of Barro and Sala-i-Martin (1992) and Sala-i-Martin (1996). Results from

the analysis showed that conditional convergence of agriculture is facilitated by foreign aid intended for agriculture and spatial externalities associated with foreign trade. They concluded that foreign aid for agriculture may not serve the purpose of mobilizing resources for an environment conducive to development, but rather may function as a substitute to public expenditure for the sector [63].

S. Mathur (2007) conducted study on analyzing the economic growth experiences of some South Asian and East Asian economies since 1960s and discussed the regression and growth accounting results at length and on the same basis some policy conclusions were suggested so that some important insights were developed on growth, efficiency and convergence process across some South Asian, East Asian, EU and some CIS countries over time [64].

V. Yilanci, E. Saridoğan and O. Artar (2014) studied stochastic convergence dynamics for selected East Asian and Pacific countries over the period 1960–2010, using a unit root test with a Fourier function capable of capturing unknown form for structural breaks and results of test showed that the stochastic convergence hypothesis not rejected for Australia, Fiji, Korea, Nepal, Pakistan, Philippines, and Thailand [70].

D. Adhikari, Y. Chen (2014) conducted the study examined the convergence of energy productivity at the sectoral level across 35 Asian countries, including Mongolia, from 1991 to 2011 by using the spatial panel data approach. The results revealed that mixed evidence of convergence process in the sectoral energy productivity for these 35 Asian countries and founded beta-convergence process exists in energy productivity in the construction, manufacturing, mining; manufacturing and utilities, transport; storage and communications, and wholesale; retail trade; restaurants and hotels sectors and the spatial spillover effect had a positive impact on the sectoral energy productivity growth in those countries [71].

L. Mei and Z. Chen (2016) developed a biennial Malmquist-Luenberger productivity index, in which it takes resources and the environment into account, and use a spatial econometric analysis to measure the Chinese provincial spatial convergence of the total factor productivity (TFP) to conclude its decomposition. The empirical results showed that, China's TFP increased significantly, mainly driven by technical improvement, there was nationwide conditional convergence of productivity except for diffusion in the northeast and east regions, because of the large spatial differences amongst various areas in China, the convergence of different region is affected by different factors and "resource curse" would present in the regions in China excluding east regions, "pollution haven" existed in the Central and western areas, suggesting that the perspective of China's industrial environment is not optimistic and the current ownership structure does not facilitate TFP growth, and industrial structure of inland areas limits local TFP growth [72].

K. Zulfiqar, M. Chaudhary, A. Aslam (2017) investigated convergence at assorted level of disaggregation among a sample of almost 60 countries (18 developed and 42 developing countries, including Taiwan and Mongolia) and tested absolute and conditional convergence hypotheses for a set of developed and developing countries by applying pooled least square methodology; The results suggested absolute convergence for countries having similar

characteristics and conditional convergence for countries having heterogeneous structures; Was calculated disparity level for each country with reference to average steady state income; The study examined the role of investment, openness and population growth in accelerating the convergence process [73].

F. Furuoka, R. Rasiah, R. Idris, P. Ziegenhain and R. Ikechukwu (2018) tested the income convergence hypothesis by deploying some innovative and powerful unit root tests, such as the Fourier augmented Dickey–Fuller (FADF) and the Fourier ADF with structural breaks (FADF–SB) methods. The results showed a positive causal relationship with 10% of the two-country pairings. 16% of the two-country pairings showed no causal relationship at all, while the remaining 30% produced inconclusive results, which suggested that other variables, such as government focus on the science, technology and innovation infrastructure to promote structural transformation may be more important than trade liberalization efforts to reduce inter-country income gaps [74].

G. Khan and V. Daly (2018) tested for output convergence during 1960-2017 amongst the leading member countries of the South Asian Association for Regional Cooperation (SAARC): Bangladesh, India, Nepal, Pakistan and Sri Lanka and found minimal evidence of growth convergence within the full group of countries. They concluded that these countries can be allocated to two non-overlapping convergence clubs, with India and Sri Lanka enjoying the more favorable growth path [75].

G. Morleo, M. Gilli, M. Mazzanti (2019) tested the existence of both absolute and conditional β-convergence as well as σ-convergence in the environmental productivity (i.e., for each sector, the ratio between value added and carbon dioxide emissions) of 14 sectors for the period 1995-2009 using data from the World Input-Output Database (WIOD). The study focused on the environmental performances of the European manufacturing industry. The results supported the hypothesis of β-convergence and highlighted other factors such as trade openness and in addition, the results indicated that the sectorial share of value added can affect sectorial environmental performances, as shown by a higher speed of convergence. But, no statistical evidence of σ-convergence was found [76].

From the literature review could be made following conclusions:

(i) studies have attempted to analyze the convergence from diverse economic aspects in different countries or regions and sectors;
(ii) main indicators used for measurement of ‘‘convergence’’ were GDP, GDP per capita (mostly real GDP per capita), Per capita income, present of GDP in Manufacturing, Productivity (TFP-Total Factor Productivity, Labor Productivity);
(iii) for sector or industry convergence analysis mostly used indicators, such as GNP per capita, GDP from sector, Productivity (TFP-Total Factor Productivity, Labor Productivity);
(iv) main factors, which considered in convergence analysis, were: Export, Investment, Human capital, Share of Government consumption in GDP, Domestic savings rate, Population growth, Fertility rate, Industry value added, Public investment, Innovation, Technological progress, Political stability, Market condition, Openness of the economy, Education;

(v) 38.5 % of investigated research works were covered up to 20 years period of dataset (average period is around 10 years), 42.3 % of research works- 21-50 years (average is about 35 years), and 19.2 % of research works covered more than 50 years (average is about 90 years);

The results of literature review were summarized in Annex 1.

3.2. Results of the industry convergence analysis and opportunities and challenges for industrial cooperation between Taiwan and Mongolia

3.2.1 Data and methodology of industry convergence analysis and Empirical results of industry convergence analysis

Data and methodology of industry convergence analysis

Taking consideration of results of literature review, in the measurement of industry convergence, was used dataset of following indicators of the countries for period of 1990-2018 (Table 5). All the data for present study is taken from national statistical and government information data of Taiwan and Mongolia. Following is a brief description of the variables used in this study:

- **GDP per capita** (current prices) is a measure of the value of goods and services produced in an economy, it does not require any adjustments for inflation.
- **Share of industry in GDP** is a measure of manufacturing and other industry production contribution to the gross domestic product. It is calculated by industry production (including construction) percentage in GDP.
- **GNI per capita** is the comparison of the gross national income and the number of population and it does not completely summarize a country's level of development or measure welfare. GNI per capita has proved to be a useful and easily available indicator that is closely correlated with other, nonmonetary measures of the quality of life, such as life expectancy at birth, mortality rates of children, and enrollment rates in school. GNI may be underestimated in lower-income economies that have more informal, subsistence activities and GNI does not reflect inequalities in income distribution[9].
- **Labor productivity** is defined as a comparison of GDP and the number of employees. It is also indicated the economic growth of the country.

Two most common and widely well-known convergence concepts, sigma-convergence and beta-convergence were used for the methodology to explore the convergence dynamics of industries of Taiwan and Mongolia.

Sigma convergence:

Sigma-convergence simply refers to a reduction of disparities among countries or regions in time. The sigma-convergence that measures the disparity of GDP per capita of the given time period can be calculated by applying the standard deviation or coefficient of variation. The standard

[9] *Per capita income: Estimating Internationally Comparabl Numbers, 1989,* *http://documents.worldbank.org/curated/en/496091468180250433/pdf/795410BR0Per0C00Box037737900PUBLIC0.pdf*

deviation of per capita GDP herein is calculated by the following equation:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(lny_{it} - ln\bar{y_t})^2} \qquad (1)$$

Where, y_{it}-GNI per capita; $\bar{y_t}$-average value of the GNI per capita of the specified time period; and N-total number of the country;

Beta-convergence:

Beta-convergence refers to a process in which poor economies grow faster than rich ones and therefore catch up with them and the concept is directly related to neoclassical growth theory. In other words, beta convergence focuses on detecting possible catching-up process. Accordingly, the growth process should on the long run, lead economies to a steady state characterized by rate of growth, which depends only on the (exogenous) rates of technological progress and labor force growth. The diminishing return also implies that the growth rate of poor economies should be higher and their income or GDP per capita levels should catch up with those of rich economies. Beta convergence is named absolute when all economies are assumed to converge towards the same steady-state (in terms of GDP per capita and growth rate). However, the steady-state may depend on features specific to each economy, in which case convergence will still take place, but not necessarily at the same long-run levels.

The methodology used to measure beta-convergence generally involves estimating a growth equation in the following form:

$$\ln(\Delta y_{i,t}) = \ln(\frac{y_{i,t}}{y_{i,t-1}}) = \alpha + \beta \ln(y_{i,t-1}) + \gamma Z_{i,t} + \varepsilon_{i,t} \qquad (2)$$

Where, $i\ and\ t$ denote the countries and time period, α, β are the parameters and $\varepsilon_{i,t}$ is the error term. $Z_{i,t}$ is factors that are supposedly affecting the growth rate and $\ln(\Delta y_{i,t})$ is natural logarithm of the average growth rate of GNI per capita, and $\ln(y_{i,t-1})$ is natural logarithm of the initial levels of GNI per capita.

A negative relationship between the growth rate and the initial level of GNI per capita and β is significant and negative, which is the sign of a convergence process. If the value of γ is restricted to 0, absolute convergence is assumed while if it is freely estimated, conditional convergence is assumed[10].

$$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha + \beta \ln(y_{i,t-1}) + \varepsilon_{i,t} \qquad (3)$$

Where, $i\ and\ t$ denote the countries and time period, α, β are the parameters and $\varepsilon_{i,t}$ is the error term. $\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right)$ is natural logarithm of the average growth rate of GNI per capita, and $\ln(y_{i,t-1})$ is natural logarithm of the initial levels of GNI per capita.

[10] *The same specification can be used to test the existence of a convergence process on other economic variables such as GDP per worker.*

If there is time impact on development indicator we can use a dummy variable for the equation which determines the convergence process is writing the following:

$$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha_t + \beta_t \ln(y_{i,t-1}) + \varepsilon_{i,t} \quad (4)$$

$$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = (\alpha_0 + \propto_1 D) + (\beta_0 + \beta_1 D) \ln(y_{i,t-1}) + \varepsilon_{i,t} \quad (5)$$

Where, $i\ and\ t$ denote the countries and time period; α, β are the parameters; and $\varepsilon_{i,t}$ is the error term; $\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right)$ is natural logarithm of the average growth rate of GNI per capita; and $\ln(y_{i,t-1})$ is natural logarithm of the initial levels of GNI per capita; D is dummy variable of time;

Reason of using this methodology is that, if a poor economy is defined without the conditioning of any other economic characteristics, tends to grow faster than a rich one, so that the poor country tends to catch up with the rich country in terms of levels of per capita income or product [9, 27].

