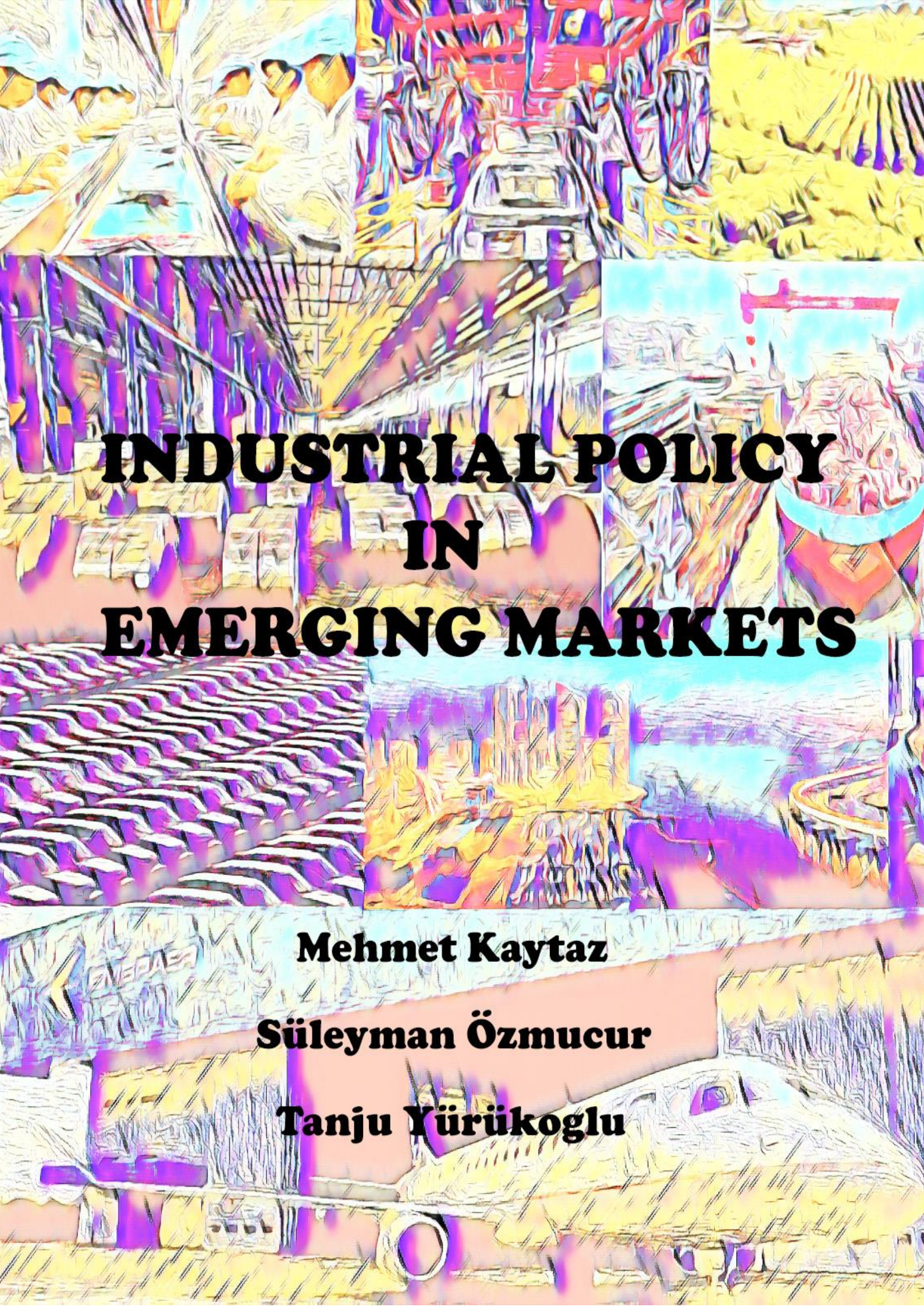

INDUSTRIAL POLICY IN EMERGING MARKETS

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Acronyms and Abbreviations

CPI	Corruption Perception Index
DNA	Norwegian Labor Party (Det Norske Arbeiderparti)
ECSC	European Coal and Steel Community
EEC	European Economic Community
ECU	European Currency Unit
ERM	Exchange Rate Mechanism
EMU	European Monetary Union
EU	European Union
EU28	European Union with 28 Member States
FDI	Foreign Direct Investment
FTA	Free Trade Agreements
GATT	General Agreement on Tariffs and Trade
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GNI	Gross National Income
GP	General Practitioner
GPFG	Government Pension Fund Global
GPI	Global Peace Index
HDI	Human Development Index (of UNDP)
ICT	Information and Communication Technology
IMF	International Monetary Fund
ILO	International Labor Organization
IP	Intellectual Property
ITO	International Trade Organization
KOF Index	KOF Konjunkturforschungsstell (Swiss Economic Institute) Globalization Index
NGO	Non-Governmental Organization
OECD	Organization for Economic Cooperation and Development
PISA	Program for International Student Assessment
PPP	Purchasing Power Parity
SAMAK	Joint Committee of the Nordic Social Democratic Labor Movement
SAP	Social Democratic Workers' Party of Sweden
TI	Transparency International
UN	United Nations
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
USD	United States Dollars
VET	Vocational education and training
WB	World Bank
WDI	World Development Indicators
WEF	World Economic Forum
WTO	World Trade Organization

Executive Summary

The literature on industrial policy is large. There is no consensus on the necessity or the success of industrial policy. On the one side there are those who believe that government intervention is necessary for economic growth and development. On the other side there are those who consider that government intervention leads to rent-seeking activities because markets are efficient. The establishment of infant industries, knowledge spillovers and scale economies, coordination failures, informational externalities, support of exports and FDI are the main arguments for industrial policy.

A general or traditional definition of industrial policy implies that every country has an industrial policy in one form or another. In the past industrial policy played an important role in the development of current advanced economies. This is true also for the recently industrialized economies. However there are failure stories as well as success ones. The counter argument for the success stories is that the market oriented policies might have produced the same results, if not better. Because no counterfactual data are available, it is not possible to reach the correct conclusions. The failures are seen as the result of governments' mistakes in identifying the appropriate industries given the endowment structure and development level of the economy. Furthermore industrial policies in the form of import substitution, planning, and state ownership produced some success stories, however when they were not adapted to new conditions and did not undergo any progressive change they failed and led to big economic crises in some cases. The industrial policy experience of the East Asian countries are considered as successful, while the Latin American ones are full of failures.

The changes that have been taking place in the global economy together with the establishment of WTO which imposed new restrictions on trade policies and subsidies led to what is called the "new" industrial policies. With the Washington Consensus some economies seemed to abandon industrial policies for a period, however gradually they started to return to some form of industrial policy. The new industrial policies focus more on horizontal policies; and they do not carry much ideological content as the traditional ones.

In this study the evaluation of industrial policies are done in two stages. For the first stage Brazil, China, Egypt, India, Iran, South Korea, Turkey, and Vietnam are selected. These are some of the countries where industrial policies were implemented at some periods and/or are being implemented. The first stage evaluations are based on the trend analysis of economic indicators such as GDP growth, human development index, economic structural transformation (shares of major sectors in total value added and total employment), economic complexity index, labor productivity, competitiveness index, share of exports of goods and services in GDP, and globalization index. The results suggest that South Korea and China have more successfully utilized industrial policies to achieve these goals of economic growth and structural transformation than the other countries in the sample.

For the second stage of evaluation three countries are selected: South Korea as one of the leading example of employment of industrial policies; Brazil as the representative of Latin American economies; and Vietnam as a latecomer to the scene. These economies are analyzed in more detail. The indicators mentioned in the preceding paragraph are evaluated for each period of distinct industrial policy implementations. Thus, it would be possible to see if there is a correlation between the policies and indicators. The determination of these periods is based on the relevant literature. Furthermore, these periods are determined empirically using least squares with breaks. For some indicators and periods a correspondence between the industrial policy and performance are empirically valid. The same is true for the literature based and empirically determined periods, that is, the empirical results support the literature-based determination of periods. The disadvantage of this method is that it may miss the performance which was a result of policies in an earlier period.

During the 1960-1973 period, priorities were exports and key sectors were labor-intensive manufacturers in South Korea. On the other hand, main instruments were import tariff protection, export subsidies, tariff-refunds, and subsidized credit and export targeting. The priorities during the 1973-1980, were heavy and chemical industries, with priority sectors steel, petrochemicals, nonferrous metals, shipbuilding, electronics and machinery and priority firms selected large enterprises. In addition to main instruments used during the earlier period, of policy loans to fund priority sectors and firms, and tax credits as investment incentives were also used as main policy instruments. During the 1980-1990 period priorities moved to high technology exports sectors, and small and medium enterprises. Main instruments used during this period were import liberalization, incentives for research and development, direct lending, and removal of restrictions on foreign investment. From 1990, priorities were private sector-led development,

competitiveness in international arena. Main instruments were supporting research and development, open capital account, and financial sector reforms. These four periods are used in this study.

Brazil roughly represents the Latin American example of industrial policies. During 1950-1980 Brazil experienced high growth rates, increase in productivity and developed a strong manufacturing base. However, it was not possible to continue with those policies which was instrumental in obtaining those developments. The abandonment of industrial policies provided stability and increased Brazil's integration to the world economy. On the other hand, the manufacturing base got smaller and productivity increases were negligible. During the recent decades various governments introduced industrial policy measures. However, it is early to see the results of these policies.

The case of Brazil also shows that macroeconomic policies, institution building, transparency, good governance constitute the background of industrial policies. If this background is not available then industrial policies may fail.

Forty-five years ago, Vietnam was a war-torn, centrally planned and predominantly rural country. Its export earnings could barely finance a third of its imports. For the following ten years, its economy muddled through with a heavy dependence on external aid from the former Soviet Union. In 1986, the Communist Party Congress adopted *Doi Moi* (Economic Renewal), a transition reform program while reiterating the Marxist-Leninist principles of the state. The principal elements of the program were: rural reform and return to private farming, price liberalization, fiscal and monetary reforms, openness to FDI and regulatory relaxation. The collapse of the former Soviet Union in 1989 halted the external assistance leading to a slowdown in growth. The economy recovered thanks to growth in agriculture and starting flow of external finance from western sources. Low wages and openness helped inflows of FDI to prime the manufacturing sector.

Since then, Vietnam's industrial policies have been broad and comprehensive in design, covering not just manufacturing but a broad range of sectors from agriculture to infrastructure and financial services. Vietnam's route to become an export oriented industrial economy was quick and effective. Essentially, Vietnam mounted itself on global supply chains taking advantage of its low wages and geographical proximity. Attempts to replicate the Vietnamese version of the Korean *chaebols*, however, failed when the bureaucrat-run large state enterprises could not compete even with heavy protection.

Vietnam's growth rate averaged 6.5 percent a year between 2000 and 2019 while exports of goods and services grew on average by 16 percent a year in current USD terms during the same period. The share of exports which accounted for 54 percent of GDP in 2000, went up to 106 percent of GDP. The share of high technology exports in manufacturing went up from 8 percent in 2008 to over 40 percent in 2018 and the share of ICT goods exports from 5 percent over a third of the total, respectively. Industrial policy was not only confined to manufacturing. Vietnam managed to become a major producer and exporter of coffee and a net exporter of rice.

This impressive record, however, came at a price. The financial system has been stressed because credit demands of large SOEs which has crowded out the private sector, in particular, new entrants. Sustainability of the financial system which needs to provide a level field for private sector, including foreign firms and SOEs, will be critical for the continued growth of the economy. While low wages were an important factor in attracting FDI initially, the education and training system fell short of providing the skills demand, hence resulting in a pressure on wages. There are also serious concerns about increasing corruption with the rapid transition the economy is undergoing.

The findings suggest that industrial policies in general are successful in promoting growth and structural transformation. The economic development of South Korea is a good example of well-designed and well-implemented industrial policies. On the other hand, the cases of Brazil and Vietnam show that the policies were instrumental in the establishment of an industrial base and integration with the global economy. However, the government, bureaucracy and entrepreneurs were not able to adapt to the changing conditions, and industrial policies lost their effectiveness. Usually, this situation leads to economic downturn and corruption. Brazil and Vietnam lived through these periods.

1 Introduction

An article in a recent of issue of The Economist is about how Europe "is rediscovering its penchant for statist intervention" (The Economist, January 20, 2020). According to the article Europe is lagging behind USA and China in terms of technical progress. While those countries are championing firms and industries and supporting them using taxpayers' money, Brussels prevents governments to give tax-breaks or subsidies in order to encourage competition. Now the climate is changing towards more support and subsidies to selected firms and industries. This development is an example of the changes in attitudes towards industrial policy over the years. Until 1980s industrial policy was theoretically justified and implemented in many developing and advanced economies. With the Washington Consensus industrial policy has lost its attraction. However, in recent years particularly after the Great Recession, and now with Covid-19 pandemic the role of state in economic policy is debated and industrial policy is becoming an essential part of economic policy in many countries.

Industrial policy has been a controversial issue. This is understandable; it does not have a generally accepted definition. And controversies start from here. The industrial policy literature is rich and there are quite a number of good comprehensive reviews (Di Maio, 2009 and 2014; Altenburg, 2011; Ambroziak, 2017; Foreman-Peck, 2014; Pack and Saggi, 2006; Pianta, 2015; Rodrik, 2004; Stiglitz et al., 2013). The discussions usually start on the need for industrial policy. It is usually associated with market imperfections and failures. Historically, infant industry arguments provided the basis for governments implementing industrial policies. The idea was to protect newly established national industries from international competition at least for a given period. Another implementation of industrial policy is picking winners. The industries and private firms are supported through large subsidies and tax and tariff measures. Consequently, large amounts of public resources are transferred to private firms.

Another issue is about the scope of industrial policy. It is usually associated with industrialization. The current framework for industrial policy includes other sectors. A related issue is the relation between industrial policy and other policies. While some considers industrial policy distinctly different from others, some consider that industrial policy is just another policy like monetary, fiscal, competition, trade, and other economic policies.

The industrial policy which has risen in the new millennium was termed as “new” to distinguish it from the traditional industrial policies. The new approach tries to eliminate the weaknesses of the “old” industrial policies. Furthermore, it focuses on learning, knowledge accumulation, and research. The level of ideological discussions is significantly low in relation to discussions about “old” industrial policies.

A bigger issue is whether industrial policy has been successful. It is generally accepted that in the development of today’s advanced economies industrial policy has been instrumental. On the other hand, non-availability of counterfactual data puts the success stories into doubt. The argument is that it could have been better without the policy or the policy was not effective. Also, industrial policy not having clearly identifiable set of goals, policy instruments and institutions like other economic policies helps this argument. Furthermore, the analysis of industrial policy requires input from areas such as development economics, economic history, and political science.

The objective of this study is to examine the experiences of some selected emerging economies in designing and implementing industrial polices and outcomes they arrived at. The countries selected are Brazil, China, Egypt, India, Iran, Korea, Turkey, and Vietnam. In selecting these countries geographical considerations, development levels, and the degree of implementing industrial policies and periods of implementation were taken into account. Brazil, Korea, and Vietnam are further examined in more detail.

The evaluation of industrial policies usually takes a specific firm or industry (Tillman, 2009?). This method is effective in studying a specific policy and a specific firm or industry. For example, in Brazil governments supported the establishment of an aircraft industry, and in Korea the governments tried to pick winners. The success of aircraft industry in Brazil, or the number or successes of the champions in Korea may be an indicator of performance of policies. In this study we followed a relatively different method. The overall performance of these countries since 1960, and where data not available since 1990 are examined under six broad categories. Namely, economic growth, human development, structural transformation, labor productivity, economic complexity and competitiveness are the criteria.

The next chapter is a brief introduction to industrial policy. The need for industrial policy, definitional issues, and ideological approaches are summarized. The evaluation problems are discussed. The conditions leading to the rise of “new” industrial policy and its main differences from the traditional one are presented.

Chapter 3 presents the empirical findings for the countries selected under six categories: economic growth, human development, structural transformation, productivity, economic complexity, and competitiveness and integration to the world economy. Economic growth is measured by the growth rate of GDP in 2010 constant US dollars. Human development is measured by the Human Development Index (HDI) of 2018. In this study as indicators of structural transformation shares of sectoral value added in GDP and shares of sectoral employment in total employment are used. The sectors are agriculture, industry, and services. Another measure of structural transformation is the share of manufacturing in total exports. Productivity is measured as GDP in 2020 constant US dollars per worker. The Index of Economic Complexity is used to measure the amount of productive knowledge a country holds. Competitiveness includes several measures: UNIDO Competitive Performance Index, share of exports in GDP, and KOF index of globalization.

For each country the growth rates of and trend values of the variables in question are estimated and compared. The estimation results present a picture of the performances of these economies during the last 60 and 30 years. Some of the results are as expected such as the declining share of agricultural value added in GDP. However, share of exports in GDP presents a different picture. The results suggest that countries which followed industrial policies successfully performed better in most of the variables of comparison.

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2 Industrial Policy: A Brief Introduction

Industrial policy has been a controversial issue. Its theoretical basis has ideological implications, because the need for industrial policy implies some form of market imperfections. On the one side there are those who believe that government intervention is necessary for economic growth and development. On the other side there are those who consider that government intervention in efficient markets is a rent-seeking activity. Then there is the definitional question. A wide definition of industrial policy would include any government intervention in the economy. Thus, there would be no difference between industrial policies and other economic policies such as monetary, fiscal, trade or competition policies. However industrial policies would be difficult to evaluate because they do not have clear and identifiable frameworks, goals and institutions as other policies (Riess and Vailila, 2006, p. 12).

A related development is that a distinction is made between traditional industrial policies as "modern" or "new". The industrial policies implemented roughly before the globalization era are considered as traditional or old-style. For example, a definition of industrial policy as "government intervention in a specific sector which is designed to boost the growth prospects of that sector and to promote development of the wider economy" (Dadush, 12016, p.1) may be classified as an old style or traditional industrial policy. According to Pack and Saggi (2006, p.2) "the industrial policy is basically any type of selective intervention or government policy that attempts to alter the sectoral structure of production toward sectors that are expected to offer better prospects for economic growth than would occur in the absence of such intervention". The emphasis is different in Rodrik's (2004) definition. Industrial policy is usually associated with industrialization. Rodrik considers it as a restructuring activity but not necessarily of manufacturing but also of agriculture and services. Industrial policy is a collaboration between private sector and government. However as different from old or traditional policy the collaboration is focused on the process rather than the outcomes. According to Noman and Stiglitz (2016) industrial policy is a set of public policy measures with the objective of influencing the allocation and accumulation resources and technology.

2.1 Why Industrial Policy?

The relationship between the state and the market has been an issue debated a lot in economics and social sciences. Should state intervene in the economy? If so, how much? In many situations state is expected to regulate some aspects of the economy. What should be its degree and scope? Which activities state should take over? And which activities should be left to the market? According to economics textbooks state should intervene in case of "externalities." Externalities arise as a result of activities of an individual economic actor in the market which has consequences for others and markets are not involved in dealing with these consequences. For example, pollution is an externality. Another argument for state intervention is the provision of public goods such as infrastructure and national defense. These goods are beneficial to all the economic actors. The existence of "asymmetric information" leads to a situation in which some market participants do not have the correct information to judge the quality of goods and services they are trading. In this case the objective of state intervention in the market is to eliminate the asymmetric information so that the functioning of markets is not disrupted. Monopolies threaten the competitive markets; they tend to charge excessively high prices and engage in predatory activities to eliminate competition. Social insurance and worsening income equality are other areas require state intervention (Acemoglu and Robinson, 2020).

There are several arguments for industrial policy within the framework of state intervention in the market. And there are also counter arguments. Pack and Saggi (2006) and Rodrik (2004) list the arguments. The main argument for industrial policy is the establishment of infant industries. In a less developed or developing economy the industrial base is small. The newly established industries cannot compete with the firms in other economies because their production costs are relatively higher. If these firms are supported and/ or protected from foreign competition for a time then it is expected that these domestic firms will gain experience, reduce costs due to learning by doing, make use of scale-economies, and eventually become efficient to be able to compete. The end result will benefit both the domestic and global economy. There are four versions of infant industry support (Baldwin, 1969). The standard argument for subsidizing R&D activities is that although in order to acquire knowledge firms have to incur costs, knowledge may not be appropriable by any individual firm. In other words, the spillovers of knowledge may discourage firms to invest in knowledge acquisition. The

subsidized R&D activities will give firms opportunity to obtain knowledge. The cost of firm-level job training is borne by the firm. However, because of the movement of labor there may be free-rider problem. If the state provides a general training, then positive externalities will arise. The protection of domestic production from foreign competition through tariffs and other measures had been the main component of industrial policy in the case of infant industry. If positive externalities exist in the domestic production of a good, then trade protection is justified. Another justification for the infant industry support is in the case of informational externalities. The cost of initial investment for determining the profitability of an investment in new industries may exceed the expected return from the investment. The state support is justified in this case. Hausman and Rodrik (2003) call this case the process of self-discovery. It is simply a process in which what can be produced profitably at world prices is determined. The counter argument is that governments cannot pick winners. Rodrik (2004) argues that picking wrong winners is part of the process of cost discovery. The effective industrial policy requires cutting the losses short in case of mistakes.

The second main argument for industrial policy is related to knowledge spillovers and scale economies. The comparative advantage theory states that under free trade an economy can increase its national income by shifting its resources to industries in which the opportunity cost of production is lower than those of its trading partners. Thus, government can support these sectors. In the same way governments can support industries where learning by doing economies is intense. Thus, human capital formation is accelerated. The end result of this argument is that governments target industries which could compete or increase human capital formation. On the other hand, this argument is criticized on the grounds that policy makers face strong informational constrains and it would not be possible for them to choose the right industry (Klimenko, 2004). This criticism is partly based on the scarcity of competent bureaucracies in developing countries. It is possible for many countries to establish competent bureaucracies in at least certain areas. There are many cases of successful industrial targeting through industrial policy. The criticism is that there may have been more successful outcomes; and because of the lack counterfactuals it is not possible to evaluate the success of a policy. On the other hand, the idea of counterfactuals is not clear. And the economic approach ignoring industrial policy does not require the competency of bureaucracy.

The third argument for industrial policy is related to coordination failures. There are interdependencies between industries. There are occasions where the viability of an investment depends on the existence of other investments. An individual firm may not be aware of this and

would act independently. If all the related parties know the situation, they may undertake these investments and produce profitably. Otherwise, they would not undertake investment thinking that it would be unprofitable. The state would be involved at this stage by providing coordination between these firms and investments would take place. The counter argument is based on the example of global value chains (Gereffi and Memedovic, 2003, Sturgeon and Lester,

2002, 2004). Firms can coordinate production across many countries through many other firms. So, they really do not need external coordination. Indeed, this is true for large multinational companies but not for those newly established smaller firms.

The fourth argument for industrial policy is based on informational externalities. According to Rodrik (2004) industrial policy is a strategic collaboration between the private and public sectors for the purpose of determining which industries would make use of comparative advantages. At a firm level, the entrepreneur may not have enough information on what investment would be profitable or not. Hence the state supports the entrepreneur in obtaining information.

The last main argument for industrial policy is related to exports and FDI. The product quality of a firm trying to enter international markets may be unknown to foreign consumers, In this case there is informational asymmetry which may lead to market failure. The industrial policy of supporting exports is justified on the grounds of eliminating this informational asymmetry (Mayer, 1984).

The FDI is expected to increase the productivity of local firms through technology transfer and linkage effects. Hence FDI creates positive externalities and the support of any activity creating positive externalities by industrial policy is justified. Both advanced economies and developing economies have been FDI beneficiaries.

An important argument against industrial policy is that they can be captured by vested interests and the opposite of intended outcomes occur. In developing countries there are many examples of this. On the other hand, this is true for many other policies. For example, the privatization process in some economies were captured by undesirable elements of the society and led to stripping productive assets.

Those economists who does not support policies propose instead that governments should provide support for R&D and intellectual protection. This support should be across-the- board.

This approach would certainly improve the productive capacity; however, the issue is the support of entrepreneurs. In developing economies, the entrepreneurship has a high social return but a low private one. And entrepreneurship is the main factor to restructure the economy, and industrial policy should target entrepreneurs.

A slightly different rationale for industrial policy is based on the idea that "it can steer the evolution of the economy towards activities that are desirable in economic terms (improving efficiency), in social terms (addressing needs and reducing inequality), in environmental terms (assuring sustainability) and in political terms (protecting key national interests)" (Pianta 2015, p. 140). Stiglitz et al. (2013) base industrial policy on learning, knowledge accumulation and research. According to Stiglitz (2017) every country has industrial policy but may not be aware of it. If governments are not involved and do not follow the developments closely then special interest groups may be dominant in determining the direction of the economy. The end result would be more rent seeking activities, inefficiencies, less economic growth and more inequalities.

2.2 Industrial Policy: Old and New

Old or traditional industrial policies are usually associated with import substitution, trade policies, planning, state ownership, and direct intervention of state in some markets. Inevitably the reasons for industrial policy focused on the elimination of market imperfections in a neoclassical world. As the earlier discussion suggests current industrial policies do not focus on market imperfections as such. It is seen as basically complementing the markets.

The main reasons for the new industrial policies are the changes that have been taking place in the global economy. Some of the countries implementing industrial policies based on import substitution faced balance of payment problems in the 1970s. The debt crisis of 1980s forced many countries to abandon the import substitution and industrial policies. Furthermore, the establishment of WTO brought new restrictions on trade policies and subsidies. Thus, it was not possible to continue with traditional import substitution and trade subsidies for many tradeable goods. WTO limits the trade policy interventions to the support of domestic R&D, regional development, and environmental sustainability. Particularly with the dominance of the Washington Consensus industrial policy as a concept was neglected or ignored in many economies. Grabas and Nützenadel (2014) in their analysis of post-war industrial policies in

Europe consider the “fading away” of the industrial sector in the face of knowledge economy. This led industrial policy to appear as just some set of instruments to protect the old manufacturing sector. However, it is possible to say that industrial policy did not disappear but changed form and content (Di Maio, 2009). For example, Altenburg (2011) considers that the policy of protecting banks and manufacturing sectors from systemic risks now implemented in many OECD countries is not different from the traditional policy of strengthening the strategic industries.

The globalization in terms of the new techniques and technologies, the digitalization, the ease and lower cost of communication, the new cooperation and transportation channels, new business models, and new customer expectations created new challenges and new opportunities for firms and economies. One important business model development is the rise of global value chains (GVC) (Gereffi, 2013; Kaytaz et al., 2018). Gereffi (2013) distinguishes between traditional policies and GVC-oriented policies. “Horizontal” policies are those that effect the whole economy. Health, education, infrastructure, and R&D expenditures are examples of horizontal policies. These expenditures can be considered as the foundation of the economy. Private sector invests in these areas however because of externalities of these public goods state plays a dominant role. “Selective” or “vertical” policies target particular industries or sectors; they try to find national champions or sectors. As different from GVC-oriented policies they are domestically oriented policies. Vertical policies, such as import substitution tries to create a supply chain domestically. GVC policies move the focus outside the country. GVC polices uses the external linkages that affect a country’s positioning in a global or regional chain. According to Gereffi (2013) GVC policies focus on the intersection of local and global actors, takes in to account of the interests, power and reach of global suppliers, considers global and regional networks as the appropriate area of activity, and is responsive to the demands of international organizations and GNOs.

As different from traditional industrial policies the new one focus on horizontal policies. Other than those mentioned in the preceding paragraph competition policies take an important place in order to create a more competitive and efficient market and level the playing ground. Now tax incentives are used in special cases marginally. Many governments are now aware of that tax incentives may easily lead to price distortions, inefficiency and fiscal imbalances. So, the focus is more on competitiveness, increase in production efficiency, increase exports and share of world markets. For example, for export promotion non-financial services are provided to exporters or free-trade zones are established. To increase production efficiency some countries

are trying to establish clusters. Meyer-Stamer (2009) distinguishes between “modern” and “post-modern” industrial policies. The modern policies are designed for improving competitive performance, while the latter focuses on improving the social welfare, more on the increasing the inclusiveness of economic activities. Page and Tarp (2017) in the first issue of *The Practice of Industrial Policy* note fruitlessness of the debate on targeting sectors or industries against providing a level playing field for all. They welcome the end of this debate and point out that in low-income countries market imperfections are widespread, and there are a lot governments can do.

Rodrik (2004) specifies ten principles of designing industrial policy. He notes that different economies are in different stages of development and face different problems and constraints. The collaboration between public and private sectors will identify the constraints and opportunities. Based on the search and decision process policies will be selected. The first principle is that **only new activities should benefit from incentives**. Here the means both new products and new technologies of producing existing products in the local economy. The idea behind is that the purpose of industrial policy is to diversify the economy and create new areas of comparative advantage, and hence increase productive capacity and capabilities of the economy, and economic growth. A new investment not necessarily increases the productive capability of an economy. In the same way programs for the support of small and medium enterprises not necessarily leads to diversification and new areas of specialization.

The second principle is the establishment of **clear benchmarks and criteria for success and failure**. Inevitably some entrepreneurs will succeed, and some will fail. It is in the nature of entrepreneurship. Hence some projects supported will be successful and some will fail. The support for the failed projects should be stopped, otherwise public resources will be wasted. The question is what should be the criteria for success? It should be clear for the entrepreneur, bureaucrat, and the public. If not clear enough both the entrepreneur and bureaucrat may try to create false outcomes so that incentives may continue. Rodrik proposes productivity increase in relative and absolute terms as the success criteria noting that its measurement is not easy. The experience of other countries or performance in the international markets can be used as rough benchmarks.

The third principle is the necessity of including **a built-in sunset clause** in the projects. Other than establishing clear benchmarks for success or failure of a project, a time limit must be set

for the duration of the support given. Even if the project is successful, the support must be withdrawn after some time, otherwise public resources will be tied up unnecessarily. This time limit should be a built-in condition in the contract.

The fourth principle deals with the focus of support: it **must target activities not sectors**. Governments usually identify sectors or industries such as tourism or biotech for support. A general focus like this ignores the area where the correction is necessary because it is too general. Furthermore, it is difficult to determine the correct measures or policies. If it is specific like an activity, then the support process becomes easier and more efficient. Rodrik gives the examples of cross-cutting programs such as supporting bilingual training instead of a general focus on tourism; or supporting feasibility studies for certain activities.

The fifth principle states that those **activities with spillovers and demonstration effects should be supported**. This is self-evident. If an activity provides spillovers and demonstration effects to other firms, whether they are possible new entrants or rivals, then that activity should be supported. With the new entrants the activity and the complementary activities will be more competitive and efficient.

The sixth principle deals with **the competence of authorities carrying out the policies**. The corruption and incompetence are common in many developing countries. However, it is possible that not all institutions are corrupt or incompetent. According to Rodrik it is better to use available resources instead of establishing new agencies. Furthermore, some it is necessary make a compromise between the requirements of the policy and the competency of an institution. For example, it is better to use credit as a policy tool rather than tax if the development bank is in better shape than the tax administration. In this case the policy is not targeted correctly, however Rodrik considers that it is better to use the second-best effectively than using the first-best tool badly.

The seventh principle is on monitoring the implementing agencies. The **monitoring must be done by a principal who has the highest authority and a clear stake in the outcomes**. The implementing agencies have to have a certain degree of autonomy so that they can function effectively. This, on the other hand, carries the risk of self-interested behavior as well as capture by private interests. Therefore, it is necessary to monitor them. And monitoring should be carried by high level politicians who are responsible for the projects and have a good knowledge of them.

The eighth principle is about the relationship between implementing agencies and the private sector. **The channels of communications between the two should be open**. For the collaboration between two, for the exploration of possibilities, and for the effective implementation the communication should be easy. This way the bureaucracy will understand the business side better, and the entrepreneurs the official side better.

The ninth principal accepts that **sometimes losers will be picked instead of winners**. It is inevitable that mistakes will be made. Some projects will fail whatever the safeguards are. The important thing is to minimize the cost of mistakes instead of minimizing the chances of mistakes. The latter may lead to doing not much.

The tenth principle is about the **renewal capacities of agencies**. The needs and conditions of productive discovery changes overtime. The agencies should be ready for these changes. They should adapt to new conditions easily and should be able to renew themselves.

2.3 Evaluation of Industrial Policy

Another disagreement among economists on industrial policy is that whether it works. Pack and Saggi (2006) cite that researchers have analyzed the impact of trade protection, subsidies to R&D, general subsidies, and preferential lending rates policies on the evolution of productivity and capital accumulation, and they have found that in few cases the industrial targeting has been effective. They give the case of Japan where in 1955-1990 the targeted sectors showed insignificant growth in total factor productivity and capital accumulation. Actually, the mining and agriculture were the sectors more encouraged. They also note that industrial policy of preferential lending rates may cause long-term harm to the financial sector. Because of the directed lending financial institutions did not develop competence for evaluating industrial projects. The stagnation in Japan and Asian financial crises of late 1990s may be the result of these policies.

Pack and Saggi (2006) cite also the case industrial clusters. Establishment of industrial clusters is part of the new industrial policies of many countries. The idea is that industrial clusters provide benefits to the firms through agglomeration economies. The state can provide overhead services for clusters which is not an intervention in markets, and firms interact, thus it is possible for productivity to grow. The well-known example of a cluster is the Silicon Valley. Here face to face interaction between firms such as software and chip producers, a pool of

workers with relevant skills, and cheaper logistics led to a high rate of productivity growth. Pack and Saggi state that the replication attempts of many governments were not successful.

According to Ambroziak (2017), on the other hand, every country has an industrial policy in some form. Hence some policies produced success and some not. Andreoni (2017) analyzes the recent industrial policies implemented in the USA, Japan, and Germany. Again the results are mixed. Foreman-Peck (2014) in analyzing the European post-war economic "miracle" recognizes the role of traditional industrial policy. And he traces the focus of industrial policy from industrialization to productivity. Di Maio (2009) mentions of abundant historical evidence that industrial policy played an important role in the development of advanced economies as well as in the industrialization of the latecomers.

Rodrik (2004) considers that old industrial policies in the form of import substitution, planning, and state ownership produce some success stories, however when they were not adapted to new conditions and did not undergo any progressive change they failed and led to big economic crises. The Washington Consensus framework leading to liberalization and opening up of the economy benefited mainly export and financial sectors as well as skilled workers, but in terms of productivity growth they were behind periods where the traditional industrial policies were dominant. Altenburg (2011) reviewing developing country experiences of industrial policy concludes that those countries which employed industrial policy in promoting structural change, in encouraging the search for new business models and markets and which channeled resources to socially desirable activities are those which caught up with the old industrialized, high income countries. Again Altenburg (2011) like (Rodrik, 2004) also concludes that those countries which strictly followed the Washington Consensus were far behind the former countries in terms of technological upgrading, economic growth and poverty reduction.

Lin (2016) argues that in the case of countries successful in the industrial transformation the role of government was crucial. The failures are because of governments' mistakes in identifying the appropriate industries given the endowment structure and development level of the economy. If governments can determine the right criteria for selecting industries to support, and play a proactive, facilitating role for externalities and coordination issues, then there is chance of success.

There is a rich literature on why the other developing economies were not as successful as the East Asian economies. Di Maio (2009) gives a comprehensive review of Latin American and East Asian countries. The globalization and liberalization policies coincided with the failure of

import substitution policies, this led to the end of traditional industrial policies in many countries. At the same time there were success stories of the East Asian economies. The dominant view at the time described the success of these countries as the result of correctly implemented export led growth strategies (Krueger, 1985; World Bank, 1993). Korea and Taiwan towards the end of first stage of import substitution strategy, they began to implement policies inducing export growth such as the unification exchange rates and a partial liberalization of imports. These countries had an export boom in mid 1960s. The export boom has been interpreted as the result of change in policy to use the comparative advantage of specialization. According to this school of thought the role of the state is marginal; the state set the rules for promoting exports and the rest followed by the markets working freely. The opposite view is that exports followed investment growth. The government played an important role in growth of investment which triggered demand for imported capital goods which in turn forced firms to export. According to Rodrik (1995) government had been responsible for investment boom through various policies. Furthermore, governments used other policies to promote exports.

In the East Asian economies, there was a good and effective combination of incentives with discipline. Subsidies and protection provided incentives, while direct government control and the use of export performance as a selection and monitoring instrument for the firms as well as the bureaucrats. On the other hand, in Latin American economies there wasn't a combination of incentive and discipline. The policies did take into account efficiency considerations and capability problems. According to Lall (2003) 1) strict selectivity and time limitation of government intervention; 2) the use public enterprises to enter risky sector (for limited periods); 3) massive investment in skill creation and technological and physical infrastructure building; 4) the centralization of strategic industrial decisions in competent authorities; 5) a highly selective use of FDI were instrumental in the East Asian success. Furthermore, the environment was conducive for investment and there was effective level of dialogue between the private and public sector. Di Maio (2008) cites three crucial differences between East Asian and Latin American countries. Firstly, in Latin America the land-owning classes put a serious opposition to social change. Secondly, the distribution of income was more equal in East Asian countries; this did not lead to a decline in savings rate when the domestic markets grew rapidly. Finally, in East Asian countries the governments were more effective in controlling the economy through state-owned enterprises, import and production of strategic raw materials, financial

system, and through firms directly. On the other hand, in Latin America the businessmen controlled the state, and a rentier attitude dominated the economic activities.

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3 Industrial Policies and Evaluation Criteria for Overall Performance

It is necessary to identify the criteria to evaluate the efficacy of industrial policies. This chapter introduces these criteria and give examples on using them (See, Methodological Appendix). Six criteria are used here, namely economic growth, human development, structural transformation, labor productivity, economic complexity and competitiveness.

3.1 Economic Growth

It is critical to find out if a policy has a significant effect on the level of economic activity and economic growth. The growth in the level of GDP is to be used as one of the criteria. Since international comparisons are also to be done, the series GDP with constant 2010 US dollars published by the World Bank, *World Development Indicators, 2020* is to be used for selected countries. Examples are provided for eight emerging economies. The countries are: South Korea, Brazil, Vietnam, China, India, Turkey, Egypt, and Iran. Obviously, it is possible to extent the list. The average growth rates in these countries are generally higher than the average growth rate for the world economy.

Average annual growth rates of GDP in 2010 constant US dollars (note that not in domestic currency) for the 1960-2019 period are 3.8% for Brazil, 8.6% for China, 5.1% for Egypt, 5.1% for India, 2.7% for Iran, 7.5% for South Korea, 4.4.% for Turkey, and 6.5% for Vietnam. There are significant differences among average annual growth rates. It may be instructive to see if these are related to industrial policies. It is also important to study growth episodes in a selected country and see if industrial policies have played a role in those rates.

The slope of the logarithmic trend line gives the average annual growth rate. One may be interested in growth rates from year-to-year. It may also be useful to see the distribution of growth rates. Similar rankings may be obtained here, with significantly different means and variances of growth rate. The standard deviation or variance of growth rates may be used as a

measure of volatility or stability. If the averages are very different, standard deviation may not be the best measure of volatility comparisons. A better measure may be the coefficient of variation (standard deviation/mean). Vietnam has the lowest coefficient of variation (note that a shorter period is used because of lack of data). Among the remaining seven, South Korea, India and Egypt have lower figures, followed by China and Turkey. Brazil and Iran have the higher coefficient of variations.