The absolute convergence hypothesis is tested for the Taiwan and Mongolia. The hypothesis tested is:

H_0: $\alpha \geq 0$ (there is no absolute convergence)

H_A: $\alpha < 0$ (there is absolute convergence)

Researchers stated that, the null hypothesis states that growth rate of GDP does not depend on the preliminary level of GDP per capita. The alternative hypothesis however, designates that growth rates and initial GDP per capita are inversely associated and hence, convergence occurs [73].

To test the hypothesis above model is estimated. A significant negative value for β implies absolute beta convergence, while a positive value implies non-convergence (3).

Empirical results of industry convergence analysis of Taiwan and Mongolia

The territory of Mongolia is about 42 times bigger than Taiwan's, and Mongolian population is ~3.3 million, but in Taiwan 20.3 million more people lives. However, by the population growth rate of Mongolia is 2.25 times higher than Taiwan (Table. 4).

Taiwan has a dynamic capitalist economy with gradually decreasing government intervention in investment and foreign trade. Exports, led by electronics, machinery, and petrochemicals provide the primary impetus for economic development. Mongolia is the developing country, rich in mineral deposits and attendant growth in mining-sector activities, but traditionally was dependent on herding and agriculture. Mongolia's copper, gold, coal, molybdenum, fluorspar, uranium, tin, and tungsten deposits attract foreign direct investment.

Recently, GDP of Taiwan is 608186.0 mill. USD, which is 44.7 times more than Mongolia (13599.4 USD), but by the growth rate of GDP, Mongolia is 2.5 times higher than Taiwan. In

2018, GDP per capita of the countries were 25792 and 4198 USD, which means, Taiwan was 6.1 times higher than Mongolia. Since 1990, unemployment rate of Mongolia was higher than Taiwan.

By the volume of export, Taiwan (335909 USD) demonstrates result 54.8 times more than Mongolia (6831.9 USD). Mongolian external debt is much higher than Taiwan. Inflation rate of Taiwan was 1.47%, while in Mongolia it was 6.8%, in 2018.

Although Taiwanese government procurement is much higher than Mongolia's, accounting for a visible share in GDP, countries are showing similar results. About investment and FDI, in 2018, Taiwan had attracted much more than Mongolia (Table 4).

Table 4. Selected main indicators of Socio- economic development of Taiwan and Mongolia

№	Indicator	1990		2000		2010		2018	
		TW	MGL	TW	MGL	TW	MGL	TW	MGL
1	Area, 000 m^2	36.2	1500.0	36.2	1500.0	36.2	1500.0	36.2	1500.0
2	Population, mln	20.3	2.2	22.2	2.4	23.1	2.8	23.6	3.3
3	Population growth, %	1.2	2.0	0.9	0.9	0.4	1.7	0.8	1.8
4	Employment	8283.0	783.5	9784.0	808.9	10493.0	1033.7	11434.0	1253.0
	Unemployment rate,%	1.67	6.30	2.99	4.60	5.21	9.90	3.71	7.80
5	GDP, mln US$	166392.0	3792.7	330725.0	3846.2	444245.0	7298.0	608186	13599.4
6	GDP per capita, US$	8205.0	1761.2	14908.0	1600.5	19197.0	2643.3	25792.0	4197.8
7	GDP growth, %	5.54	-3.18	6.31	1.14	10.25	6.36	2.75	6.95
8	Export, mln US$	5477.85	467.98	12090.56	613.88	278008.0	3355.90	335909.0	6831.90
9	Import, mln US$	4853.93	1033.2	10398.41	771.84	256274.0	4074.40	286333.0	6561.70
11	Share of Industry in GDP, %	39.22	41.21	30.94	22.20	33.39	33.19	36.45	38.72
12	External Debt, mln US$	-	1375.0	34757.0	41431.0	101581.0	238806.0	191161.0	806802.0
13	Inflation, %	4.13	268.20	1.19	11.60	1.12	10.10	1.47	6.80
14	Government consumption, mln US$	29983.83	623.60	52023.04	174.03	67034.80	912.21	87434.20	1455.30
15	Government consumption share in GDP, %	18.02	24.40	15.73	15.30	15.08	12.68	14.37	12.74
16	Investment, mln US$	2301.77	39.68	7607.75	98.75	7701.095	2663.22	11672.47	2530.53
17	FDI, mln US$	2,301.77	11.10	7607.75	53.70	3811.56	1691.40	11440.23	1494.40

Source: *National accounts yearbook, 2018, Chinese statistical agency, ISSN-1011-2146* [77]; *https://eng.stat.gov.tw/public/data/dgbas03/bs4/NiYBE/naye.pdf*, *https://www.moeaic.gov.tw/business_category.view?seq=0&lang=en; Bureau of Trade-Trade statistics https://cus93.trade.gov.tw/FSCE050F/FSCE050F; https://knoema.com/TWEDBSTATS2017/external-debt-statistics-of-taiwan; www.1212.mn*; *https://www.mongolbank.mn/liststatistic.aspx?id=1*

During 1990-2018, for 29 years, the average economic growth of Mongolia was 8.6%, and for Taiwan it was 4.74%. The average economic growth of Mongolia was higher than Taiwan, about an average of 3.86 points per year (Figure. 2, Table 5).

The industry share in the GDP was similar in both countries. In 1990, the share of industry production of Mongolia was 41.21%, for Taiwan it was 39.22%. But in 2018, the industry share in GDP of both countries decreased by 6.0-7.1 percent (Table 5).

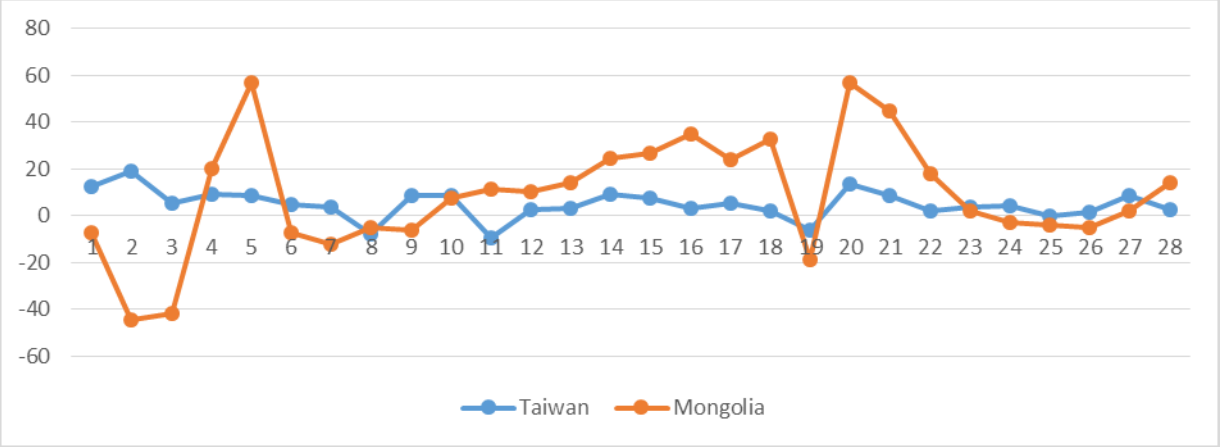


Figure 2. Economic growth of Taiwan and Mongolia, 1990-2018

GDP per capita of Mongolia was 1172.4 dollars in 1990, it increased by 3.5 times and reached 4121.73 dollar in 2018. For Taiwan, per capita GDP of 2018 was 25.8 thousand dollars and it increased by 3.1 times from 1990 (Figure 3)