Figure 3.1 Log GDP (Constant 2010 US Dollars)

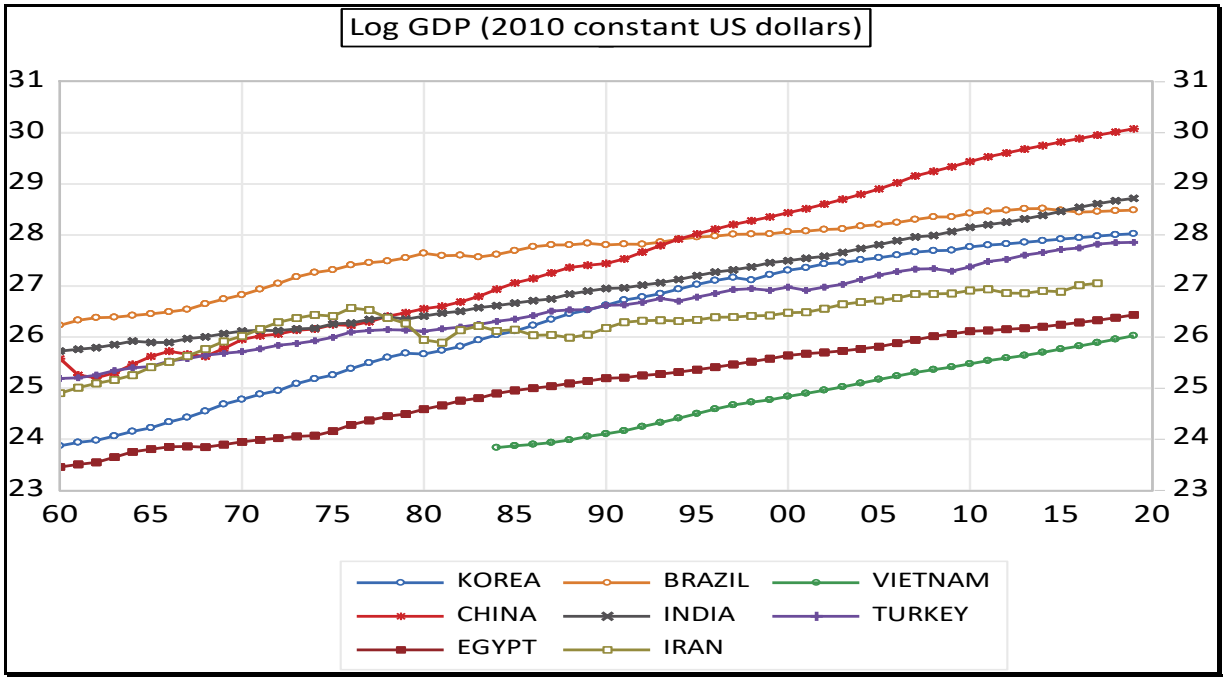


Table 3.1 Trend Lines in Log GDP (2010 constant USD)

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	26.559	25.002	23.518	25.518	25.498	24.119	25.267	22.214
	(0.046)	(0.033)	(0.021)	(0.029)	(0.068)	(0.055)	(0.015)	(0.023)
	[572.0]	[762.7]	[1094.6]	[878.4]	[375.0]	[435.4]	[1704.7]	[963.6]
@TREND	0.038	0.086	0.051	0.051	0.027	0.075	0.044	0.065
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.000)	(0.001)
	[27.6]	[90.0]	[81.9]	[60.1]	[13.1]	[46.1]	[100.6]	[120.6]
Observations:	60	60	60	60	58	60	60	36
R-squared:	0.929	0.993	0.991	0.984	0.753	0.973	0.994	0.998
F-statistic:	764.3	8099.2	6712.5	3611.5	170.5	2123.7	10122.1	14541.2
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: Standard errors are given in parentheses. t-ratios are given in square brackets.

Figure 3.2 GDP Growth in Selected Countries

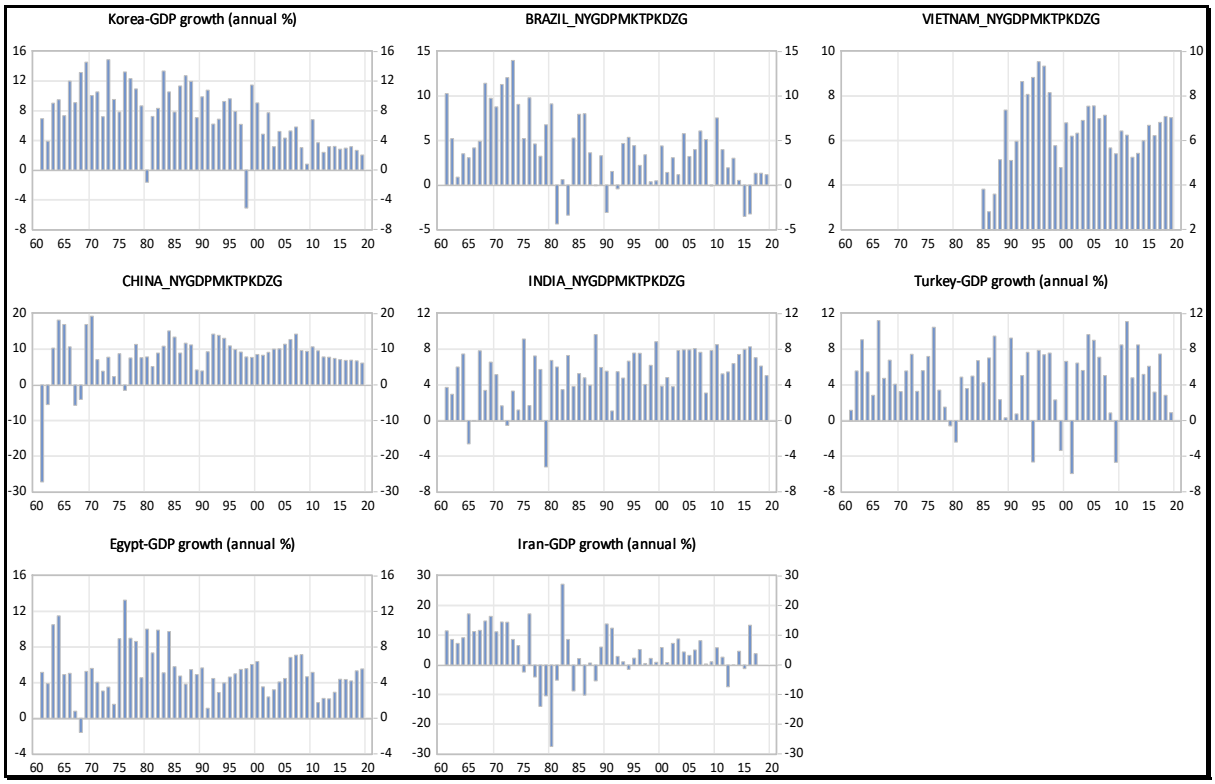


Figure 3.3 Histograms for Growth

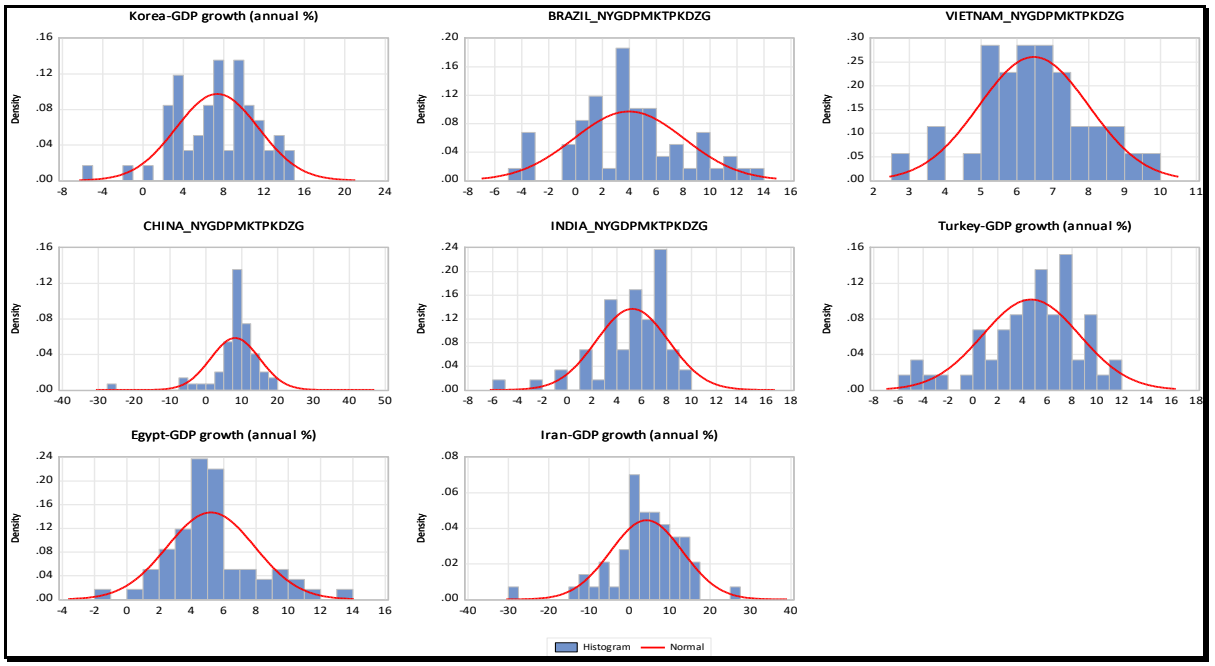


Table 3.2 Test for Equality of Means

Test for Equality of Means Between Series
Date: 07/09/20 Time: 10:04
Sample: 1960 2020
Included observations: 61

Method	df	Value	Probability
Anova F-test	(7, 438)	5.257848	0.0000
Welch F-test*	(7, 186.258)	6.366064	0.0000

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	7	925.8110	132.2587
Within	438	11017.69	25.15453
Total	445	11943.50	26.83932

Category Statistics

Variable	Count	Mean	Std. Dev.	Std. Err. of Mean
KOREA_NYGDPMKTPKDZG	59	7.365334	4.092147	0.532752
BRAZIL_NYGDPMKTPKDZG	59	3.971767	4.104251	0.534328
VIETNAM_NYGDPMKTPKDZG	35	6.469462	1.528513	0.258366
CHINA_NYGDPMKTPKDZG	59	8.168875	6.816214	0.887395
INDIA_NYGDPMKTPKDZG	59	5.242304	2.912011	0.379112
TURKEY_NYGDPMKTPKDZG	59	4.691435	3.917312	0.509991
EGYPT_NYGDPMKTPKDZG	59	5.207657	2.716580	0.353669
IRAN_NYGDPMKTPKDZG	57	4.243518	8.949648	1.185410
All	446	5.633423	5.180668	0.245312

Table 3.3 Test for Equality of Variances

Test for Equality of Variances Between Series
Date: 07/09/20 Time: 09:23
Sample: 1960 2020
Included observations: 61

Method	df	Value	Probability
Bartlett	7	188.7335	0.0000
Levene	(7, 438)	12.09045	0.0000
Brown-Forsythe	(7, 438)	11.70233	0.0000

Category Statistics

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.
KOREA_NYGDPMKTPKDZG	59	4.092147	3.260710	3.254612
BRAZIL_NYGDPMKTPKDZG	59	4.104251	3.171773	3.165134
VIETNAM_NYGDPMKTPKDZG	35	1.528513	1.167786	1.166465
CHINA_NYGDPMKTPKDZG	59	6.816214	4.036439	3.962007
INDIA_NYGDPMKTPKDZG	59	2.912011	2.197884	2.164243
TURKEY_NYGDPMKTPKDZG	59	3.917312	3.018819	2.967792
EGYPT_NYGDPMKTPKDZG	59	2.716580	1.937434	1.912221
IRAN_NYGDPMKTPKDZG	57	8.949648	6.634574	6.623664
All	446	5.180668	3.270860	3.243295

Bartlett weighted standard deviation: 5.015430

Table 3.4 Coefficient of Variation

Variable	Count	Mean	Std. Dev.	Coefficient of Variation
KOREA_NYGDPMKTPKDZG	59	7.365	4.092	0.556
BRAZIL_NYGDPMKTPKDZG	59	3.972	4.104	1.033
VIETNAM_NYGDPMKTPKDZG	35	6.469	1.529	0.236
CHINA_NYGDPMKTPKDZG	59	8.169	6.816	0.834
INDIA_NYGDPMKTPKDZG	59	5.242	2.912	0.555
TURKEY_NYGDPMKTPKDZG	59	4.691	3.917	0.835
EGYPT_NYGDPMKTPKDZG	59	5.208	2.717	0.522
IRAN_NYGDPMKTPKDZG	57	4.244	8.950	2.109
All	446	5.633	5.181	0.920

3.2 Human Development

The Human Development Index (HDI) does not just rely on per capita gross domestic product to measure development. It is a more general measure of achievements in three key dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. In 2018, 200 countries were ranked according to Human Development Index. Norway was the leader in HDI with 0.954, followed by Switzerland, Ireland and Germany. South Korea ranked 22nd; and Turkey ranked 59th with an index value of 0.806. These countries were among the very high human development (between 0.8 and 1.0). Iran ranked 74th, Brazil ranked 88th, China ranked 94th; Egypt ranked 125th; Vietnam ranked 128th; and India ranked 139th. Iran, Brazil, China and Egypt were among the countries with high human development (between 0.7 and 0.8), and Vietnam and India were among countries with medium human development (between 0.55 and 0.70) (United Nations Development Program (UNDP), *Human Development Report*, 2019).

South Korea has the highest Human Development Index in 1990, as can be seen from the highest intercept term (0.553) in the trend line. Brazil has the highest number among the eight in 1990 (the first year that comparable data are available). The slope (the coefficient associated with trend) is highest in China (0.010). There is an improvement of 0.01 in the index on average during the 1990-2018 period. China is followed by Turkey (0.009), India (0.006), Iran (0.008), and Vietnam (0.008), South Korea (0.006), Egypt (0.006), and Brazil (0.005). The lower rate of increase in South Korea is related to its higher level at the start.

Figure 3.4 Human Development Index

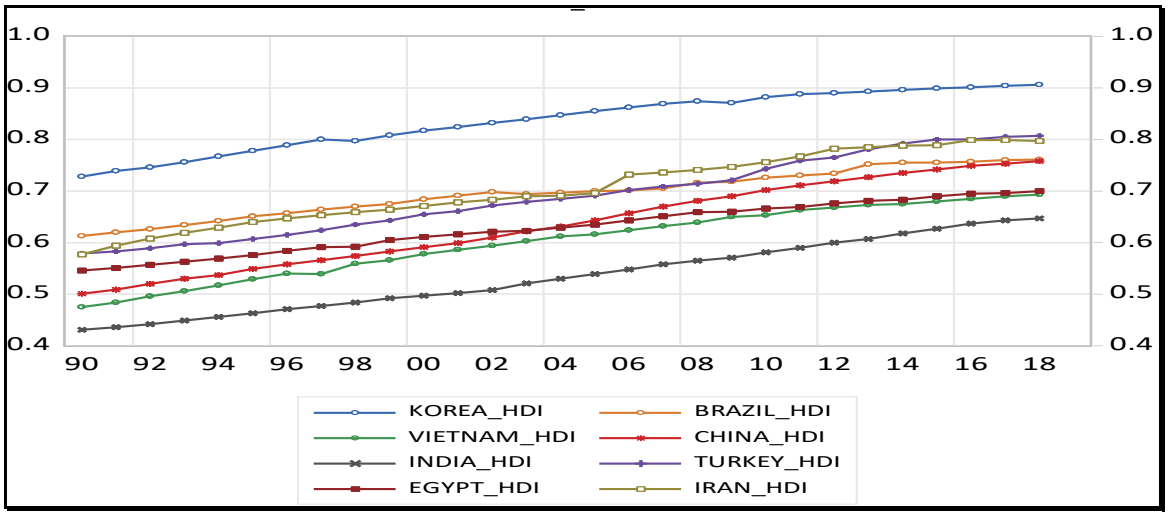


Table 3.5 Trends in Human Development Index

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	0.465	0.208	0.379	0.182	0.352	0.553	0.300	0.251
	(0.006)	(0.005)	(0.004)	(0.004)	(0.009)	(0.010)	(0.007)	(0.009)
	[76.3]	[39.5]	[100.5]	[41.2]	[41.3]	[53.4]	[41.5]	[27.5]
@TREND	0.005	0.010	0.006	0.008	0.008	0.006	0.009	0.008
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[38.5]	[82.9]	[67.5]	[81.4]	[42.0]	[27.9]	[54.8]	[38.9]
Observations:	29	29	29	29	29	29	29	29
R-squared:	0.982	0.996	0.994	0.996	0.985	0.966	0.991	0.982
F-statistic:	1484.7	6868.0	4553.9	6627.0	1766.1	776.1	2999.2	1512.9
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.3 Structural Transformation

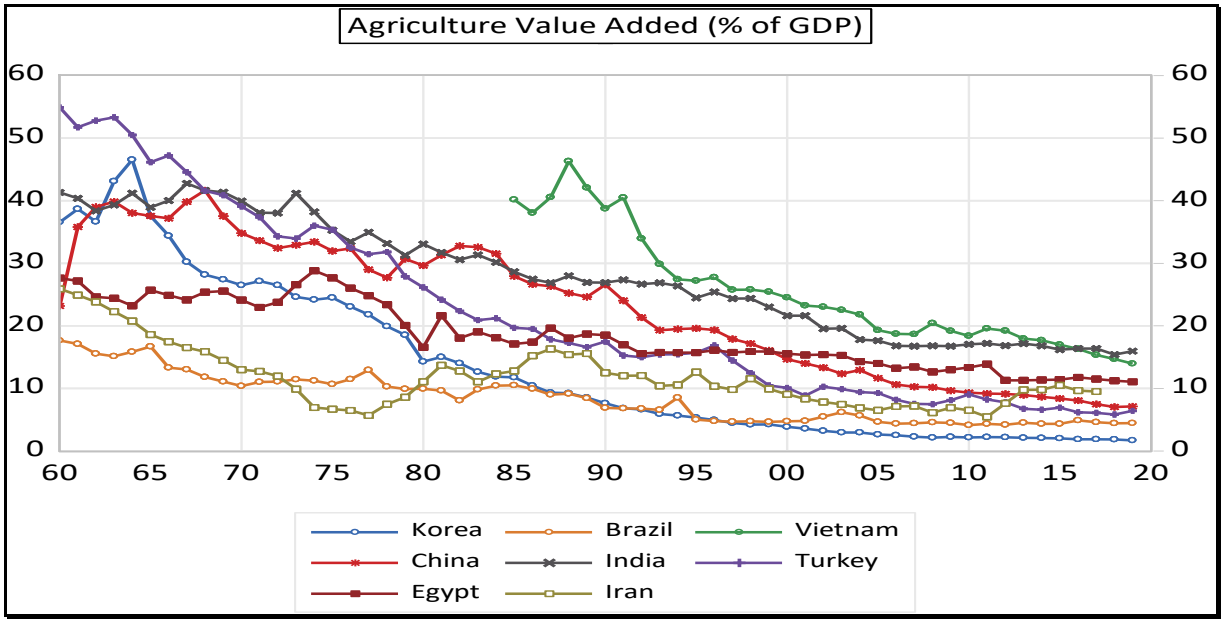
There are typical patterns of development and stylized facts. Shares of sectoral value added in GDP, shares of sectoral employment in total employment, urbanization rate, life expectancy at birth, school enrolment rate, birth rate, infant mortality rate, fertility rate, daily calorie supply are among the widely used indicators (Chenery, 1960; Chenery and Syrquin, 1975; Chenery, Robinson and Syrquin, 1986). The relationship (in general quadratic) between these indicators and per capita GDP and population are studied in detail. Here, shares of sectoral valued added in GDP, and shares of sectoral employment in total employment are used. The other simplification is just to study the trends in these indicators.

3.3.1 Shares of Sectoral Value added in GDP

Economic development manifests itself in a number of ways. A change in the structure of production is the most obvious one. As economies develop, the share of agriculture in total value added decreases, and share of industry and services increase. A similar pattern is also observed in employment. The share of agriculture in total employment decreases, while share

of industry and services increase. It is natural to think that policies adopted may play a role in the speed and shape of this transformation. It is important to observe the extent of this effect.

Figure 3.5 Agriculture Value Added (% of GDP)



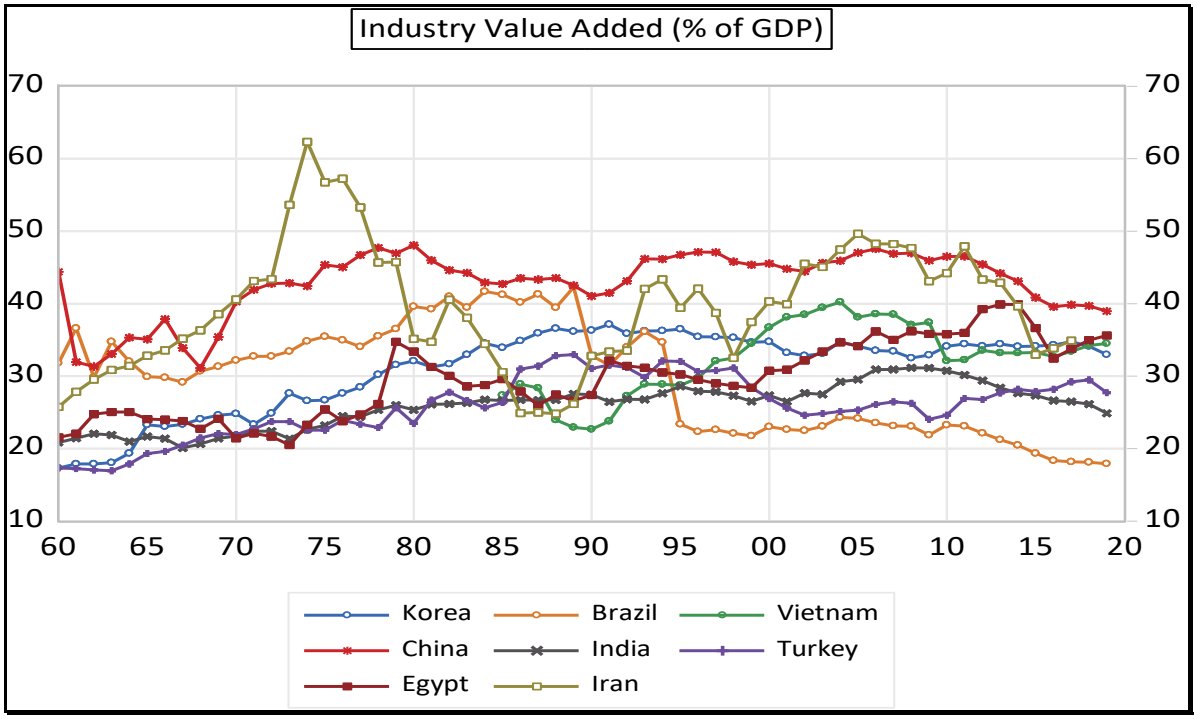
The share of agricultural value added decreases in all the countries under study. The intercept term shows the estimated share in 1990, and the slope shows the estimated average change in a year. For example, share of agriculture in South Korea was 33.6% of GDP in 1990, and the share decreases by 0.68 on average every year. In China, the share of agriculture was 40.7% of GDP in 1990, and the share decreases on average by 0.60 every year. The rate of decrease in the share of agriculture in GDP was even higher in Turkey (0.82) and Vietnam (0.83).

Table 3.6 Trends in Share of Agriculture in GDP (%)

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	14.593	40.671	26.917	42.732	17.307	33.638	46.490	60.103
	(0.355)	(0.806)	(0.451)	(0.451)	(0.947)	(1.241)	(1.168)	(2.403)
	[41.1]	[50.5]	[59.6]	[94.7]	[18.3]	[27.1]	[39.8]	[25.0]
@TREND	-0.209	-0.599	-0.287	-0.505	-0.196	-0.679	-0.821	-0.825
	(0.010)	(0.024)	(0.013)	(0.013)	(0.029)	(0.036)	(0.034)	(0.056)
	[-20.2]	[-25.4]	[-21.7]	[-38.3]	[-6.8]	[-18.7]	[-24.1]	[-14.8]
Observations:	60	60	60	60	58	60	60	35

R-squared:	0.875	0.918	0.891	0.962	0.455	0.858	0.909	0.869
F-statistic:	406.5	645.4	472.7	1467.8	46.7	350.2	578.4	219.8
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 3.6 Industry Value Added (% of GDP)

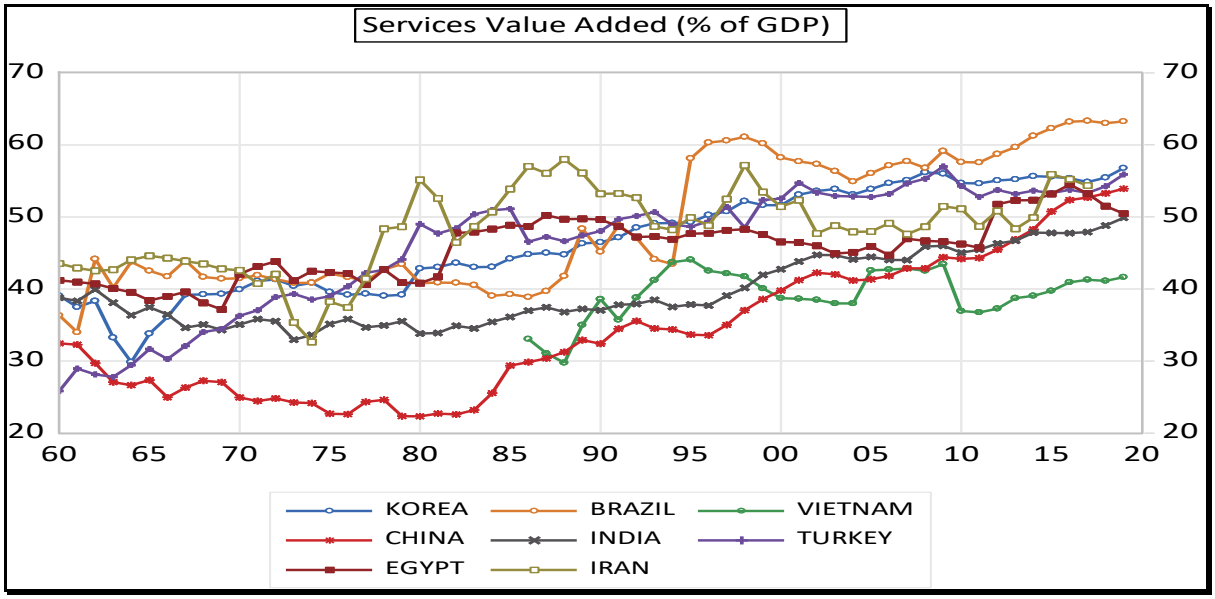


The share of industrial value added decreases in Brazil, but increases in all other countries under study during 1960-2019 period. This variable is most likely to require a non-linear relationship than others. The linearity assumption may be the reason for a relatively lower determination coefficients, although significant at the five percent level with the exception of Iran. The intercept term shows the estimated share in 1960, and the slope shows the estimated average change in a year. For example, the share of industry in South Korea was 23.5% of GDP in 1960, and the share increases by 0.25 on average every year. In China, the share of agriculture was 39.2% of GDP in 1960, and the share increases on average by 0.12 every year. The rate of increase in the share of industry in GDP was higher in Vietnam (0.30) (note that the start date is 1985) and Egypt (0.26). An opposite trend is observed in Brazil. The share of industry was 38.3 in 1960, and the share decreased by about 0.3 every year.

Table 3.7 Trends in the Share of Industrial Value Added in GDP

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	38.348	39.217	21.835	21.650	36.736	23.526	21.219	19.879
	(1.369)	(1.008)	(0.646)	(0.433)	(2.193)	(0.892)	(0.847)	(2.833)
	[28.0]	[38.9]	[33.8]	[49.9]	[16.8]	[26.4]	[25.1]	[7.0]
@TREND	-0.295	0.122	0.261	0.144	0.095	0.251	0.155	0.299
	(0.040)	(0.029)	(0.019)	(0.013)	(0.066)	(0.026)	(0.025)	(0.066)
	[-7.4]	[4.1]	[13.8]	[11.4]	[1.4]	[9.6]	[6.3]	[4.6]
Observations:	60	60	60	60	58	60	60	35
R-squared:	0.484	0.227	0.767	0.690	0.035	0.616	0.404	0.387
F-statistic:	54.4	17.0	191.0	129.4	2.1	92.9	39.3	20.8
Prob(F-stat):	0.000	0.000	0.000	0.000	0.157	0.000	0.000	0.000

Figure 3.7 Services Value Added (% of GDP)



The share of services value added increases in all other countries under study. The intercept term shows the estimated share in 1960, and the slope shows the estimated average change in a year. For example, the share of services in South Korea was 34.8% of GDP in 1960, and the share increases by 0.4 on average every year. In China, the share of agriculture was 20.1% of GDP in 1960, and the share increases on average by 0.48 every year. The rate of increase in the

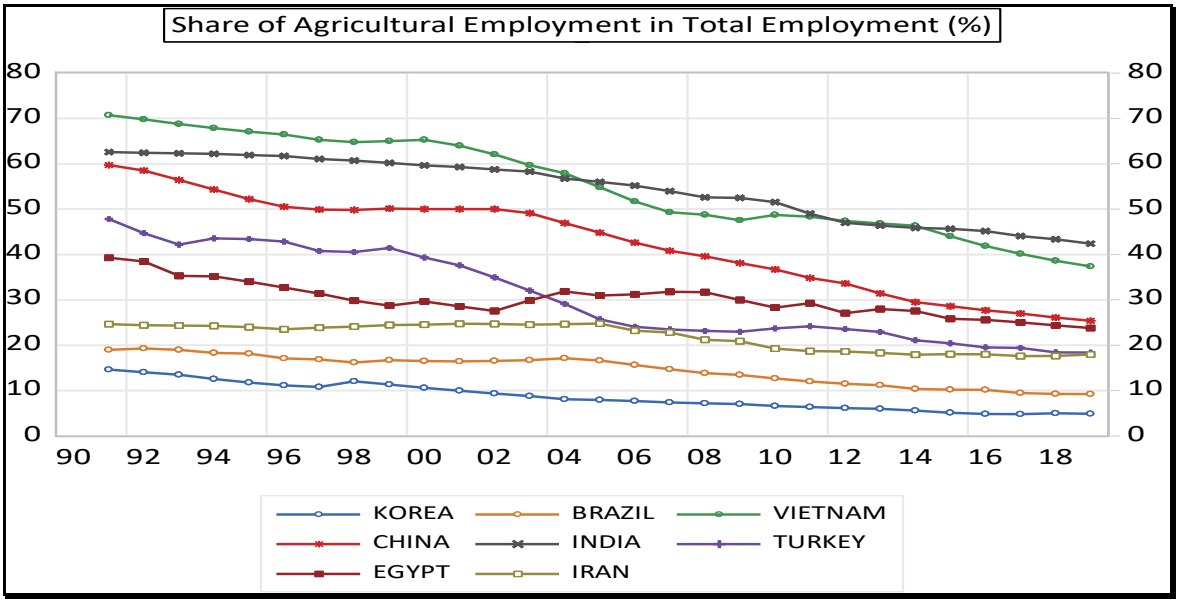
share of services in GDP was higher in Iran (0.42), Egypt (0.40) and Brazil (35.6). The share of services value added in GDP increases on average 0.46 per year in Brazil, 0.48 in China, and 0.46 in Turkey.

Table 3.8 Trends in Shares of Services Value Added in GDP

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	35.608 (1.091) [32.6]	20.111 (1.115) [18.0]	39.771 (0.656) [60.6]	32.668 (0.659) [49.6]	42.620 (1.193) [35.7]	34.785 (0.474) [73.5]	32.523 (0.904) [36.0]	33.128 (2.451) [13.5]
@TREND	0.458 (0.032) [14.4]	0.477 (0.033) [14.6]	0.200 (0.019) [10.4]	0.237 (0.019) [12.3]	0.200 (0.036) [5.5]	0.400 (0.014) [28.9]	0.458 (0.026) [17.3]	0.146 (0.056) [2.6]
Observations :	60	60	60	60	58	60	60	34
R-squared:	0.781	0.787	0.651	0.722	0.353	0.935	0.838	0.173
F-statistic:	206.6	214.2	108.2	150.8	30.5	835.3	299.8	6.7
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014

3.3.2 Shares of Sectoral Employment in Total Employment

Figure 3.8 Share of Agricultural Employment in Total Employment (%)



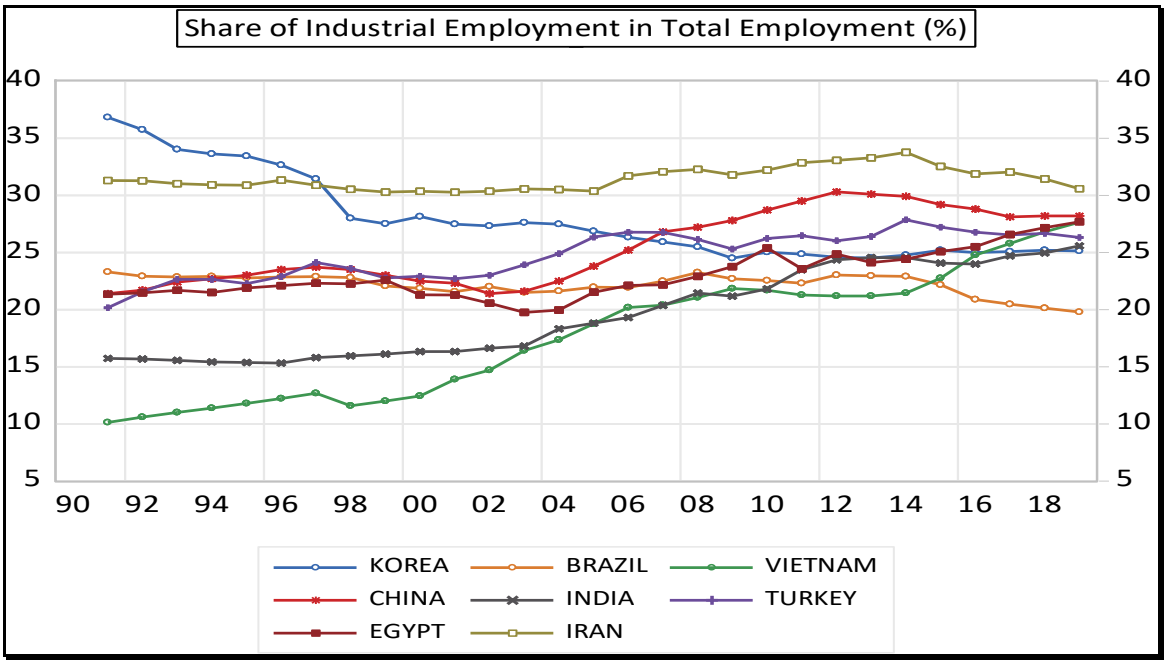
In addition to shares of sectoral value added in GDP, shares of sectoral employment in total employment are also to be studied to address the issue of structural transformation. decreases in all the countries under study. The World Bank, World Development Indicators data on the shares of sectors in total employment are available for a shorter period, 1991-2019.

As in the share of agricultural value added in GDP, the share of agricultural employment in total employment has a negative trend in all countries. In Korea, the share of agriculture in total employment decreases by 0.35 per year. The decrease reaches to 1.2 a year in China and Vietnam, and 1.1 in Turkey. In India the rate of decrease was 0.8.

Table 3.9 Trends in Shares of Agricultural Employment in Total Employment

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	31.519	97.801	47.501	90.286	35.567	24.409	81.170	110.724
	(0.877)	(1.926)	(2.048)	(1.464)	(1.374)	(0.604)	(2.724)	(1.978)
	[35.9]	[50.8]	[23.2]	[61.7]	[25.9]	[40.4]	[29.8]	[56.0]
@TREND	-0.376	-1.228	-0.387	-0.797	-0.304	-0.350	-1.121	-1.230
	(0.019)	(0.042)	(0.045)	(0.032)	(0.030)	(0.013)	(0.060)	(0.043)
	[-19.6]	[-29.2]	[-8.7]	[-24.9]	[-10.1]	[-26.5]	[-18.8]	[-28.5]
Observations:	29	29	29	29	29	29	29	29
R-squared:	0.934	0.969	0.735	0.958	0.791	0.963	0.929	0.968
F-statistic:	384.1	851.5	74.8	621.1	102.2	703.8	355.0	810.2
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 3.9 Share of Industrial Employment in Total Employment (%)

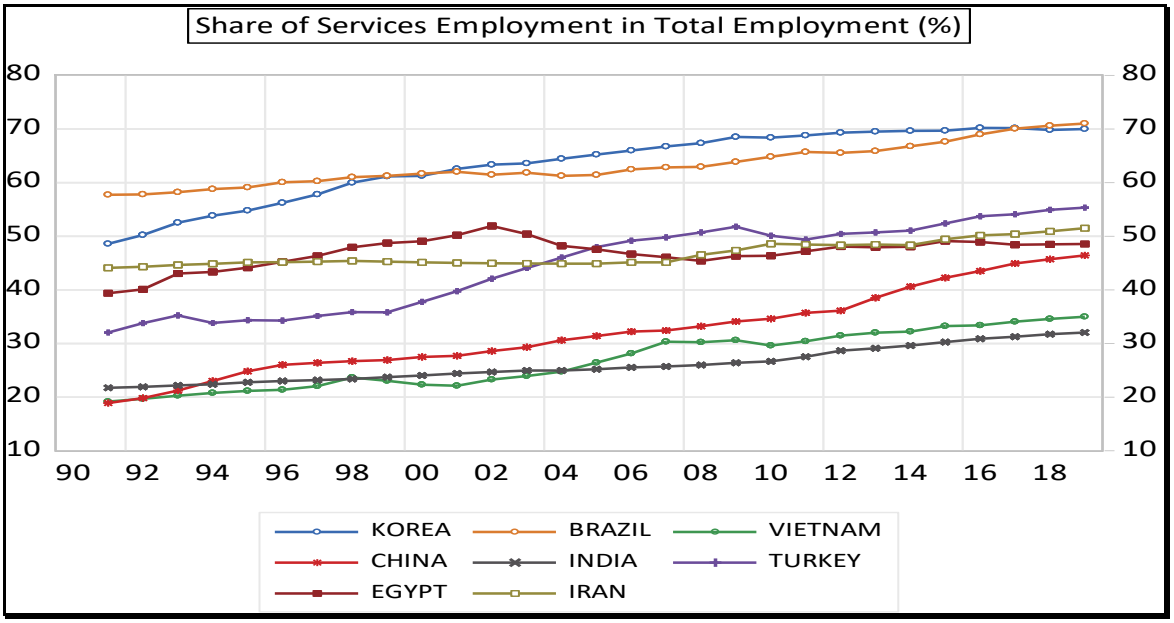


The share of industrial employment in total employment decreases in Brazil (by 0.06) and South Korea (by 0.39), and increases in China (by 0.32), Egypt (by 0.20), India (by 0.43), Iran (by 0.06), Turkey (by 0.22), and Vietnam (by 0.63).

Table 3.10 Share of Industrial Employment in Total Employment (%)

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	24.941 (0.787) [31.7]	10.871 (1.625) [6.7]	14.101 (1.300) [10.8]	0.207 (1.096) [0.2]	28.557 (0.855) [33.4]	45.411 (1.800) [25.2]	14.992 (0.933) [16.1]	-10.447 (1.253) [-8.3]
@TREND	-0.061 (0.017) [-3.6]	0.323 (0.035) [9.1]	0.198 (0.028) [7.0]	0.431 (0.024) [18.0]	0.064 (0.019) [3.5]	-0.389 (0.039) [-9.9]	0.217 (0.020) [10.6]	0.627 (0.027) [22.9]
Observations:	29	29	29	29	29	29	29	29
R-squared:	0.320	0.754	0.642	0.923	0.306	0.783	0.807	0.951
F-statistic:	12.7	82.9	48.4	323.9	11.9	97.7	113.1	524.5
Prob(F-stat):	0.001	0.000	0.000	0.000	0.002	0.000	0.000	0.000

Figure 3.10 Share of Services Employment in Total Employment (%)



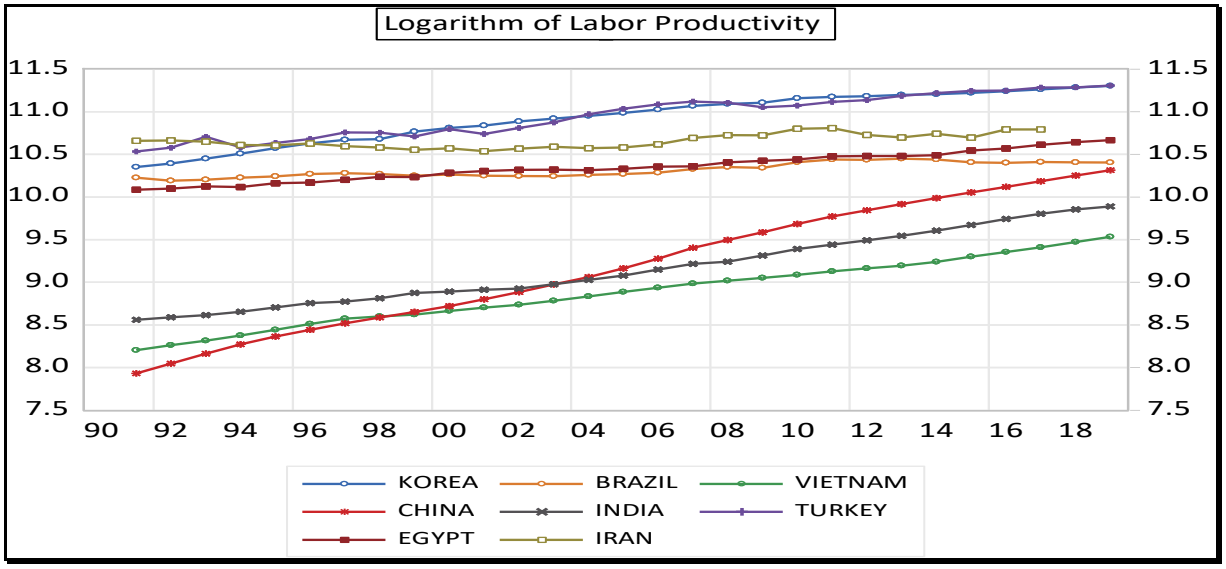
As the share of services value added in GDP, the share of services employment in total employment increases in all other countries under study. The share of services employment in total employment increases by 0.43 a year in Brazil, by 0.91 a year in China, by 0.19 a year in Egypt, by 0.37 a year in India, by 0.24 a year in Iran, by 0.74 a year in Korea, by 0.90 a year in Turkey, and by 0.60 a year in Vietnam.