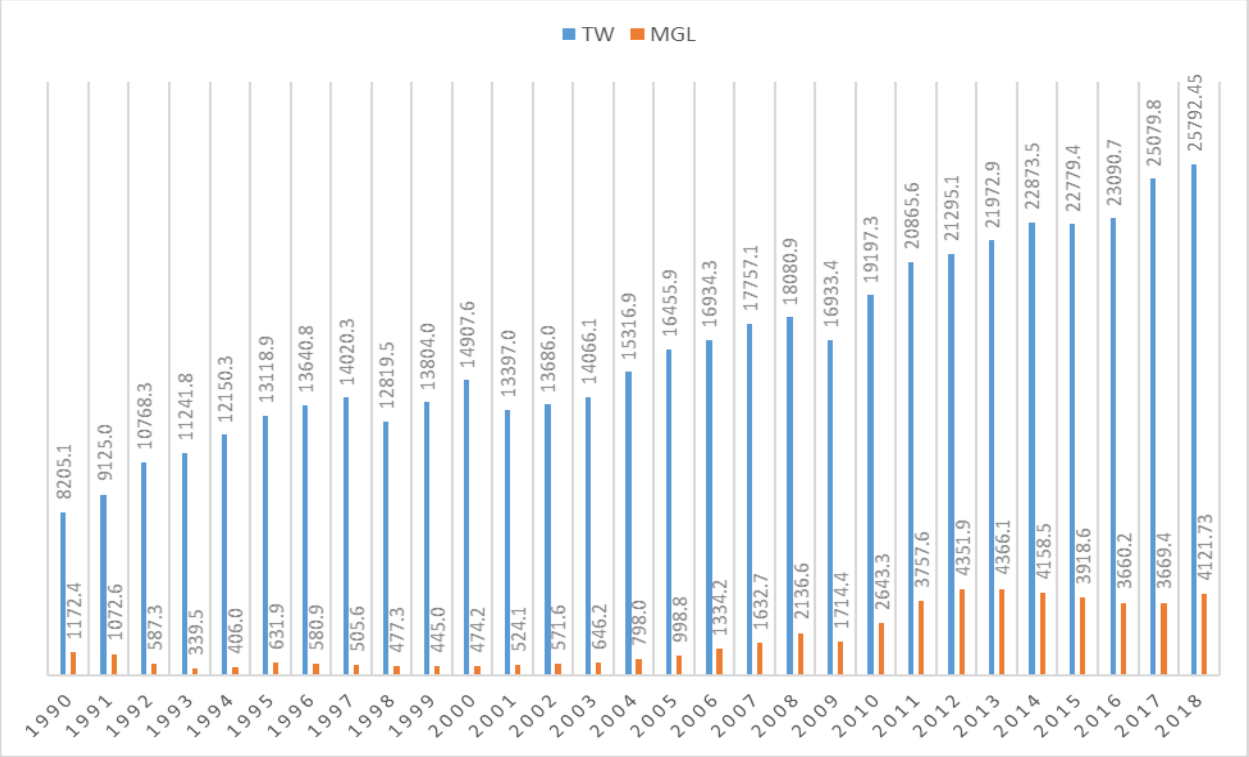


Figure 3. Per capita GDP of Taiwan and Mongolia, 1990-2018

Table 5. Dataset for industry convergence analysis

Years	TAIWAN						MONGOLIA					
	GDP mln. $	GDP per capita $	GNI mln. $	GNI per capita $	Labor productivity $	% Industry in GDP	GDP mln. $	GDP per capita $	GNI mln. $	GNI per capita $	Labor productivity $	% Industry in GDP
1990	166392.00	8205.14	170752.00	8420.00	20088.37	39.22	2560.79	1172.44	7136.79	3270.00	1172.44	41.21
1991	187100.00	9125.05	192150.00	9372.00	22409.87	38.78	2379.02	1072.64	6839.26	3080.00	1072.64	34.34
1992	222947.00	10768.31	227741.00	11000.00	25827.97	37.26	1317.61	587.30	6230.89	2780.00	587.30	34.69
1993	234943.00	11241.83	239257.00	11448.00	26865.98	36.30	768.40	339.52	6084.14	2690.00	339.52	30.04
1994	256213.00	12150.28	260266.00	12343.00	28662.38	34.80	925.82	405.97	6439.29	2820.00	405.97	31.42
1995	279013.00	13118.91	283188.00	13315.00	308642.70	33.62	1452.17	631.92	7011.43	3050.00	631.92	32.84
1996	292473.00	13640.83	296445.00	13826.00	32253.31	32.99	1345.72	580.91	7357.33	3180.00	580.91	23.65
1997	303315.00	14020.29	306408.00	14163.00	33055.25	32.67	1180.93	505.59	7779.86	3330.00	505.59	28.52
1998	279926.00	12819.47	281931.00	12911.00	30135.21	32.15	1124.44	477.33	8216.55	3490.00	477.33	22.60
1999	303827.00	13804.04	306573.00	13929.00	32373.68	31.07	1057.41	445.00	8588.86	3610.00	445.00	22.30
2000	330725.00	14907.60	335101.00	15105.00	34846.17	30.94	1136.90	474.22	8840.04	3690.00	474.22	22.20
2001	299303.00	13397.03	304898.00	13647.00	31898.43	28.89	1268.00	524.06	9328.61	3860.00	524.06	21.94
2002	307429.00	13686.02	314257.00	13990.00	32518.40	30.66	1396.56	571.59	9908.39	4060.00	571.59	22.48
2003	317374.00	14066.13	326733.00	14481.00	33153.03	31.59	1595.30	646.19	10756.15	4360.00	646.19	25.22
2004	346881.00	15316.86	357752.00	15797.00	35446.66	32.24	1992.07	797.98	12239.79	4900.00	797.98	28.33
2005	374042.00	16455.87	382902.00	16846.00	37622.41	31.76	2523.47	998.83	13332.72	5280.00	998.83	32.50
2006	386492.00	16934.32	395897.00	17346.00	38224.90	31.83	3414.06	1334.21	15033.70	5880.00	1334.21	38.69
2007	406940.00	17757.12	416850.00	18189.00	39531.77	32.52	4235.00	1632.73	16838.01	6490.00	1632.73	37.73
2008	415824.00	18080.88	425520.00	18503.00	39971.55	30.87	5623.22	2136.56	18543.23	7050.00	2136.56	30.85
2009	390788.00	16933.36	402958.00	17460.00	38018.10	31.08	4583.85	1714.36	18222.06	6820.00	1714.36	30.06
2010	444245.00	19197.31	457379.00	19765.00	42337.27	33.39	7189.48	2643.29	18830.83	6920.00	2643.29	33.19
2011	483957.00	20865.61	496583.00	21410.00	45191.61	32.62	10409.80	3757.56	22505.27	8120.00	3757.56	31.33
2012	495536.00	21295.06	510127.00	21922.00	45629.47	32.66	12292.77	4351.89	25907.97	9170.00	4351.89	30.77
2013	512957.00	21972.88	526477.00	22552.00	46772.77	33.72	12582.12	4366.08	30095.52	10440.00	4366.08	30.51
2014	535332.00	22873.53	549791.00	23492.00	48319.52	35.57	12226.51	4158.53	32212.67	10960.00	4158.53	31.50
2015	534474.00	22779.44	548253.00	23367.00	47729.42	36.29	11749.62	3918.58	33305.44	11110.00	3918.58	31.04
2016	543002.00	23090.75	556957.00	23684.00	48194.02	36.87	11186.73	3660.15	34050.99	11140.00	3660.15	33.88
2017	590780.00	25079.81	605477.00	25704.00	52041.93	36.83	11425.76	3669.42	34222.15	10990.00	3669.42	38.36
2018	608186.00	25792.45	521939.00	26376.00	53191.01	36.45	13066.75	4121.73	39615.51	12500.00	4121.73	38.72

Source: National accounts yearbook, 2018, Chinese statistical agency, ISSN-1011-2146 https://eng.stat.gov.tw/public/data/dgbas03/bs4/NiYBE/naye.pdf, https://data.worldbank.org/

The growth rate of the per capita GDP of Mongolia was more fluctuated than Taiwan. During the period of 1990 to 1992, Mongolia experienced decline of per capita GDP, but in Taiwan it increased. The constant growth is observed in Mongolian economy, since 1997, had due to the development of service sector (Figure 4).

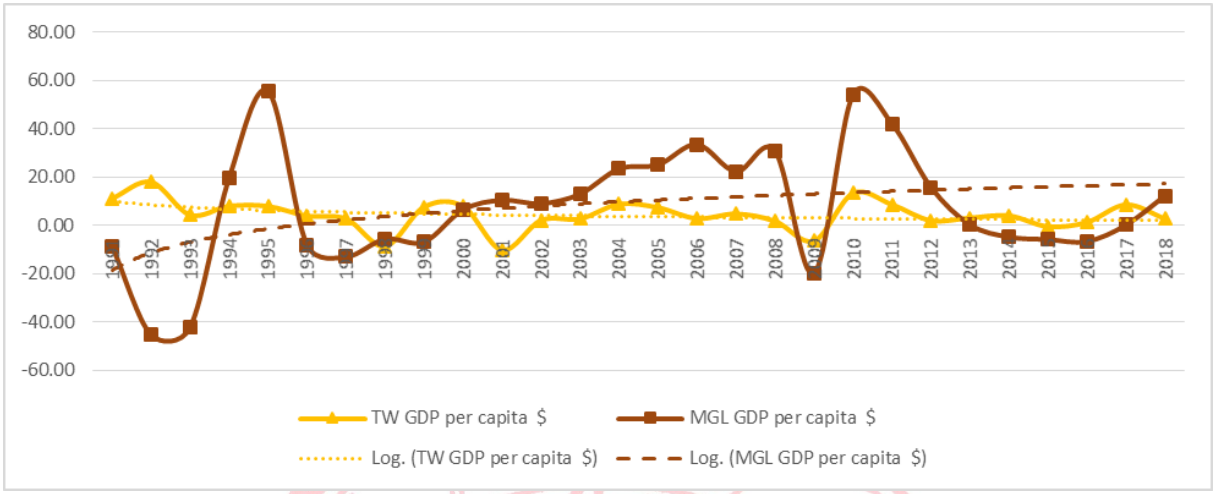


Figure 4. Growth rate of GDP per capita of Taiwan and Mongolia, 1990-2018

The industry share in the GDP of both countries have similar scenario, but labor productivity is distinguishing. From 2005 to 2007, Mongolian industry share in GDP was higher than that of Taiwan's, but until 2005, it was reverse situation. In one-third of the study time period, the labor productivity was declining in Mongolia, in the contrary Taiwan had steady increase (Figure 5).

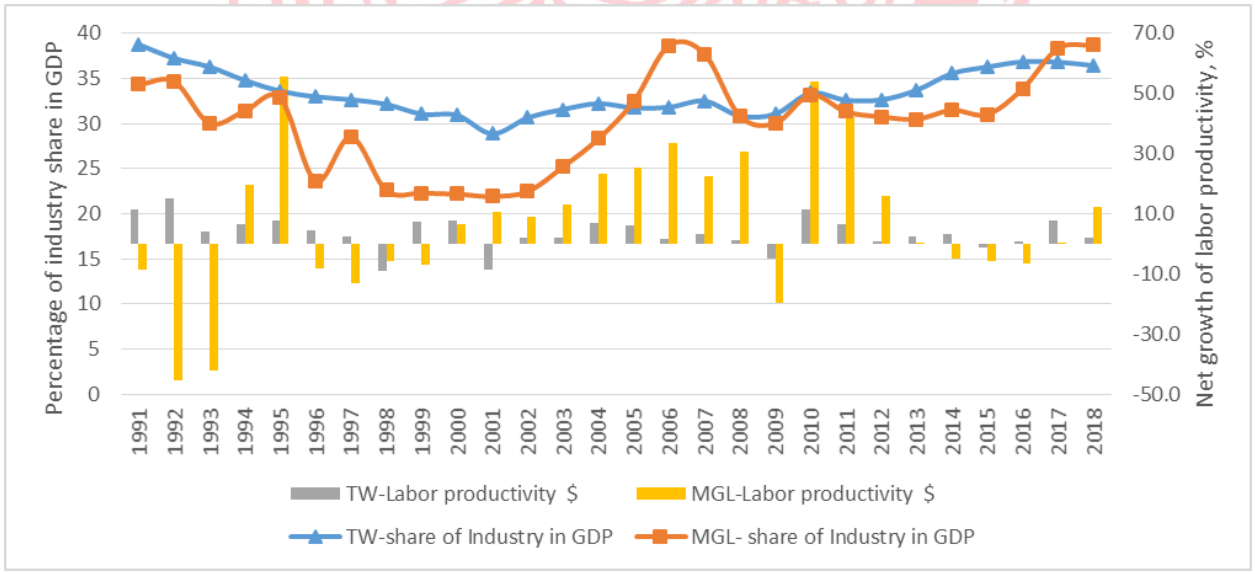


Figure 5. Labor productivity change and share of industry in GDP of Taiwan and Mongolia, 1990-2018

Sigma convergence analysis:

Figure 6 indicated the sigma convergence of per capita GNI and industry share of Taiwan and Mongolia during 1990-2018. The GNI per capita had divergence until 1993, and convergence since 2000. During 2009-2010 were a little divergence and convergence started again post 2010 (Figure 6).

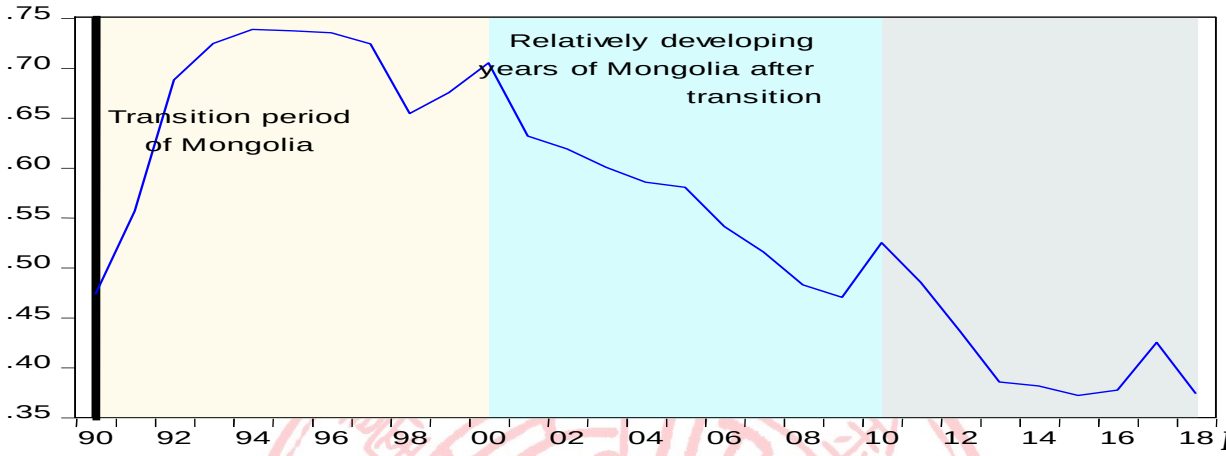


Figure 6. Sigma-convergence of per capita GNI per capita for Taiwan and Mongolia

Since 1990, in Mongolian was in transitioning period, continued until 1999. During 1990-1999, there were many unexpected happenings, such as unplanned privatization and unregulated transitions, and the closing of large state-owned enterprises.

Figure 7 illustrates sigma convergence process of industry production of both countries. An industry share in the GDP of Mongolia and Taiwan, has similar structure. During the period 1990-1993, when Mongolia went through its first transitional period and large factories were not yet to be shut down, divergence in industry production was observed. From 1993, large state-owned factories stopped operating and started to close. However, since 2000, the convergence of industry production was observed again, it may be related to Mongolian economic recovery due to rapid development of service sector (Figure 7).

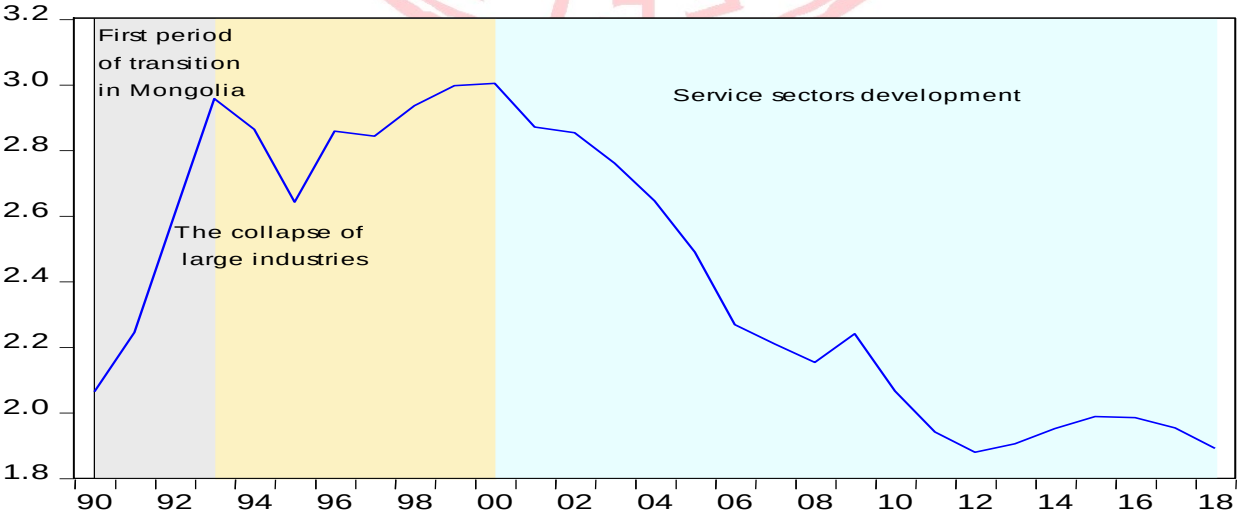


Figure 7. Sigma convergence of industrial production of Taiwan and Mongolia

Beta convergence analysis:

GNI per capita data of period 1990-2018 were analyzed, and the result of the analysis was no unconditional beta convergence. So, researcher assumed the need of calculating time impact on GNI per capita. After analyzing the sigma convergence result, there was little convergence process since 2000. Therefore, dummy variables were used for the time impact for Taiwan and Mongolian GNI per capita.

The result of the analysis indicated in 3 periods: 1991-2018, 1991-2000 and 2001-2018 (Table 6).

Table 6. Indicated periods of convergence analysis, Taiwan & Mongolia

Indicator		*Period*	*Constant α*	*Speed of convergence β*	*t -statistics*	R^2	*F- statistics*
GNI per capita		1991-2018	0.0235	0.00221	0.194	0.0007	0.0375
	with dummy variable for time	1991-2000	-0.217	0.02892	1.526	0.1024	1.9787
		2001-2018	0.3201	-0.02891	-2.2613	0.1024	1.9788
Industrial production		1991-2018	9.2429	0.7387	0.4581	0.0038	0.2099
	with dummy variable for time	1991-2000	-0.3411	0.0339	2.1892	0.2451	5.6282
		2001-2018	0.3744	-0.02795	-2.9719	0.2451	5.6282

Source: Authors calculation

Conclusion

The sigma convergence result urged the assumption about time impact for the industry production and national income. Therefore, we analyzed data for 3 periods. From the analysis concluded following:

- For the total of 29 years (1991-2018), there was no convergence in industry production and gross national income per capita in both countries. It explained by speed of convergence which is beta coefficient is positive and t- statistics is insignificant. It could be explained as the result of many unexpected happenings, such as unplanned privatization and unregulated transitions, and the closing of large state-owned enterprises etc.
- 1991-2000, GNI per capita indicator of Taiwan and Mongolia had no convergence. Result of tests indicated that, there is positive and significant t- statistics for beta coefficient (β=0.0339, t statistics 2.1892), which means, industry production of Taiwan and Mongolia had divergence. At that time, Taiwanese key economic and industrial indicators were relatively stable, while most of the privatized enterprises in Mongolia failed and the industrial sector collapsed.
- 2001-2018, in GNI per capita and industrial production indicators, observed convergence process. Here, beta coefficients are negative and significant (β_{GNI} =-0.02891, t- statistics -2.2613; β_{ind} =-0.02795, t- statistics -2.9719). This can be related to the recovery of Mongolian industrial sector since 2001 and the rapid economic growth of the country.

3.2.2 The opportunities and challenges of the industrial cooperation between Taiwan and Mongolia

Current situation of trade and economic cooperation between Taiwan and Mongolia

Taiwan and Mongolia's socio-economic relations had faced number of political obstacles.
In 2002, after the 91 years of Mongolia's declaration of independence, Taiwan finally recognized Mongolia as an independent country. In September 2002, as a representative office of R.O.C, the Taipei Trade and Economic Representative Office opened its doors for Mongolians in Ulaanbaatar. Its counterpart - Ulaanbaatar Trade and Economic Representative Office in Taiwan was established in Taipei, in December 2003. It was a new development stage of socio-economic relations between the two countries.

Since 2016, Taiwan renewed its economic development model, which seeks to boost growth by promoting innovation, increasing employment and ensuring equitable distribution of economic benefits. Under this model, Taiwan is striving to strengthen global and regional connections through initiatives such as "New Southbound Policy", aimed to diversify their international market by expanding links with ASEAN member states, as well as South Asia, Australia and New Zealand. Taiwan will continue monitoring the development of regional economic integration and seek all possible opportunities for participation [78].

The industrial sectors of both countries are structurally complementary. Mongolia is rich in natural resources. Industry sector of the country consists from mining (coal, copper, molybdenum, fluorspar, tin, tungsten, gold); construction and production of construction materials; oil processing; food and beverages sector; processing of animal-origin products, cashmere and other natural fiber manufacturing.

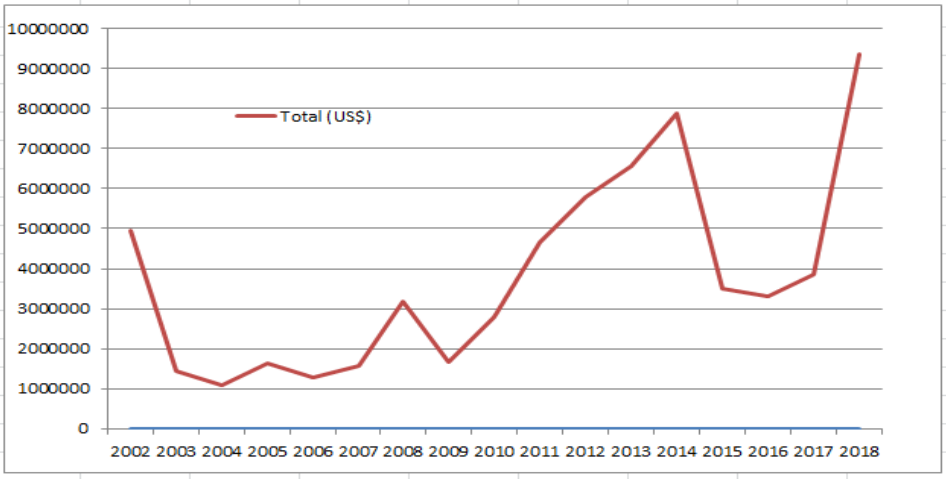
Taiwan has accumulated great experiences in creation of wealth from value-added raw materials, finished products, and sales in foreign markets. The country has strong advantages in development of high-technology and innovation. In the industry sector, production of electronics, machinery, and petrochemicals plays key role. There are real opportunities and resources for both Taiwanese and Mongolian companies to work together and enter the world market together.

Since 2002, the total amount of Taiwanese exports to Mongolia reached 64,513,679 USD. In 2018, it reached 9,344,503 USD, which is 2.5 times increase from 2017 [79] (Figure 8).

In 2018, Mongolian total exports to Taiwan reached 32,631,717 USD. Major export products include coal, copper concentrate, fluorspar, wool and leather. Mongolia's top three imports from Taiwan are electronics, hardware and pharmaceuticals, accounting for more than 80 percent of total imports. In 2017 and 2018, the total bilateral foreign trade turnover between Taiwan and Mongolia, exceeded 40 million USD [79]. However, it accounts for only 0.3% of Mongolia's total foreign trade turnover, is quite dissatisfactory [80, p.99].

台灣出口蒙古貿易統計 (2002-2018)

Year	Total (US$)
2002	4,954,656
2003	1,448,868
2004	1,092,695
2005	1,639,065
2006	1,285,085
2007	1,578,894
2008	3,186,533
2009	1,681,031
2010	2,783,132
2011	4,650,164
2012	5,773,907
2013	6,551,308
2014	7,867,039
2015	3,502,971
2016	3,320,083
2017	3,853,745
2018	9,344,503



Source: Information of Taipei Trade and Economic Representative Office in Ulaanbaatar, R.O.C
https://www.roc-taiwan.org/mn_en/post/3325.html

Figure 8. Taiwan's exports to Mongolia, 2002-2018

The Taiwanese government is providing a total of 30 mill. USD loans from Export-Import Bank of Taiwan to Mongolian businesses through 6 Mongolian commercial banks: Golomt Bank, Khan Bank, State Bank, Trade and Development Bank, Khas Bank, and the Development Bank of Mongolia, to intensify cooperation between Taiwan and Mongolia [11][81].