Table 3.11 Share of Services Employment in Total Employment (%)

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	43.541 (1.021) [42.7]	-8.672 (1.381) [-6.3]	38.398 (2.412) [15.9]	9.507 (0.702) [13.5]	35.875 (1.014) [35.4]	30.180 (2.132) [14.2]	3.839 (2.160) [1.8]	-0.277 (1.065) [-0.3]
@TREND	0.437 (0.022) [19.6]	0.905 (0.030) [30.0]	0.190 (0.053) [3.6]	0.366 (0.015) [23.9]	0.239 (0.022) [10.8]	0.739 (0.047) [15.9]	0.904 (0.047) [19.2]	0.603 (0.023) [25.9]
Observations:	29	29	29	29	29	29	29	29
R-squared:	0.934	0.971	0.324	0.955	0.812	0.903	0.932	0.961
F-statistic:	383.7	898.3	12.9	570.2	116.4	251.6	367.2	671.9
Prob(F-stat):	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000

3.4 Productivity

Figure 3.11 Trends in Productivity (Log Scale)



One of the main goals of industrial policies is to increase productivity and hence competitiveness on a global scale. Any measure of success of a policy should include the effect on productivity. Ideally, total factor productivity comparisons can be used, but those figures are not available for all the countries. The World Bank, World Development Indicators have labor productivity variable as measured by GDP constant 2020 US dollars per worker. Logarithmic trend equations are used to estimate annual growth in labor productivity during 1991-2019 period. Labor productivity increased at an annual average of 8.6% in China, 4.9% in India, 4.4% in Vietnam, 3.4% in South Korea, 2.8% in Turkey, 2.0% in Egypt, 0.9% in Brazil, and 0.7% in Iran.

Table 3.12 Trends in Productivity

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	9.915	5.311	9.470	6.970	10.348	9.413	9.670	6.876
	(0.037)	(0.043)	(0.021)	(0.052)	(0.069)	(0.061)	(0.054)	(0.025)
	[271.0]	[123.5]	[448.4]	[134.3]	[149.4]	[154.4]	[180.1]	[271.6]
@TREND	0.009	0.086	0.020	0.049	0.007	0.034	0.028	0.044
	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
	[11.2]	[91.7]	[42.6]	[42.8]	[4.6]	[25.3]	[24.3]	[80.3]

Observations:	29	29	29	29	27	29	29	29
R-squared:	0.822	0.997	0.985	0.985	0.454	0.960	0.956	0.996
F-statistic:	125.0	8408.8	1812.0	1833.6	20.8	639.7	590.4	6448.6
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.5 Economic Complexity

The index of Economic Complexity attempts to measure the amount of productive knowledge that each country holds (see, Hausmann, Hidalgo, Bustos, Coscia, Chung, Jimenez, Simoes, Yildirim, *The Atlas of Economic Complexity*, Harvard & MIT, Puritan Press. Cambridge, Massachusetts, 2011 for the book). This measure for productive knowledge can account for the enormous income differences between the nations of the world and has the capacity to predict the rate at which countries will grow. (pp. 7 and 8). They stress that economic complexity is not about export-oriented growth, openness, export diversification or country size (pp. 29). Their cross-country growth equations with these variables yield significant coefficients for the economic complexity index. Latest data are obtained from their web-site <http://atlas.media.mit.edu/en/rankings/country/eci/> which includes data for the 1964-2017 period for most countries.

Trends in economic complexity index is another important criterion to study the effectiveness of industrial policies. However, a linear trend may not be the most appropriate function. Determination coefficients are much lower, and in cases of India, Vietnam, and Iran they are not significant at the one percent level. Estimated values in 1960 are positive for China, India, and Korea, and negative for others. Economic complexity index increased by 0.023 in Brazil, 0.021 in South Korea, 0.019 in Turkey, 0.006 in China, 0.005 in Iran and 0.002 in India. On the other hand, the index decreased by 0.006 in Egypt and 0.005 in Vietnam.

Figure 3.12 Economic Complexity Index

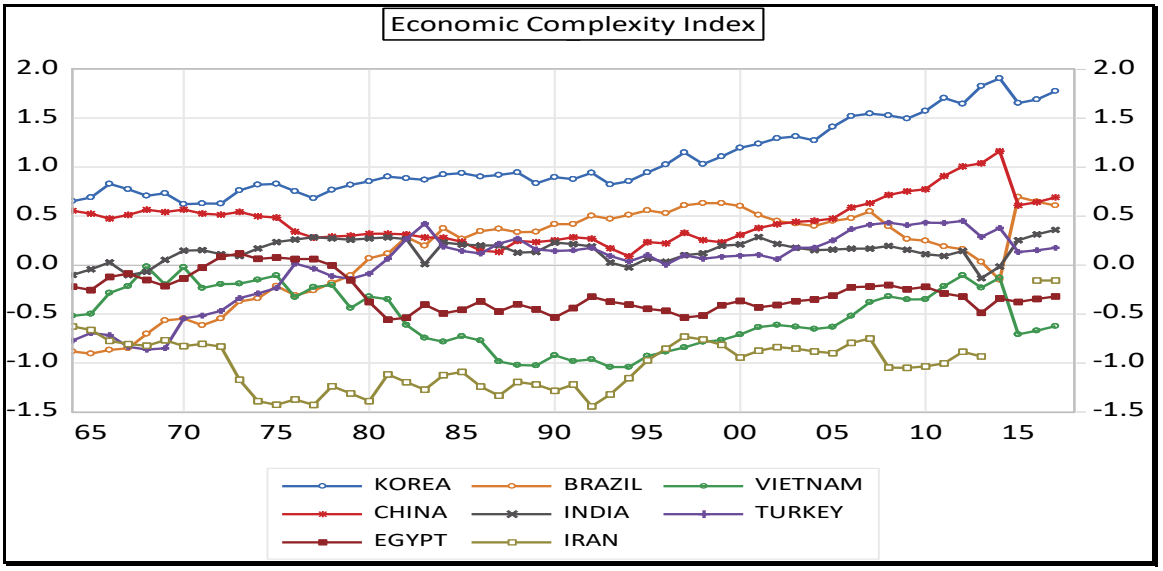


Table 3.13 Trends in Economic Complexity

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	-0.588	0.273	-0.123	0.098	-1.162	0.419	-0.569	-0.376
	(0.089)	(0.066)	(0.050)	(0.034)	(0.084)	(0.042)	(0.065)	(0.090)
	[-6.6]	[4.2]	[-2.5]	[2.9]	[-13.8]	[9.9]	[-8.8]	[-4.2]
@TREND	0.023	0.006	-0.006	0.002	0.005	0.021	0.019	-0.005
	(0.003)	(0.002)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.003)
	[9.0]	[3.0]	[-3.8]	[1.6]	[2.1]	[17.4]	[9.9]	[-2.0]
Observations:	54	54	54	54	52	54	54	54
R-squared:	0.607	0.151	0.218	0.046	0.083	0.853	0.654	0.069
F-statistic:	80.2	9.3	14.5	2.5	4.5	302.3	98.3	3.9
Prob(F-stat):	0.000	0.004	0.000	0.120	0.039	0.000	0.000	0.054

3.6 Competitiveness Index

3.6.1 UNIDO Competitiveness Performance Index

United Nations Industrial Development Organization (UNIDO) publishes competitiveness performance index for 142 countries. Trends in China (0.012) and Korea (0.007) are higher than others. In Brazil, the trend is negative (0.001). Initial level in Brazil is higher than others.

Figure 3.13 UNIDO Competitiveness Performance Index

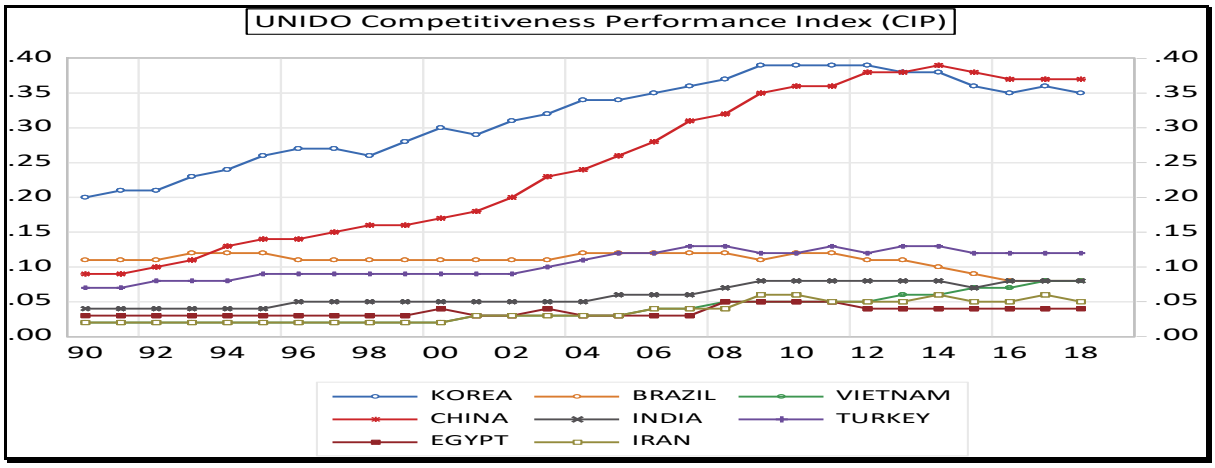


Table 3.14 Trends in UNIDO Competitiveness Index

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	0.143	-0.300	0.011	-0.018	-0.036	0.026	0.011	-0.058
	(0.010)	(0.024)	(0.006)	(0.005)	(0.006)	(0.025)	(0.009)	(0.007)
	[13.7]	[-12.7]	[1.9]	[-3.2]	[-5.8]	[1.0]	[1.2]	[-8.6]
@TREND	-0.001	0.012	0.001	0.002	0.002	0.007	0.002	0.002
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
	[-3.3]	[23.5]	[4.6]	[14.4]	[11.6]	[11.7]	[11.1]	[14.6]
Observations:	29	29	29	29	29	29	29	29
R-squared:	0.286	0.954	0.441	0.885	0.833	0.835	0.819	0.887
F-statistic:	10.8	553.9	21.3	207.2	134.8	136.5	122.5	212.2
Prob(F-stat):	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.6.2 UNIDO Rank of Competitiveness Performance Index

Instead of using the index itself, one may prefer to use the rank among 142 countries. All countries except Brazil have negative trends, ranging from negative 0.36 in Turkey to negative 2.14 in Vietnam. In general, the fit for the equations with ranks are better than the ones using actual index figures.

Figure 3.14 Rank of UNIDO Competitiveness Performance Index

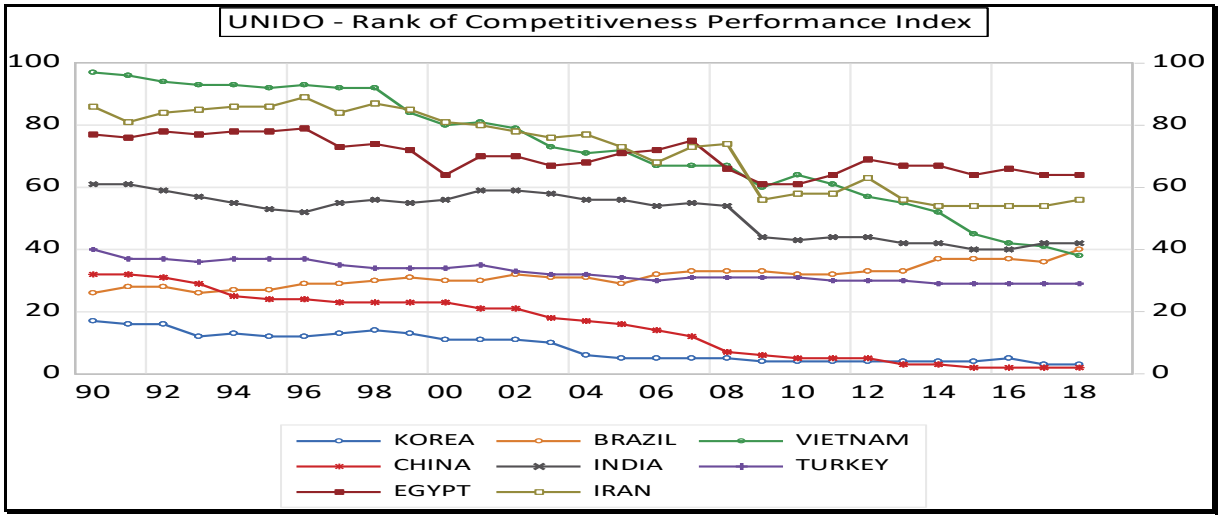


Table 3.15 Trends in Rank of UNIDO Competitiveness Performance Index

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	14.607	68.447	93.456	83.228	133.898	30.981	48.560	166.587
	(1.350)	(1.985)	(3.304)	(3.724)	(4.710)	(1.629)	(0.928)	(3.290)
	[10.8]	[34.5]	[28.3]	[22.4]	[28.4]	[19.0]	[52.3]	[50.6]
@TREND	0.383	-1.203	-0.532	-0.721	-1.400	-0.511	-0.359	-2.142
	(0.030)	(0.044)	(0.074)	(0.083)	(0.105)	(0.036)	(0.021)	(0.073)
	[12.7]	[-27.1]	[-7.2]	[-8.7]	[-13.3]	[-14.1]	[-17.3]	[-29.2]
Observations:	29	29	29	29	29	29	29	29
R-squared:	0.857	0.965	0.658	0.736	0.868	0.880	0.918	0.969
F-statistic:	161.3	737.0	51.9	75.1	177.3	197.7	300.6	850.4
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.7 Share of Exports in GDP

Increases in labor productivity, economic complexity, and competitiveness are all expected to lead to an increase in exports of goods and services. A more productive, complex, and competitive economy will take its place in the world economy as an exporter of goods and services. Therefore, it may be useful to look at another indicator such as the share of exports of goods and services in GDP.

During 1960-2019 period, there is no significant trend in the share of exports of goods and services in GDP in two countries, Egypt and Iran. Remaining six countries realized significant trends. For example, the trend coefficient, annual increase in the share, was 0.69 in South Korea, 0.49 in China, and 0.45 in Turkey, 0.37 in India, and 0.13 in Brazil. Vietnam has the highest annual change (2.77), but the start date was much later than 1960. It is well known that post-1980 was a period of higher share of exports in almost all the countries.

Figure 3.15 Exports of Goods and Services (% of GDP)

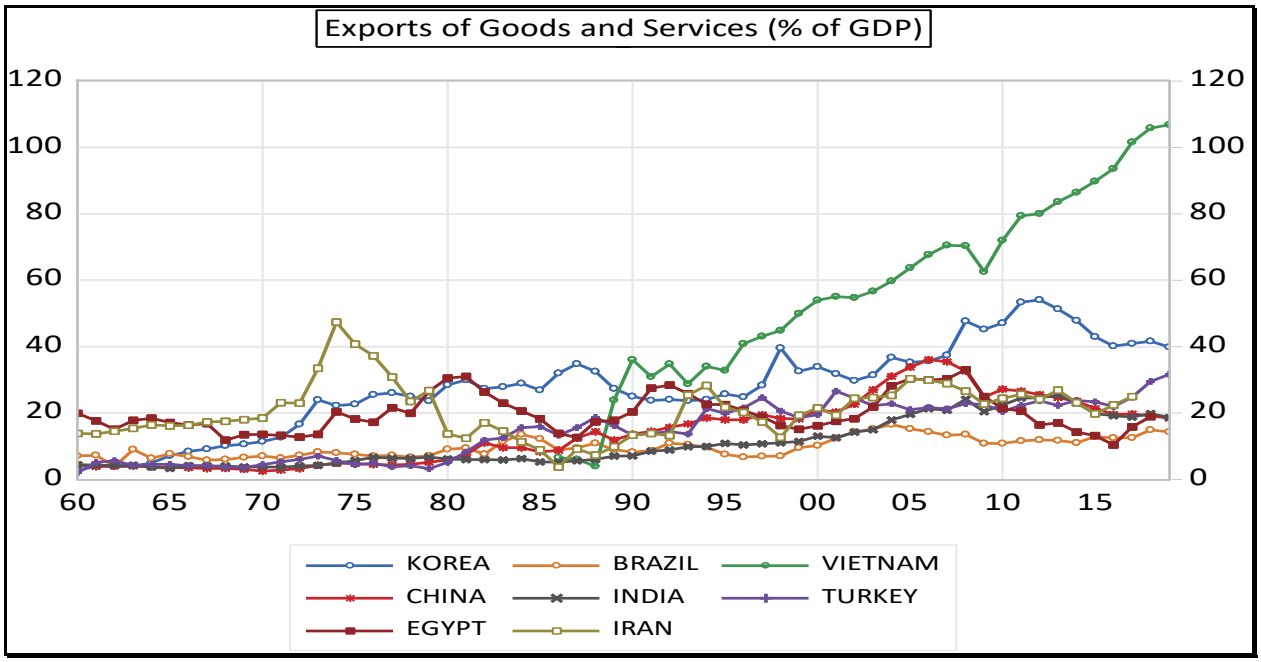


Table 3.16 Trends in Share of Exports of Goods and Services in GDP

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	5.957	-0.226	17.857	-0.064	18.032	7.445	1.180	-60.744
	(0.487)	(1.205)	(1.427)	(0.754)	(2.108)	(1.405)	(0.757)	(4.002)
	[12.2]	[-0.2]	[12.5]	[-0.1]	[8.6]	[5.3]	[1.6]	[-15.2]
@TREND	0.129	0.492	0.067	0.367	0.094	0.689	0.454	2.765
	(0.014)	(0.035)	(0.042)	(0.022)	(0.064)	(0.041)	(0.022)	(0.092)
	[9.1]	[14.0]	[1.6]	[16.6]	[1.5]	[16.8]	[20.5]	[30.1]
Observations:	60	60	59	60	58	60	60	34
R-squared:	0.587	0.771	0.042	0.827	0.037	0.829	0.879	0.966
F-statistic:	82.5	195.4	2.5	276.8	2.2	281.4	419.6	908.2
Prob(F-stat):	0.000	0.000	0.119	0.000	0.146	0.000	0.000	0.000

3.8 KOF Index of Globalization

Globalization has many dimensions; and it may not be possible to measure it with a single indicator. Therefore, researchers try to construct and index using a combination of variables which are relevant. Here, one of the most common measures of globalization, namely the KOF globalization index, is to be utilized to study the effects of globalization. The KOF globalization index was introduced by Dreher (2006) and updated in Dreher, Gaston, and Martens (2008) and Dreher, Gaston, Martens, and Van Boxem (2010). Gygli, Haelg, and Sturm (2018) introduce the differentiation between de facto and de jure measures along the different dimensions of globalization, the differentiation between trade and financial globalization within the economic dimension of globalization and time-varying weighting of the variables entering the index.

As the share of exports of goods and services in GDP, globalization index may be regarded as another summary measure of effectiveness of industrial policies. All 8 countries have positive trends in KOF globalization index during the 1970-2017 period. China leads the pack with a trend coefficient of 1.11, closely followed by South Korea (1.06). Vietnam (0.98), India (0.85), Iran (0.84) follow the leaders. Turkey (0.79), Egypt (0.69), and Brazil (0.513) have slightly lower average annual increases in the index values.

Figure 3.16 KOF Globalization Index

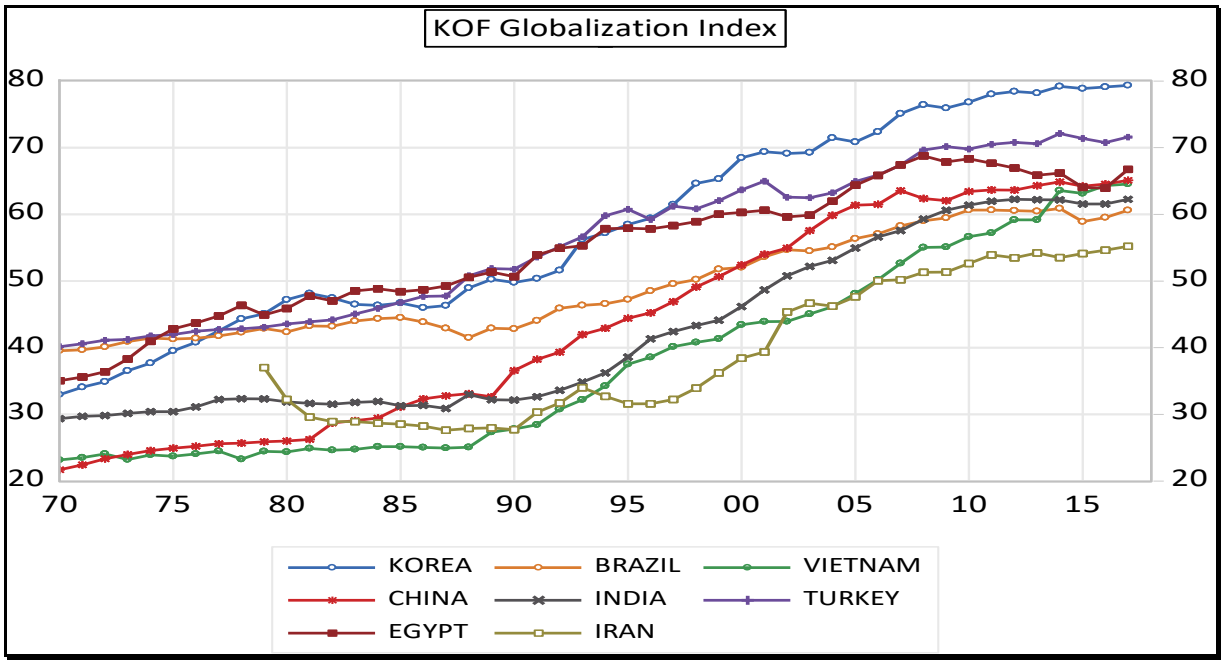


Table 3.17 Trends in KOF Globalization Index

Dep. Var:	BRAZIL	CHINA	EGYPT	INDIA	IRAN	KOREA	TURKEY	VIETNAM
C	31.967 (0.790) [40.5]	6.284 (1.113) [5.6]	31.757 (0.857) [37.1]	14.109 (1.641) [8.6]	7.740 (2.336) [3.3]	22.479 (0.933) [24.1]	29.637 (0.717) [41.3]	5.088 (1.579) [3.2]
@TREND	0.513 (0.022) [23.6]	1.108 (0.031) [36.1]	0.686 (0.024) [29.0]	0.847 (0.045) [18.7]	0.839 (0.059) [14.2]	1.060 (0.026) [41.2]	0.788 (0.020) [39.8]	0.975 (0.044) [22.4]
Observations:	48	48	48	48	39	48	48	48
R-squared:	0.923	0.966	0.948	0.884	0.846	0.974	0.972	0.916
F-statistic:	554.7	1301.6	842.0	350.4	202.8	1696.8	1586.6	501.0
Prob(F-stat):	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.9 Conclusions

South Korea and China generally lead other six countries based on trend analysis of economic indicators such as growth, human development index, economic structural transformation (shares of major sectors in total value added and total employment), economic complexity

index, labor productivity, competitiveness index, share of exports of goods and services in GDP, and globalization index. It is important to state that these countries have successfully utilized industrial policies to achieve these goals.

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4 Industrial Policies and Evaluation of Specific Periods: The Case of South Korea

Two distinct approaches may be followed to test the significance of industrial policies. The first approach assumes no prior knowledge of specific periods (trends with unknown breaks). The second approach assumes that specific periods of policies are known to the researcher, and it is to be checked if trends are different in different periods (See Methodological Appendix).

Weiss (2011, 2015) identifies 4 periods in South Korea. According to Weiss, during the 1960-1973 period, priorities were exports and key sectors were labor-intensive manufacturers. On the other hand, main instruments were import tariff protection, export subsidies, tariff-refunds, and subsidized credit and export targeting (Weiss, 2011, Table 7.1, Weiss, 2015, pp. 7). The priorities during the second period, 1973-1980, were heavy and chemical industries, with priority sectors steel, petrochemicals, nonferrous metals, shipbuilding, electronics and machinery and priority firms selected large enterprises. In addition to main instruments used during the earlier period, of policy loans to fund priority sectors and firms, and tax credits as investment incentives were also used as main policy instruments. During the 1980-1990 period priorities moved to high technology exports sectors, and small and medium enterprises. Main instruments used during this period were import liberalization, incentives for research and development, direct lending, and removal of restrictions on foreign investment. From 1990, priorities were private sector-led development, competitiveness in international arena. Main instruments were supporting research and development, open capital account, and financial sector reforms. These four periods are used in this study.

4.1 Industrial Policies and Economic Growth in South Korea

As suggested in sub-sections on the methodology, first, the trend line for the entire period is estimated. Then, it will be tested if there are breaks in the trend. Finally, using dummy variables, we will study if trends are different in different periods.

Average annual growth rate was 7.5% during 1960-2019 period. Residuals (Actual-Fitted) show overestimation at the beginning (1960-1972) and at the end of the period (2008-2019), and underestimation around the middle of the period (1973-2007). This is a clear indication that there needs to be more than one trend equation for these 60 years. Recursive coefficients also support that trend coefficient is not the same constant for the entire period.

Least squares with breaks indicate four breaks (five distinct periods). Average annual growth rates are 8.4% during the period of 1960-1968; 10.1% during 1969-1979, 9.5% during 1980-1993, 5.4% during 1994-2006, and 3.1% during the 2007-2019 period. The 1960-1993 period has an average higher than the average annual growth rate for the 1960-2019 period, and the 1994-2019 period has a relatively lower growth rate.

Table 4.1 Logarithmic Trend for Real GDP (2020 Constant US dollars) in Korea

Dependent Variable: LOG(KOREA-Real GDP)
Method: Least Squares
Date: 07/24/20 Time: 20:05
Sample (adjusted): 1960 2019
Included observations: 60 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.11917	0.055398	435.3790	0.0000
@TREND	0.074630	0.001619	46.08329	0.0000

R-squared	0.973415	Mean dependent var	26.32076
Adjusted R-squared	0.972956	S.D. dependent var	1.321038
S.E. of regression	0.217244	Akaike info criterion	-0.182830
Sum squared resid	2.737296	Schwarz criterion	-0.113019
Log likelihood	7.484903	Hannan-Quinn criter.	-0.155523
F-statistic	2123.669	Durbin-Watson stat	0.031834
Prob(F-statistic)	0.000000		

Figure 4.1 Logarithmic Trend for Real GDP - Actual, Predicted, and Residuals

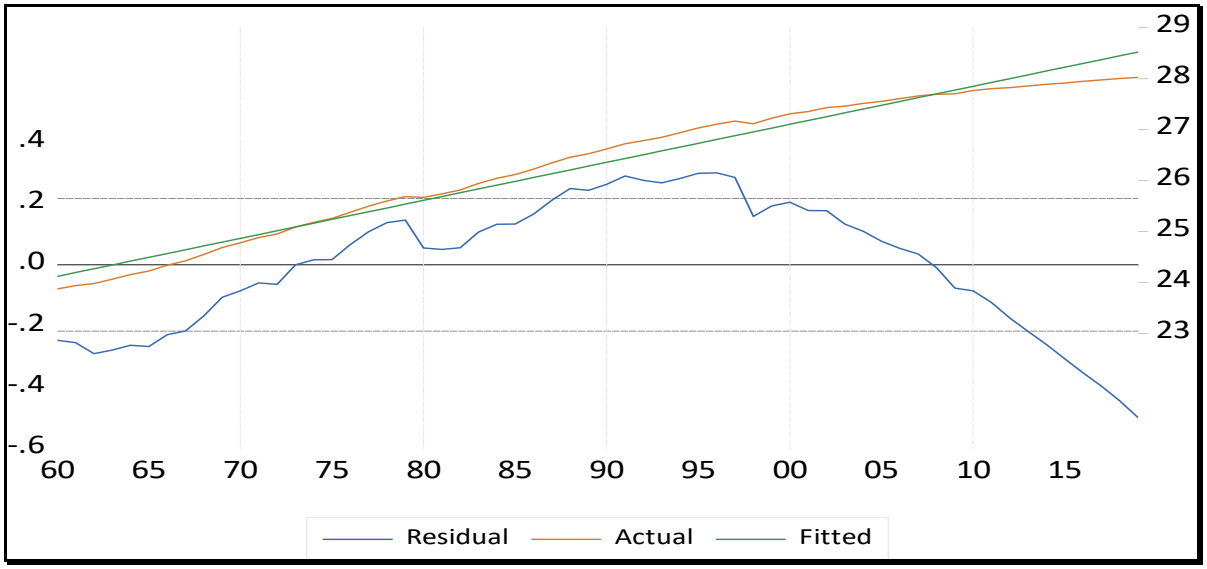


Figure 4.2 Recursive Coefficients for Trend

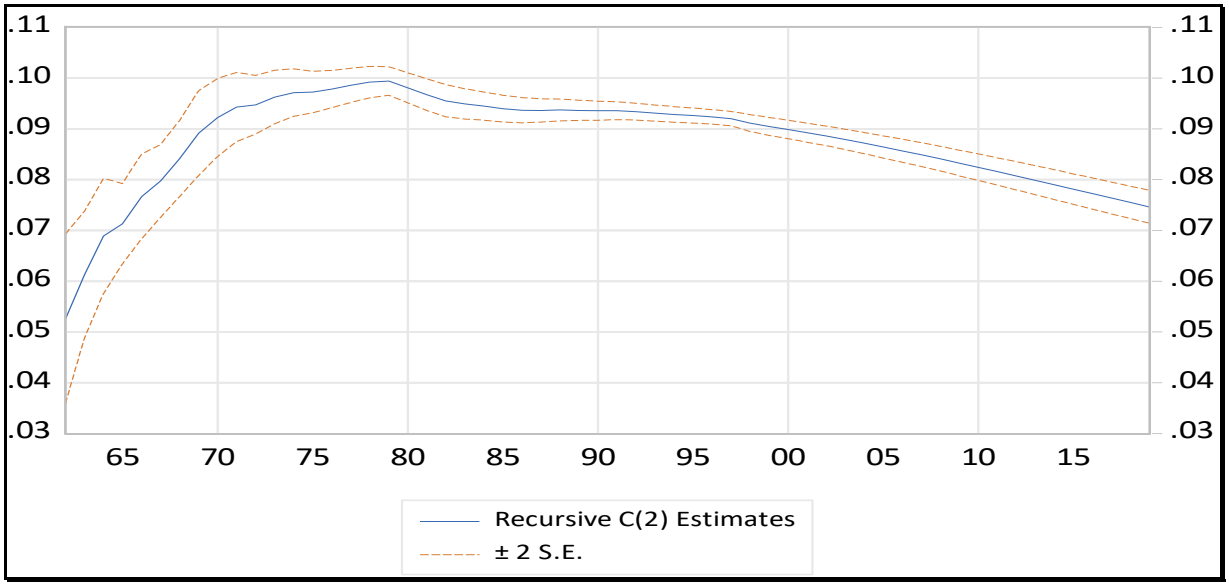


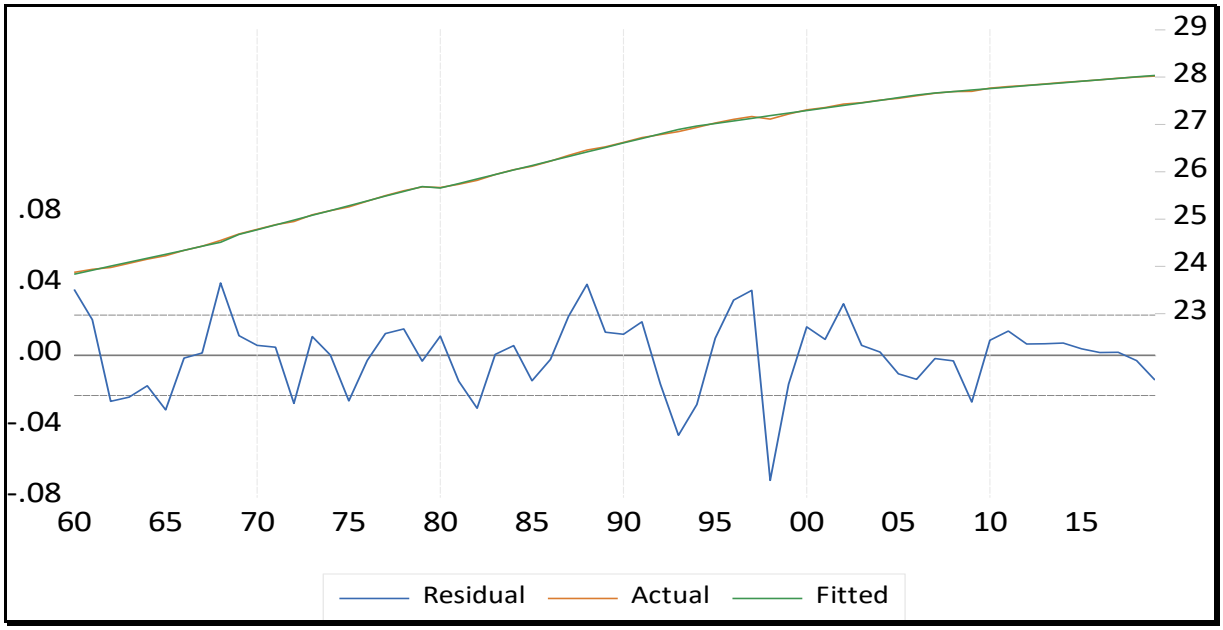
Table 4.2 Real GDP - Trends with Breaks

Dependent Variable: LOG(KOREA-Real GDP)
Method: Least Squares with Breaks
Date: 07/16/20 Time: 10:15
Sample (adjusted): 1960 2019
Included observations: 60 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1969, 1980, 1994, 2007
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1968 -- 9 obs				
C	23.83519	0.013937	1710.220	0.0000
@TREND	0.084117	0.002927	28.73513	0.0000
1969 - 1979 -- 11 obs				
C	23.76212	0.031030	765.7717	0.0000
@TREND	0.101292	0.002162	46.85147	0.0000
1980 - 1993 -- 14 obs				
C	23.74981	0.040297	589.3712	0.0000
@TREND	0.095309	0.001503	63.39832	0.0000
1994 - 2006 -- 13 obs				
C	25.11660	0.067525	371.9600	0.0000
@TREND	0.054407	0.001681	32.37010	0.0000
2007 - 2019 -- 13 obs				
C	26.20537	0.089303	293.4418	0.0000
@TREND	0.031036	0.001681	18.46517	0.0000

R-squared	0.999750	Mean dependent var	26.32076
Adjusted R-squared	0.999705	S.D. dependent var	1.321038
S.E. of regression	0.022675	Akaike info criterion	-4.584090
Sum squared resid	0.025708	Schwarz criterion	-4.235033
Log likelihood	147.5227	Hannan-Quinn criter.	-4.447555
F-statistic	22245.12	Durbin-Watson stat	1.457444
Prob(F-statistic)	0.000000		

Figure 4.3 Real GDP- Trends with Breaks - Actual, Fitted, and Residuals



Equations for different periods may be derived from a single equation. The first column has the equation for the entire period (1960-2019). The second column has the equation with dummy variables for the constant; there is a common trend. The common trend is 5.3%. The intercept for the 1960-1972 period is 24.055; dummy variables for other periods are all equal to zero (KOREA_D_19731979=KOREA_D_19801989=KOREA_D_19902020=0). Using the equation from the second column, equations for individual periods may be derived. The intercept for the second period 24.537=24.055+0.482 (KOREA_D_19731979=1, other dummy variables=0). The intercept for the 1980-1989 period is 24.792=24.055+0.737, and the intercept for the 1990-2020 period is 25.108=24.055+1.053. It is also possible to estimate four different equations for four periods, but because of smaller number of observations in each case, the standard errors of parameter estimates will be larger. In a similar way, four equations for four different periods with varying slopes and a common intercept may be obtained from the equation on the third column. Finally, equations with both varying intercepts and slopes may be obtained from the equation on the fourth column.

Table 4.3 Trends with Dummy Variables for Periods with Different Industrial Policies

Dep. Var:	LOG(KOREA -Real GDP)	LOG(KOREA -Real GDP)	LOG(KOREA -Real GDP)	LOG(KOREA -Real GDP)
C	24.119 (0.055) [435.4]	24.055 (0.037) [661.2]	24.141 (0.091) [266.0]	23.804 (0.029) [812.3]
@TREND	0.075 (0.002) [46.1]	0.053 (0.002) [22.1]	0.054 (0.013) [4.0]	0.095 (0.004) [22.8]
KOREA_D_19731979		0.482 (0.061) [7.8]		-0.056 (0.172) [-0.3]
KOREA_D_19801989		0.737 (0.067) [11.0]		-0.145 (0.155) [-0.9]
KOREA_D_19902020		1.053 (0.100) [10.5]		1.558 (0.061) [25.6]
@TREND*KOREA_D_19731979			0.024 (0.011) [2.2]	0.007 (0.011) [0.7]
@TREND*KOREA_D_19801989			0.025 (0.011) [2.3]	0.004 (0.007) [0.6]
@TREND*KOREA_D_19902020			0.019 (0.012) [1.6]	-0.048 (0.004) [-11.1]
Observations:	60	60	60	60
Sum of squared residuals	2.737296	0.799165	2.253856	0.162527
R-squared:	0.973	0.992	0.978	0.998
F-statistic:	2123.7	1757.8	614.4	4698.7
Prob(F-stat):	0.000	0.000	0.000	0.000

Table 4.4 Equations Derived for Four Periods

Periods	intercept	intercept	intercept	intercept
1960-1972		24.055	24.141	23.804
1973-1979		24.537		23.748
1980-1989		24.792		23.659
1990-2019		25.108		25.362
1960-2019	24.119			
	trend	trend	trend	trend
1960-1972		0.053	0.054	0.095
1973-1979			0.078	0.102
1980-1989			0.079	0.099
1990-2019			0.073	0.047
1960-2019	0.075			

Estimation Command:
==========
LS LOG(KOREA_NYGDPMKTPKD) C KOREA_D_19731979 KOREA_D_19801989 KOREA_D_19902020 @TREND @TREND*KOREA_D_19731979 @TREND*KOREA_D_19801989 @TREND*KOREA_D_19902020

Estimation Equation:
==========
LOG(KOREA_NYGDPMKTPKD) = C(1) + C(2)*KOREA_D_19731979 + C(3)*KOREA_D_19801989 + C(4)*KOREA_D_19902020 + C(5)*@TREND + C(6)*@TREND*KOREA_D_19731979 + C(7)*@TREND*KOREA_D_19801989 + C(8)*@TREND*KOREA_D_19902020

Substituted Coefficients:
==========
LOG(KOREA_NYGDPMKTPKD) = 23.8040290622 - 0.0559137812533*KOREA_D_19731979 - 0.145094460754*KOREA_D_19801989 + 1.55779039899*KOREA_D_19902020 + 0.0947370573115*@TREND + 0.00748172181842*@TREND*KOREA_D_19731979 + 0.0044057995929*@TREND*KOREA_D_19801989 - 0.0475578017348*@TREND*KOREA_D_19902020

Wald Test:
Equation: ZANDB_D6_TR_KOREA_ Real GDP

Test Statistic	Value	df	Probability
F-statistic	67.89686	(3, 52)	0.0000
Chi-square	203.6906	3	0.0000

Null Hypothesis: C(6)=0,C(7)=0,C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	0.007482	0.011349
C(7)	0.004406	0.007420
C(8)	-0.047558	0.004309

Restrictions are linear in coefficients.