Mongolian businesses and companies can apply for this loan up to five years. Through this financing loan, aimed to help Mongolian businesses solve the problem of lacking funds to purchase high-quality equipment and spare parts made in Taiwan. Currently, this loan was allocated to more than 10 Mongolian companies and enterprises, and the borrowers are very satisfied with the loan services [79].

Some attractive advantages of Mongolia for Taiwanese partners:

Taiwan and Mongolia have a great potential to expand bilateral trade and economic relations and industrial collaboration. Mongolia has several advantages, could be attractive to foreign partners, who wishes economic cooperation with, including Taiwanese businesses. They are:

- Huge natural/ mineral resources, livestock raw materials and vast territory;
- Strategic geographical location-neighboring with two largest global economies and commodity markets;
- Young and well-educated population;
- Attractive environment for FDI and trade through an open economic policy;

[11] *http://www.roc-taiwan.org/mn_en/post/5492.html*

Huge natural resources, livestock raw materials and vast territory:

Mongolia is estimated to hold 1.3 trillion USD in mineral deposits, but only 25% of the country was geologically surveyed [82]. As mentioned before, the major exports include copper, gold, molybdenum, coal and fluorspar concentrates. China provides a ready market for Mongolia's mineral wealth.

Livestock total of 66 million 463.7 thousand head in 2018. Country is leading in camel wool production in the world, ranked at 1st, by total number of horse (3 million 939.8 thousand head) ranked at 6th, by horsemeat supply at number 6th; by total number of sheep (30 million 553.5 thousand head) is at 15th and by total number of goat (27 million 130.0 thousand head) is ranked at 9th in the world. Besides, Mongolia is leading the number of horse, sheep, goat per capita is 1st in the world. By number of camel (459.7 thousand head) and cow (4 million 380.7 thousand head) is within the top 10 in the world. Moreover, by export income of wool and cashmere is ranked in the first 10 in the world, and by consumption of mutton and chevron is 2nd place in the world [32, 83, 84]. There is considerable demand from Russia, China, Korea and Japan and other countries for these products.

Strategic geographical location-neighboring with two largest global economies and commodity markets:

Mongolia is landlocked between Russia and China. It is bordered by Russia on the north and China on the south. This unique geographical location provides good opportunity to supply any products produced in Mongolia to two huge markets of the world. China and Russia are main trade partners of the country and yet to be expanded. As of 2018, 65.8% of Mongolia's total foreign trade turnover is accounted by China, and 14.0% by Russia [32].

Young and well-educated population:

Young and well- educated population of Mongolia is considered to be a great asset as investors are facing considerable challenges. Mongolia offers excellent opportunities with its growing, young, and dynamic population is an indispensable contributor to a strong labor pool and a lucrative domestic market. Mongolia has a high literacy rate, consistently rated around 98.6 percent. Over 70% of total population of the country is under 40 and young people open to new ideas, products, services and innovation. Labor force in Mongolia is capable of quickly adapting to changes resulting from competitive economy to meet the increased demand for skilled workers. Education remains a priority for the Mongolian government, as shown in its below average education expenditure when compared to other Asian countries. Mongolia spends 4.2 percent of its GDP on education by 2018 [84].

Attractive environment for FDI and trade through an open economic policy:

Mongolia could provide promising future for Taiwanese or joint partnership with Mongolian businesses, as a gateway to nearby markets. There are several agreements on mutual protection

and promotion of investment and on avoidance of double taxation and economic partnership agreements and participation in programs for supporting export of less developing countries.
According to Mongolian legal regulations, foreign investors can set up 4 types of business entities [84]:

1. Limited Liability Company (LLC) which can have up to 50 shareholders, or only one owner;
2. Joint Stock Company (JSC) which must have MNT10 million of capital to list on the Mongolian Stock Exchange (MSE) and one third of the board as non-shareholders;
3. Representative and branch offices, which cannot conduct commercial activities;
4. Partnerships which, can conduct profit generating activities;

A company must be registered with the General Authority for State Registration (GASR). By setting up a foreign invested company, investor could get legal protection and can obtain a year-long multi-entry investor's visa to Mongolia. Investors can also enter the market by finding a local partner and granting them distributorship rights. It is also possible to do direct exports.

Since 1997, the country is a member of the WTO, Mongolian legislation recognizes the primacy of international treaties in cases of conflict with domestic legislation. In most cases, parties are free to select international arbitration as the method for dispute resolution when drafting contracts in Mongolia. If a claim or complaint is filed and then upheld against a foreign citizen for violation of rights, freedom or lawful interests they can be banned from exiting Mongolia.

The 'charter capital' is required a minimum of 100,000 USD per investor for a foreign business entity. This must be deposited to any Mongolian bank account, prior to registration, but can be withdrawn after registration. A business entity is regarded as 'foreign invested' if a foreign investor holds 25% or more shares. Projects that meet certain requirements may qualify for favorable tax treatment for periods up to 27 years [84].

According to Mongolian investment and tax regulations, there are some investment opportunities with tax credits and exemptions [85]:

- According to Corporate Income Tax, income generated from production and planting of the following products only shall be subject to 50% tax credit: grain, potato, vegetable, milk, fruits and berries, soiling crop[12];
- According to amendments in Corporate Income Tax, affected on February 2017, taxpayer operating in the following sectors with annual taxable income not more than 1.5 billion MNT, only the income from activities of the following areas of operation will enjoy 90% of tax discount[12]:
  - Crop and livestock production, related support activities;
  - Food production;
  - Textile and clothing industry;
  - Manufacturing of construction materials.

[12] */http://www.legalinfo.mn/additional/details/3016?lawid=33*

- According to Investment Law, imported machineries and technical equipment may be exempted from customs duty, VAT rate may be zero rated during the construction works in following cases [85][12]:
  - building construction materials, oil and agricultural processing and export product plants;
  - building plants to use nano, bio and innovative technologies;
  - building power plants and railway;
- Government Decree No. 191 of 2014, exempted manufacturing equipment and spare parts intended for small and medium industrial purposes from customs duties and value added tax. This list includes milk production factory, fruit processing factory, beverage factory, meat factory, sausage factory, vegetable canning factory, poultry farming and bee breeding, bread and bakery factory and other 30 types of industrial equipment [NDA]. List of SME production equipment and spare parts from Customs and VAT exemption is in the appendix of the decree[13].

In addition, latest trade facilitation agreements signed and particular programs that Mongolia is participating has created favorable conditions for entities engaging in agriculture and industry sectors to freely export their products on a global market [84]. These include:

- Since 2005, Mongolia is included in Generalized System of Preferences (GSP+) by European Union (EU). The program aimed to support developing countries that export to EU markets. The program eases import tariffs for products when entering EU markets and it includes total of 7200 types of goods and products for tariff concession. For Mongolia, GSP + regulation highly benefits semi-processed cashmere and cashmere products. For instance, while normal tariff in EU for knit textile and garment accessories is 12%, and 6.5% for processed horse and cattle leather, these products will be exported without tariffs by accessing the system. In addition, live animals, meat, meat products, dairy products, vegetables, and fruits are exempted from tariffs [14] [84, 86].
- Mongolia and Japan have signed an Economic Partnership Agreement (EPA) in force from 2015, which enabled a certain number of goods from Mongolia to be exported to Japan with zero tax conditions. According to the terms of agreement, live animal, livestock, meat, dairy products, egg, pure honey, grains, vegetable and other 9300 types of goods and products will be exported from Mongolia to Japan under discounted tariffs. For instance, for key products to increase access to the Japanese market such as processed meat products and dairy products, about 10 percent and 25-40 percent of taxes are subject to direct elimination of quantitative restrictions respectively, and 3-12 percent taxes from vegetables will be lowered and nullified [84, 85][15].

[13] *http://www.legalinfo.mn/annex/?lawid=10455*

[14] *http://www.mongolchamber.mn/documents/EU_2006_2008_order.pdf*

[15] *http://www.mongolchamber.mn/chamber/index.php/2015-06-18-10-47-55#*

In Mongolia, import duty is payable at the rates from 0% to 25% on the customs value of imported goods. Most goods are subject to 5%. Normally customs value is calculated on the Cost, Insurance and Freight (CIF) value [87]. The documents required for customs clearance are the contract, which includes product description, purchase frequency, length of the trade and Incoterms conditions, receipts, invoice, packing list, insurance documents, certificate of origin, other relevant documents such as related country's inspection authority certificate required for food products.

Regarding standards and technical regulations in Mongolia, the Mongolian Agency for Standardization and Metrology (MASM) has responsibility for standards. Labelling of goods in English or Russian is acceptable. But, for medicine, there must be included instructions in Mongolian.

Mongolia has joined the World Intellectual Property Organization (WIPO) and signed and ratified most treaties and conventions. The Intellectual Property Office of Mongolia, Mongolian Customs Authority and the National Police have an obligation to protect intellectual property rights.

Government of Mongolia highlights following top priorities of industry development, including heavy industry (coal and coke chemical production, copper smelting, steel and oil production), light industry (production of cashmere, wool, leather and hide, and wood products), bio preparations and food production, cement and construction material production, information technology manufacturing and SMEs on the rise and trend is likely to continue with the rapidly rising GDP. Given the rising demand and better investment climate, there is high potential for industrial base to grow.

Industry cooperation opportunities for Taiwanese businesses with Mongolian partners:

Industry cooperation opportunities for Taiwanese businesses could be defined by five following challenging directions:

1. Investment in mining, mineral processing and manufacturing;
2. Export production machinery, equipment and technology to Mongolian industry and SMEs;
3. Import raw materials and industrial products from Mongolia;
4. Provide engineering consultancy services for Mongolian industry or manufacturers, SMEs on S&T, innovation development;
5. Establish a joint venture company, better if export-oriented, to produce final products using Mongolian resources;

1. Investment in mining, mineral processing, heavy industry and manufacturing:

Mongolia is rich in mineral recourses. Mining still is leading sector of Mongolian industry and plays significant role in economic development. The recent action program by the Government of Mongolia aimed to create a favorable investment and legal environment to attract foreign investment in geology and mining; endorsed mutually beneficial joint projects and programs; purposed to support the construction of copper concentrate smelter and refinery, create

conditions to construct a metallurgical complex, to render policy of supporting the setup of a coal washing, a coal deep processing plant, a coal gas extracting plant, a plant for liquefied fuels and lubricants, and developing a metal component and assembly factory; to ensure sustainable development of the sector and enhancing the competitiveness of the country on the international minerals market.

Energy sector also has remarkable potential of regional electricity exports, especially in renewable energy, which is estimated to have electricity output of 15,000 terawatt-hours per year from the country's solar and wind resources alone[16]. The Government planned to develop renewable energy production and to implement projects aimed at saving electricity, increasing efficiency, reducing electricity loss and introducing new and innovative technologies [88]. According to custom law regulations, R&D and production equipment for renewable energy and parts thereof have exemptions from import duties and taxes [87].

Taiwanese businesses could participate in big projects, regarding mineral processing and renewable energy production, based on their knowledge, experiences and advanced technology in field of heavy industry.

2. Export production machinery, equipment to Mongolian industry and SMEs:

According to the National Statistics Office (NSO), 77 percent of enterprises registered in the business registration are SMEs, 72 percent of the total workforce work in this sector, and SMEs account for 17.8 percent of GDP and 2.3 percent of exports. And this fact makes the sector profoundly important in the economic development of Mongolia. Therefore, it is necessary to introduce modern high-performance technical equipment to SMEs and increase the quantity and quality of products. The Government of Mongolia has taken a number of measures to develop SMEs. These include the establishment and operation of the SME Support Fund, the Loan Guarantee Fund, and the implementation of measures to exempt SME-friendly equipment from import duties. "The Law on exemption from customs duty for equipment and spare parts for small and medium enterprises imported for the purpose of supporting small and medium enterprises, increasing jobs, import-substitution, and production of export-oriented products" was approved on February 9, 2017 and was valid until December 31, 2018 [83, 87]. Currently, gas fuel, its containers, equipment, special use machines, machinery and appliances or accessories; special purpose machinery, appliances, machinery, fittings, raw materials, chemicals, explosives and parts thereof imported by contractors and subcontractors for the duration of the prospecting activities and the first five years of mining of crude oil and operations related to non-traditional crude oil; special purpose devices, equipment or vehicle for use by people with disabilities are being exempted from Customs duties [87].

Taiwanese manufacturers may use the opportunities noted above and export a variety of machinery and equipment of production purposes to Mongolia.

3. Import raw materials and industrial products from Mongolia:

Mongolia is producing quite amount of precious natural fibers, such as high-quality and ethical cashmere, yak hair, sheep's wool, camel and horse hair, as well free-ranged red meat and animal skin. There is great potential for export because of the country image is ecologically-clean and

[16] *https://www.irena.org/publications/2016/Mar/Renewables-Readiness-Assessment-Mongolia*

natural. In Mongolia, annually 10 million hides and skins, 9500 tons of cashmere, 1400 tons of camel wool, 260 tons of yak wool, and 33600 tons of sheep wool, on an average [83].

Taiwanese businesses could import these raw materials or high-quality end products, as well invest or setup export-oriented factories for processing cashmere, wool, and leather. In addition, there are also opportunities to do business in the food production sector, which is based on meat, milk and crops.

4. **Provide engineering consultancy services for Mongolian industry or manufacturers, SMEs on S&T, innovation development:**

As a country of rapid S&T and innovation development, for Taiwan sharing its rich experience of R&D, research and engineering consultancy services with Mongolian manufacturers, researchers and innovators, is a feasible opportunity. Research institutes and universities played a key role in Taiwan's industrial development, particularly the Industrial Technology Research Institute (ITRI) and all kind of professional associations [89]. There is a great opportunity for Taiwanese businesses, researchers and engineers in the field of technology transferring, establishment and operation of industrial technology research and testing institutes, technology transfer center, forming University-Industry collaboration, and a creation of Start-Up businesses, building entrepreneurship and innovation ecosystem, and collaborate with Mongolian counterparts.

5. **Establish a joint venture company, better if export-oriented, to produce final products using Mongolian resources:**

Advantageous opportunities are waiting for Taiwanese businesses to enter the world market on favorable conditions, proposed by the Mongolian government and other countries and international organizations, if establish processing factories, partnered with Mongolian counterparts.

As mentioned earlier, the Government of Mongolia to foreign investors provides a variety of other tax and non-tax benefits. The Investment Law provides an option for entities to enter into an Investment Agreement with the Government of Mongolia, if the investment value exceeds 500 billion MNT. Advantages offered by the Investment Agreement are longer stabilization period than the timeframes set in the Investment Law, possibility of the legal protection stipulated in the Investment Law, as well as tax stabilization terms and other financial incentives and benefits. The tax benefits may include exemption from taxes, preferential tax treatments, accelerated depreciation and amortization that is deductible from taxable income, carrying forward of losses, and deduction of employee training expenses from taxable income. The ton-tax benefits may include longer land lease rights (up to 60 years, plus one-time extension of up to 40 years), residential permits for international investors and their families, expedited registration process if the investment involves a free economic zone or industrial complex, and financial guarantees for investment projects involving innovative technology. In addition, equipment imported for construction purposes may be exempted from custom duties and value added taxes [84, 90].

CONCLUSION

1. Industrial policy has again become a major issue in all countries, which is defined as … "is any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity towards sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention—that is, in the market equilibrium" (Warwick 2013, UNIDO, 2018). The global financial crisis led to a reassessment of the role of the state "vis-à-vis"[17] the private sector in promoting growth and development. However, the role of industrial policy has long been the subject of extensive debates.

2. Industrial policy plays a vital role in social-economic development of a country, which could be explained by a sound industrial policy that promotes enhancement of industry development of not only the industrial sector, but also economy of a country. Also, a successful implementation of the industrial policy encourages economic growth and helps creating jobs, reducing unemployment and poverty. The industrial development level is a main result of implementation of industrial policy leads to social-economic prosperity of a nation.

3. Industrial policy is usually seen as separate from broader macroeconomic policies, such as tightening credit and taxing capital gains. Many types of industrial policies contain common elements with other types of intervention practices of a government, such as trade policy, small and medium enterprise development support policy, S&T and innovation policy, environmental sustainability policy, investment policy and others. Industrial policy could be classified by its orientations and implementation strategies: import-substitution, export-orientation, innovation-driven, demand-driven and traditional strategy, "catch-up" strategy, comparative-advantage-defying (CAD) strategy, and comparative-advantage-following (CAF) strategy etc.

4. For last 60 years, Taiwan has succeeded in transforming itself from an agricultural society into an industrialized society, had shown "economic miracle", through the combined effects of industrial policy, collaboration between industry and universities, continued promotion of innovative new business models, and the tireless efforts of both the public and private sectors. Today, Taiwan is one of the advanced economies and developed countries. The national economy of the country is the 7th largest in Asia, 34th largest in the world. It ranked as 15th in the world by the Global Competitiveness Index (GCI) and as 24th in nominal GDP of investment and foreign trade.

5. Industrial policy of Taiwan is based on new technologies and innovation and supports society's long-term targets. During the period of implementation of Taiwan's industrial policy, various strategies were effectively used, government interventions and regulations regarding country's socio-economic conditions and development challenges. The case of Taiwan's industrial policy implementation demonstrates political stability, adequate

[17] Note: "vis-à-vis"- face-to-face, opposite

government intervention, fruitful partnership with business and effective private sector involvement, research –based concept and actions. It was encouraged by key role of industrial policy research institutions and resultative implementation of projects, based on sound and accurate feasibility studies, instead of just political consideration. Therefore, Taiwan's industrial policy and its implementations are widely recognized as successful.

6. In terms of industrial development, the declaration of national independence in 1911 became starting point of development of modern industry for Mongolia. At that time, the national economy of the country was dominated by nomadic pastoralism. Industry was limited by few small coal mines, logging farms, publishing houses, power plants, and brick factories. The Government of Bogd Khanate Mongolia had taken several important economic reforms regarding to strengthen the economy and raise the national treasury by upgrading financial and tax system, improving usage of natural resources. But, due to the unstable socio-political situation in the country, weak economic base, and lack of national treasury, the policy of economic and industrial development of Mongolia, just came independent, was not implemented effectively.

7. In 1921, following the victory of the People's Revolution, Mongolia began to pursue the path of socialism. Since then, certain policies and activities to develop the country's economy and lay the foundation for a modern industrial sector began to be implemented intensively. "The Basic Economic Policy", adopted by the government in 1922, set goals for the country's industrialization, primarily in mining, quarrying, and the processing of animal-sourced raw materials. The opening of the Industrial Complex in Ulaanbaatar in 1932 laid a solid foundation for the emergence and development of a modern industrial sector. During this period, a large number of factories and enterprises were established, and completely new industries (light and food industry, construction, energy, mining, etc.) emerged. By 1989, industry was a key sector of the Mongolian economy, accounting for almost 50 percent of GDP.

8. After the 1990s, with transition to market economy Mongolia experienced a radical change in its socio-economic development. This involved the rapid opening-up of the economy to foreign trade and the privatization of most of the big industrial enterprises. It was demanded to establish a new socio-economic system, to develop policies and activities, and to lay legal basis for the market relations. Even though, Mongolia is one of the richest countries in natural resources, faces critical policy challenges. Resent industrial development policy of Mongolia focuses on development of Heavy and Light industry, and SMEs, establishment of Industrial parks, Free economic zones, Export promotion and Import substitution. There are three broad options for the government intervention Development of the mineral sector; Modernization of traditional activities; development of new activities.

9. Nowadays, Mongolia is one of the lower-middle-income economies. The country ranked as 129th in nominal GDP, as 116th by GDP per capita, and as 100th by the Global Competitiveness Index (GCI) in the world. The Industry sector contributes 40% of GDP, employs 270.6 thousand people, which is 23% of total workforce. To look at the industrial

sector composition, as a matter of 2018, the share of value added mining and quarrying - 67.6%, the manufacturing sector - 26.4%, electric and thermal energy - 4.8%, and water supply, waste water treatment, waste management - 1.2 %. Industry sector of the country consists of mining; construction and production of construction materials; oil; food and beverages; processing and producing products with natural fiber, fur and animal skin.

10. Mongolia is rich in natural resources, but for value added activities, level and capability of technological basis of the industry is still weak. For the past decades, Mongolian government has taken several steps to mitigate this issue. But, Governments' efforts focused on industrial policy reforms, it is yet to show satisfactory results. In contrast, Taiwan has been implementing several staged industrial policies, based on new technologies and innovation and supports society's long-term targets. During implementation of Taiwan's industrial policy, various strategies were effectively used, government interventions and regulations regarding country's socio- economic conditions and development challenges. Taiwan's industrial policy and its implementations are widely recognized as successful and valuable case for other countries, specially, developing ones. In the perspective of Industrial and economic development, both countries could combine their resources and competitive advantages to enhance trade, economic and industrial cooperation.

11. In this research, with the aim of better investigation of development opportunities of industrial cooperation between Taiwan and Mongolia, conducted industry convergence analysis, using two most common and well-known convergence concepts, sigma-convergence and beta-convergence. To explore the convergence dynamics of industries of both countries, used dataset of 29 years (1990-2018) period. The empirical results of industry convergence analysis indicated no convergence in industry production and gross national income per capita in both countries, for the whole chosen period (1991-2018). In 1991-2000, industry production of Taiwan and Mongolia had divergence, but in period of 2001-2018, convergence tendency in GNI per capita and industrial production indicators, was observed. These results could be explained with following facts. 1) In between 1991 and 2000, Taiwan's key economic and industrial indicators were relatively stable, while most of Mongolia's privatized enterprises failed and the industry as a whole collapsed. 2) However, since 2001, Mongolian industrial recovered and showed rapid economic growth.