Wald Test:
Equation: ZANDB_D6_TR_KOREA _Real GDP

Test Statistic	Value	df	Probability
F-statistic	223.0382	(3, 52)	0.0000
Chi-square	669.1147	3	0.0000

Null Hypothesis: C(2)=0,C(3)=0,C(4)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	-0.055914	0.172862
C(3)	-0.145094	0.154634
C(4)	1.557790	0.060965

Restrictions are linear in coefficients.

Wald Test:
Equation: ZANDB_D6_TR_ KOREA-Real GDP

Test Statistic	Value	df	Probability
t-statistic	0.251559	52	0.8024
F-statistic	0.063282	(1, 52)	0.8024
Chi-square	0.063282	1	0.8014

Null Hypothesis: C(5)+C(6)=C(5)+C(7)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6) - C(7)	0.003076	0.012227

Restrictions are linear in coefficients.

Wald Test:
Equation: ZANDB_D6_TR_ KOREA-Real GDP

Test Statistic	Value	df	Probability
t-statistic	5.177310	52	0.0000
F-statistic	26.80454	(1, 52)	0.0000
Chi-square	26.80454	1	0.0000

Null Hypothesis: C(5)+C(6)=C(5)+C(8)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6) - C(8)	0.055040	0.010631

Restrictions are linear in coefficients.

Wald Test:
Equation: ZANDB_D6_TR_ KOREA-Real GDP

Test Statistic	Value	df	Probability
t-statistic	8.291577	52	0.0000
F-statistic	68.75026	(1, 52)	0.0000
Chi-square	68.75026	1	0.0000

Null Hypothesis: C(5)+C(7)=C(5)+C(8)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7) - C(8)	0.051964	0.006267

Restrictions are linear in coefficients.

4.2 Industrial Policies and Human Development in South Korea

Since the Human Development Index is already in the index form, the level rather than the logarithm of it is used in the trend equation. Although, the data are available from 1990, the intercept term is for the first year available in the Eviews workfile, which is 1960. Therefore, the equation indicates that the estimated value of the index was 0.55 in 1960 (trend=0). The index, then increased by an average of 0.006445 every year. There is overestimation after 2013, and underestimation from 1998 to 2009. Recursive coefficient estimates show that there is a decrease in the slope coefficient from 1998 to 2018.

Least squares with breaks indicate three breaks (four distinct periods). Average annual increase was 0.0103 during 1990-1997, 0.0079 during 1998-2006, 0.0036 during 2007-2010, and 0.0027 during 2011-2018. The slower increase during the last two periods is clear. This is expected, since the country already reached to a relatively high level by 2006.

Figure 4.4 Korea- Human Development Index

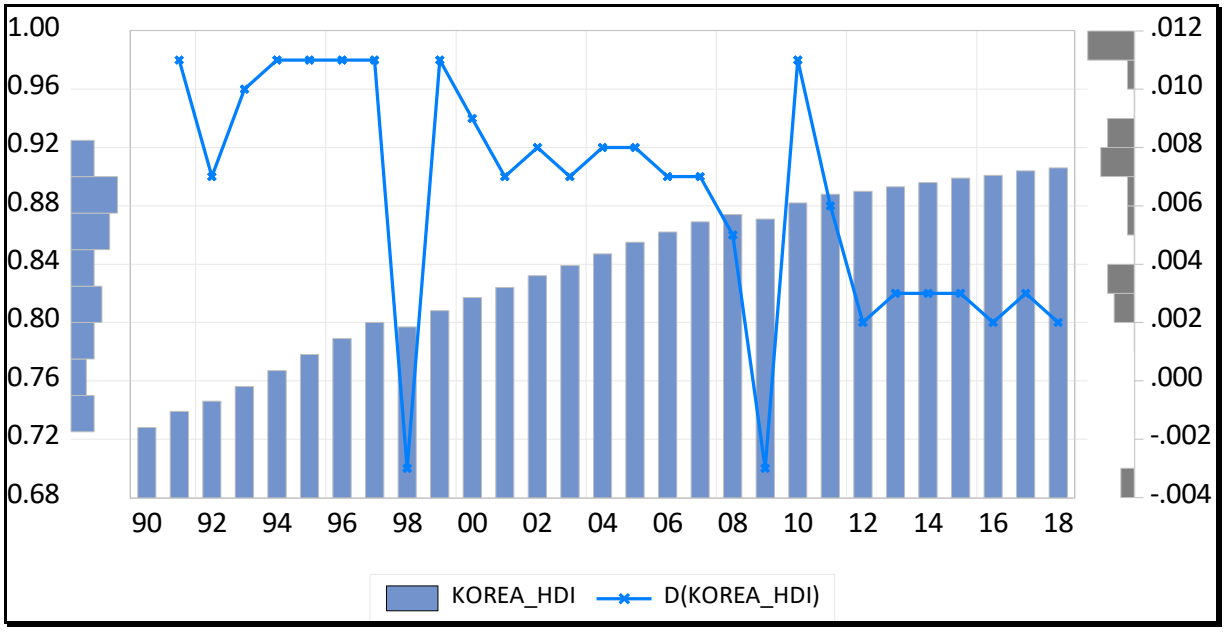


Table 4.5 Korea – Human Development Index

Dependent Variable: KOREA_HDI
Method: Least Squares
Date: 03/02/20 Time: 09:37
Sample: 1990 2018
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.552876	0.010362	53.35800	0.0000
@TREND	0.006445	0.000231	27.85792	0.0000

R-squared	0.966379	Mean dependent var	0.836448
Adjusted R-squared	0.965134	S.D. dependent var	0.055822
S.E. of regression	0.010423	Akaike info criterion	-6.223049
Sum squared resid	0.002933	Schwarz criterion	-6.128753
Log likelihood	92.23421	Hannan-Quinn criter.	-6.193517
F-statistic	776.0636	Durbin-Watson stat	0.157029
Prob(F-statistic)	0.000000		

Figure 4.5 Human Development Index – Actual, Fitted and Residuals

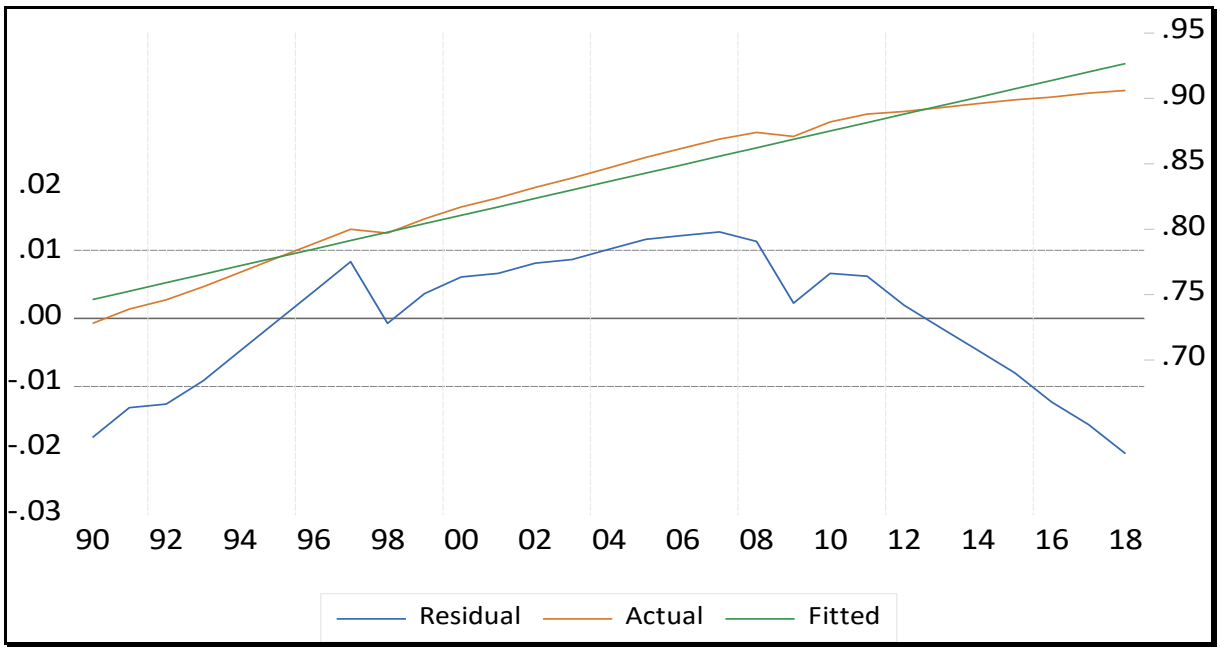


Figure 4.6 Human Development – Index – Recursive Estimates

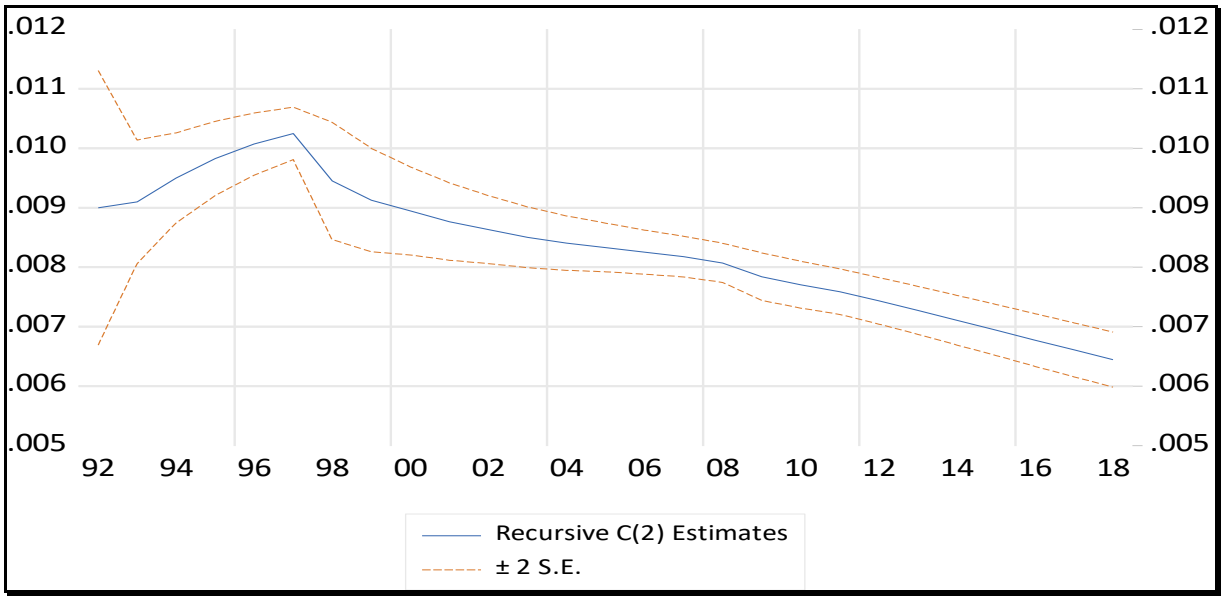


Table 4.6 Korea – Human Development Index, Trends with Breaks

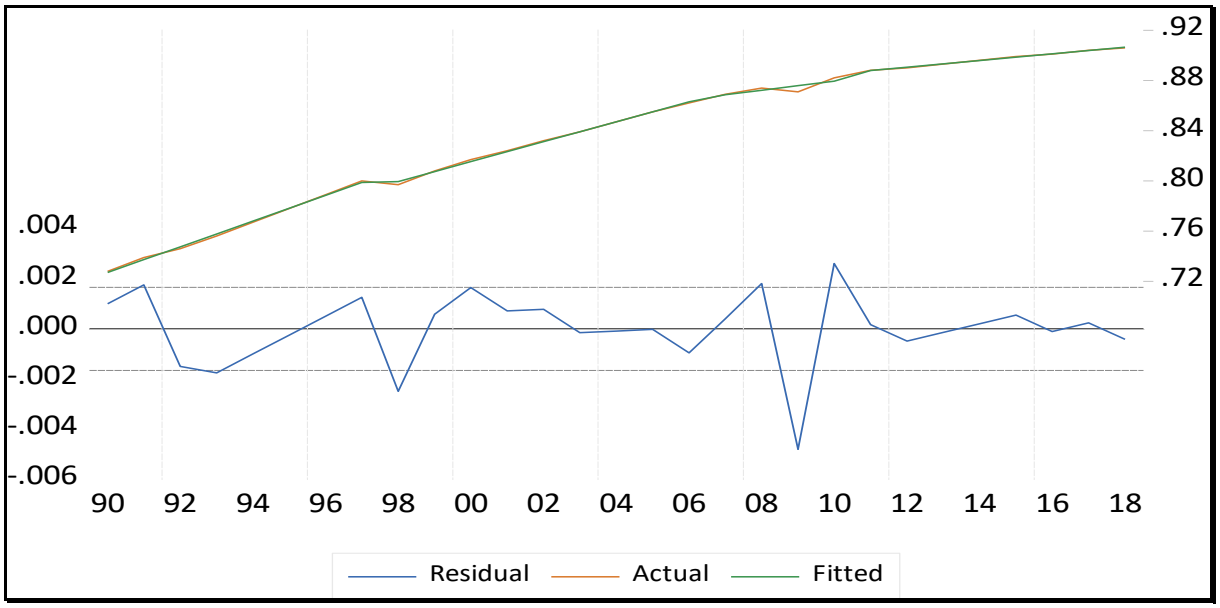
Dependent Variable: KOREA_HDI
Method: Least Squares with Breaks
Date: 03/02/20 Time: 09:37
Sample: 1990 2018
Included observations: 29
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1998, 2007, 2011
Selection: Trimming 0.15, , Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1990 - 1997 -- 8 obs				
C	0.419500	0.008582	48.88401	0.0000
@TREND	0.010250	0.000256	40.10671	0.0000
1998 - 2006 -- 9 obs				
C	0.498022	0.008998	55.35087	0.0000
@TREND	0.007933	0.000214	37.10221	0.0000
2007 - 2010 -- 4 obs				
C	0.699400	0.035934	19.46355	0.0000
@TREND	0.003600	0.000741	4.860221	0.0001
2011 - 2018 -- 8 obs				

C	0.752440	0.013941	53.97409	0.0000
@TREND	0.002655	0.000256	10.38768	0.0000

R-squared	0.999340	Mean dependent var	0.836448
Adjusted R-squared	0.999120	S.D. dependent var	0.055822
S.E. of regression	0.001656	Akaike info criterion	-9.739545
Sum squared resid	5.76E-05	Schwarz criterion	-9.362360
Log likelihood	149.2234	Hannan-Quinn criter.	-9.621415
F-statistic	4540.706	Durbin-Watson stat	2.610530
Prob(F-statistic)	0.000000		

Figure 4.7 Shares of Sectors in GDP



4.3 Industrial Policies and Structural Transformation in South Korea

4.3.1 Shares of Sectoral Value Added in GDP

As expected in the development process the share of agriculture in GDP has been decreasing during the period under investigation. According to the estimated trend equation for the entire period, the share of agricultural value added in GDP was estimated to be 33.658 in 1960 and decreasing by 0.685 a year on average since 1960. The determination coefficient (R2) was 0.86 for this equation. The determination coefficient improves to 0.95 with additional intercept

dummies and increases to 0.90 with additional slope dummies. These results indicate that the rate of decrease in the share was not very different for different periods, but the averages of shares were different. The higher determination coefficient (R2=0.98) for the equation with for both intercept dummies and slope dummies support the view that there are equations with varying intercepts and varying slopes.

Least squares with breaks suggest a single break in 1989. The estimated slope for the 1960-1988 period was -1.193, and the estimated slope for the 1989-2018 period was -0.199. The slowdown in the decrease is expected as the share start to level off.

Figure 4.8 Shares of Sectors in Employment

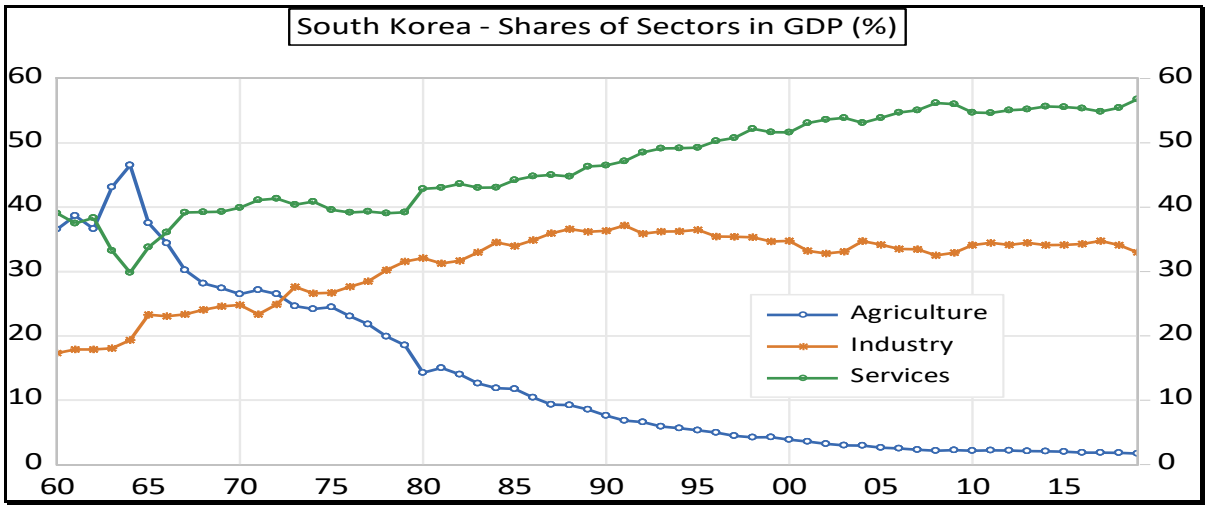


Table 4.7 Share of Agricultural Value Added - Trends with Dummy Variables for Periods with Different Industrial Policies

Eq Name:	ZANDB_D0_TR_KOREA_NVAGR TOTLZS	ZANDB_D4_TR_KOREA_NVAGR TOTLZS	ZANDB_D5_TR_KOREA_NVAGR TOTLZS	ZANDB_D6_TR_KOREA_NVAGR TOTLZS
Dep. Var:	KOREA_NVAGR TOTLZS	KOREA_NVAGR TOTLZS	KOREA_NVAGR TOTLZS	KOREA_NVAGR TOTLZS
C	33.658	35.410	35.103	41.687
	(1.223)	(0.896)	(1.870)	(1.063)
	[27.5]	[39.5]	[18.8]	[39.2]
@TREND	-0.685	-0.306	-0.562	-1.353
	(0.036)	(0.061)	(0.277)	(0.150)
	[-18.8]	[-5.0]	[-2.0]	[-9.0]
KOREA_D_19902020		-18.315		-29.921

		(2.523)		(2.279)
		[-7.3]		[-13.1]
KOREA_D_19731979		-8.250		-2.699
		(1.510)		(6.271)
		[-5.5]		[-0.4]
KOREA_D_19801989		-16.283		-12.234
		(1.678)		(5.610)
		[-9.7]		[-2.2]
@TREND*KOREA_D_19902020			-0.135	1.167
			(0.246)	(0.157)
			[-0.5]	[7.4]
@TREND*KOREA_D_19731979			-0.244	0.307
			(0.218)	(0.412)
			[-1.1]	[0.7]
@TREND*KOREA_D_19801989			-0.393	0.625
			(0.227)	(0.269)
			[-1.7]	[2.3]
Observations:	59	59	59	59
R-squared:	0.8617	0.9497	0.9008	0.9775
F-statistic:	355.0	255.0	122.6	316.5
Prob(F-stat):	0.000	0.000	0.000	0.000

Table 4.8 Share of Agricultural Value Added -Trends with Breaks

Dependent Variable: KOREA_NVAGRTOTLZS
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Break: 1989
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1988 -- 29 obs				
C	40.84461	0.746008	54.75093	0.0000
@TREND	-1.193462	0.045741	-26.09193	0.0000
1989 - 2018 -- 30 obs				

C	12.43088	1.928063	6.447341	0.0000
@TREND	-0.198863	0.043471	-4.574609	0.0000

R-squared	0.974947	Mean dependent var	13.78573
Adjusted R-squared	0.973580	S.D. dependent var	12.67903
S.E. of regression	2.060870	Akaike info criterion	4.349522
Sum squared resid	233.5951	Schwarz criterion	4.490372
Log likelihood	-124.3109	Hannan-Quinn criter.	4.404504
F-statistic	713.4421	Durbin-Watson stat	0.822223
Prob(F-statistic)	0.000000		

The share of industry shows a pattern which is expected in the development process. However, it is also clear that different periods have different rates of change in the share of industrial value added in GDP. According to the estimated trend equation for the entire period, the share of industrial value added in GDP was estimated to be 22.706 in 1960 and increasing by 0.275 a year on average since 1960. The determination coefficient (R2=0.70) for this equation was not as high as the equation for the share of agriculture. The determination coefficient improves to 0.90 with additional intercept dummies and increases to 0.82 with additional slope dummies. These results indicate that the rate of decrease in the share was not very different for different periods, but the averages of shares were different. The higher determination coefficient (R2=0.97) for the equation with for both intercept dummies and slope dummies support the view that there are equations with varying intercepts and varying slopes.

Least squares with breaks suggest two breaks (1989 and 2001) with three distinct trend equations. The estimated slope for the 1960-1988 period was the highest with 0.659, and the estimated slope for the 1989-2000 period was -0.166. The slope coefficient estimated for the third period (2001-2018) was 0.166.

Table 4.9 Share of Industrial Value Added Trends with Dummy Variables

Eq Name:	ZANDB_D0_TR_KOREA_NV	ZANDB_D4_TR_KOREA_NV	ZANDB_D5_TR_KOREA_NV	ZANDB_D6_TR_KOREA_NV
Dep. Var:	INDTOTLZS KOREA_NVIN DTOTLZS	INDTOTLZS KOREA_NVIN DTOTLZS	INDTOTLZS KOREA_NVIN DTOTLZS	INDTOTLZS KOREA_NVIN DTOTLZS
C	22.706	21.032	21.005	17.193
	(0.809)	(0.562)	(1.112)	(0.555)
	[28.1]	[37.4]	[18.9]	[31.0]
@TREND	0.275	0.065	0.247	0.705
	(0.024)	(0.038)	(0.165)	(0.079)
	[11.4]	[1.7]	[1.5]	[9.0]
KOREA_D_19902020		10.611		18.352
		(1.583)		(1.191)
		[6.7]		[15.4]
KOREA_D_19731979		5.976		-0.672
		(0.948)		(3.276)
		[6.3]		[-0.2]
KOREA_D_19801989		10.785		1.209
		(1.053)		(2.930)
		[10.2]		[0.4]
@TREND*KOREA_D_19902020			0.048	-0.729
			(0.146)	(0.082)
			[0.3]	[-8.9]
@TREND*KOREA_D_19731979			0.197	0.016
			(0.130)	(0.215)
			[1.5]	[0.1]
@TREND*KOREA_D_19801989			0.260	-0.092
			(0.135)	(0.141)
			[1.9]	[-0.7]
Observations:	59	59	59	59
R-squared:	0.6954	0.9005	0.8236	0.9691
F-statistic:	130.1	122.2	63.0	228.8
Prob(F-stat):	0.000	0.000	0.000	0.000

Table 4.10 Share of Industrial Value Added - Trends with Breaks

Dependent Variable: KOREA_NVINDTOTLZS
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1989, 2001
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1988 -- 29 obs				
C	17.43824	0.287193	60.71954	0.0000
@TREND	0.659181	0.017609	37.43445	0.0000
1989 - 2000 -- 12 obs				
C	40.91714	2.300359	17.78728	0.0000
@TREND	-0.165565	0.066346	-2.495480	0.0157
2001 - 2018 -- 18 obs				
C	25.88292	1.793957	14.42784	0.0000
@TREND	0.165822	0.036044	4.600517	0.0000

R-squared	0.982015	Mean dependent var	30.66844
Adjusted R-squared	0.980318	S.D. dependent var	5.655190
S.E. of regression	0.793380	Akaike info criterion	2.471116
Sum squared resid	33.36096	Schwarz criterion	2.682391
Log likelihood	-66.89792	Hannan-Quinn criter.	2.553589
F-statistic	578.7723	Durbin-Watson stat	1.307175
Prob(F-statistic)	0.000000		

The share of services value added in GDP shows an increasing pattern, which is expected in the development process. Least squares with breaks suggest a single break in 2010 with two distinct trend equations. The estimated slope for the 1960-2009 period was 0.417. The

estimated slope for the 2010-2018 period was -0.054, but statistically insignificant. The slope is about zero after 2010 and the share of services in GDP stays about the same.

Table 4.11 Share of Services Value Added - Least Squares with Breaks

Dependent Variable: KOREA_NVSRVTOTLZS
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Break: 2010
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 2009 -- 50 obs				
C	34.83070	0.466751	74.62365	0.0000
@TREND	0.417146	0.016415	25.41221	0.0000
2010 - 2018 -- 9 obs				
C	56.69107	11.69061	4.849282	0.0000
@TREND	-0.054180	0.216246	-0.250547	0.8031

R-squared	0.939380	Mean dependent var	46.38012
Adjusted R-squared	0.936073	S.D. dependent var	6.624943
S.E. of regression	1.675032	Akaike info criterion	3.934931
Sum squared resid	154.3153	Schwarz criterion	4.075781
Log likelihood	-112.0805	Hannan-Quinn criter.	3.989913
F-statistic	284.0965	Durbin-Watson stat	0.668974
Prob(F-statistic)	0.000000		

4.3.2 Shares of Sectoral Employment in Total Employment

In the process of development, the share of sectors in total employment shows a similar pattern to shares in GDP. In general, the share of agriculture in total employment decreases, and the shares of industry and services increase, maybe not in a linear fashion. These are typical patterns of development. Data for the shares in employment from the World Bank World Development Indicators start in 1991, so we had to work with a shorter data set.

The method of least squares with breaks, suggest three breaks (1998, 2005, and 2015) for the trend in the share of agriculture in total employment. The estimated trend coefficients were: -0.679 for 1991-1997, -0.648 for 1998-2004, -0.256 for 2005-2014, and -0.028 for 2015-2019. The last period coefficient is not statistically significant. In short, the decrease in the share of agricultural employment in total employment were statistically significant and relatively big from 1991 to 2004. The average decrease in the share was relatively smaller from 2005 to 2014, and statistically insignificant from 2015 to 2019.

The method of least squares with breaks, suggest two breaks (1998 and 2009) for the trend in the share of industry in total employment. The estimated trend coefficients were: -0.82 for 1991-1997, -0.231 for 1998-2008, and 0.055 for 2009-2019. The last period coefficient is not statistically significant at the 10 percent level. In short, the decrease in the share of industrial employment in total employment were statistically significant and relatively big from 1991 to 1997. The average decrease slowed down from 1998 to 2008, and somewhat leveled off from 2009 to 2019.

The method of least squares with breaks, suggest three breaks (1998, 2003, and 2009) for the trend in the share of employment in services in total employment. The estimated trend coefficients were: 1.499 for 1991-1997, 0.812 for 1998-2002, 0.753 for 2003-2008, and 0.175 for 2009-2019. The increase in the share of services employment and the slowing pace of the increase is clear from this equation.

Figure 4.9 Shares of Sectors in Total Employment (%)

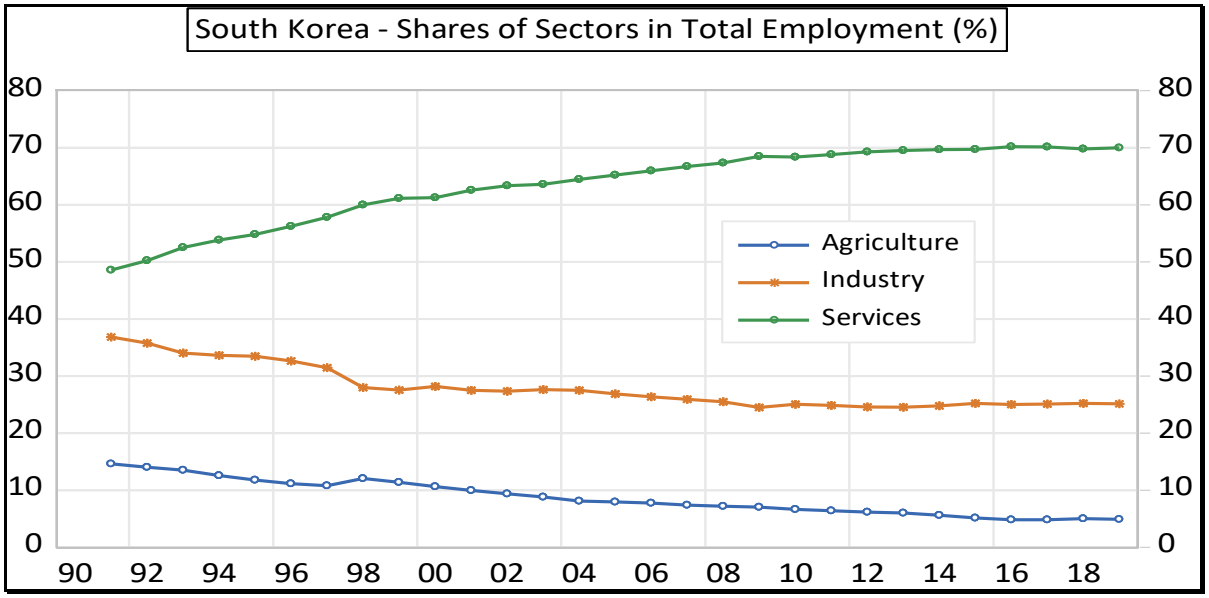


Table 4.12 Share of Agricultural Employment - Least Squares with Breaks

Dependent Variable: KOREA_SLAGREMPLZS
Method: Least Squares with Breaks
Date: 07/21/20 Time: 13:41
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1998, 2005, 2015
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 1997 -- 7 obs				
C	35.71143	0.679283	52.57224	0.0000
@TREND	-0.679071	0.019944	-34.04816	0.0000
1998 - 2004 -- 7 obs				
C	36.59732	0.818694	44.70206	0.0000
@TREND	-0.648179	0.019944	-32.49922	0.0000
2005 - 2014 -- 10 obs				
C	19.48020	0.576115	33.81306	0.0000
@TREND	-0.256424	0.011619	-22.06913	0.0000

2015 - 2019 -- 5 obs				
C	6.519098	1.902871	3.425928	0.0025
@TREND	-0.028100	0.033373	-0.841986	0.4093

R-squared	0.999095	Mean dependent var	8.654276
Adjusted R-squared	0.998793	S.D. dependent var	3.037698
S.E. of regression	0.105536	Akaike info criterion	-1.430578
Sum squared resid	0.233895	Schwarz criterion	-1.053393
Log likelihood	28.74338	Hannan-Quinn criter.	-1.312448
F-statistic	3310.963	Durbin-Watson stat	2.075231
Prob(F-statistic)	0.000000		

Table 4.13 Share of Industrial Employment - Least Squares with Breaks

Dependent Variable: KOREA_SLINDEMPLZS
Method: Least Squares with Breaks
Date: 07/21/20 Time: 13:41
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1998, 2009
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 1997 -- 7 obs				
C	61.84357	2.280145	27.12265	0.0000
@TREND	-0.820071	0.066947	-12.24949	0.0000
1998 - 2008 -- 11 obs				
C	37.01822	1.456317	25.41907	0.0000
@TREND	-0.230618	0.033777	-6.827745	0.0000
2009 - 2019 -- 11 obs				
C	21.92900	1.827062	12.00233	0.0000
@TREND	0.054909	0.033777	1.625655	0.1176

R-squared	0.992626	Mean dependent var	27.92003
Adjusted R-squared	0.991024	S.D. dependent var	3.739036
S.E. of regression	0.354252	Akaike info criterion	0.944376
Sum squared resid	2.886376	Schwarz criterion	1.227265
Log likelihood	-7.693451	Hannan-Quinn criter.	1.032973
F-statistic	619.2531	Durbin-Watson stat	1.403489
Prob(F-statistic)	0.000000		

Table 4.14 Share of Services Employment - Least Squares with Breaks

Dependent Variable: KOREA_SLSRVEMPLZS
Method: Least Squares with Breaks
Date: 07/21/20 Time: 13:40
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1998, 2003, 2009
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 1997 -- 7 obs				
C	2.444993	1.846398	1.324196	0.1997
@TREND	1.499143	0.054212	27.65329	0.0000
1998 - 2002 -- 5 obs				
C	29.18102	3.630835	8.036999	0.0000
@TREND	0.812000	0.090714	8.951183	0.0000
2003 - 2008 -- 6 obs				
C	31.28268	3.122291	10.01914	0.0000
@TREND	0.752857	0.068573	10.97883	0.0000
2009 - 2019 -- 11 obs				
C	59.98149	1.479504	40.54162	0.0000
@TREND	0.175264	0.027351	6.407862	0.0000

R-squared	0.998591	Mean dependent var	63.42569
Adjusted R-squared	0.998122	S.D. dependent var	6.619526
S.E. of regression	0.286864	Akaike info criterion	0.569330
Sum squared resid	1.728104	Schwarz criterion	0.946515
Log likelihood	-0.255290	Hannan-Quinn criter.	0.687460
F-statistic	2126.919	Durbin-Watson stat	1.482657
Prob(F-statistic)	0.000000		

4.4 Industrial Policies and Productivity in South Korea

An important indicator of performance is productivity. The World Bank World Development Indicators have data on labor productivity (GDP per person employed, constant 2011 PPP$) for countries and regions. Data are available from 1991 to 2019.

The average annual growth rate from the logarithmic trend equation for labor productivity is 3.37%. It should be noted that this growth rate in productivity may be different than the one based on local currency. This number is the preferred one for international comparisons. Obviously, one may use the constant US dollar, and not constant purchasing power parity US dollar. All of these are possible alternatives.

Recursive estimates of the slope coefficient suggest a higher growth rate in productivity compared with later years. This was expected, as there will be a limit on growth.

Least squares with breaks give similar results, slowing rate of growth in productivity GDP per person employed, constant 2011 PPP$). Statistical tests show that there are three breaks (1996, 2003, and 2012) with four periods with distinct trend coefficients. Average annual growth rates in productivity are: 5.56% for 1991-1995, 4.41% for 1996-2002, 3.24% for 2003-2011, and 1.75% for 2012-2019.

Figure 4.10 Korea – Labor Productivity (GDP per person employed (constant 2011 PPP $))

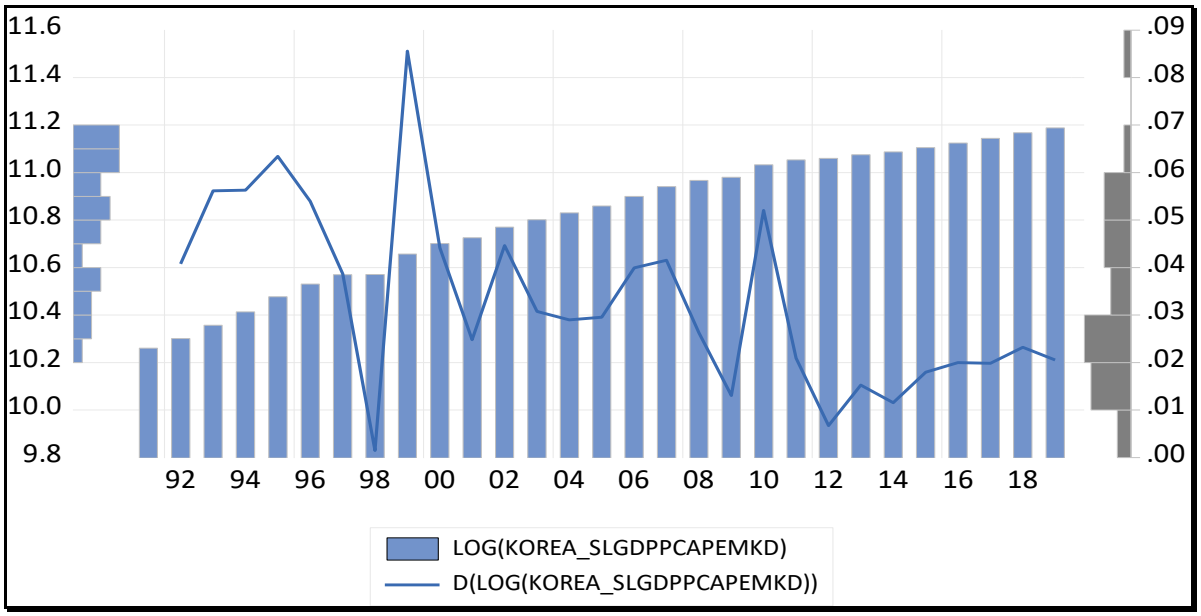


Table 4.15 Korea – Trend in Labor Productivity

Dependent Variable: LOG(KOREA_SLGDPPCAPEMKD)
Method: Least Squares
Date: 07/20/20 Time: 20:02
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.412791	0.060960	154.4094	0.0000
@TREND	0.033685	0.001332	25.29227	0.0000

R-squared	0.959502	Mean dependent var	10.92863
Adjusted R-squared	0.958002	S.D. dependent var	0.292810
S.E. of regression	0.060007	Akaike info criterion	-2.722245
Sum squared resid	0.097222	Schwarz criterion	-2.627949
Log likelihood	41.47255	Hannan-Quinn criter.	-2.692712
F-statistic	639.6989	Durbin-Watson stat	0.112672
Prob(F-statistic)	0.000000		

Figure 4.11 Korea – Trend in Labor Productivity, Actual, Predicted, and Residuals

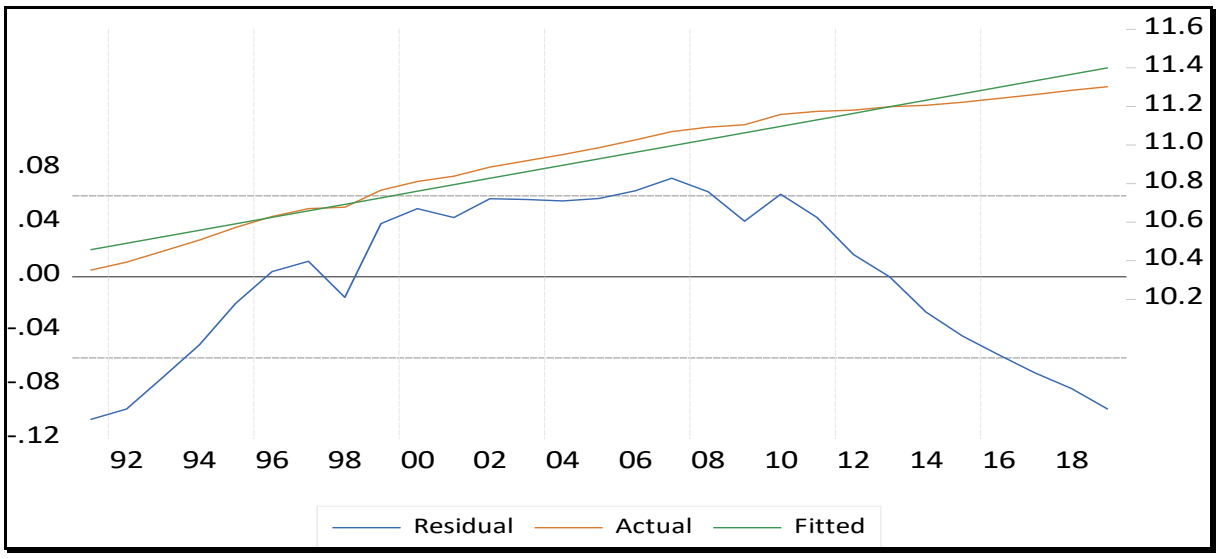


Figure 4.12 Labor Productivity - Recursive Estimates

Table 4.16 Korea – Labor Productivity Trends with Breaks

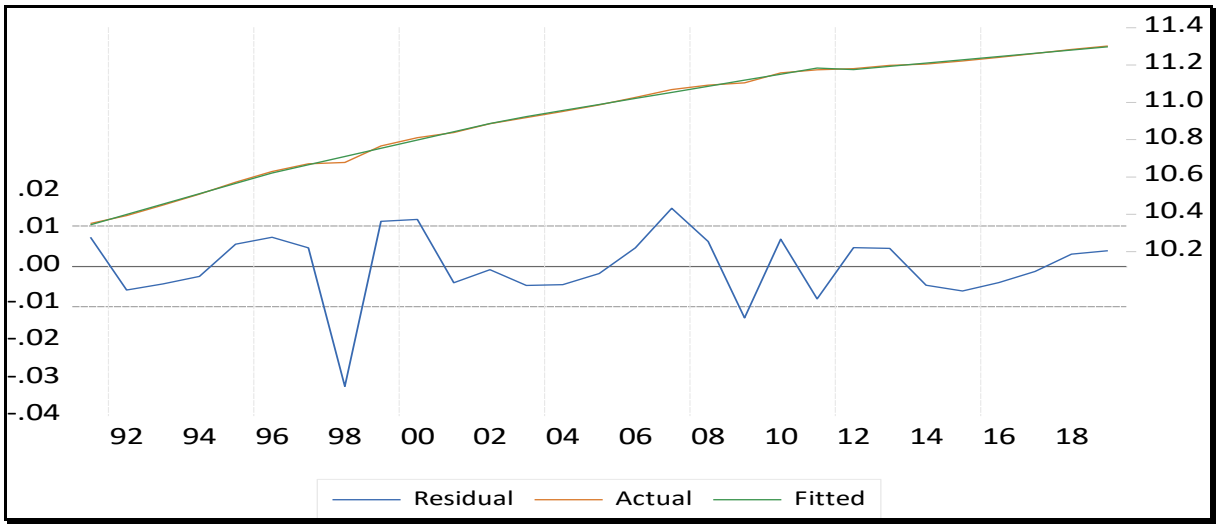
Dependent Variable: LOG(KOREA_SLGDPPCAPEMKD)
Method: Least Squares with Breaks
Date: 07/20/20 Time: 20:07
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1996, 2003, 2012
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 1995 -- 5 obs				
C	8.618046	0.113046	76.23481	0.0000
@TREND	0.055662	0.003422	16.26361	0.0000
1996 - 2002 -- 7 obs				
C	9.032535	0.079873	113.0865	0.0000
@TREND	0.044140	0.002045	21.58086	0.0000
2003 - 2011 -- 9 obs				
C	9.527776	0.065769	144.8678	0.0000
@TREND	0.032464	0.001397	23.23421	0.0000
2012 - 2019 -- 8 obs				
C	10.26819	0.092764	110.6910	0.0000

@TREND	0.017456	0.001670	10.45238	0.0000

R-squared	0.998975	Mean dependent var	10.92863
Adjusted R-squared	0.998634	S.D. dependent var	0.292810
S.E. of regression	0.010823	Akaike info criterion	-5.985357
Sum squared resid	0.002460	Schwarz criterion	-5.608172
Log likelihood	94.78767	Hannan-Quinn criter.	-5.867227
F-statistic	2924.836	Durbin-Watson stat	2.292322
Prob(F-statistic)	0.000000		

Figure 4.13 Korea–Labor Productivity Trends with Breaks, Actual, Predicted, and Residuals



4.5 Industrial Policies and Economic Complexity in South Korea

Economic complexity is an important indicator to measure the nature of the production process. An elaborate system will be more effective in a global market. It is critical to see how economic complexity changes with industrial policies. Are these policies effective in improving economic complexity?