12. In the historical perspective, Taiwanese and Mongolian socio-economic relationship had faced number of political obstacles. Since 2002, after official recognition of Mongolian independency by Taiwan, the bilateral relation has entered into new stage of development. For instance, in 2018 amount of Taiwanese export to Mongolia, was doubled that of 2002. By 2018, the total bilateral foreign trade turnover exceeded 40 million USD. However, it accounts for only 0.3% of Mongolia's total foreign trade turnover, is quite dissatisfactory. The both countries have complementary advantages and disadvantages, if successfully synergized, could bring economic prosperity and development. Therefore, taking advantage of Mongolian rich natural resources and Taiwanese advanced industry, there is a promising possibility to broaden trade, economic and industrial cooperation.

13. The governments of Taiwan and Mongolia are making significant efforts to intensify trade and economic cooperation between the two countries. Taiwan has taken a number of measures to promote business cooperation between the two countries. For example, The Taiwanese government has provided a total of 30 mill. USD loan for Mongolian businesses, from Export-Import Bank of Taiwan through six Mongolian commercial banks. Also, eagerly encouraging entrepreneurs and businesses from both countries to participate in international trade fairs, taking place in both countries, as well as organizing joint exhibitions. Mongolia, on the other hand, is creating favorable conditions for foreign investors by providing tariff and non-tariff concessions through investment, tax and customs policies, including the EU's "GSP + (Generalized System of Preferences) program" (exempting customs duty for 7.200 types of products to EU), "EPA (Economic Partnership Agreement) between Japan and Mongolia", which allows 9300 types of goods to be exported to Japan under discounted tariffs.

14. On the contrary, Mongolian government's prioritized industries, such as coal and coke chemical production, copper smelting, steel and oil production, cement and construction material production, cashmere, wool, leather and hide, wood product manufacturing, food production, ICT, provide significant opportunities for foreign investors and businesses. Furthermore, for priming suitable environment of the foreign investment, the Government of Mongolia offers tax and non-tax benefits, under the Investment Law. The offered tax benefits are exemption from taxes, preferential tax treatments, accelerated depreciation and amortization that is deductible from taxable income, carrying forward of losses, and deduction of employee training expenses from taxable income. And, the ton-tax benefits are extended land lease rights, visa permits for international investors and their families, expedited registration process if the investment involves a free economic zone or industrial complex, and financial guarantees for investment projects involving innovative technology. In addition, equipment imported for construction purposes may be exempted from custom duties and value added taxes.

15. Finally, Industry cooperation opportunities for Taiwanese businesses could be defined by 5 following challenging directions: 1) Investment in mining, mineral processing and manufacturing; 2) Export production machinery, equipment and technologies to Mongolian industry and SMEs; 3) Import raw materials and industrial products from Mongolia; 4) Provide engineering consultancy services for Mongolian industry or manufacturers, SMEs on S&T, innovation development; 5) Establish a joint venture company, better if export-oriented, to produce final products using Mongolian resources.

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Annex 1.

Results of Comparative study of Main works on Convergence analysis (Literature review)

№	Author and year	Objects of analysis and time period	Used measures and indexes	Main findings	Ref.
1.	Baumol W. J. (1986)	Maddison's dataset, data of 110 years period: 1870-1979	Productivity (GDP per work-hour), Exports	Checked the existence of convergence; Results showed little convergence among the groups: an average annual growth rate in per capita real GDP of 3.1 % for industrialized countries, 3.6% for centrally planned economies, 3.0% for middle-income market economies, and only 1.5% for the low- income group, with a world average growth rate of 2.7%;	[44]
2.	Dowrick S., Nguyen D.T. (1989)	24 OECD member countries, data of 35 years period: 1950-1985	Total factor productivity (TFP), Labor productivity (per capita income)	Analyzed the existence of convergence; Results showed that, in the postwar period, OECD member countries have been converged significantly by level of Labor productivity and TFP, within the OECD group there had been systematic TFP catching-up;	[46]
3.	Barro R. J., Sala-i-Martin X. (1990)	48 economies-US states, data of 188 years period: 1840 - 1988	Real per capita GDP of the State, Personal income per capita, Nominal gross state product (GSP) per capita, Sectoral composition of income, Sectoral productivity	Tested the existence of β-convergence; Results showed that, for the U.S. states the tendency for economies that were further below the steady-state position to grow faster over various periods,1840-1988; poor states tended to grow faster than rich states (even if do not hold constant any variables other than initial per capita income or product); Concluded in the open-economy versions of the neoclassical growth model it is possible to find convergence effects associated with technological diffusion even if the returns to capital are constant (a=1);	[47]
4.	Quah D. (1990)	Convergence hypothesis, Francis Gahon's classical fallacy, works for 1986-1990 (5 years)	Productivity (per capita income), measures of average education, health, openness of the economy	Developed an analogy between those regressions and Galton's classical fallacy of regression towards the mean and showed using the same reasoning that reveals Galton's error—that a negative cross-section regression coefficient on initial levels was perfectly consistent with absence of convergence in the sense of (d)-"poorer countries eventually catching up with richer countries"; Results showed that cross-section regressions of growth rates on initial levels shed no light on the validity of the convergence hypothesis in the sense of case (d);	[48]
5.	Barro R. J. (1991)	98 countries, data of 25 years period: 1960-1985	Real per capita GDP, Human capital (1960 school-enrollment rates), Fertility rates, Physical investment to GDP, Share of Government consumption in GDP, Public investment, Political stability, Market condition	Analysis showed that, for 98 countries in the period 1960-1985, the growth rate of real per capita GDP was positively related to initial human capital (proxied by 1960 school-enrollment rates) and negatively related to the initial (1960) level of real per capita GDP; Countries with higher human capital also had lower fertility rates and higher ratios of physical investment to GDP; Growth was inversely related to the share of government consumption in GDP, but insignificantly related to the share of public investment; Growth rates were positively related to measures of political stability and inversely related to a proxy for market distortions;	[49]
6.	Barro R. J., and Sala-i-Martin X.,	Endogenous growth model; Model with convergence	GDP per capita/ Output per capita; Labor productivity/ Output for effective worker;	Discussed how countries to be technological leaders and poorly defined intellectual property rights imply that leaders have insufficient to invent and followers have excessive incentive to copy; Considered government policy, as a reflection of infrastructure	[52]

	(1995)	implication of the neoclassical model, works for 1928-1995 (52 years)		services, tax rates, degree of maintenance of property rights, rule of law and the effect of these policies on outcomes are analogous to those from pure differences in levels of technology, and trade is assumed to be balanced between 2 countries; domestic output equals to total domestic expenditures, which are for consumption, production of intermediates and R&D;	
7.	Fukuda Sh., Toya H. (1995)	East Asian countries (NIEs), ASEAN countries, Japan, data of 6 years period: 1986-1991	GDP, GDP per capita, Export-GDP ratios, Human capital	Investigated a tendency to convergence in East Asian countries (i.e., the Asian newly industrialized economies [NIEs], the ASEAN countries, and Japan); Presented the cross-country evidence that per capita growth rates in East Asian countries have little correlation with the starting level of per capita product; Showed given the export-GDP ratios, subsequent growth rates in East Asian countries are negatively related to the initial level of per capita GDP;	[53]
8.	Sala-i-Martin X. (1996).	110 countries- of OECD, US states, Prefectures of Japan, Regions within several European countries, data of 40 years period: 1950-1990	GDP, real GDP per capita, Income per capita (personal income) of states, prefectures and regions	Discussed the classical approach to convergence analysis, the concepts of σ-convergence, absolute β-convergence and conditional β--convergence, which were are applied to a variety of data sets that include a large cross-section of 110 countries, the sub-sample of OECD countries, the states within the United States, the prefectures of Japan, and regions within several European countries. Except for the large cross-section of countries, all data sets displayed strong evidence of σ -convergence and absolute β-convergence. The cross-section of countries exhibited σ-divergence and conditional β-convergence. The speed of conditional convergence was very similar across data sets, was close to 2 % per year.	[55]
9.	Quah D. (1996)	77 regions within several European countries, data of 8 years period: 1982-1989	Income per capita of regions	Methodologically, provided an empirical framework to study the predictions of models such as in Krugman and Venables (1995). The empirical results highlighted the importance of spatial and national spillovers in understanding regional income distribution dynamics and demonstrated strong evidence against strawman hypothesis.	[54]
10.	Lim L. K. McAleer, M. (2000)	5 founding ASEAN countries (ASEAN-5) and USA, data of 28 years period: 1965-1992	GDP, real GDP per capita, initial GDP per capita (1965)	Used different tests of convergence and catching up, focused on the growth performance of the ASEAN-5 economies; Tests for convergence did not support income convergence between pairs of ASEAN-5 countries and despite evidence of limited convergence between Singapore and the ASEAN-3 countries, no evidence of technological catching up by ASEAN-5 to the technology leader, apart from Singapore, with further support regarding limited convergence with the USA;	[58]
11.	Kim J. U (2001)	17 Asian countries, Newly Industrialized Economies (NIEs), data of 32 years period: 1960-1992	Panel data- GDP per capita and Average Growth Rate;	Tested the 0-hypothesis of endogenous growth theories; Used the modified test procedure with heterogeneous intercepts allowing different growth rates across economies; Results showed strong evidence that the per capita incomes of 17 Asian countries and NIEs converge around a cross-country group mea, however, growth rates did not parallel balanced growth paths that appear to be absolute. These results supported the conditional convergence of the exogenous growth model against the endogenous growth model; Concluded the empirical study for growth theory might be subject to great variation	[59]