A linear trend estimated for the entire period (1964-2017) shows that the index increases by an annual average of 0.0215. The estimated value of the index for period the initial period (1960) is 0.41. At the end of the period the index reaches to a level close to 2. Recursive estimates show an annual rate around 0.01 to 0.02 since 1980.

Least squares with breaks suggest a single break (1993) in the trend. The trend coefficient for the 1964-1992 period was 0.0097, compared with a trend coefficient of 0.041 for the 1993-2017 period. The yearly increase in the index of economic complexity picked up significantly after 1993. This was a big accomplishment for South Korea.

Equations with dummy variables give support to the equation with varying intercepts and slopes.

Figure 4.14 Korea - Economic Complexity Index

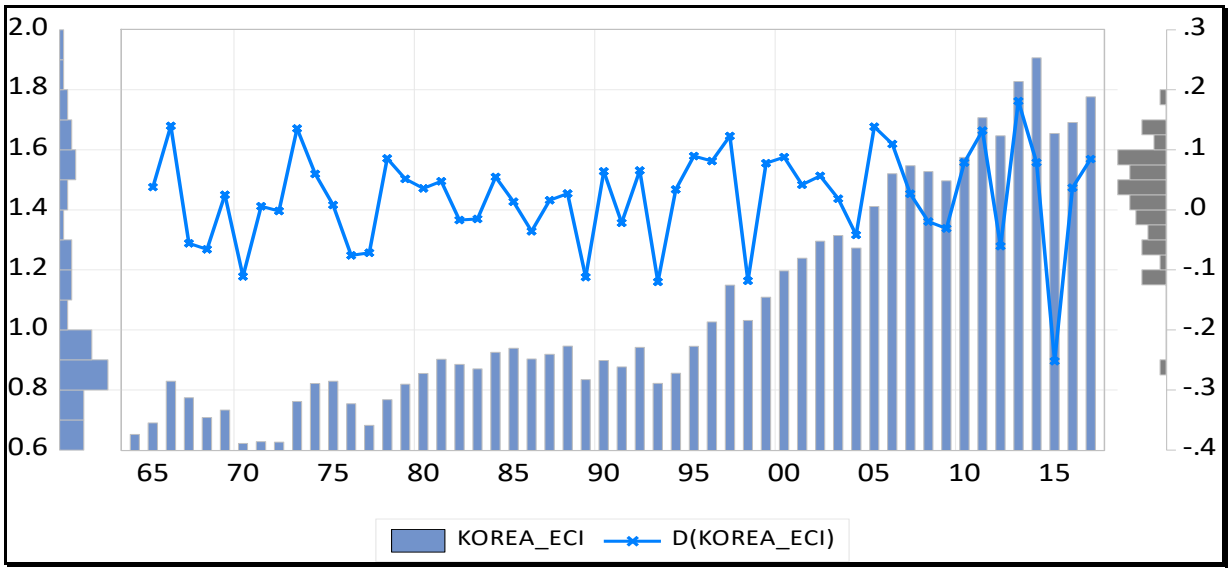


Table 4.17 Korea ECI – Trend Line

Dependent Variable: KOREA_ECI
Method: Least Squares
Date: 03/02/20 Time: 09:35
Sample: 1964 2017
Included observations: 54

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.418641	0.042263	9.905721	0.0000
@TREND	0.021452	0.001234	17.38579	0.0000

R-squared	0.853218	Mean dependent var	1.072931
Adjusted R-squared	0.850395	S.D. dependent var	0.365366
S.E. of regression	0.141319	Akaike info criterion	-1.039256
Sum squared resid	1.038499	Schwarz criterion	-0.965590
Log likelihood	30.05991	Hannan-Quinn criter.	-1.010846

F-statistic	302.2658	Durbin-Watson stat	0.330075
Prob(F-statistic)	0.000000		

Figure 4.15 Korea ECI Trend Line, Actual, Predicted, and Residuals

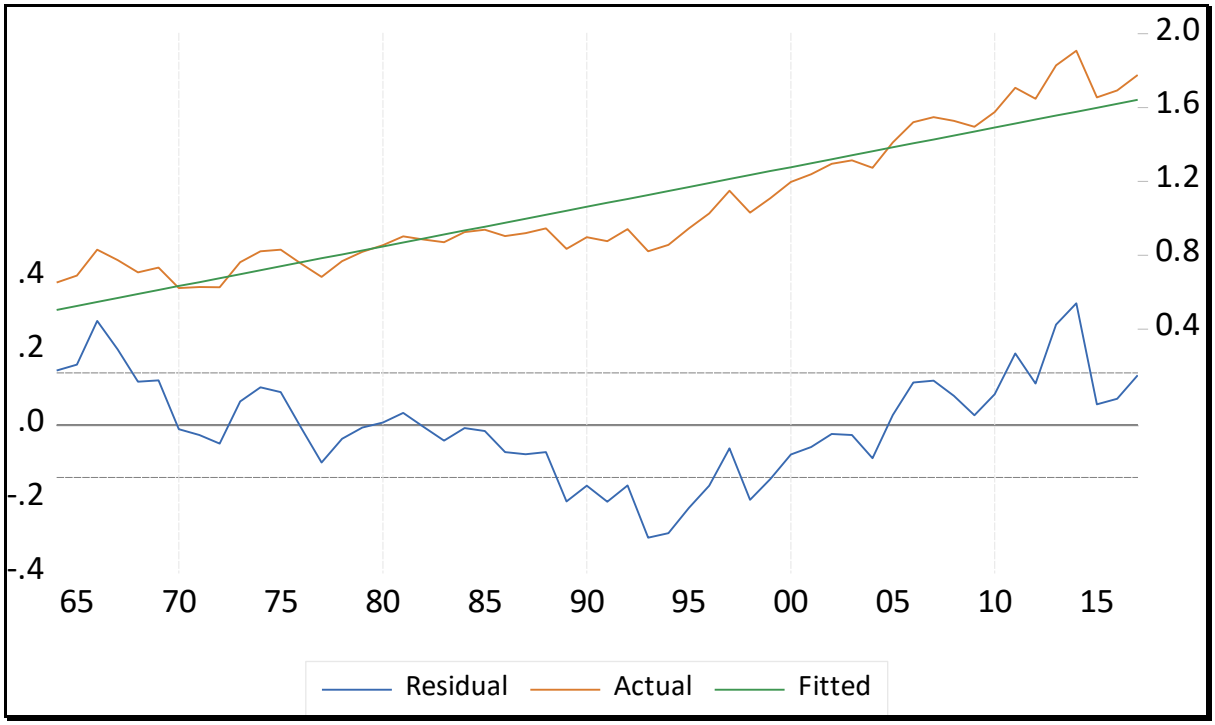


Figure 4.16 Economic Complexity Index - Recursive Estimates

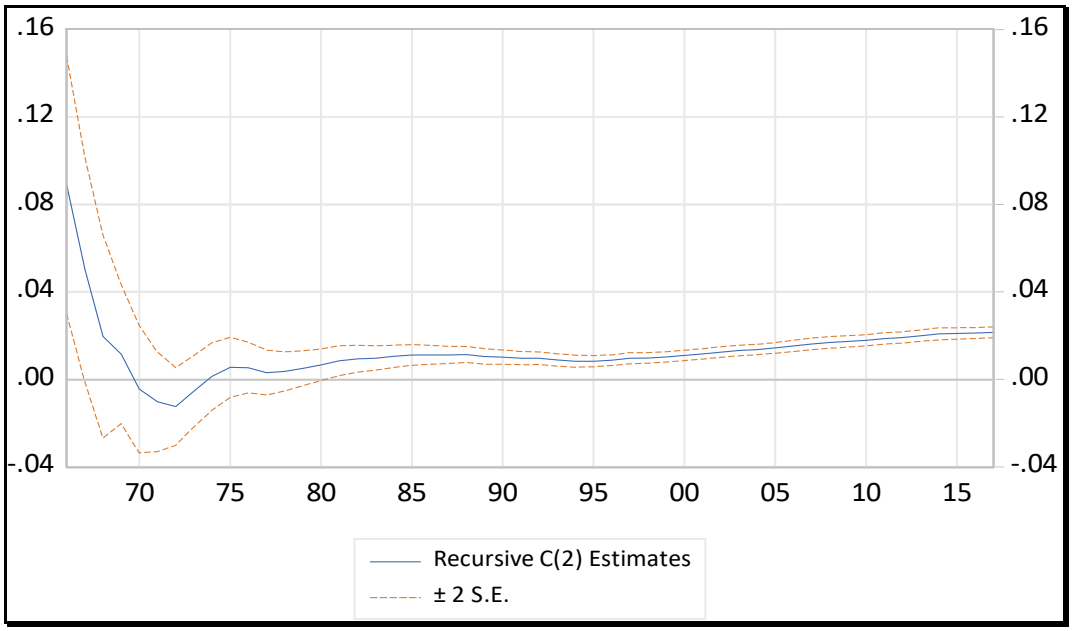


Table 4.18 Korea ECI - Trend with Breaks

Dependent Variable: KOREA_ECI
Method: Least Squares with Breaks
Date: 03/02/20 Time: 09:35
Sample: 1964 2017
Included observations: 54
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Break: 1993
Selection: Trimming 0.15, , Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
		1964 - 1992 -- 29 obs		
C	0.632797	0.031715	19.95271	0.0000
@TREND	0.009659	0.001598	6.045446	0.0000
		1993 - 2017 -- 25 obs		
C	-0.463277	0.090993	-5.091336	0.0000
@TREND	0.041002	0.001997	20.53581	0.0000

R-squared	0.963376	Mean dependent var	1.072931
Adjusted R-squared	0.961179	S.D. dependent var	0.365366
S.E. of regression	0.071988	Akaike info criterion	-2.353437
Sum squared resid	0.259116	Schwarz criterion	-2.206105
Log likelihood	67.54281	Hannan-Quinn criter.	-2.296617
F-statistic	438.4118	Durbin-Watson stat	1.219268
Prob(F-statistic)	0.000000		

Figure 4.17 Korea ECI Trend with Breaks, Actual. Predicted, and Residuals

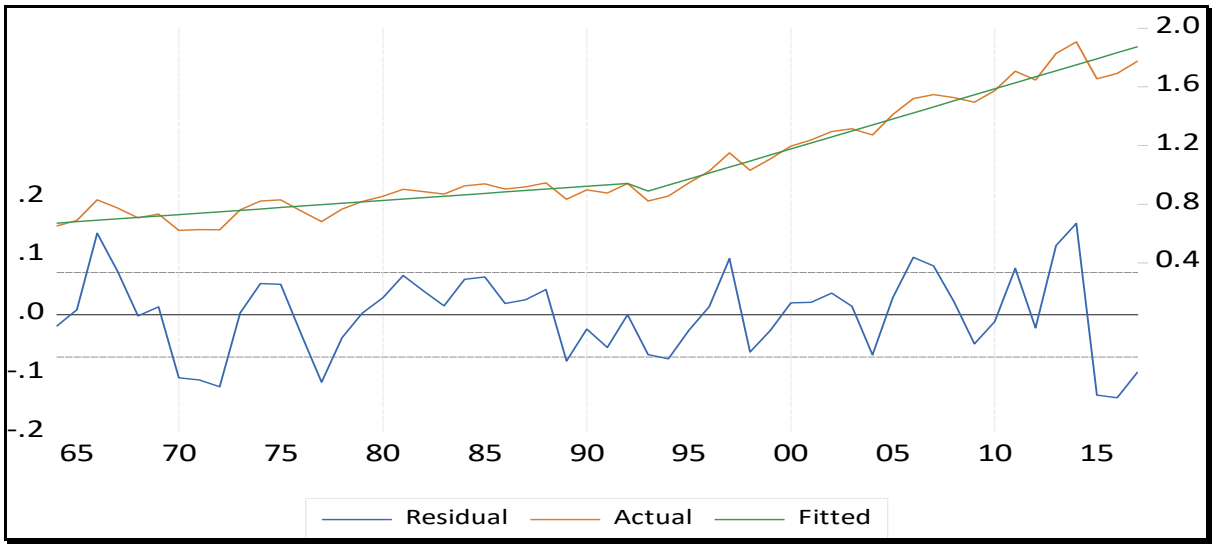


Table 4.19 Economic Complexity Index (ECI) - Trends with Dummy Variables

Eq Name:	ZANDB_D0_ECI_TR_KOREA_ECI	ZANDB_D4_ECI_TR_KOREA_ECI	ZANDB_D5_ECI_TR_KOREA_ECI	ZANDB_D6_ECI_TR_KOREA_ECI
Dep. Var:	KOREA_ECI	KOREA_ECI	KOREA_ECI	KOREA_ECI
@TREND	0.021	0.035	0.048	-0.012
	(0.001)	(0.002)	(0.012)	(0.009)
	[17.4]	[15.4]	[3.9]	[-1.4]
KOREA_D_19731979		-0.202		0.028
		(0.055)		(0.227)
		[-3.7]		[0.1]
KOREA_D_19801989		-0.381		0.043
		(0.061)		(0.205)
		[-6.3]		[0.2]
KOREA_D_19902020		-0.619		-1.160
		(0.091)		(0.105)
		[-6.8]		[-11.0]
C	0.418	0.413	0.265	0.795
	0.042	(0.039)	(0.096)	(0.076)
	[9.9]	[10.6]	[2.8]	[10.4]
@TREND*KOREA_D_19731979			-0.016	0.010
			(0.008)	(0.016)
			[-2.0]	[0.6]
@TREND*KOREA_D_19801989			-0.022	0.015
			(0.009)	(0.012)

			[-2.4]	[1.2]
@TREND*KOREA_D_19902020			-0.023	0.051
			(0.010)	(0.009)
			[-2.2]	[5.6]
Observations:	54	54	54	54
R-squared:	0.8532	0.9268	0.8709	0.9680
F-statistic:	302.3	155.0	82.6	198.5
Prob(F-stat):	0.000	0.000	0.000	0.000

4.6 Industrial Policies and Competitiveness Index

4.6.1 UNIDO Competitiveness Performance Index

United Nations Industrial Development Organization (UNIDO) releases Competitiveness Performance Index (CIP). Both the value of the index for the country and the rank of the country in the world are published for the post-1990 period. South Korea ranks the third in the last year the index is available.

According to the estimated linear trend coefficient, the Index for South Korea increases by 0.006581 every year. Recursive coefficients show that there is a decreasing trend in the slope coefficient.

Least squares with breaks suggest a break in 2011. The slope for the 1990-2010 period was 0.009494, and the slope for the 2011-2018 period was negative 0.006429.

Table 4.20 Competitiveness Performance Index - Trend Equation

Dependent Variable: KOREA_CIP
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.025941	0.025229	1.028212	0.3130
@TREND	0.006581	0.000563	11.68353	0.0000

R-squared	0.834867	Mean dependent var	0.315517
Adjusted R-squared	0.828751	S.D. dependent var	0.061330
S.E. of regression	0.025380	Akaike info criterion	-4.443271
Sum squared resid	0.017391	Schwarz criterion	-4.348975
Log likelihood	66.42743	Hannan-Quinn criter.	-4.413739
F-statistic	136.5048	Durbin-Watson stat	0.214957
Prob(F-statistic)	0.000000		

Figure 4.18 Competitiveness Index - Actual, Fitted, and Residuals

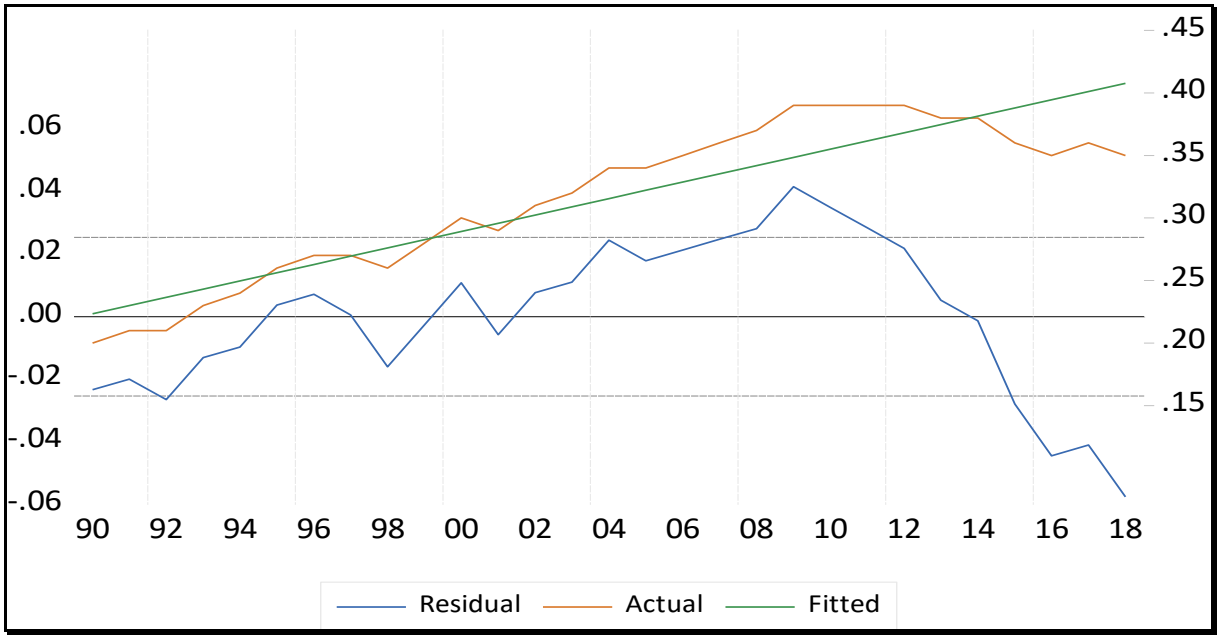


Figure 4.19 Competitiveness Index - Recursive Estimates

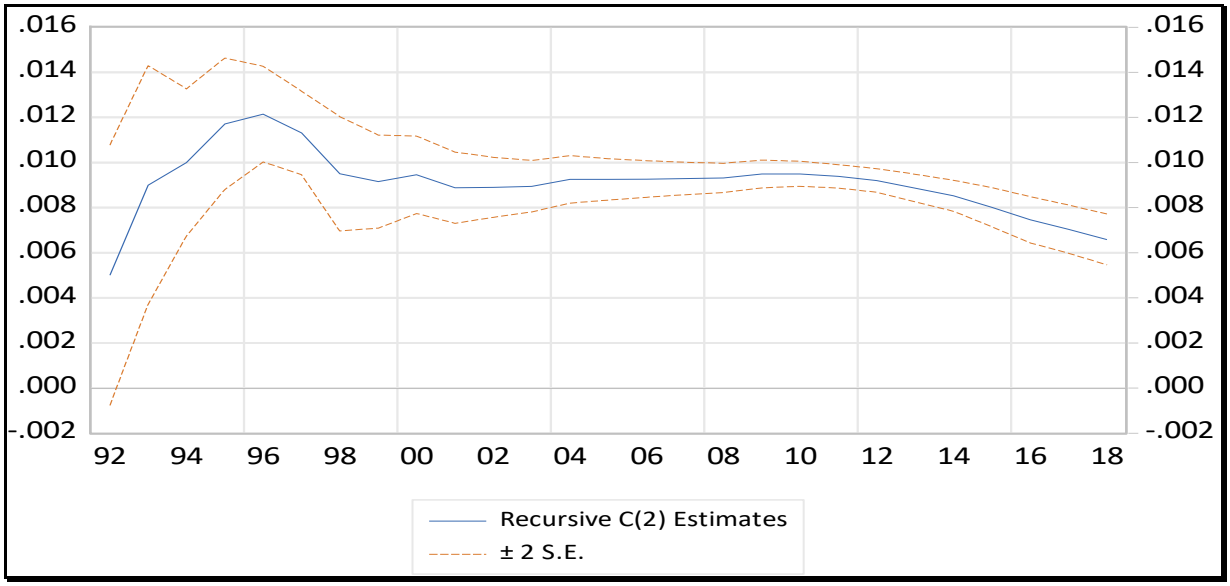


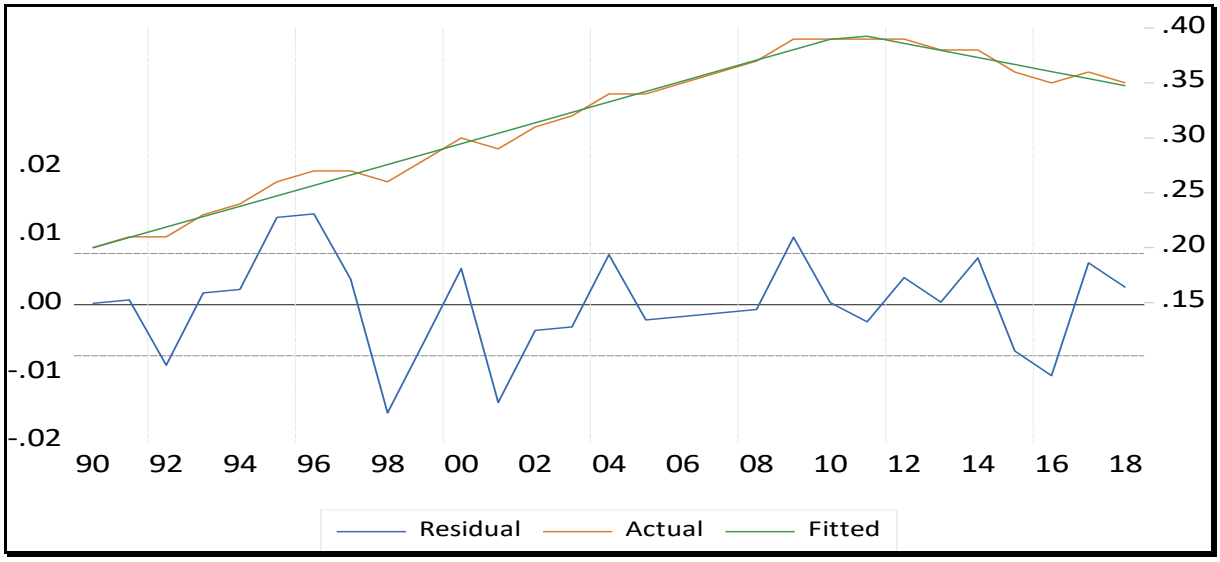
Table 4.21 Competitiveness Performance Index - Least Squares with Breaks

Dependent Variable: KOREA_CIP
Method: Least Squares with Breaks
Date: 07/21/20 Time: 14:52
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Break: 2011
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1990 - 2010 -- 21 obs				
C	-0.084978	0.010873	-7.815347	0.0000
@TREND	0.009494	0.000269	35.32212	0.0000
2011 - 2018 -- 8 obs				
C	0.720357	0.062774	11.47538	0.0000
@TREND	-0.006429	0.001151	-5.586166	0.0000

R-squared	0.986796	Mean dependent var	0.315517
Adjusted R-squared	0.985212	S.D. dependent var	0.061330
S.E. of regression	0.007458	Akaike info criterion	-6.831603
Sum squared resid	0.001391	Schwarz criterion	-6.643011
Log likelihood	103.0582	Hannan-Quinn criter.	-6.772539
F-statistic	622.8095	Durbin-Watson stat	1.781910
Prob(F-statistic)	0.000000		

Figure 4.20 Competitiveness Index - Least Squares with Breaks - Actual, Fitted, and Residuals



4.6.2 Rank of UNIDO Competitiveness Performance Index

In terms of the rank of the CIP, a negative trend of 0.511 was estimated for the 1990-2018 period. The slope was negative 0.9286 for the 1990-1996 period and negative 0.6071 for the 1997-2003 period. The slope was a much smaller negative (negative 0.14) for the 2004-2018 period.

Table 4.22 Rank of Competitiveness Performance Index - Trend Equation

Dependent Variable: KOREA_CIP_RANK
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30.98128	1.628722	19.02183	0.0000
@TREND	-0.511330	0.036365	-14.06112	0.0000

R-squared	0.879848	Mean dependent var	8.482759
Adjusted R-squared	0.875398	S.D. dependent var	4.641588
S.E. of regression	1.638436	Akaike info criterion	3.891834
Sum squared resid	72.48079	Schwarz criterion	3.986130
Log likelihood	-54.43159	Hannan-Quinn criter.	3.921366
F-statistic	197.7150	Durbin-Watson stat	0.593310
Prob(F-statistic)	0.000000		

Figure 4.21 Rank of Competitiveness Index - Actual, Fitted, and Residuals

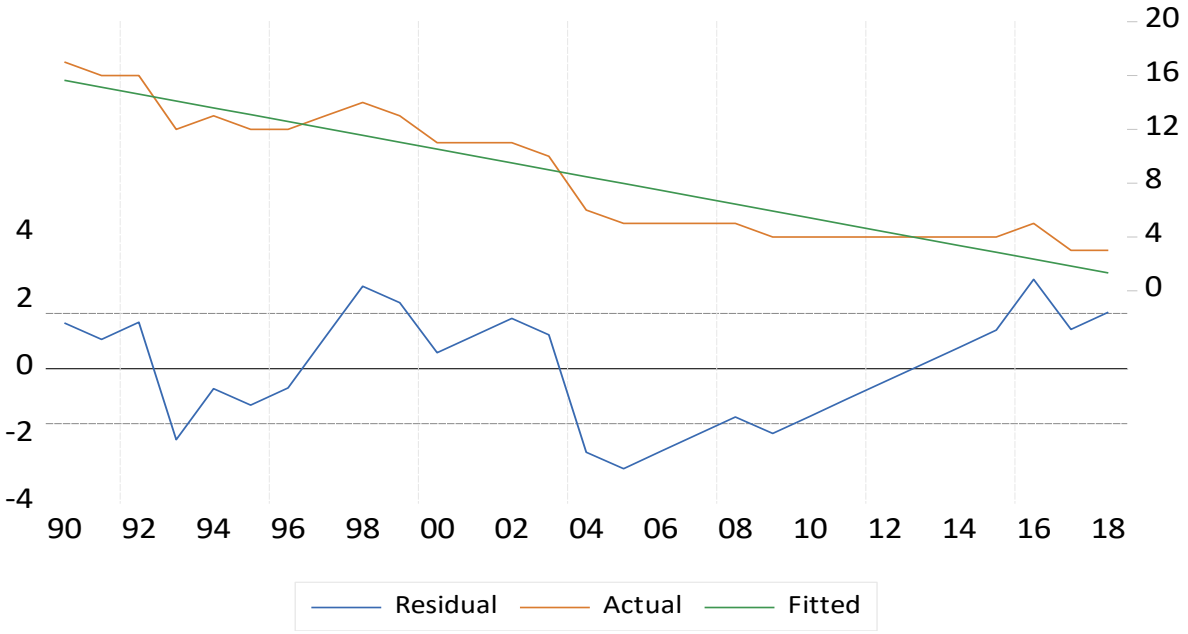


Figure 4.22 Rank of Competitiveness Index - Recursive Estimates

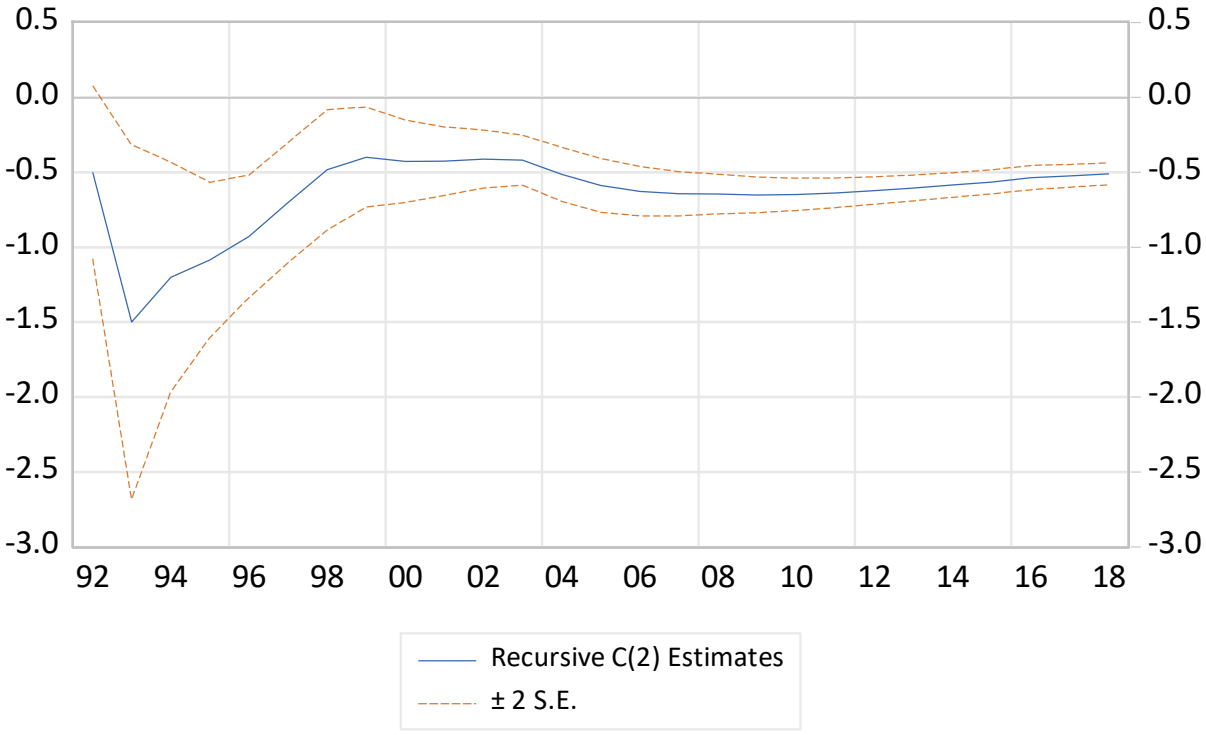


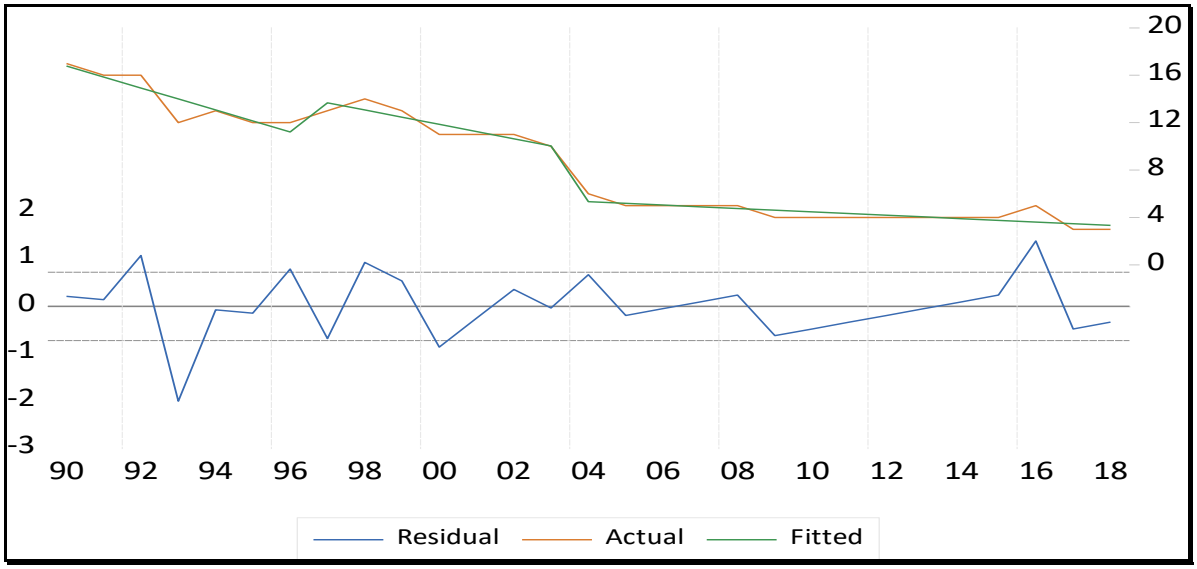
Table 4.23 Rank of Competitiveness Performance Index - Least Squares with Breaks

Dependent Variable: KOREA_CIP_RANK
Method: Least Squares with Breaks
Date: 07/21/20 Time: 14:54
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1997, 2004
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1990 - 1996 -- 7 obs				
C	44.64286	4.515159	9.887327	0.0000
@TREND	-0.928571	0.136572	-6.799114	0.0000
1997 - 2003 -- 7 obs				
C	36.14286	5.469721	6.607806	0.0000
@TREND	-0.607143	0.136572	-4.445574	0.0002
2004 - 2018 -- 15 obs				
C	11.61905	2.210477	5.256353	0.0000
@TREND	-0.142857	0.043188	-3.307798	0.0031

R-squared	0.980088	Mean dependent var	8.482759
Adjusted R-squared	0.975759	S.D. dependent var	4.641588
S.E. of regression	0.722673	Akaike info criterion	2.370273
Sum squared resid	12.01190	Schwarz criterion	2.653161
Log likelihood	-28.36895	Hannan-Quinn criter.	2.458870
F-statistic	226.4133	Durbin-Watson stat	2.457785
Prob(F-statistic)	0.000000		

Figure 4.23 Rank of Competitiveness Index - Least Squares with Breaks - Actual, Fitted, and Residuals



4.7 Share of Exports of Goods and Services in GDP

An alternative measure hinting competitiveness is the share of exports of goods and services in GDP. As the country becomes more competitive in a global scale, exports and the share of exports in GDP are expected to increase. Since this indicator is readily available from the World Bank, World Development Indicators and the series is also longer (starts in 1960), it is widely used as a good proxy.

A single linear trend estimated for the 1960-2019 period shows that the share of exports of goods and services in GDP was estimated to be 7.44 in 1960, and the annual increase was 0.689. Residuals from this equation show that it was not a very smooth trend, but there were big movements around the estimated line. Recursive estimates suggest that the slope coefficient increased until 1975 and reached to 1.4, and then slowly decreased to 0.7.

Least squares with breaks show that the slope coefficient was 1.04 for the 1960-1972 period, and 0.556 for the 1973-1989 period. 1990-2001 period witnessed an estimated annual increase of 1.11, and 2002-2010 period had an estimated annual increase of 2.24. The final period (2011-2019) had a negative trend of almost 2.

Table 4.24 Share of Exports of Goods and Services in GDP - Trend

Dependent Variable: KOREA_NEEXPGNFSZS
Method: Least Squares
Date: 07/21/20 Time: 14:55
Sample (adjusted): 1960 2019
Included observations: 60 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.445077	1.405109	5.298576	0.0000
@TREND	0.688987	0.041076	16.77354	0.0000

R-squared	0.829086	Mean dependent var	27.77018
Adjusted R-squared	0.826139	S.D. dependent var	13.21481
S.E. of regression	5.510132	Akaike info criterion	6.283820
Sum squared resid	1760.970	Schwarz criterion	6.353631
Log likelihood	-186.5146	Hannan-Quinn criter.	6.311127
F-statistic	281.3516	Durbin-Watson stat	0.358401
Prob(F-statistic)	0.000000		

Figure 4.24 Share of Exports of Goods and Services in GDP - Trend - Actual, Fitted, and Residuals

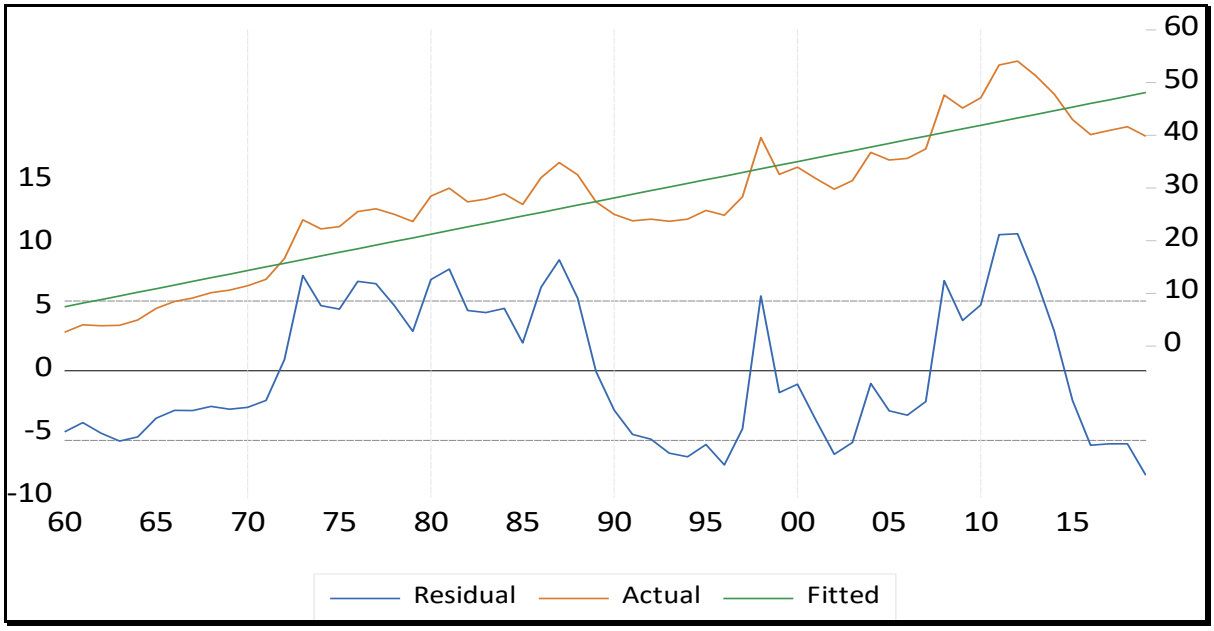


Figure 4.25 Share of Exports of Goods and Services in GDP - Trend - Recursive Estimates

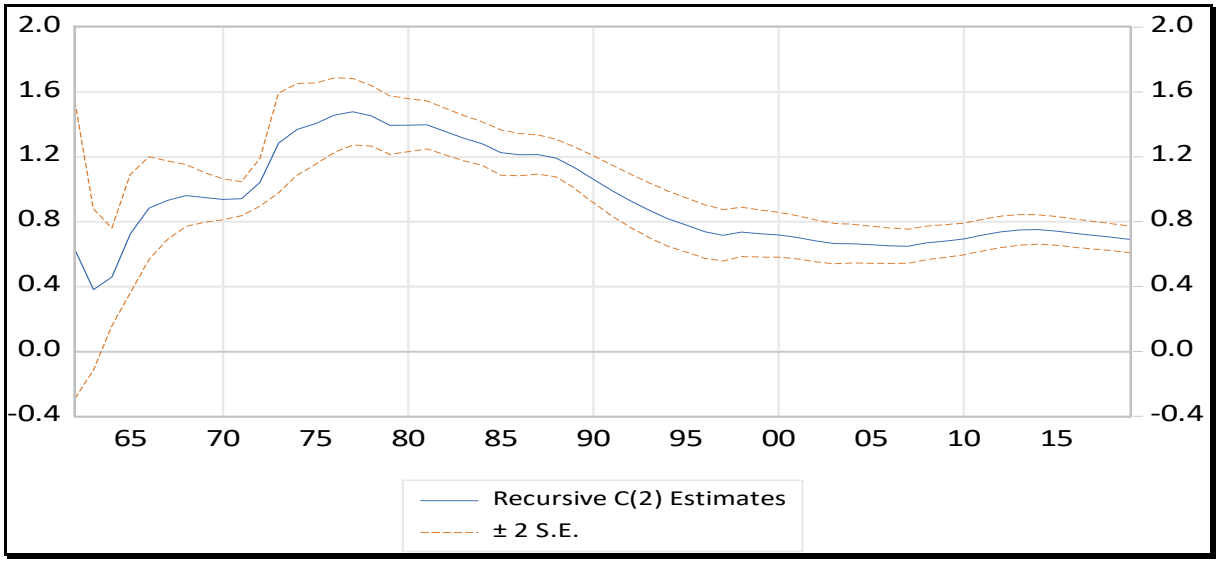


Table 4.25 Share of Exports of Goods and Services in GDP - Least Squares with Breaks

Dependent Variable: KOREA_NEEXPGNFSZS
Method: Least Squares with Breaks
Date: 07/21/20 Time: 14:57
Sample (adjusted): 1960 2019
Included observations: 60 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1973, 1990, 2002, 2011
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1972 -- 13 obs				
C	1.870705	1.262751	1.481452	0.1448
@TREND	1.041993	0.178580	5.834882	0.0000
1973 - 1989 -- 17 obs				
C	15.68161	2.571964	6.097136	0.0000
@TREND	0.555995	0.119272	4.661574	0.0000
1990 - 2001 -- 12 obs				
C	-11.24379	7.185756	-1.564733	0.1240
@TREND	1.108540	0.201465	5.502387	0.0000

2002 - 2010 -- 9 obs

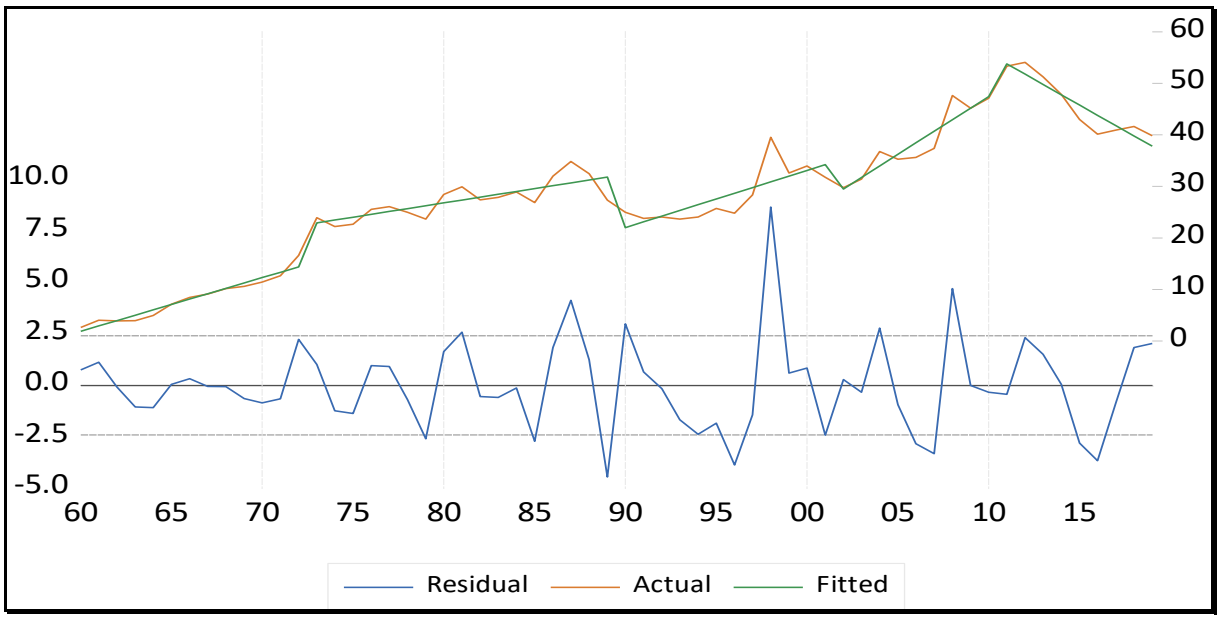
C	-64.70889	14.32959	-4.515753	0.0000
@TREND	2.242844	0.311023	7.211180	0.0000

2011 - 2019 -- 9 obs

C	155.6494	17.12512	9.088953	0.0000
@TREND	-1.997527	0.311023	-6.422438	0.0000

R-squared	0.971833	Mean dependent var	27.77018
Adjusted R-squared	0.966764	S.D. dependent var	13.21481
S.E. of regression	2.409176	Akaike info criterion	4.747458
Sum squared resid	290.2064	Schwarz criterion	5.096516
Log likelihood	-132.4237	Hannan-Quinn criter.	4.883994
F-statistic	191.6843	Durbin-Watson stat	1.861067
Prob(F-statistic)	0.000000		

Figure 4.26 Share of Exports of Goods and Services in GDP - Least Squares with Breaks - Actual, Fitted, and Residuals



4.8 KOF Globalization Index

KOF globalization index is commonly used to measure the degree of globalization for the economy. It is also important to study this index to draw some conclusion about the level that the country took its place in the world economy.

A single linear trend estimated for the 1970-2017 period shows that the index had an estimated annual increase of 1.06. Recursive estimates suggest that the slope coefficient decreased until 1992, and then slowly increased.

Least squares with breaks show that the slope coefficient was 1.36 for the 1970-1982 period, and 0.590 for the 1983-1990 period. The estimated slope was 1.85 for the 1991-1999, and 0.607 for the 2000-2006 period, and 0.413 for the 2007-2017 period.

Regression with dummy variables suggest that a single trend may be a satisfactory representation. Although, there are differences in estimated trends in different periods, these differences are not statistically discernable at the five percent significance level.

Table 4.26 KOF Globalization Index - Trend Equation

Dependent Variable: KOREA_KOFGI
Method: Least Squares
Date: 07/08/20 Time: 17:34
Sample (adjusted): 1970 2017
Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.47918	0.932689	24.10148	0.0000
@TREND	1.059823	0.025728	41.19284	0.0000

R-squared	0.973606	Mean dependent var	57.98325
Adjusted R-squared	0.973033	S.D. dependent var	15.03729
S.E. of regression	2.469384	Akaike info criterion	4.686588
Sum squared resid	280.5013	Schwarz criterion	4.764555
Log likelihood	-110.4781	Hannan-Quinn criter.	4.716052
F-statistic	1696.850	Durbin-Watson stat	0.219917
Prob(F-statistic)	0.000000		

Figure 4.27 KOF Globalization Index - Trend - Actual, Fitted, and Residuals

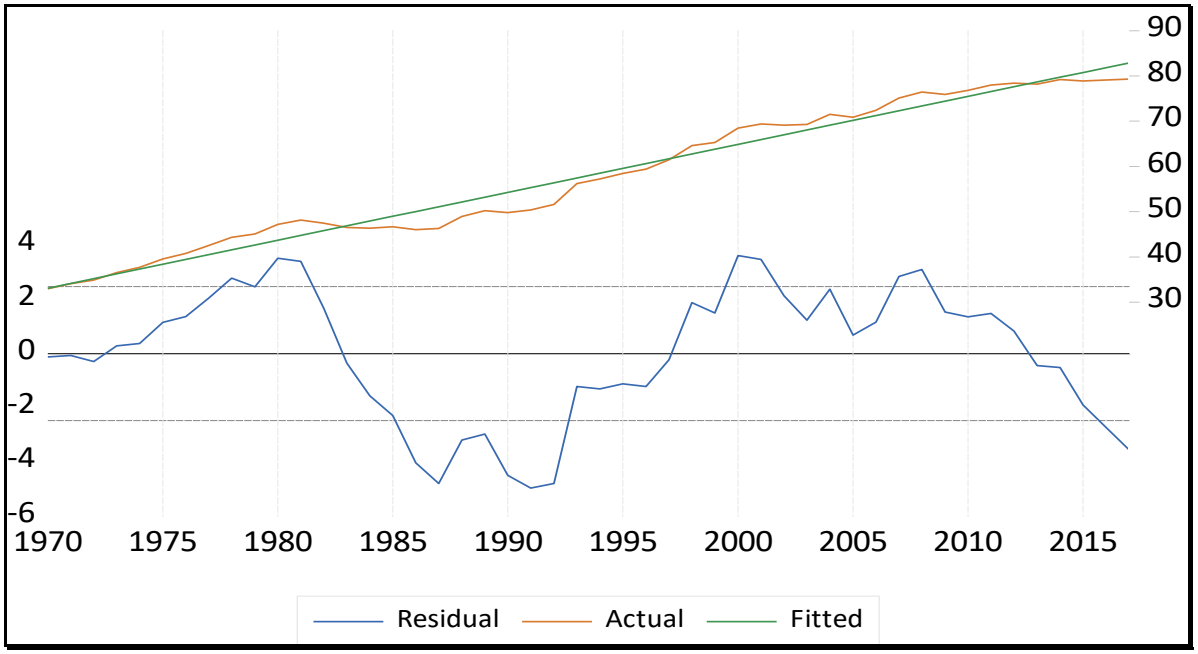


Figure 4.28 KOF Globalization Index - Trend - Recursive Estimates

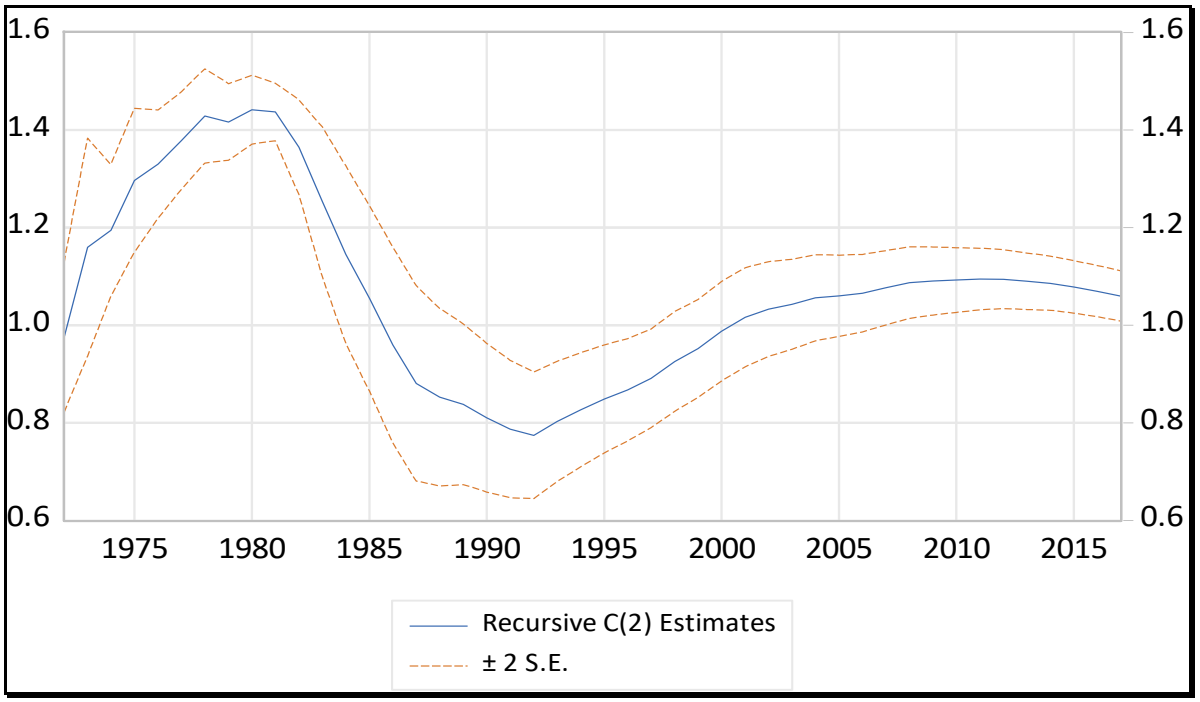


Table 4.27 KOF Globalization Index - Least Squares with Breaks

Dependent Variable: KOREA_KOFGI
Method: Least Squares with Breaks
Date: 07/21/20 Time: 15:04
Sample (adjusted): 1970 2017
Included observations: 48 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1983, 1991, 2000, 2007
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1970 - 1982 -- 13 obs				
C	19.02330	0.937025	20.30182	0.0000
@TREND	1.364820	0.057026	23.93351	0.0000
1983 - 1990 -- 8 obs				
C	31.96400	3.157500	10.12320	0.0000
@TREND	0.590259	0.118708	4.972360	0.0000
1991 - 1999 -- 9 obs				
C	-6.679212	3.485586	-1.916238	0.0629
@TREND	1.856518	0.099318	18.69261	0.0000
2000 - 2006 -- 7 obs				
C	44.05041	6.258403	7.038603	0.0000
@TREND	0.606815	0.145387	4.173788	0.0002
2007 - 2017 -- 11 obs				
C	56.28675	3.821320	14.72966	0.0000
@TREND	0.413138	0.073351	5.632306	0.0000

R-squared	0.997884	Mean dependent var	57.98325
Adjusted R-squared	0.997383	S.D. dependent var	15.03729
S.E. of regression	0.769316	Akaike info criterion	2.496422
Sum squared resid	22.49019	Schwarz criterion	2.886256
Log likelihood	-49.91413	Hannan-Quinn criter.	2.643741
F-statistic	1990.971	Durbin-Watson stat	2.033400
Prob(F-statistic)	0.000000		

Figure 4.29 KOF Globalization Index - Least Squares with Breaks - Actual, Fitted, and Residuals

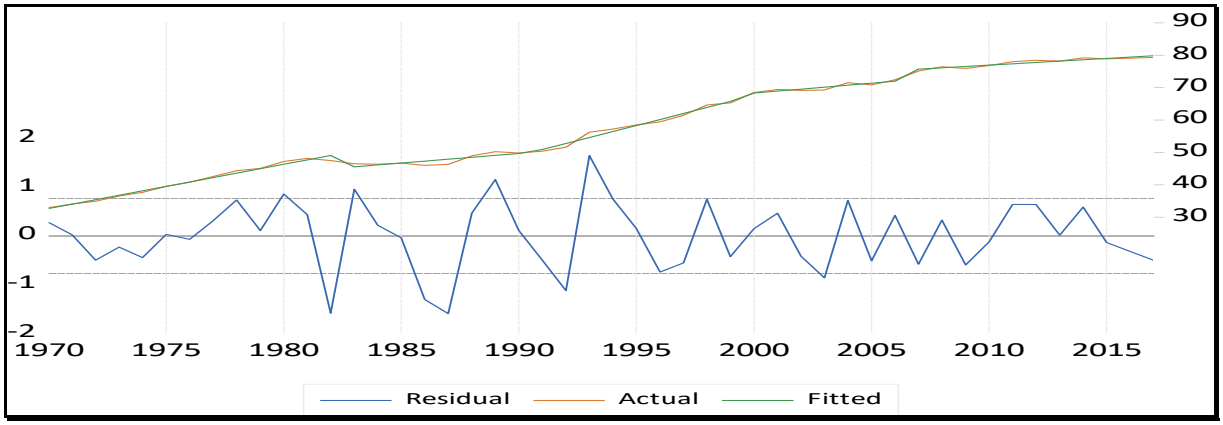


Table 4.28 KOF Globalization Index - Least Squares with Dummy Variables

Eq Name:	ZANDB_D0_TR_KOREA_KOFGI	ZANDB_D4_TR_KOREA_KOFGI	ZANDB_D5_TR_KOREA_KOFGI	ZANDB_D6_TR_KOREA_KOFGI
Dep. Var:	KOREA_KOFGI	KOREA_KOFGI	KOREA_KOFGI	KOREA_KOFGI
C	22.479 (0.933) [24.1]	21.947 (2.179) [10.1]	21.922 (1.520) [14.4]	23.242 (16.174) [1.4]
@TREND	1.060 (0.026) [41.2]	1.093 (0.233) [4.7]	1.096 (0.055) [20.0]	0.976 (1.466) [0.7]
@TREND*KOREA_D_19731979		0.098 (0.150) [0.7]		0.521 (1.518) [0.3]
@TREND*KOREA_D_19801989		-0.066 (0.169) [-0.4]		-0.815 (1.484) [-0.5]
@TREND*KOREA_D_19902020		-0.018 (0.194) [-0.1]		0.156 (1.467) [0.1]
KOREA_D_19731979			1.476 (1.690) [0.9]	-6.252 (17.365) [-0.4]
KOREA_D_19801989			-1.380 (1.755) [-0.8]	20.215 (17.127) [1.2]
KOREA_D_19902020			-0.974 (2.310) [-0.4]	-3.871 (16.316) [-0.2]
Observations:	48	48	48	48
R-squared:	0.9736	0.9771	0.9764	0.9838
F-statistic:	1696.8	458.2	444.2	347.3
Prob(F-stat):	0.000	0.000	0.000	0.000

4.9 Conclusions

Distinct periods of industrial policies show that there are differences in terms of performances based on industrial policies that were used during that period. These can be seen with the help of dummy variables used for four distinct periods, and with the help of the method of least squares with breaks. We hope that these methods are seen to be useful and can be implemented for other countries also.

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5 Industrial Policies and Evaluation of Specific Periods: The Case of Brazil

The letter "B" stands for Brazil in in the acronym BRICS (Brazil, Russia, India, China, and South Africa). The term was coined in the first years of the new millennium to distinguish the new emerging economies which were larger and showed higher growth rates than many other economies. These countries were projected to be the dominant suppliers of manufactured goods, raw materials, and services by 2050. Brazil together with South Africa was among the projected suppliers of raw materials. Brazil is the 5th largest country in terms of area, it is the 7th most populous country with a population of about 214 million, and as of 2018 it is the 9th largest economy in the world. The size, natural resources and economic potential of Brazil gave support to its inclusion among this group of countries. This is not the first time that Brazil was hailed as a success story.

The first section of this chapter will give an overview of economic and industrial policies and related economic developments in Brazil since 1950s. Some specific examples of industrial policies will be presented. The following sections deal with the empirical results on the correlation between industrial policies and some economic variables. The methodology is discussed in Chapter 3 and in Chapter 4, Section 1. The detailed results are presented in appendix to the chapter.

5.1 Economic Developments, Economic and Industrial Policies

In Latin America there are two major approach to industrial policy; it is not very different from other IP discussions (Figueiredo, 2008). Until the 1970's "dependency theory" was prominent. External debt issues and chronic inflation lead many economies to liberalize; particularly in the 1990s the Washington consensus was generally accepted. Some economists find that structural reforms of the 1990s improved industrial performance in terms of technical efficiency, productivity gains, and resource allocations in the manufacturing sectors. However, other group of economists consider that reforms of 1990s did not have any positive effect on industrialization patterns of Latin American countries. The technical efficiency is measured more in terms of R&D expenditures as percentage of GDP and number of patent applications.

These measures are useful indicators of innovative activities, but may not be sufficient the indicators of industrialization. Furthermore they consider that the reforms erased the earlier gains, organization of production and technological capabilities, and pushed these economies to low levels of development.

Brazil is considered among the countries that were successful in using industrial policies to catch up with the richer countries (Ocampo, 2014). Brazil like many other countries went through different stages of economic policy and industrial policies in the face of changing domestic and international economic conditions as well as political conditions. It would be better to divide these developments into roughly four periods. The period until 1980 was the time when import substitution policies were implemented at full-force. The 1981-1989 period was dominated inflation and debt problems; also some half-hearted liberalization attempts were made. 1990 is the year when dedicated liberalization policies started to take place. The period 1994-2004 is considered as the period where industrial policy abandoned. The year 2004 signals the return of industrial policy in Brazil.

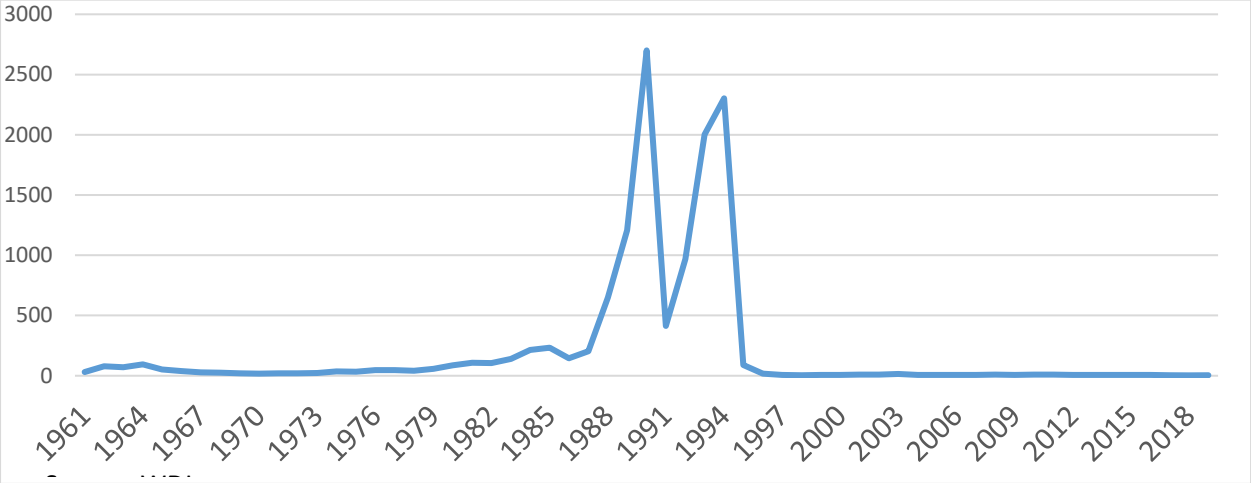
5.1.1 1950-1980

Similar to other Latin American countries import substitution industrialization policy dominated this period. Brazil at the end of the World War II was under favorable conditions compared to many other economies (Coes, 1995). It had quite large international reserves. This was short-lived because of the overvaluation of the Brazilian currency. Government instead of adjusting exchange rates introduced exchange controls. The 30% of receipts from exports would go to Banco Brasil, and the trade division would distribute foreign currency among importing firms giving priority to “essential goods” and goods of “national interest”. This approach to policy continued for many decades like in many other developing economies. In a few years 30% was raised to 75%. In 1950’s government set up a series of protectionist policies and measures. It took a leading allocating role in market. The two development plans determined the prioritized sectors. These sectors were protected through tariffs and were supported with financial and fiscal incentives. The tariff system was based on ad valorem taxes and The Law of Similar permitted only the import of goods not being produced in Brazil. The list changed from time to time. Also federal government had discretionary powers on the import regime. The state-owned companies were established during this time. For example, the oil

monopoly company Petrobras was established during partly in solution to balance of payments problems. The state owned companies gave governments opportunity to directly involve in industrial development.

In 1955 the new government promising "fifty years of progress in five" embarked on an ambitious investment program. Construction of the new capital city Brasilia started in this period. New investments were encouraged by subsidized credit and tax incentives. Furthermore, the program included incentives for foreign investment. Between 1957-1961 GDP grew 7% annually. These investment projects were financed mainly through taxation; when the tax revenue become insufficient the government increased the monetary base and started the chronic inflation problem. The 30% inflation rate was not much compared to some later rates, however, it was the beginning of a story to be repeated several times (**Hata! Başvuru kaynağı bulunamadı.**).

Figure 5.1 Annual Inflation Rate (%)



This is also the period in which foreign trade policy embodied real industrial policy. The tax system was converted to a large range of ad valorem tariffs. Those goods which are produced or should be produced (according to the policymakers) domestically enjoyed high tariffs; essential intermediate goods and capital goods imports were taxed at lower rates.

The next four-year period was characterized by rising inflation, slowdown in economic growth and worsening balance of payments problems. Also nationalist measures reduced flow of foreign capital. In 1964 the Brazilian military ousted the civilian government and stayed in power for two decades. This was the beginning of a stabilization period. The stabilization program was successful in the short-run, however it saw the seeds of other problems. The government intervention in the allocation of resources and price mechanism increased greatly.

As a result of successful stabilization program the Brazilian economy performed impressively during 1968-73. The real output increased, inflation fell down to relatively low levels and balance of payments improved. The 1973 oil crisis caught Brazil at almost full capacity. The various governments tried to overcome the oil shocks by economic growth supported by subsidies, foreign borrowing, and increasing exports. This policy was relatively successful. However, the accommodative monetary policy fueled inflationary tendencies.

Until 1970s the macroeconomic conditions were favorable. As in the case in many other countries the subsidiaries of TNCs were established and assembly industries began to develop. Brazil was on the way to becoming industrialized. Some new sectors such as petrochemicals and pulp & paper were successfully structured. An important example of successful industrial policy was the development of aeronautics industry through a state-owned company.

Box 5.1 Aeronautics Industry and Embraer

One of the widely accepted examples of a successful IP in developing countries is the aeronautics industry in Brazil (Goldstein and McGuire, 2004). It is also considered a good example of an infant industry which succeeded after long periods of protection (Altenburg, 2011). The efforts to build an aeronautics industry in Brazil goes back to the beginning of the 20th century. After the World War II a prominent military general promoted the modernization of technological and industrial base of Brazil through the establishment of an aerospace industry (Sikkink, 1991). With this in mind CTA (Aerospace Technical Center) was established in 1945 to coordinate research activities; this was followed by the establishment of the engineering school ITA (Aeronautics Technological Institute) in 1950. The main force behind the establishment of these two institutions was the Ministry of Military Aviation. ITA was supported by an agreement with the Massachusetts Institute of Technology and the California Institute of Technology. ITA was planned to provide high level education and research in aerospace science and technology. Several other institutions were established with the aim promoting aerospace industry and other high technology industries. IPD (Research and Development Institute) performed R&D in aeronautical engineering, electronics, new materials and mechanics. INPE (National Institute of Space Research) is attached to Ministry of Science and aims to provide research and qualified personnel in space and atmospheric sciences. Two other institutions contributed to the strengthening of R&D and education base of aeronautical industry. These were IAE (Institute of Space Activities) and IFI (Institute of Development and

Industrial Coordination). These education and research institutes had a considerable influence in the establishment of Embraer in 1969. It is even considered that Embraer was a natural spin-off of CTA and ITA (Joosung and Yoon, 2015).

Embraer started as a state-owned enterprise to manufacture small aircraft for military use. The industrial policies followed by the Brazilian governments can be summarized as follows. Firstly, the Ministry of Military Aviation created research and education institutions; and worked for these institutions to integrate with other institutions of research and learning and private companies in order to guarantee the technological development of the aviation industry. These institutions also provided qualified personnel for the industry. This is one of the distinguishing characteristics of the Brazilian aeronautics industry in comparison to other latecomers. The Brazilian approach was to give more importance in terms of resources to indigenous basic research and thus obtain technological superiority. While others like South Korea concentrated on developing its production capacities to replicate foreign partners' manufacturing techniques (Etzkowitz and Brisolla, 1999; Joosung and Yoon, 2015). Even Brazilian Development Bank (BNDES) showed special effort in supporting the R&D cooperation between Embraer and other research and academic institutions.

The R&D activities and production of required components and parts may be widely dispersed in terms of both industry and location. The Brazilian governments understood the importance of forming industrial clusters so that the R&D activities would be conducted more efficiently. The establishment and growth of this industrial cluster formed by CTA, ITA, IPD and INPE in the city of Sao Jose dos Campos was encouraged by the successive governments.

Brazilian government supported Embraer through marketing, financial, regulatory, and international activities. The government and the armed forces provided a ready customer for the first model of aircraft produce by Embraer. They bought approximately a third of the production before 1980. Furthermore, the payments were up-front. The government contributed also towards the development expenditures (Casanova et al., 2009). Brazilian Development Bank (BNDES) provided alternate financing for the customers of Embraer as well as export support schemes and tax holidays. The government provided support to Embraer through tariff policies; in order to induce foreign manufacturers to supply assembly kits to Embraer the import duties were raised.

In summary the government was the owner, developer and buyer (Maculan, 2013). Embraer entered into licensing agreements with some international companies in order to deepen its technological base, acquire production knowledge in tooling and parts manufacturing, tracing technology and assembly. By the mid-1970s Embraer had acquired significant know-how in aircraft design, manufacturing, commercialization and servicing (Joosung and Yoon, 2015). By the end of the decade Embraer became internationally competitive both in civilian and military niche areas. This ended in the 1980s. Firstly, the management system based on military traditions was not conducive to international competitions. Secondly, with the debt crisis and Brazil becoming more democratic public policies to support Embraer were not feasible. And Embraer went into difficulties and after several attempts Embraer was privatized in 1994. After several years of difficulty Embraer became competitive again.

Currently Embraer is the largest Brazilian exporter of high-value-added products. It directly employs more than 20 000 people. It has 1700 planes in operation in commercial aviation and client portfolio of more than 100 airlines in 60 countries. However, in recent months its main competitor Fokker was acquired by Airbus and Embraer started negotiations with Boeing. The agreement with Boeing fell through; it seems future of Embraer is uncertain.

On the other hand, already existing sectors such as textile and automotive have not developed as expected. Overall economic growth and the rise in consumer demand for durables led many industries to grow.

In evaluating industrial policy in Brazil Auty (1995) characterizes it as market usurping with low openness. He criticizes it as stressing self-sufficiency instead of efficiency and competitiveness. Furthermore, the renewal and prolonging support of infant industries did not create incentives for the firms to enter international markets, and created vested interests. As in some other countries the support was extended to heavy and chemical industries.

Auty (1995) gives example of two industries which had an important place in Brazilian industrial policy but regressed eventually: steel and automotive. The first integrated steel plant was built in 1944. This was followed by two more integrated plants being built in in the second half of 1950s. The result was the dilution of scale economies as well as managerial and labor skills. In the second half of 1970s two more plant were built. The steel production increased.

However, the plants stayed small and uncompetitive. These plants suffered from high construction costs, high capital costs, excess capacity and low productivity. In the early 1980s facing a depressed domestic demand the steel plants entered the international markets, and increased exports, but they were unprofitable; and contributed to the increase in national debt.

With the establishment of steel industry governments targeted shipbuilding and automotive industries as downstream products. Five automotive firms were licensed in the second half of 1950s. These firms established assembly lines and enjoyed import duty tax rebates, favorable tax structure and strong protection. The car production reached 75000 in 1962. This number was not enough for economies of scale even for a single plant. In this sector there were also multi-national companies such as Volkswagen. The domestic content requirement was 95%; it was not possible for the assembler to be efficient under these conditions. Only Volkswagen made profits, still its costs were higher than those in the European community. The other firms just survived with strong protection. As President Collor declared shortly after assuming power in 1990, "Brazil does not produce cars, it produces carts" (Coes, 1995).

5.1.2 1980-2000

In the 1980s Brazil has undergone some important economic fluctuations and made attempts to change the main economic policies. The second oil shock exacerbated the existing problems. In 1981 for the first time Brazil had a negative growth since the World War II. Mexico suspended interest payments on its debts; this was followed by international lenders stopping new loans to Brazil and rollover of existing debts. Brazil went into recession and inflation rates were still high. In 1985 a civilian government took over. The stabilization attempts and failures continued until 1994. The Cruzado Plan ended in 1987 with inflation rate reaching 1000 % annually and the government declaring moratorium for foreign debt. There was the Bresser Plan of 1987, then the Summer Plan which ended in 1989 with monthly inflation rate approaching 30%. These were followed by the two Collor plans which were not successful in bringing down inflation but were successful in introducing some structural changes. These changes were in the direction of market liberalization, trade liberalization and privatization. In 1992 the new government started Real Plan which strengthened the liberalization and privatization policies and were successful in bringing down inflation.

By the end of 1980s Brazil was one of the most closed economies in the world. Between 1990-1993 the tariffs were reduced from 50% to 15% in stages. The computer industry was one of the most protected. However, it did not reach international competitiveness. Finally, the protection was abandoned in 1992.

The semi-conductor industry faced elimination with the declining protection. In the late 1960s there were about 20 consumer electronics firms in Brazil, three of which was foreign owned. The "market reserve" policy which was introduced in 1980s encouraged the emergence of local electronics component firms. And at the end of 1980s there were 23 semiconductor firms. With the liberalization policies the tariffs were reduced from 114% to 21% and the new law on information and communication technologies provided tax incentives to final goods rather than intermediaries. Consequently 20 of these 23 semiconductor producing firms left the market in early 1990s (Figueiredo, 2008).

Privatization process started in the early 1980s, however there was not any serious privatization. The companies to be privatized were failed companies and foreigner were not allowed in the process. Sectors such as steel, petroleum and derivatives, energy, telecommunications, and aeronautics were sectors under the public domain and were in some cases public monopolies. Privatization became a priority in 1990s.

5.2 Return of Industrial Policy

The supporters of industrial policy consider that despite inefficiencies associated with high levels of protection the state-led industrialization was successful in Latin American countries as well as reducing poverty and contributing to human development (Ocampo, 2014). During the market reforms under the Washington Consensus policies some of the institutions responsible for industrial policy were lost. There has been deindustrialization during this period (Nassif et al., 2018). Starting in 2004 with the new government industrial policy was given importance again. Kupfer et al (2013) and Ferraz et al (2014) analyze the three recent programs. PITCE (Industrial, Technological and Foreign Trade Policy) was introduced in 2004 and continued until 2008. The objective of this program was for reforming and modernizing the institutional basis. PITCE focused on technology-intensive industries, such as capital goods, semi-conductors, software and pharmaceuticals. It was expected that these industries could

provide gains in productivity and windows of opportunity to develop robust scientific and technological systems in areas, such as energy, health and agriculture. Another focus was on exports because PITCE was introduced at a time of external vulnerability. The gains in productivity would raise the gains in the higher segments of the international markets. There were some institutional changes particularly to promote innovation and technological progress. To this end some laws such as "Innovation Law" arranging fiscal incentives; some institutions such as Patent Office were reorganized; new programs were established at the Brazilian Development Bank. Two new institution were created: National Industrial Council as an advisory board consisting of businessmen, workers and government officials and Brazilian Development Agency to provide technical support for the policy.

In the middle of the year 2008 the government introduced PDP (Productive Development Policy). The PDP was conceived under favorable international and domestic conditions. Global macroeconomic conditions were conducive to economic growth and the demand for Brazilian exports resulted in abundant reserves. Furthermore the investment levels were relatively high resembling 1970s. With this background the government planned to foster investment and productive capacity, maintain the robustness of balance of payments, increase innovation capacity, and strengthen small and medium enterprises. 34 programs were developed for the next two years. These programs were categorized as mobilizing programs in strategic areas, programs to strengthen competitiveness, and programs to consolidate and expand leadership. Each category of program was led by a ministry or a government institution. Each program targeted specific sectors. For example, nanotechnology was one of the strategic areas; agribusiness was one of the sectors to be more competitive; and bioethanol was one of the sectors targeted by leadership programs.

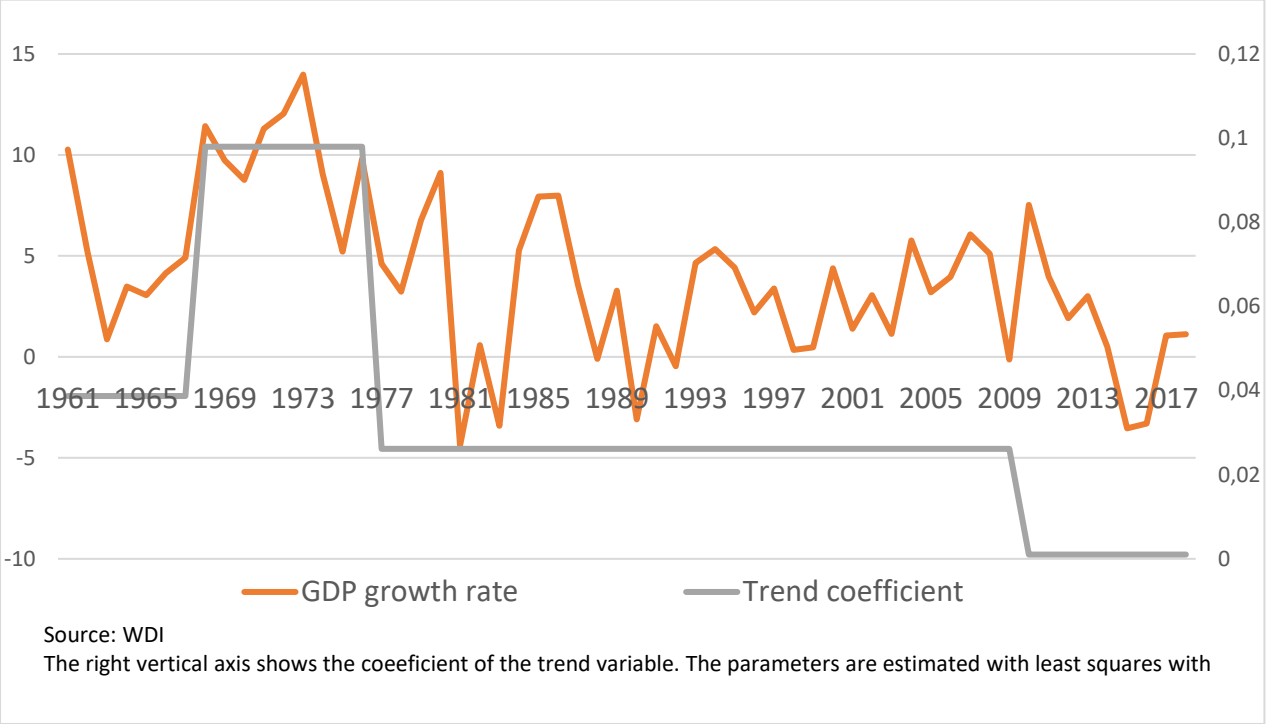
Unfortunately, the global financial and economic crisis of 2008 influenced the macro targets adversely. The evolution of productivity was slow and imports tended to increase. Brazil had a high rate of GDP growth in 2010. This encouraged the policymakers and in 2011 PBM (Plan for Bigger Brazil) was put into action. The purpose of PBM was a higher rate of economic growth through innovation and technological development. Four guiding principles were specified: building and strengthening critical competencies, enhancing productivity and technology upgrade along value chains, expanding domestic and international markets for Brazilian companies, and ensuring environmentally sustainable and socially inclusive economic growth. The Plan covered the period 2011-14. For the implementation 19 sectoral committees and 9 systemic coordination teams were established.

Slowing down economy and fierce international competition pushed the Plan away from its main objectives. The Plan put short-term measures into action to protect the domestic market. These measures included interest rates reduction for capital goods acquisition, tax cuts on the payroll, investment and exports, and reduction in the energy bill. Furthermore, legal procedures were established for government purchases favoring domestically produced goods. Also, special measures were devised or existing ones were modified so that innovation, production of energy efficient products and local industries could be encouraged.