				depending on different sample countries and sample periods;	
12.	Joian A. (2002)	8 East Asian countries and USA, UK, Germany, data of 25 years period: 1966-1990	GDP, GDP per capita, TFP, Productivity: GDP/ Population GDP/Effec. worker GDP/Effec. capital, Panel data;	Carried out empirical analysis, corresponding to theoretical analysis; Comparison of East Asia with some advanced economies in the world, with the aim to show-the economy of region can converge to the advanced economy or if it converge how long time this economy need to catch-up others' level; Conducted same analysis within the region; Analysis showed both theoretical and empirical analysis ruled out absolute β convergence among East Asian countries; "Asian tigers" countries, as star-performance in the region, converge rapidly both among themselves and with some the most advanced economies in the world;	[60]
13.	Arrighi G., Silver B. J., Brewer B. D. (2003)	First World, Third World, data of 40 years period: 1960-1999	GDP, GNP, Gross National Product per capita, % of GDP in Manufacturing,	Demonstrated empirically widespread convergence in the degree of industrialization between former First and Third World countries since 1960 had not been associated with convergence in the levels of income enjoyed on average by the residents of these 2 groups of countries. Findings contradicted the widely made claim that the significance of the North-South divide was diminishing; Offered an explanation for the persistence of the North-South income divide, despite rapid Third World industrialization and despite dramatic changes in the world political-ideological context for development; Concluded by pointing to several contemporary processes that may destabilize not only the "globalization project," but also the global hierarchy of wealth that has characterized historical capitalism;	[61]
14.	Nair M., Kuppusamy M. (2004)	14 sample countries, data of 9 years period: 1995-2003	ICT infrastructure, human capital, innovation and productivity	Examined the trends pertaining to the above-mentioned indicators for selected developed and developing countries. Results from the empirical analysis showed countries that have invested heavily into ICT infrastructure, human capital and innovation tend to have higher productivity levels and the gap between the developed and developing countries have increased over the seven years from 1995 to 2001;	[62]
15.	Barrios, E. B. (2007)	Agriculture sector of 27 Asian countries, data of 11 years period: 1995-2005	GDP from Agriculture	Demonstrated significant evidence of conditional convergence ($p<0.047$) in agricultural growth among some Asian countries; The level of public expenditure on agricultural services among Asian countries may not be large enough to influence convergence of agricultural growth; The role of international trade in economic convergence and regional integration cannot be ignored. The importance of spatial distance is also associated with country-specific random effects. The implication is that to effectively achieve the goals of regional integration, careful matching among countries engaged in bilateral or multilateral agreements should be done to facilitate convergence in agricultural growth;	[63]
16.	Mathur, S. K. (2007)	8 East Asian, 5 South Asian, Common wealth of Independent States (15) and 16 European Union countries (UK	GDP per capita, Domestic savings rate, Population growth, Trade openness, Industry value added and Human capital (proxied by life expectancy)	Tested conditional convergence across regions and countries and examined the effects of domestic savings rate, population growth, trade openness, industry value added and human capital (proxied by life expectancy) on GDP per capita growth across regions; Results showed that absolute convergence hypothesis tends to hold for the EU region (all industrialized countries) and for the countries in the EU and East Asian regions together only. The EU countries including UK seem to have same steady state level of incomes	[64]

		not part of EU but included), data of 40 years period: 1961- 2001		implying that convergence hypothesis holds. For the industrialized countries of the EU, the assumption that their economies have similar technology levels, investment rates and population growth may not be a bad one. The neoclassical model then would predict convergence, the same as the results we get for absolute convergence above.	
17.	Apergis N., Christou Ch., Miller S. (2012)	42 countries, data of 29 years period: 1980-2008;	Industry stock price data;	Explored the convergence dynamics of international equity markets using the panel convergence methodology developed by Phillips and Sul (2007) and considered both country and industry effects; Empirical results suggested that the equity markets of 33 of the 42 counties in sample do form a unified convergence club and showed more numerous stock-price convergence clubs in certain industries, country factors played a more important role in explaining the actual convergence in real stock prices than industry factors; The volatility of stock prices exhibited much more evidence of convergence than stock prices.	[65]
18.	Tadashi Ito (2010)	Mexico, USA, 18 manufacturing industries, data of 15 years period: 1986-2000	Total factor productivity (TFP) panel data	Revisited how NAFTA contributed to the productivity convergence between Mexico and the USA; Paper provided some counter-evidence to the previous literature's findings of technology convergence toward a smaller gap level and NAFTA's positive effect on it and applied a difference-in-difference approach and finds no evidence of sizeable effects of NAFTA; Main result suggested an increasing TFP gap level, while some robustness checks, although not documenting increasing gaps, weaken the claim of the previous literature.	[66]
19.	Andreano S., Laureti L., Postiglione P. (2013)	26 countries (MENA-Middle East and North Africa), data of 57 years period: 1950-2007	GDP, GDP per capita in PPP, Openness (export+import/ GDP), export price index/import price index, Value added of agriculture & mining sector on Total VA, Inflation rate, Fertility rate, Migration rate, Number of patent application, Public expenditure/ GDP, Investment/ GDP	Evaluated the economic growth of the MENA countries, using a conditional β-convergence approach and a set of state, environmental, and economic covariates as conditioning variables of the model; The empirical analysis of the natural logarithm of per-capita GDPs for 26 MENA countries over the last 60 years strongly confirmed the hypothesis of conditional convergence; Results showed the degree of international openness and the government intervention and expenditure are important economic control variables; Concluded that the improvement of governance factors, such as actions to reduce corruption, the greater reliability and efficiency of government, political stability and violence reduction, play a role in stimulating the long-run behavior and moving up the development path of the steady-state and technological development and human capital are both highly relevant for the growth;	[68]
20.	Corazziari I., Gabrielli G., Paterno A., Salvini S. (2014),	105 countries with a population of at least 1 mln in 2010, defined by UN "less" or "least" developed, 1995, 2000, 2005, 2010, comparison of	Demographic parameters-(mortality and fertility); Socio-economic characteristics (living condition, socio sanitary situation),	Analyzed the trends of specific demographic parameters regarding mortality and fertility, jointly with some socio-economic characteristics (living condition, socio sanitary situation); Assessed convergence patterns in demographic behaviors prevail or marked differences persist; Results showed the mortality seems to confirm that a large part of developing countries are converging on a uniform model of health and mortality, leaving backward in particular the countries characterized by high values of HIV-AIDS prevalence and – consequently – high mortality, almost all of these countries are localized	[69]

		4 periods		in Sub-Saharan Africa; Countries converged to different models characterized to the belonging to specific territorial contexts;	
21.	Yilanci V., Saridoğan E., Artar O. (2014)	18 East Asian and Pacific countries, data of 50 years period: 1960-2010	Real GDP per worker	Conducted analysis of stochastic convergence dynamics for selected East Asian and Pacific countries over the period 1960–2010, using unit root test with a Fourier function capable of capturing unknown form for structural breaks; Test results showed that not be reject the stochastic convergence hypothesis for Australia, Fiji, Korea, Nepal, Pakistan, Philippines, and Thailand;	[70]
22.	Adhikari D., Chen Y. (2014)	35 Asian countries, data of 20 years period: 1991-2011	Energy productivity, as a ratio of gross VA to energy use, i.e., inverse of energy intensity, Energy use (kg of oil equivalent per capita) and gross VA in constant 2005 US dollars	Examined the convergence of energy productivity at the sectoral level across 35 Asian countries from 1991 to 2011 by using 2 well-known convergence concepts such as sigma-convergence and beta-convergence and the spatial panel data approach. The results revealed that mixed evidence of convergence process in the sectoral energy productivity for these 35 Asian countries and found beta-convergence process exists in energy productivity in the construction, manufacturing, mining; manufacturing and utilities, transport; storage and communications, and wholesale; retail trade; restaurants and hotels sectors; There was no evidence of energy productivity convergence in the agriculture; hunting; forestry and fishing sector over the study period; The spatial spillover effect had a positive impact on the sectoral energy productivity growth in 35 Asian countries;	[71]
23.	Mei L., Chen Z. (2016)	30 Chinese provinces, data of 14 years period: 1999-2012	Total factor productivity (TFP), Output variables: Gross regional product (GRP), CO_2.Carbon emission; Input variables: Labor, Capital stock, Energy consumption; Independent variables: technology patents, energy structure, ownership structure, industrial structure, urbanization level, FDI	Developed a biennial Malmquist-Luenberger productivity index, taking resources and the environment into account, and use a spatial econometric analysis to measure the Chinese provincial spatial convergence of the total factor productivity (TFP); Empirical results showed that: 1) China's TFP increased significantly in recent years, mainly driven by technical improvement; 2) there was nationwide conditional convergence of productivity except for diffusion in the northeast and east regions; 3) the perspective of China's industrial environment is not optimistic; 4) the current ownership structure does not facilitate TFP growth, and industrial structure of inland areas limits local TFP growth;	[72]
24.	Zulfiqar K., Chaudhary M., Aslam A. (2017)	60 countries (18 developed, 42 developing), data of 40 years period: 1970-2010	Real GDP per capita (constant prices); Investment share of PPP converted GDP per capita at 2005 constant prices; Population (in thousands); Openness (at 2005 constant prices, %)	Investigated convergence at assorted level of disaggregation among a sample of almost 60 countries and tested absolute and conditional convergence hypotheses for a set of developed and developing countries by applying pooled least square methodology; The results suggested absolute convergence for countries having similar characteristics and conditional convergence for countries having heterogeneous structures; Was calculated Ddsparity level for each country with reference to average steady state income; The study scrutinized the role of investment, openness and population growth in accelerating the convergence process;	[73]

25.	Furuoka F., Rasiah R., Idris R., Ziegenhain P. Ikechukwu R. (2018)	5 ASEAN countries, data of 55 years period: 1960- 2015	Real per capita income	Tested the income convergence hypothesis by using unit root tests, such as the Fourier augmented Dickey–Fuller (FADF) and the Fourier ADF with structural breaks (FADF–SB) methods; Results showed a positive causal relationship with 10% of the two-country pairings. 60% of the two-country pairings showed no causal relationship at all, while the remaining 30% produced inconclusive results; These findings suggested that other variables, such as government focus on the science, technology and innovation infrastructure to promote structural transformation may be more important than trade liberalization efforts to reduce inter-country income gaps;	[74]
26.	Khan G. Y., Daly V. (2018)	5 SAARC member countries, data of 57 years period: 1960-2017	GDP per capita	Tested output convergence during 1960-2017 amongst the leading member countries of the South Asian Association for Regional Cooperation (SAARC): Bangladesh, India, Nepal, Pakistan and Sri Lanka using the method developed by Enders and Lee (2011) and the technique introduced by Phillips and Sul (2007, 2009); Results showed minimal evidence of growth convergence within the full group of countries and found these countries can be allocated to two non-overlapping convergence clubs, with India and Sri Lanka;	[75]
27.	Morleo G., Gilli M., Mazzanti M. (2019)	14 sectors for the period, data of 15 years period: 1995-2009	Environmental productivity (the ratio between value added and carbon dioxide emissions);	Focused on the environmental performances of the European manufacturing industry; Tested the existence of absolute and conditional β-convergence and σ-convergence in the environmental productivity (i.e., for each sector, the ratio between value added and carbon dioxide emissions); The results supported the hypothesis of β-convergence and highlight other factors such as trade openness and indicated that the sectorial share of value added can affect sectorial environmental performances, as shown by a higher speed of convergence. No statistical evidence of σ-convergence was found.	[76]
28.	Tsyrkunov D. (2010)	10 Central and East European countries (post socialist countries), data of 18 years period: 1991-2008	GDP per capita, Human development index (HDI)	Analyzed of economic convergence in Central and Eastern Europe using sigma-convergence concept. Results showed the absence of the effect of reducing divergence in the region and the differentiation of income between CEE countries could explained by fundamental differences in the current economic policy. Concluded that the collapse of the world socialist system has caused differences in levels of economic development in the countries of Central and Eastern Europe, followed by a strong and a sharp drop in GDP and manufacturing and differences in structural and market reforms, and participation in various regional integration associations have led to even greater divergence between countries in the region.	[67]

Note: *by the author (L. Oyuntsetseg, 2019)*