5.3 Industrial Policies and Economic Growth

This section and following sections present empirical results as discussed in the methodological chapter. Brazil had an average annual growth rate 3.8% during 1960-2018 (**Hata! Başvuru kaynağı bulunamadı.**). There were lots of ups and downs. While in 1973 it peaked at approximately 14%, there were occasions where it was negative. The least squares regression with breaks suggest four periods: 1960-67, 1968-76, 1977-2009, and 2010-2018. These periods roughly correspond to the periods put forward at the first section of this chapter. The 1967-76 period is when the government put more effort on industrialization and economic growth. With the foreign exchange shortages and inflationary tendencies this period ended. Debt problems, hyperinflation and stabilization attempts took over almost the next two decades. The successful stabilization program, and liberalization policies led to a more stable rate of economic growth. However, it should be noted that the critiques of the liberalization policies point out that the period starting in 1994 had lower growth rates than in the sixties and seventies. The financial crisis of 2008 led to lower growth rates. In evaluating breaks one should be aware that the trend coefficient shows the change in trend per year, and the direction also depends on the starting value, namely the constant.

Figure 5.2 Brazil: GDP growth rate (2020 constant US dollars) and structural breaks

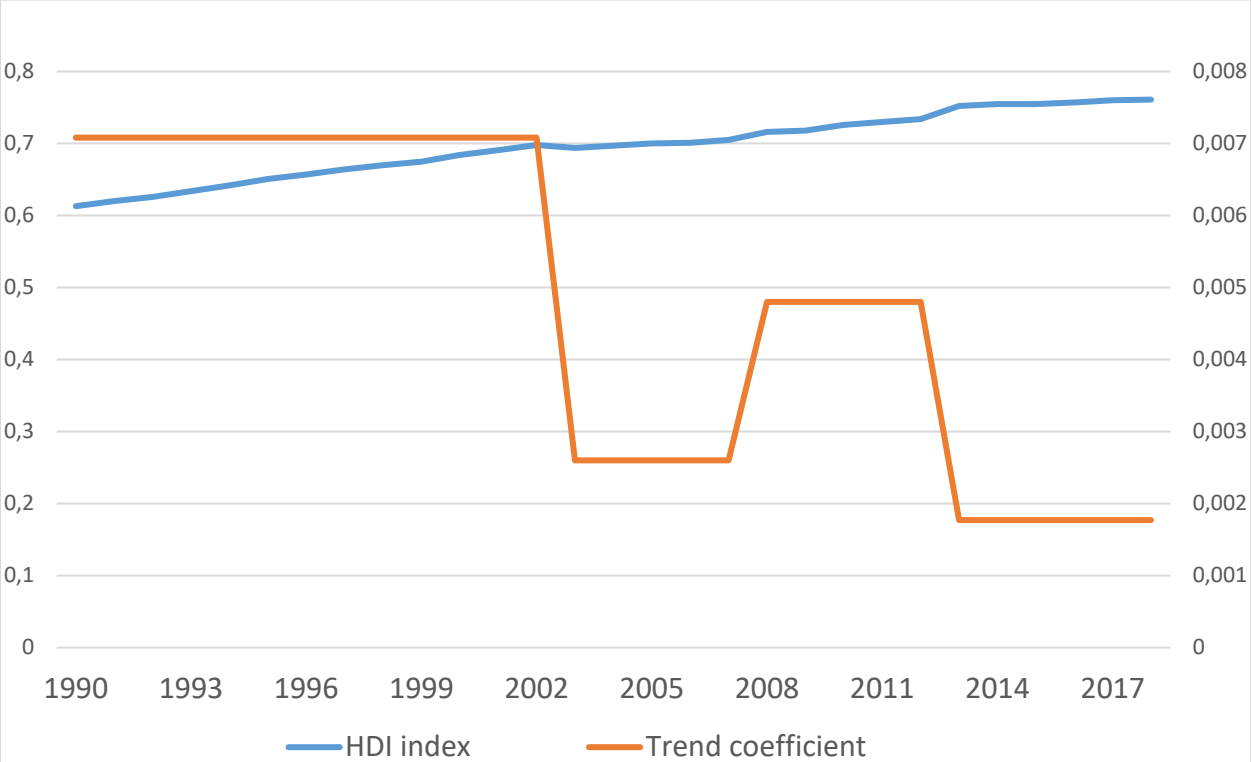


Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with

5.4 Industrial Policies and Human Development Index

Human Development Index is an important indicator of economic and social development in an economy. In 2019 Brazil ranked 79th out of 181 countries. The index figure increased on average by 0.005244 every year. The breaks seem to correspond more to the changes in government and social and economic policies. However the tendency is for the increase (**Hata! Başvuru kaynağı bulunamadı.**).

Figure 5.3 Human Development Index and structural breaks



Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given the appendix to the chapter.

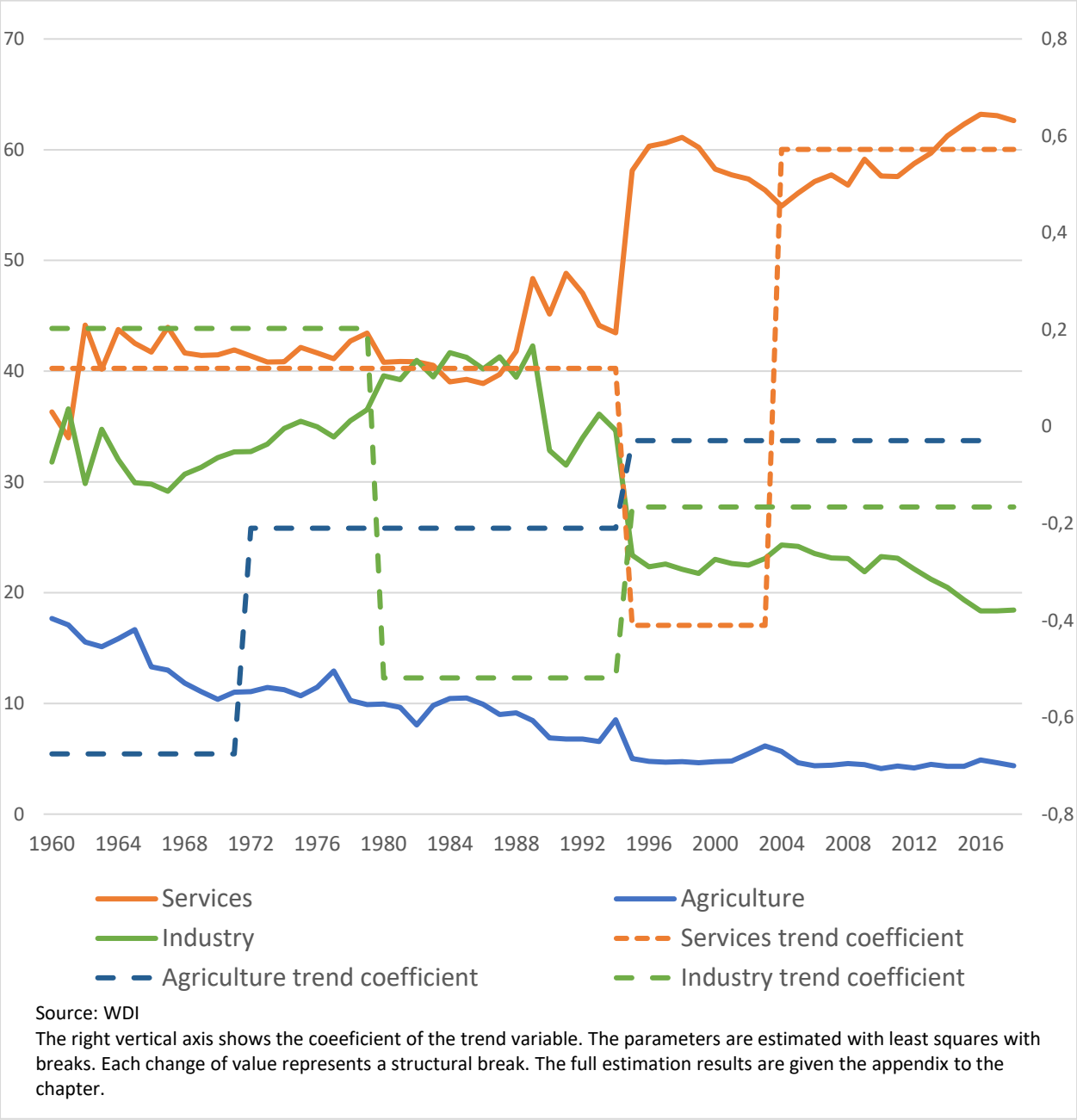
5.5 Industrial Policies and Structural Transformation

5.5.1 Shares of Sectoral Value Added in GDP

An important indicator of structural change in an economy is the change in sectoral shares in GDP overtime. It is expected that as an economy starts to develop, the share of agriculture declines rather fast, and the share of industry increases, as the economy matures the share of services increases and becomes the largest sector. This was the experience of current developed

economies. The experience of Brazil is similar in general terms. The share of agriculture has declined from about 20% in 1960 to about 4% in 2019 (Figure 5.4)

Figure 5.4 Brazil: Sectoral value added shares in GDP (%)



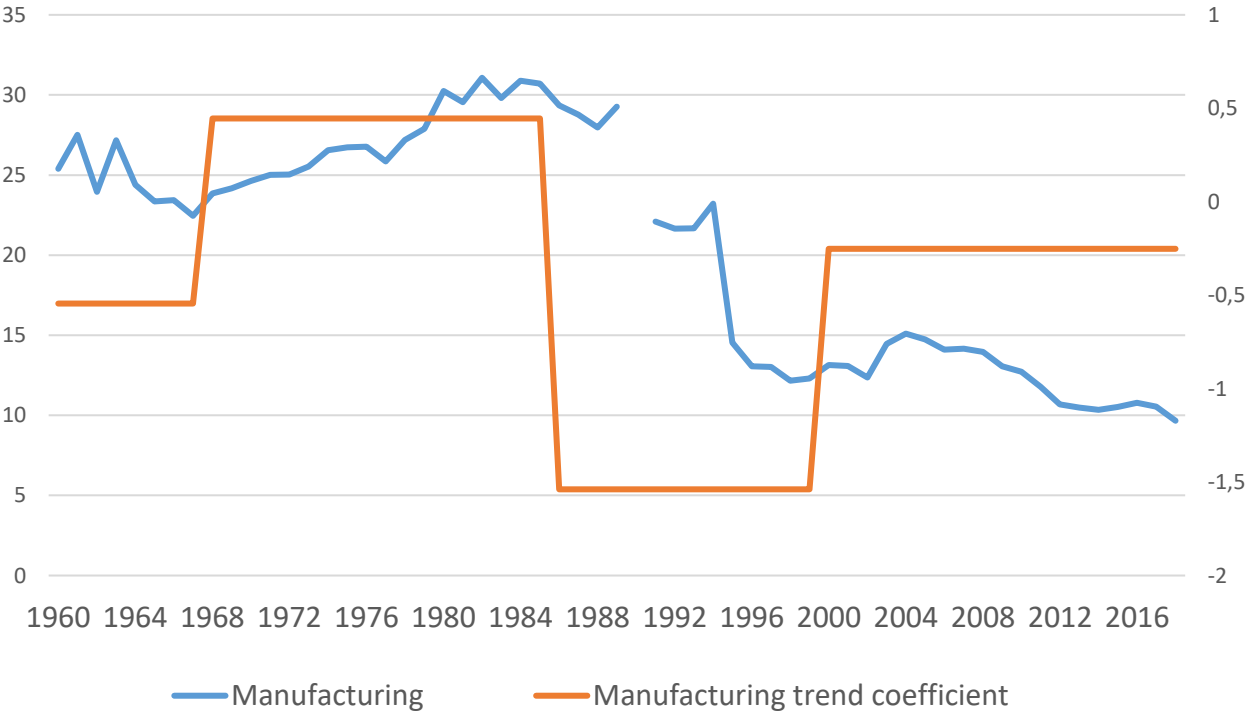
Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given the appendix to the chapter.

Services and industry follow the expected developments. The major break seems to be in 1994-1996 period where successful stabilization and liberalization polices became effective. During

this period the share of services increased by about 17 percentage points while that of industry decreased by the same percentage.

The picture is clearer in the case of manufacturing sector. During the period under study the share of manufacturing value added in GDP increased from 25% to 31% in 1982, then decreased to less than 10% in 2018 (**Hata! Başvuru kaynağı bulunamadı.**). There are four periods; in the first two the share of manufacturing tends to increase; during the third there is a sharp decline. This is the period of hyperinflation, debt crisis, and mostly unsuccessful stabilization programs. During the last period with the start of new industrial policies there is tendency for manufacturing to increase however this end with the Great Recession. These two figures support the arguments of those who believe that industrialization of Brazil ended early.

Figure 5.5 Brazil: Share of manufacturing value added in GDP(%)

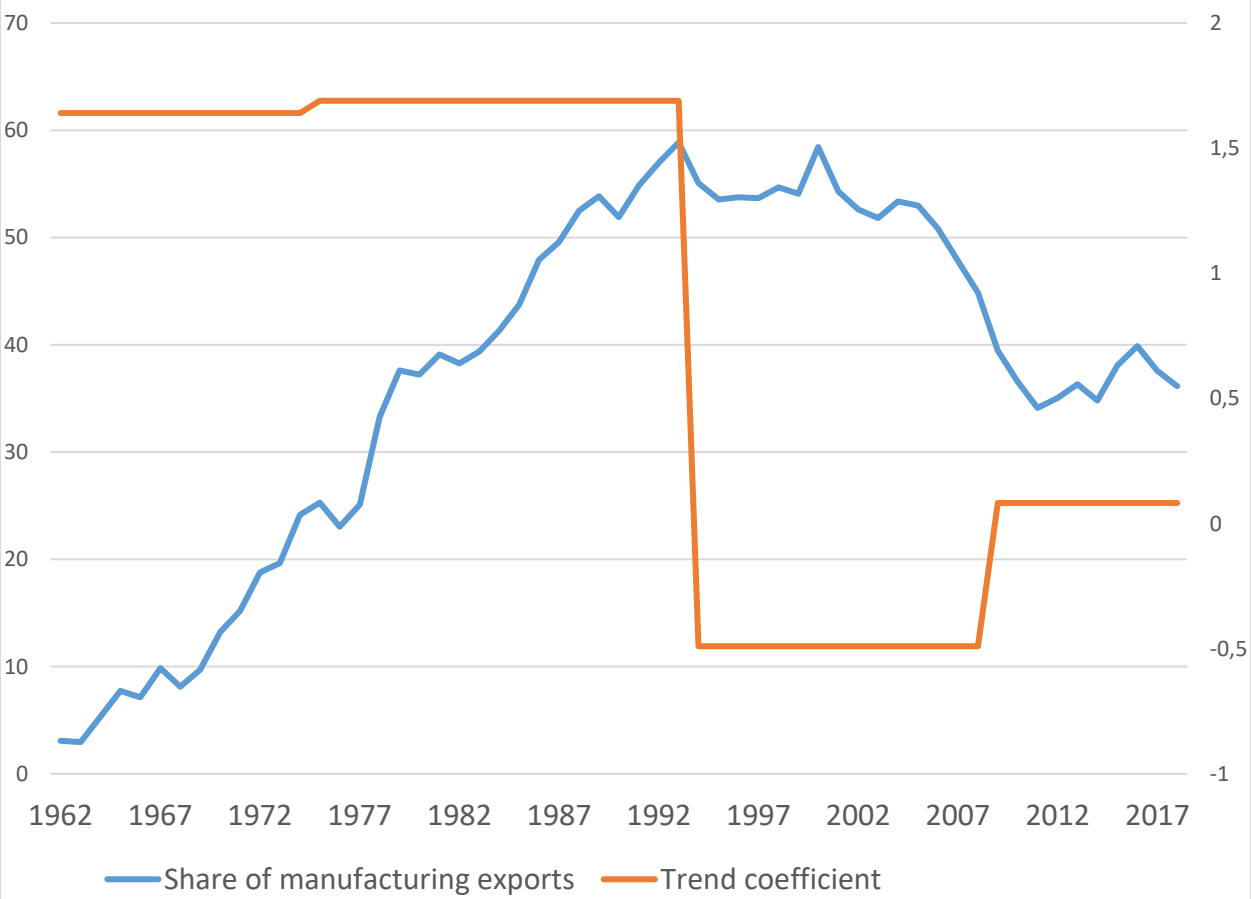


Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

Another indicator related to industrialization is the share of manufacturing goods in exports. The development of manufacturing share in exports is similar to the share of manufacturing value added in GDP (**Hata! Başvuru kaynağı bulunamadı.**). In the beginning of 1990s the share of manufacturing exports reached almost to 60%. With the new millennium

manufacturing exports sharply declined, down to 34% of total exports in 2011. The decline stopped at that year, and there has been some increase, though small. Trend coefficients and the related structural breaks move in the same direction. There has been some criticism of export growth in the 1980s as being not profitable. Also this development was seen another indication of early de-industrialization. In developing concept of BRICS as mentioned in the beginning of the chapter, Brazil was predicted to be one of the main exporters of raw materials. The share of exports in GDP has not changed significantly during the last two decades, share of manufacturing exports fell significantly. Avrichir (2015) comparing Brazil to other BRICS economies points out that in Brazil exports of manufactured goods and services represent about 11-13% of GDP, while this percentage is double in other BRICS economies. Another development is the continuing decline of exports with high technological content.

Figure 5.6 Brazil: Share of manufacturing in merchandise exports (%)

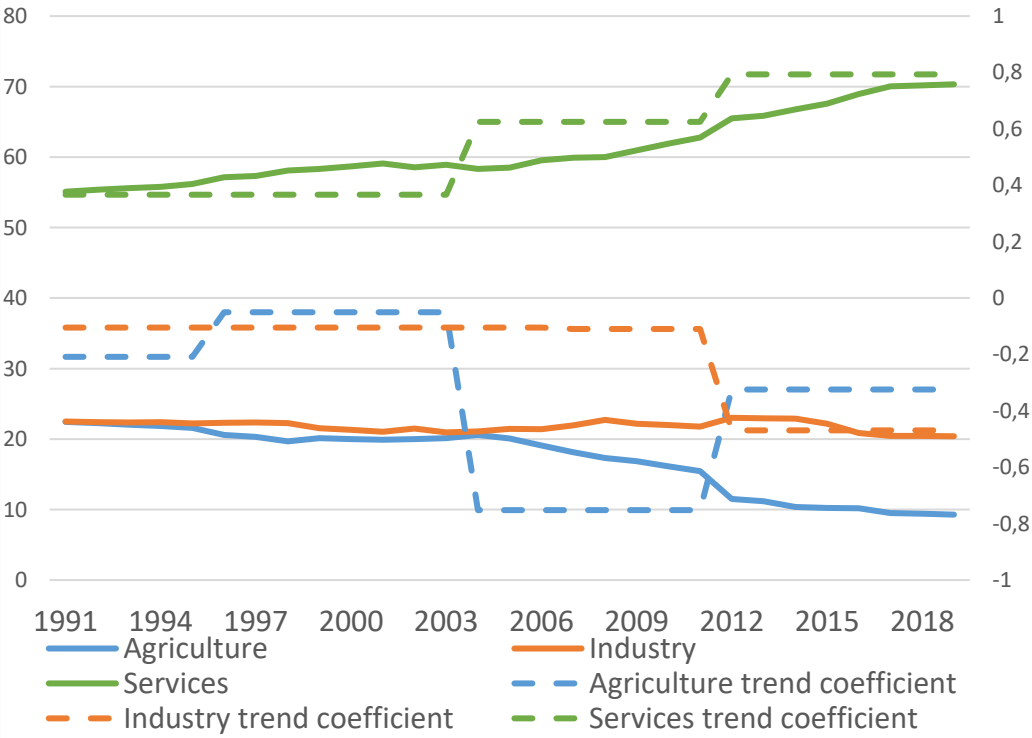


Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given the appendix to the chapter.

5.6 Shares of Sectoral Employment in Total Employment

Another indicator of structural transformation is the changes taking place in employment patterns. As in shares of value added in GDP it is expected that in the initial stages of economic development the employment in agriculture declines while employment in industry increases. As the economy develops employment in services tends to increase. These changes are results of the changes in the composition of output, changes and shifts in demand, and changes in productivity. It is expected that productivity increases in agriculture and industry lead to shifts in employment. Unfortunately, available data covers the period starting in 1991 which may not be enough for a longer term analysis. The data shows the projected developments: a steady increase in the share of services, and a decrease in agriculture (**Hata! Başvuru kaynağı bulunamadı.**). The share of employment in industry follows a more or less stable trend. Starting in 2004 it tends to increase but then in 2015 starts to decline again.

Figure 5.7 Brazil: Shares of sectoral employment in total (%)

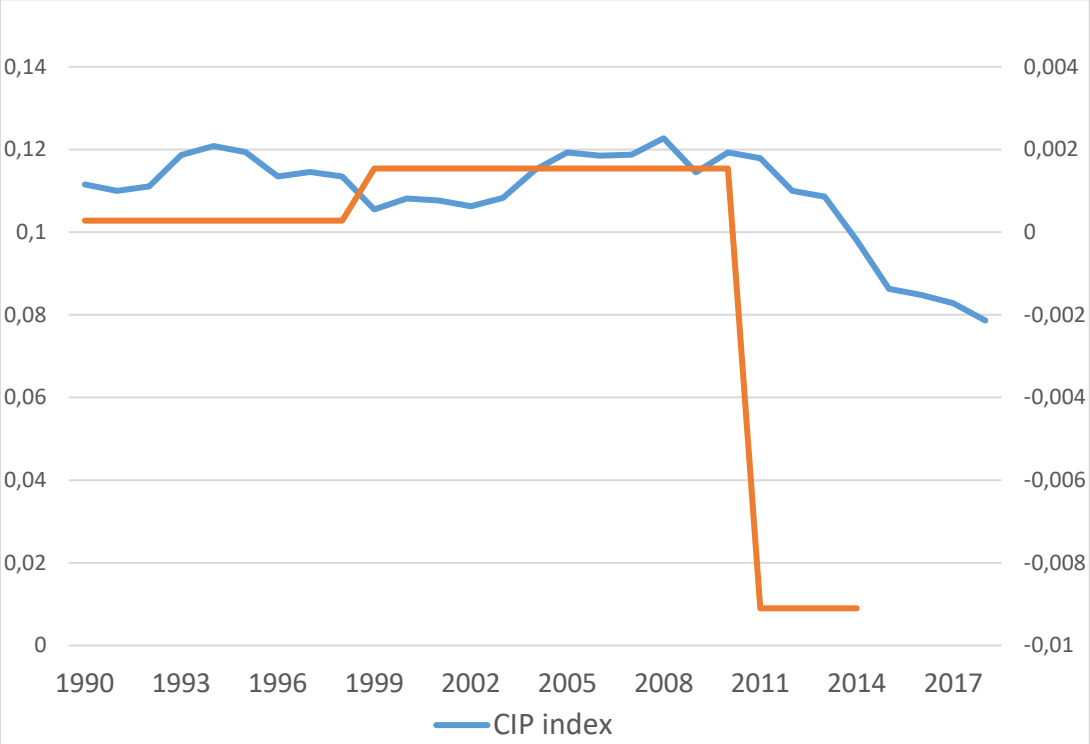


Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full

5.6.1 Industrial Policies and UNIDO Competitive Industrial Performance Index

Brazil is often criticized for not being competitive (Avrichir, 2015). Brazil ranks 40th among 152 countries in UNIDO's Competitive Industrial Performance Index (CIP) in 2018. Its rank was 26th in 1990. After 2010 there is steady decline in Brazil's industrial performance (**Hata! Başvuru kaynağı bulunamadı.**). The related indices move in the same direction. The Industrialization Intensity Index value declined from 0.54 in 1990 to 0.35 in 2018. And Brazil's rank fell to 60th. This is in line with decline of the share of manufacturing exports in total exports. Furthermore, Brazil's rank in the Share of Medium and High-Tech Activities in Total Manufacturing Value Added Index was 45th in 2018. The Index value declined from 0.76 in 1990 to 0.44 in 2018. Consequently, Brazil's place in Share of Medium and High-Tech Activities in Manufacturing Export Index moved in the same direction. In 2018 Brazil's rank was 60th.

Figure 5.8 Brazil: UNIDO Competitive Industrial Performance Index



Source: UNIDO
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

5.7 Industrial Policies and Productivity

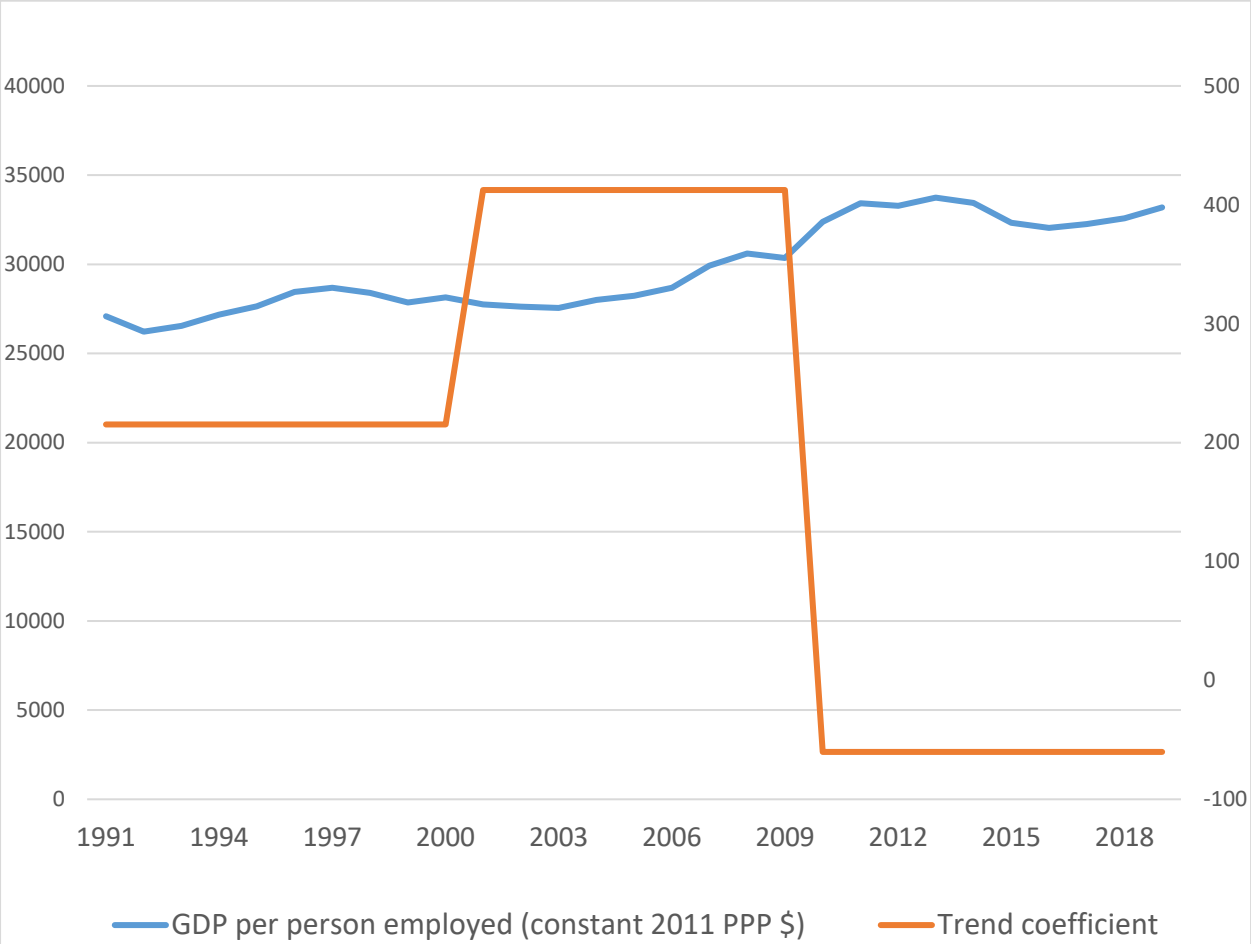
Increase in productivity is an important objective of industrial policy. For economic growth to be sustainable steady increase in productivity is essential. Nassif et al. (2020) estimate growth rates of labor productivity for the period 1950-2011 (Table 5.1). They find that for the period overall growth rate is 2.1% per year. However, the growth rate in agriculture and mining is 3.7% while it is 2% in manufacturing. The interesting thing is that significant growth in manufacturing industry took place during 1950-1979 when industrial policies were implemented. As expected, it is negative in the turbulent period of 1980-1994, then turns positive.

Table 5.1 Brazil: Average annual growth rates of labor productivity (%)

	Agriculture and Mining	Manufacturing	Overall
1950–1979	3.2	4.1	4.4
1980–1994	1.6	−1.7	−0.9
1995–2011	4.9	1.2	0.8
1980–2011	4	−0.5	−0.2
1950–2011	3.7	2	2.1
Source: Nassif, André, Lucilene Morandi, Eliane Araújo, and Carmem Feijó. "Economic Development and Stagnation in Brazil (1950-2011)." Structural Change and Economic Dynamics (2020), p.8.			

The overall productivity measured as GDP per person employed increased on average 264 PPP USD per year (**Hata! Başvuru kaynağı bulunamadı.**). The trend tends to increase until 2009, however, possibly as a result of the Great Recession, it turns to decrease.

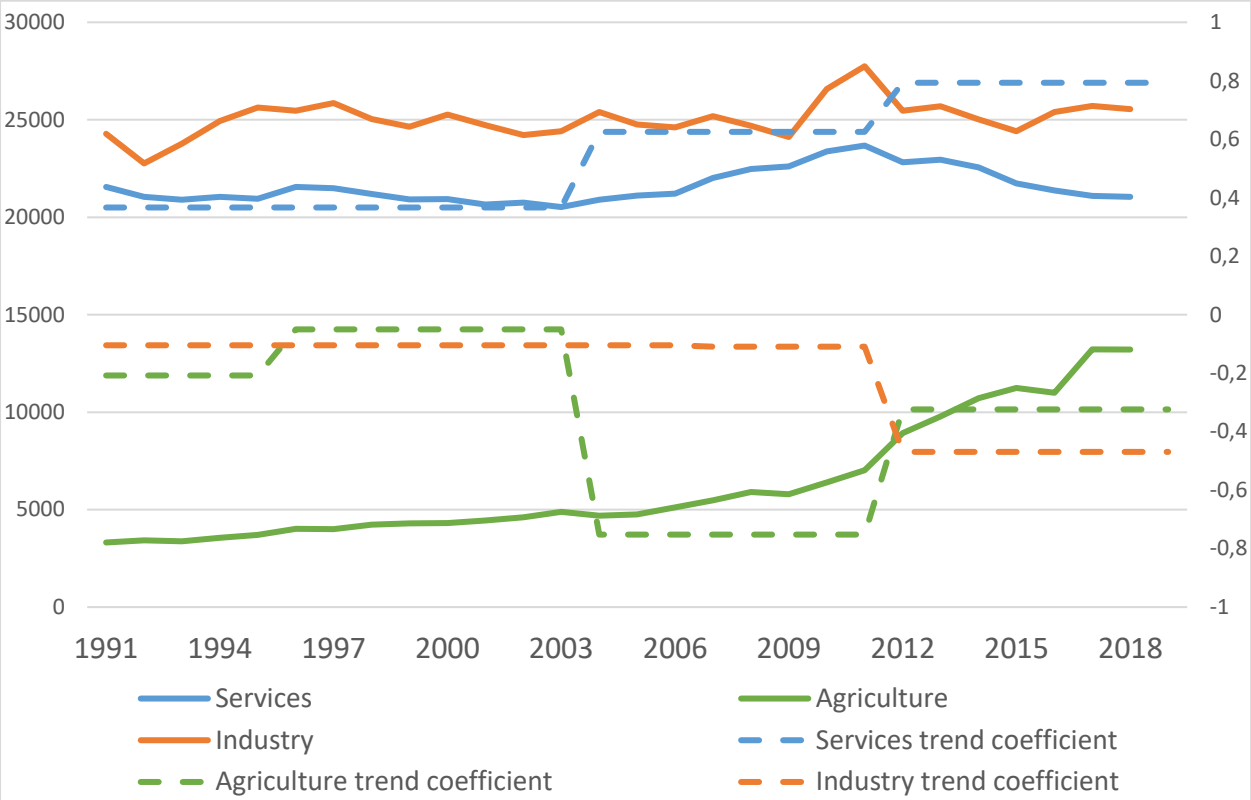
Figure 5.9 Brazil: Productivity (GDP per person employed in constant 2011 PPP USD)



Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

On a sectoral basis productivity measured as value added per worker the industrial sector including construction has the highest level (**Hata! Başvuru kaynağı bulunamadı.**). Services and agriculture follow industrial sector, respectively. On the other hand, trend coefficient for services have been always positive and increasing during the period under study. 2012 onwards the trend for industry turned to negative and below both services and agriculture.

Figure 5.10 Brazil: Sectoral productivity (value added per worker in 2010 constant USD)



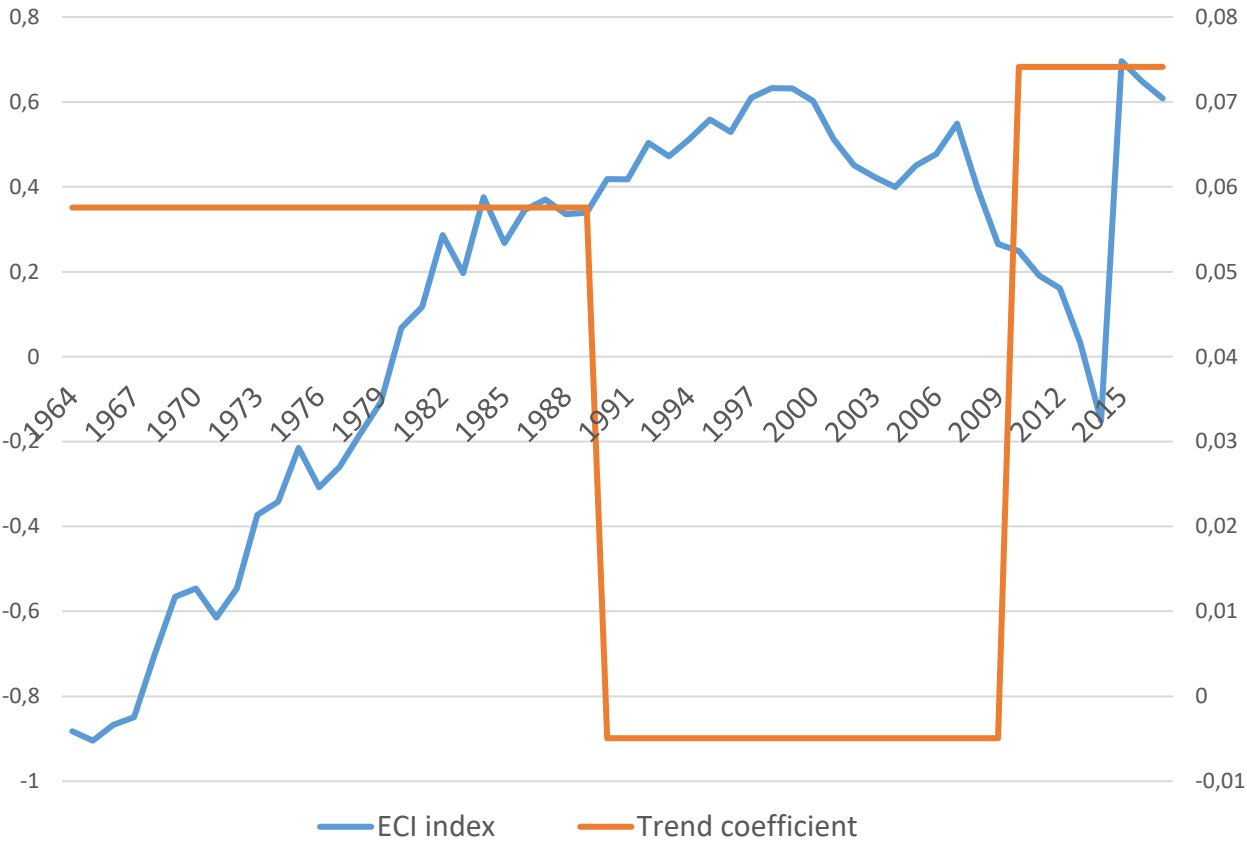
Source: WDI

The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

5.8 Industrial Policies and Economic Complexity

Economic Complexity Index as discussed in Chapter 3 may function as an important indicator of development and structural transformation of an economy. Out of 131 countries in 2017 Japan is at the top of the list and Brazil ranks 37th. Brazil, since 1964 had a steady rise in the index until 1999 (**Hata! Başvuru kaynağı bulunamadı.**). Then there was a tendency for the index figures to decline, however in the last two years a sharp increase is observed. The estimated structural breaks imply that industrial policies of might not have a direct effect on the index.

Figure 5.11 Brazil: Economic Complexity Index



Source: OECD
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

5.9 Industrial Policies and Globalization

Brazil followed an industrialization policy based on import substitution. Inevitably, as mentioned before, there were quite a lot of restrictions on imports. On the other hand, Brazil is a resource rich economy dependent on exports of raw materials. The development of foreign trade and KOF index may give some idea about integration of Brazil to the world economy.

5.9.1 Share of Foreign Trade in GDP

In Brazil the share of foreign trade in GDP has increased steadily from about 13% in 1960 to about 28% in 2018 other than a few periods (**Hata! Başvuru kaynağı bulunamadı.**). A decline in imports during 1984-1998 was inevitable because of debt problems and unsuccessful stabilization attempts. For the exports the same period is where the share was stable with small fluctuations. With the liberalization policies it increased greatly, however with the great recession the growth rate seemed to decline. It is difficult make a comment on the role of industrial policies on the growth of foreign trade.

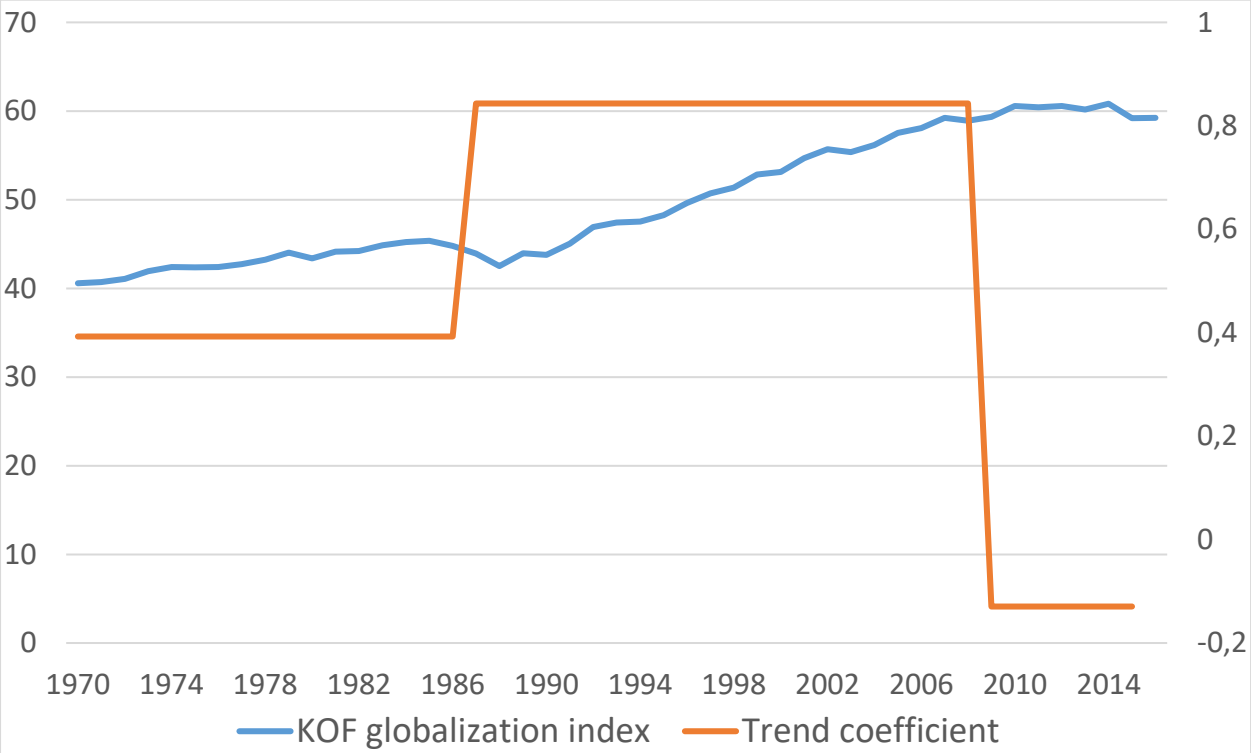
Figure 5.12 Brazil: Share of foreign trade in GDP(%)

Source: WDI
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

5.9.2 KOF Globalization Index

Since the 1970s Brazil's KOF index has been increasing (**Hata! Başvuru kaynağı bulunamadı.**). The middle period where the increase in the index value is very clear starts with the liberalization attempts and continues until the great recession. The last period trend coefficient takes on a negative value like in many other countries. The data available suggests that the end of industrial policies gave impetus to the globalization efforts.

Figure 5.13 Brazil: KOF Globalization Index



Source: UNIDO
The right vertical axis shows the coeeficient of the trend variable. The parameters are estimated with least squares with breaks. Each change of value represents a structural break. The full estimation results are given in the appendix to the chapter.

5.10 Conclusions

As in other case studies it is difficult to reach conclusive results for the success of industrial policies in Brazil. Still there are some definite developments. During 1950-1980 Brazil experienced high growth rates, increase in productivity and developed a strong manufacturing base. However it was not possible to continue with those policies which was instrumental in obtaining those developments. The abandonment of industrial policies provided stability and increased Brazil's integration to the world economy. On the other hand the manufacturing base got smaller and productivity increases are negligible. It is early to see the results of recent policies.

The case of Brazil also shows that macroeconomic policies, institution building, transparency, good governance constitute the background of industrial policies. If this background is not available then industrial policies may fail. Avrichir (2015) mentions of the World Economic Forum reporting the persistent weakness of transport structure, the noticeable deterioration in the functioning of institutions and the deficiencies in the education system. Gereffi (2013) thinks that industrial policy regime in Brazil is too complex and unstable. Firms have difficulty in making projection because policies change often. He gives the example of electronic industries facing uncertainty because of local production incentives and on the other hand import tariffs. This situation and uncertainty create what is called "brazil cost" which refers to the increasing operational costs of doing business in Brazil. On top of this, he points out excessive layers of bureaucracy and corruption.

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Appendix to Chapter 5

Dependent Variable: LOG(BRAZIL_ GDP (constant 2010 US$))
Method: Least Squares
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.54909	0.046175	574.9690	0.0000
@TREND	0.038019	0.001373	27.68994	0.0000

R-squared	0.930803	Mean dependent var	27.65163
Adjusted R-squared	0.929589	S.D. dependent var	0.676828
S.E. of regression	0.179597	Akaike info criterion	-0.562893
Sum squared resid	1.838538	Schwarz criterion	-0.492468
Log likelihood	18.60534	Hannan-Quinn criter.	-0.535402
F-statistic	766.7330	Durbin-Watson stat	0.048674
Prob(F-statistic)	0.000000		

Dependent Variable: LOG(BRAZIL_ GDP (constant 2010 US$))
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks
Breaks: 1968, 1977, 2010
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error
	1960 - 1967 -- 8 obs	
C	26.26966	0.021642
@TREND	0.038675	0.005173
	1968 - 1976 -- 9 obs	

C	25.86549	0.053129
@TREND	0.097963	0.004328

1977 - 2009 -- 33 obs

C	27.03283	0.021052
@TREND	0.026177	0.000613

2010 - 2018 -- 9 obs

C	28.41707	0.233999
@TREND	0.001014	0.004328

R-squared	0.997842	Mean dependent var
Adjusted R-squared	0.997546	S.D. dependent var
S.E. of regression	0.033527	Akaike info criterion
Sum squared resid	0.057329	Schwarz criterion
Log likelihood	120.9092	Hannan-Quinn criter.
F-statistic	3369.357	Durbin-Watson stat
Prob(F-statistic)	0.000000	

Dependent Variable: BRAZIL_Human_Development_Index)
Method: Least Squares
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.465340	0.006095	76.34269	0.0000
@TREND	0.005244	0.000136	38.53118	0.0000

R-squared	0.982139	Mean dependent var	0.696069
Adjusted R-squared	0.981477	S.D. dependent var	0.045054
S.E. of regression	0.006132	Akaike info criterion	-7.284197
Sum squared resid	0.001015	Schwarz criterion	-7.189900
Log likelihood	107.6209	Hannan-Quinn criter.	-7.254664
F-statistic	1484.651	Durbin-Watson stat	0.448957
Prob(F-statistic)	0.000000		

Dependent Variable: BRAZIL_ Human_Development_Index
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1990 2018
Included observations: 29 after adjustments

Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks
Breaks: 2003, 2008, 2013
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
		1990 - 2002 -- 13 obs		
C	0.400802	0.002956	135.5972	0.0000
@TREND	0.007082	8.17E-05	86.72372	0.0000
		2003 - 2007 -- 5 obs		
C	0.582400	0.015686	37.12916	0.0000
@TREND	0.002600	0.000348	7.462666	0.0000
		2008 - 2012 -- 5 obs		
C	0.484800	0.017427	27.81888	0.0000
@TREND	0.004800	0.000348	13.77723	0.0000
		2013 - 2018 -- 6 obs		
C	0.658352	0.014624	45.01939	0.0000
@TREND	0.001771	0.000263	6.726100	0.0000

R-squared	0.999552	Mean dependent var	0.696069
Adjusted R-squared	0.999402	S.D. dependent var	0.045054
S.E. of regression	0.001102	Akaike info criterion	-10.55490
Sum squared resid	2.55E-05	Schwarz criterion	-10.17772
Log likelihood	161.0461	Hannan-Quinn criter.	-10.43677
F-statistic	6686.070	Durbin-Watson stat	1.887412
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Agriculture, forestry, and fishing, value added (% of GDP)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.66742	0.352440	41.61678	0.0000
@TREND	-0.213018	0.010480	-20.32645	0.0000

R-squared	0.878766	Mean dependent var	8.489911
Adjusted R-squared	0.876639	S.D. dependent var	3.902922
S.E. of regression	1.370815	Akaike info criterion	3.501999
Sum squared resid	107.1107	Schwarz criterion	3.572424
Log likelihood	-101.3090	Hannan-Quinn criter.	3.529490
F-statistic	413.1644	Durbin-Watson stat	0.519517
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Agriculture, forestry, and fishing, value added (% of GDP)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks
Breaks: 1972, 1995
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1971 -- 12 obs				
C	17.76188	0.426446	41.65093	0.0000
@TREND	-0.675583	0.065672	-10.28725	0.0000
1972 - 1994 -- 23 obs				
C	14.36203	0.590928	24.30420	0.0000
@TREND	-0.209539	0.024686	-8.488030	0.0000
1995 - 2018 -- 24 obs				
C	6.052977	1.088707	5.559785	0.0000
@TREND	-0.029034	0.023158	-1.253726	0.2154

R-squared	0.963003	Mean dependent var	8.489911
Adjusted R-squared	0.959513	S.D. dependent var	3.902922
S.E. of regression	0.785321	Akaike info criterion	2.450697
Sum squared resid	32.68668	Schwarz criterion	2.661972
Log likelihood	-66.29556	Hannan-Quinn criter.	2.533170
F-statistic	275.9119	Durbin-Watson stat	1.409275

Prob(F-statistic)	0.000000

Dependent Variable: BRA_ Manufacturing, value added (% of GDP)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30.32094	1.114796	27.19864	0.0000
@TREND	-0.335938	0.033090	-10.15215	0.0000

R-squared	0.647945	Mean dependent var	20.58454
Adjusted R-squared	0.641658	S.D. dependent var	7.230433
S.E. of regression	4.328256	Akaike info criterion	5.802081
Sum squared resid	1049.093	Schwarz criterion	5.873130
Log likelihood	-166.2603	Hannan-Quinn criter.	5.829756
F-statistic	103.0661	Durbin-Watson stat	0.147351
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Manufacturing, value added (% of GDP)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 58 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks
Breaks: 1968, 1986, 2000
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1967 -- 8 obs				
C	26.61153	0.869603	30.60194	0.0000
@TREND	-0.543890	0.207875	-2.616431	0.0117
1968 - 1985 -- 18 obs				
C	19.95343	1.058610	18.84870	0.0000
@TREND	0.445698	0.061204	7.282171	0.0000
1986 - 1999 -- 13 obs				
C	71.00503	2.987624	23.76639	0.0000

@TREND	-1.538849	0.090669	-16.97222	0.0000

2000 - 2018 -- 19 obs

C	24.72766	2.782156	8.887949	0.0000
@TREND	-0.251530	0.056427	-4.457594	0.0000

R-squared	0.969548	Mean dependent var	20.58454
Adjusted R-squared	0.965284	S.D. dependent var	7.230433
S.E. of regression	1.347183	Akaike info criterion	3.561350
Sum squared resid	90.74505	Schwarz criterion	3.845549
Log likelihood	-95.27915	Hannan-Quinn criter.	3.672051
F-statistic	227.4164	Durbin-Watson stat	1.662366
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Industry (including construction), value added (% of GDP)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	38.23033	1.386467	27.57393	0.0000
@TREND	-0.288980	0.041227	-7.009538	0.0000

R-squared	0.462941	Mean dependent var	29.84992
Adjusted R-squared	0.453519	S.D. dependent var	7.294838
S.E. of regression	5.392662	Akaike info criterion	6.241266
Sum squared resid	1657.606	Schwarz criterion	6.311691
Log likelihood	-182.1173	Hannan-Quinn criter.	6.268757
F-statistic	49.13363	Durbin-Watson stat	0.236509
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Industry (including construction), value added (% of GDP)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments

Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Breaks: 1980, 1995
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
		1960 - 1979 -- 20 obs		
C	30.99370	0.870953	35.58596	0.0000
@TREND	0.202522	0.078372	2.584115	0.0126
		1980 - 1994 -- 15 obs		
C	52.31127	3.302532	15.83975	0.0000
@TREND	-0.518780	0.120779	-4.295270	0.0001
		1995 - 2018 -- 24 obs		
C	29.72672	2.801791	10.60990	0.0000
@TREND	-0.165961	0.059597	-2.784729	0.0074

R-squared	0.929861	Mean dependent var	29.84992
Adjusted R-squared	0.923244	S.D. dependent var	7.294838
S.E. of regression	2.021027	Akaike info criterion	4.341233
Sum squared resid	216.4811	Schwarz criterion	4.552508
Log likelihood	-122.0664	Hannan-Quinn criter.	4.423706
F-statistic	140.5281	Durbin-Watson stat	1.252219
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Services, value added (% of GDP)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	35.64875	1.108638	32.15546	0.0000
@TREND	0.456224	0.032965	13.83948	0.0000

R-squared	0.770653	Mean dependent var	48.87925

Adjusted R-squared	0.766629	S.D. dependent var	8.926062
S.E. of regression	4.312046	Akaike info criterion	5.794012
Sum squared resid	1059.843	Schwarz criterion	5.864437
Log likelihood	-168.9234	Hannan-Quinn criter.	5.821503
F-statistic	191.5313	Durbin-Watson stat	0.457579
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Services, value added (% of GDP)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1995, 2004
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1960 - 1994 -- 35 obs				
C	39.84487	0.730073	54.57657	0.0000
@TREND	0.119985	0.036921	3.249747	0.0020
1995 - 2003 -- 9 obs				
C	74.89457	11.13142	6.728213	0.0000
@TREND	-0.410289	0.284798	-1.440633	0.1556
2004 - 2018 -- 15 obs				
C	30.01880	6.747703	4.448743	0.0000
@TREND	0.572017	0.131836	4.338861	0.0001

R-squared	0.944185	Mean dependent var	48.87925
Adjusted R-squared	0.938919	S.D. dependent var	8.926062
S.E. of regression	2.206033	Akaike info criterion	4.516413
Sum squared resid	257.9287	Schwarz criterion	4.727688
Log likelihood	-127.2342	Hannan-Quinn criter.	4.598886
F-statistic	179.3127	Durbin-Watson stat	1.079542
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Manufactures exports (% of merchandise exports)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1962 2018
Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.54241	3.458577	4.783009	0.0000
@TREND	0.685125	0.101084	6.777804	0.0000

R-squared	0.455114	Mean dependent var	37.09616
Adjusted R-squared	0.445207	S.D. dependent var	16.85661
S.E. of regression	12.55555	Akaike info criterion	7.932660
Sum squared resid	8670.297	Schwarz criterion	8.004346
Log likelihood	-224.0808	Hannan-Quinn criter.	7.960519
F-statistic	45.93863	Durbin-Watson stat	0.042759
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Manufactures exports (% of merchandise exports)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1962 2018
Included observations: 57 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Breaks: 1978, 1994, 2009
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1962 - 1977 -- 16 obs				
C	-1.941668	1.130053	-1.718210	0.0921
@TREND	1.640602	0.107019	15.32999	0.0000
1978 - 1993 -- 16 obs				
C	2.948486	2.773221	1.063199	0.2929
@TREND	1.689307	0.107019	15.78509	0.0000
1994 - 2008 -- 15 obs				
C	72.88181	4.861874	14.99048	0.0000
@TREND	-0.490203	0.117929	-4.156755	0.0001
2009 - 2018 -- 10 obs				
C	32.41122	11.63999	2.784471	0.0076
@TREND	0.082054	0.217257	0.377683	0.7073

R-squared	0.988009	Mean dependent var	37.09616
Adjusted R-squared	0.986296	S.D. dependent var	16.85661
S.E. of regression	1.973335	Akaike info criterion	4.326798
Sum squared resid	190.8085	Schwarz criterion	4.613542
Log likelihood	-115.3137	Hannan-Quinn criter.	4.438237
F-statistic	576.7528	Durbin-Watson stat	1.348301
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_Employment in agriculture (% of total employment) (modeled ILO estimate)

Method: Least Squares

Date: 07/03/20 Time: 11:50

Sample (adjusted): 1991 2019

Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	40.12510	1.716062	23.38209	0.0000
@TREND	-0.511512	0.037492	-13.64315	0.0000

R-squared	0.873320	Mean dependent var	17.10707
Adjusted R-squared	0.868628	S.D. dependent var	4.660558
S.E. of regression	1.689230	Akaike info criterion	3.952895
Sum squared resid	77.04448	Schwarz criterion	4.047191
Log likelihood	-55.31698	Hannan-Quinn criter.	3.982428
F-statistic	186.1357	Durbin-Watson stat	0.220504
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_Employment in agriculture (% of total employment) (modeled ILO estimate)

Method: Least Squares with Breaks

Date: 07/03/20 Time: 11:50

Sample (adjusted): 1991 2019

Included observations: 29 after adjustments

Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Breaks: 1996, 2004, 2012
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 1995 -- 5 obs				
C	28.90600	2.163953	13.35796	0.0000
@TREND	-0.208400	0.065514	-3.180989	0.0045
1996 - 2003 -- 8 obs				
C	22.07060	1.264845	17.44925	0.0000
@TREND	-0.050262	0.031968	-1.572275	0.1308
2004 - 2011 -- 8 obs				
C	53.67426	1.520229	35.30668	0.0000
@TREND	-0.752048	0.031968	-23.52526	0.0000
2012 - 2019 -- 8 obs				
C	28.19318	1.775716	15.87707	0.0000
@TREND	-0.324060	0.031968	-10.13711	0.0000

R-squared	0.998518	Mean dependent var	17.10707
Adjusted R-squared	0.998024	S.D. dependent var	4.660558
S.E. of regression	0.207174	Akaike info criterion	-0.081564
Sum squared resid	0.901343	Schwarz criterion	0.295621
Log likelihood	9.182672	Hannan-Quinn criter.	0.036566
F-statistic	2021.253	Durbin-Watson stat	1.963568
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_Employment in industry (% of total employment) (modeled ILO estimate)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1991 2019

Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.24237	0.744840	31.20450	0.0000
@TREND	-0.031666	0.016273	-1.945937	0.0621

R-squared	0.122997	Mean dependent var	21.81738
Adjusted R-squared	0.090516	S.D. dependent var	0.768815
S.E. of regression	0.733195	Akaike info criterion	2.283661
Sum squared resid	14.51450	Schwarz criterion	2.377957
Log likelihood	-31.11308	Hannan-Quinn criter.	2.313193
F-statistic	3.786671	Durbin-Watson stat	0.437608
Prob(F-statistic)	0.062140		

Dependent Variable: BRA_Employment in industry (% of total employment) (modeled ILO estimate)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 2007, 2012
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 2006 -- 16 obs				
C	25.83830	0.730148	35.38775	0.0000
@TREND	-0.104613	0.018830	-5.555553	0.0000
2007 - 2011 -- 5 obs				
C	27.46290	5.382394	5.102357	0.0000
@TREND	-0.109100	0.109799	-0.993633	0.3307
2012 - 2019 -- 8 obs				
C	47.68357	2.976026	16.02257	0.0000
@TREND	-0.469190	0.053576	-8.757401	0.0000

R-squared	0.832458	Mean dependent var	21.81738
Adjusted R-squared	0.796036	S.D. dependent var	0.768815
S.E. of regression	0.347215	Akaike info criterion	0.904247

Sum squared resid	2.772842	Schwarz criterion	1.187136
Log likelihood	-7.111581	Hannan-Quinn criter.	0.992844
F-statistic	22.85579	Durbin-Watson stat	1.521400
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_Employment in services (% of total employment) (modeled ILO estimate)

Method: Least Squares with Breaks

Date: 07/03/20 Time: 11:50

Sample (adjusted): 1991 2019

Included observations: 29 after adjustments

Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks

Breaks: 2004, 2012

Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 2003 -- 13 obs				
C	43.67426	1.051795	41.52356	0.0000
@TREND	0.366621	0.028283	12.96276	0.0000
2004 - 2011 -- 8 obs				
C	30.54317	2.799814	10.90900	0.0000
@TREND	0.625131	0.058875	10.61793	0.0000
2012 - 2019 -- 8 obs				
C	24.12324	3.270346	7.376359	0.0000
@TREND	0.793250	0.058875	13.47346	0.0000

R-squared	0.994986	Mean dependent var	61.07565
Adjusted R-squared	0.993896	S.D. dependent var	4.883764
S.E. of regression	0.381554	Akaike info criterion	1.092861
Sum squared resid	3.348412	Schwarz criterion	1.375749
Log likelihood	-9.846478	Hannan-Quinn criter.	1.181458
F-statistic	912.8582	Durbin-Watson stat	1.351783
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_Employment in services (% of total employment) (modeled ILO estimate)
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	36.63292	1.622939	22.57196	0.0000
@TREND	0.543172	0.035458	15.31888	0.0000

R-squared	0.896816	Mean dependent var	61.07565
Adjusted R-squared	0.892994	S.D. dependent var	4.883764
S.E. of regression	1.597564	Akaike info criterion	3.841309
Sum squared resid	68.90970	Schwarz criterion	3.935605
Log likelihood	-53.69898	Hannan-Quinn criter.	3.870842
F-statistic	234.6681	Durbin-Watson stat	0.152288
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_Competitive Industrial Performance Index
Method: Least Squares
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1990 2014
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.137707	0.008844	15.57064	0.0000
@TREND	-0.000162	0.000208	-0.778199	0.4444

R-squared	0.025655	Mean dependent var	0.130923
Adjusted R-squared	-0.016708	S.D. dependent var	0.007421
S.E. of regression	0.007483	Akaike info criterion	-6.875811
Sum squared resid	0.001288	Schwarz criterion	-6.778301
Log likelihood	87.94764	Hannan-Quinn criter.	-6.848766
F-statistic	0.605594	Durbin-Watson stat	0.726826
Prob(F-statistic)	0.444384		

Dependent Variable: BRA_ Competitive Industrial Performance Index
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:50
Sample (adjusted): 1990 2014
Included observations: 25 after adjustments

Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Breaks: 1999, 2011
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
		1990 - 1998 -- 9 obs		
C	0.123525	0.019164	6.445601	0.0000
@TREND	0.000280	0.000562	0.497482	0.6246
		1999 - 2010 -- 12 obs		
C	0.062890	0.016249	3.870343	0.0010
@TREND	0.001541	0.000364	4.232000	0.0005
		2011 - 2014 -- 4 obs		
C	0.602424	0.102238	5.892398	0.0000
@TREND	-0.009101	0.001947	-4.674736	0.0002

R-squared	0.727548	Mean dependent var	0.130923
Adjusted R-squared	0.655850	S.D. dependent var	0.007421
S.E. of regression	0.004353	Akaike info criterion	-7.830114
Sum squared resid	0.000360	Schwarz criterion	-7.537584
Log likelihood	103.8764	Hannan-Quinn criter.	-7.748978
F-statistic	10.14740	Durbin-Watson stat	1.498011
Prob(F-statistic)	0.000075		

Dependent Variable: BRA_ GDP per person employed (constant 2011 PPP $)
Method: Least Squares
Date: 06/19/20 Time: 13:56
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17898.53	1098.644	16.29148	0.0000
@TREND	263.9977	24.00297	10.99854	0.0000

R-squared	0.817528	Mean dependent var	29778.43
Adjusted R-squared	0.810770	S.D. dependent var	2486.095
S.E. of regression	1081.466	Akaike info criterion	16.87650
Sum squared resid	31578383	Schwarz criterion	16.97079
Log likelihood	-242.7092	Hannan-Quinn criter.	16.90603
F-statistic	120.9679	Durbin-Watson stat	0.362519
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ GDP per person employed (constant 2011 PPP $)
Method: Least Squares with Breaks
Date: 06/19/20 Time: 13:56
Sample (adjusted): 1991 2019
Included observations: 29 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Breaks: 2001, 2010
Selection: Trimming 0.15, , Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1991 - 2000 -- 10 obs				
C	19976.28	2200.542	9.077891	0.0000
@TREND	215.3046	61.78518	3.484728	0.0020
2001 - 2009 -- 9 obs				
C	10186.39	3265.592	3.119308	0.0048
@TREND	412.4578	72.44955	5.693035	0.0000
2010 - 2019 -- 10 obs				
C	36144.07	3371.966	10.71899	0.0000
@TREND	-60.15600	61.78518	-0.973632	0.3404

R-squared	0.958144	Mean dependent var	29778.43
Adjusted R-squared	0.949045	S.D. dependent var	2486.095
S.E. of regression	561.1918	Akaike info criterion	15.67999
Sum squared resid	7243533.	Schwarz criterion	15.96288
Log likelihood	-221.3599	Hannan-Quinn criter.	15.76859
F-statistic	105.3008	Durbin-Watson stat	1.306186
Prob(F-statistic)	0.000000		

Dependent Variable: BRAZIL_ Economic Complexity Index
Method: Least Squares
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1964 2017
Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.588085	0.089242	-6.589782	0.0000
@TREND	0.023339	0.002605	8.957685	0.0000

R-squared	0.606776	Mean dependent var	0.123759
Adjusted R-squared	0.599214	S.D. dependent var	0.471366
S.E. of regression	0.298411	Akaike info criterion	0.455642
Sum squared resid	4.630546	Schwarz criterion	0.529308
Log likelihood	-10.30233	Hannan-Quinn criter.	0.484052
F-statistic	80.24012	Durbin-Watson stat	0.230683
Prob(F-statistic)	0.000000		

Dependent Variable: BRAZIL_Economic Complexity Index
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1964 2017
Included observations: 54 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1990, 2010
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1964 - 1989 -- 26 obs				
C	-1.163399	0.060010	-19.38689	0.0000
@TREND	0.057543	0.003311	17.37953	0.0000
1990 - 2009 -- 20 obs				
C	0.685643	0.196004	3.498101	0.0010
@TREND	-0.004939	0.004910	-1.005862	0.3195
2010 - 2017 -- 8 obs				
C	-3.661599	1.046232	-3.499798	0.0010

@TREND	0.074129	0.019538	3.794120	0.0004

R-squared	0.934649	Mean dependent var	0.123759
Adjusted R-squared	0.927842	S.D. dependent var	0.471366
S.E. of regression	0.126620	Akaike info criterion	-1.190820
Sum squared resid	0.769561	Schwarz criterion	-0.969822
Log likelihood	38.15215	Hannan-Quinn criter.	-1.105590
F-statistic	137.2996	Durbin-Watson stat	1.528639
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Exports of goods and services (% of GDP)
Method: Least Squares
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.983055	0.494275	12.10471	0.0000
@TREND	0.128005	0.014697	8.709409	0.0000

R-squared	0.570957	Mean dependent var	9.695192
Adjusted R-squared	0.563430	S.D. dependent var	2.909613
S.E. of regression	1.922482	Akaike info criterion	4.178421
Sum squared resid	210.6684	Schwarz criterion	4.248846
Log likelihood	-121.2634	Hannan-Quinn criter.	4.205913
F-statistic	75.85381	Durbin-Watson stat	0.702932
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_ Exports of goods and services (% of GDP)
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1960 2018
Included observations: 59 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined
Breaks
Breaks: 1983, 2001, 2009
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.

1960 - 1982 -- 23 obs

C	6.363526	0.505106	12.59839	0.0000
@TREND	0.074759	0.039322	1.901175	0.0629

1983 - 2000 -- 18 obs

C	16.14582	1.814290	8.899250	0.0000
@TREND	-0.210535	0.056831	-3.704590	0.0005

2001 - 2008 -- 8 obs

C	14.40400	8.600849	1.674718	0.1001
@TREND	-0.001189	0.193022	-0.006160	0.9951

2009 - 2018 -- 10 obs

C	-5.544897	7.378751	-0.751468	0.4558
@TREND	0.329215	0.137722	2.390428	0.0206

R-squared	0.837470	Mean dependent var	9.695192
Adjusted R-squared	0.815162	S.D. dependent var	2.909613
S.E. of regression	1.250924	Akaike info criterion	3.411117
Sum squared resid	79.80539	Schwarz criterion	3.692817
Log likelihood	-92.62796	Hannan-Quinn criter.	3.521081
F-statistic	37.54115	Durbin-Watson stat	1.785294
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_KOF Index
Method: Least Squares
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1970 2015
Included observations: 46 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	32.49680	0.693396	46.86615	0.0000
@TREND	0.534402	0.019751	27.05705	0.0000

R-squared	0.943305	Mean dependent var	49.86488
Adjusted R-squared	0.942017	S.D. dependent var	7.385493
S.E. of regression	1.778408	Akaike info criterion	4.031819
Sum squared resid	139.1603	Schwarz criterion	4.111325
Log likelihood	-90.73183	Hannan-Quinn criter.	4.061602
F-statistic	732.0840	Durbin-Watson stat	0.184533
Prob(F-statistic)	0.000000		

Dependent Variable: BRA_KOF Index
Method: Least Squares with Breaks
Date: 07/03/20 Time: 11:49
Sample (adjusted): 1970 2015
Included observations: 46 after adjustments
Break type: Bai-Perron tests of L+1 vs. L sequentially determined Breaks
Breaks: 1987, 2009
Selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Variable	Coefficient	Std. Error	t-Statistic	Prob.
1970 - 1986 -- 17 obs				
C	35.78436	0.503449	71.07841	0.0000
@TREND	0.392837	0.026988	14.55616	0.0000
1987 - 2008 -- 22 obs				
C	20.19527	0.696724	28.98603	0.0000
@TREND	0.843193	0.018319	46.02835	0.0000
2009 - 2015 -- 7 obs				
C	67.48881	5.360944	12.58898	0.0000
@TREND	-0.129423	0.103019	-1.256303	0.2163

R-squared	0.995157	Mean dependent var	49.86488
Adjusted R-squared	0.994552	S.D. dependent var	7.385493
S.E. of regression	0.545125	Akaike info criterion	1.745504
Sum squared resid	11.88644	Schwarz criterion	1.984022
Log likelihood	-34.14659	Hannan-Quinn criter.	1.834854
F-statistic	1643.998	Durbin-Watson stat	2.127486
Prob(F-statistic)	0.000000		

6 Vietnam: An Asian Newcomer to Industrialization

Before reunification, Vietnam had a dual economic system. In the North, a command economy linked closely to the Soviet economic sphere and in the South, an open market economy which was destabilized by the war existed. The former had a population of about 23 million and the latter about 20 million and both had the same economic size. Both had suffered from the war that lasted for years.

6.1 Economic Developments, Economic and Industrial Policies

6.1.1 The 1976-1991 Period

Following years of war that ended in 1976 and the North and South reunification, the Vietnamese economy muddled through with heavy dependence on external assistance from the Soviet Union. Like the other centrally planned economies, Vietnam had a comprehensive industrial policy which exercised a central control on the balance of inputs and outputs but cared little about efficiency, producing mainly for domestic consumption and limited exports to Comecon countries.

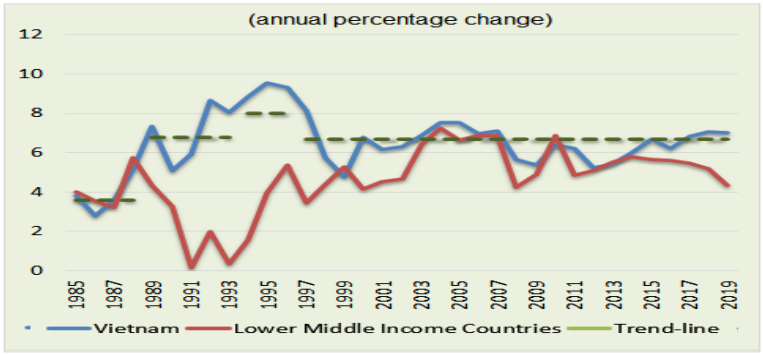
Vietnam had a predominantly rural economy. Agriculture accounted for a third of GDP and two-thirds of employment. Infrastructure in the North was war-torn and dilapidated in the South because of lack of maintenance. Exports could only finance a third of imports. With an extremely low domestic savings rate, most of the public investment was financed by Soviet assistance. After a short-lived recovery and non-Soviet external assistance, GDP growth was meager, averaging 0.4 percent until 1980 with an annual inflation rate of about 20 percent. (Van Arkadie and Mellon, 2003).

While the growth rate improved in the early 1980s, increasing macroeconomic imbalances led to hyperinflation resulting from heavy subsidies to state owned enterprises (SOEs) which we were losing money. (Figure 6.1) Annual inflation went up as high as 411 percent in 1988 before subsiding to double digit levels in the early 1990s. (Figure 6.2)

With the deteriorating economic situation, *Doi Moi* (Economic Renewal) was launched at the Party Congress in 1986. It reiterated the Marxist-Leninist principles of the state and defined the "transition" nature of the reforms it proposed. It covered: rural reform and return to private farming, price liberalization, fiscal and monetary reforms, openness to FDI and regulatory relaxation.

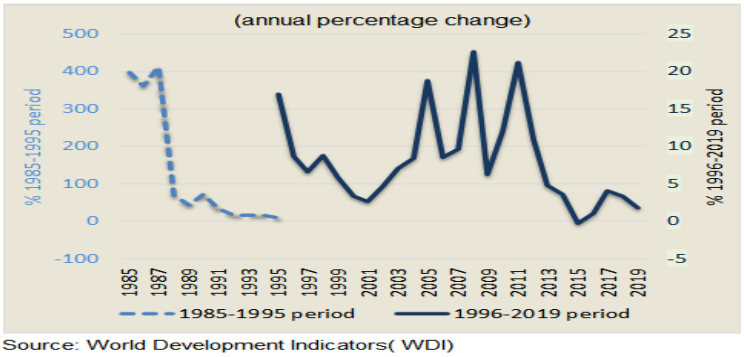
While it was a comprehensive program, it was criticized by western observers for having ambitious targets as overreaching regulatory and administrative controls. By 1989, massive assistance from the Soviet Union was coming to a halt leading to the acceleration of Doi Moi. GDP grew by 7.4 percent and current account deficit was more than halved to 4.9 percent of GDP. For the next two years, foreign savings declined precipitously with the flows from the Soviet Union collapsing and delays in the western aid in replacing them. By 1991, foreign savings declined to 2.1 percent of GDP. (Figure 6.3) While growth suffered some averaging 5.5 percent in 1990 and 1991, supply response from agriculture and services helped avoid the economy's collapse. Sudden drop in public investment was replaced by increases in private investment.

Figure 6.1 Vietnam: Changes in Gross Domestic Product



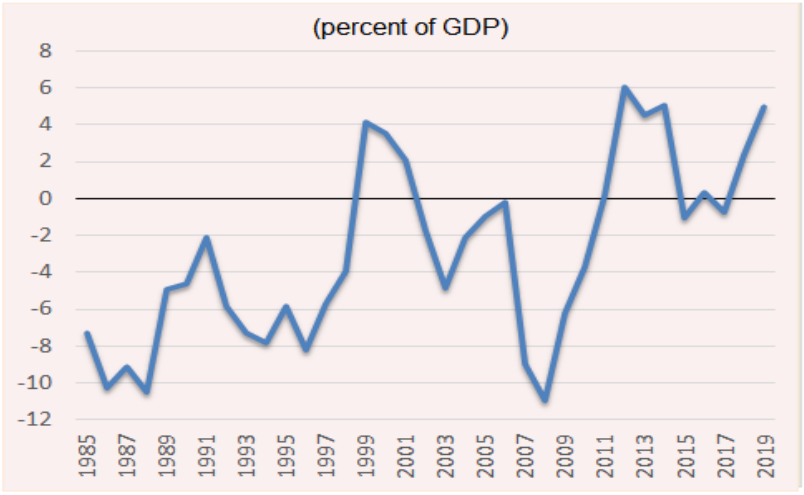
Source: World Development Indicators(WDI). Trend lines were calculated by Prof Ozmucur based on WDI data

Figure 6.2 Vietnam: Inflation



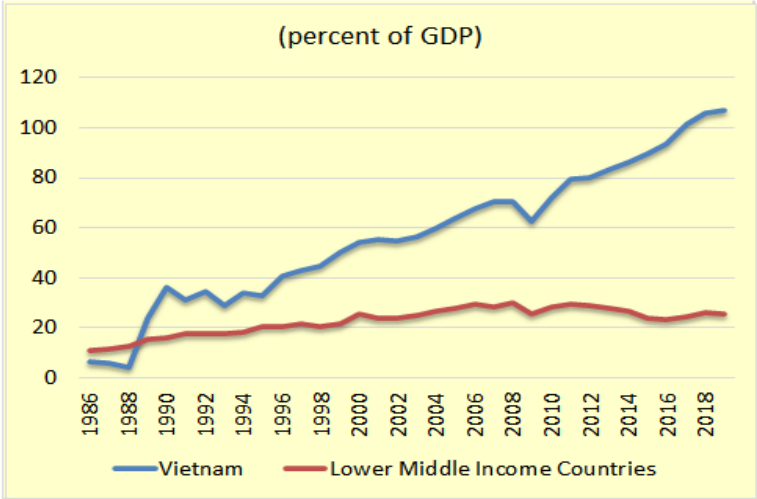
Source: World Development Indicators(WDI)

Figure 6.3 Vietnam: Current Account Balance



Source: World Development Indicators(WDI)

Figure 6.4 Vietnam: Exports of Goods



Source: World Development Indicators(WDI).

6.1.2 The 1992-2019 Period

Unlike the transition economies of the former Soviet Union, Vietnam's growth resumed strongly in 1992. It averaged 8.8 percent during the 1992-1997 period, significantly above the average for other low-income countries. (Figure 6.1) Vietnam weathered the 1997 Asian crisis as well as the 2007/2008 global financial crisis well and did better than other low-income countries. Economic growth averaged 6.5 percent between 2000 and 2019 and remained above five percent a year except in 1999 when it decelerated to 4.8 percent. Inflation which spiked to

the 20 percent-22 percent range in 2008 started to decline again in 2012 and was 1.8 percent in 2019. (Figure 6.2)

What was remarkable in Vietnam's recent economic history was the rapid and sustained growth in exports. During the 2000-2019 period, exports of goods and services grew on average by 16 percent a year, compared with China's export growth of 13.3 percent during the same period in current USD terms. The share of exports which accounted for 54 percent of GDP in 2000, went up to 106 percent of GDP. There was also significant change in the composition of exports during the same period. The share of high technology exports in manufacturing went up from 8 percent in 2008 to over 40 percent in 2018 and the share of ICT goods exports from 5 percent over a third of the total, respectively.

Vietnam's industrial policies during the last thirty-five years were broad and comprehensive in design, covering not just manufacturing but a broad range of sectors from agriculture to infrastructure and financial services. Vietnam's route to become an export oriented industrial economy was much shorter than many other predominantly rural countries. Once the Moi Doi implementation accelerated in 1991, the transformation of the economy started at a fast pace. While the private sector saw a booming growth, increases in industrial production came from state owned enterprises. Unlike China where local governments and communes have had a lot of experience managing SMEs, the SOEs in Vietnam were centrally managed. (Perkins and Vu Thanh Tu Anh - 2009) Most of the ministries in Hanoi were operational with hands-on management of enterprises rather than policy making entities. The latter function was carried out by the Party and the political process. As the economy grew, however, central authorities found it increasingly difficult to enforce plan discipline (Although the SOEs were given *de facto* autonomy, their input and output prices were still not determined by the market until 1990 when commodity prices were liberalized.

At one point, Vietnam tried creating conglomerates out of the SOEs with a view to make them export oriented like *chaebols* like Samsung, Hyundai et al. in Korea. But the large Vietnamese SOEs were not competitive even behind heavy protection. Unlike the Korean model, which was privately owned, they were governed by bureaucrats.

The share of the state-owned sector in industrial value-added even increased in the early 1990s. Vietnam also became attractive to foreign direct investment (FDI) with cheaper labor than China. As a result, two-pronged industrialization took shape; foreign owned firms produced for export markets while domestic public and private sector produced for domestic

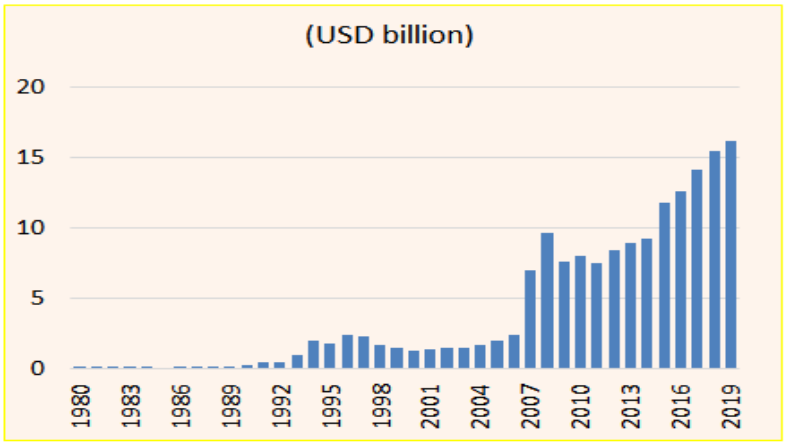
consumption. By the year 2000, foreign owned companies accounted for a third of gross industrial output. SOEs accounted for about half and the private sector the remainder. FDI started to flow in 1990 and went up from $180 million to almost two billion dollars in 1995. The flows averaged $1.8 billion a year between 1995 and 2007 when the second wave of much larger flows started averaging $10.4 billion a year since then. (Figure 6.5) About half of the first wave went into manufacturing for export markets. Manufacturing exports accounted for about half of total exports by 1994 and almost all of it by foreign owned companies.

Two significant events in Vietnam's economic history helped shaped its industrial policies. The first is the accession to WTO which was completed in 2007 following several years of bilateral negotiations. After the CMEA collapsed, Vietnam has joined ASEAN and AFTA and started lowering tariffs ahead of its WTO negotiations. By the time the WTO accession is formalized, Vietnam had adopted almost a free trade regime. (Perkins and Vu Thanh Tu Anh - 2009)

The second important event was adopting of the Enterprise Law of 2005 which intended to level the playing field among the SOEs, domestic private sector and foreign owned firms. It built upon the Enterprise Law of 2000 which had simplified the regulations to start a new business and removed some of the preferential treatment of SOEs. There has been a steady improvement in the constraints to starting a business in Vietnam as measured by the Doing Business methodology of the World Bank[1]. Vietnam's score for the starting a business dimension went up from 66.1 in 2004 to 85.1 in 2020, the number of days to set up a new business declined from 61 days to 16 days, respectively. (Figure 6) These improvements in the investment climate put Vietnam ahead of the East Asia and Pacific regional average and most Indochinese neighboring countries. (Figure 6.7)

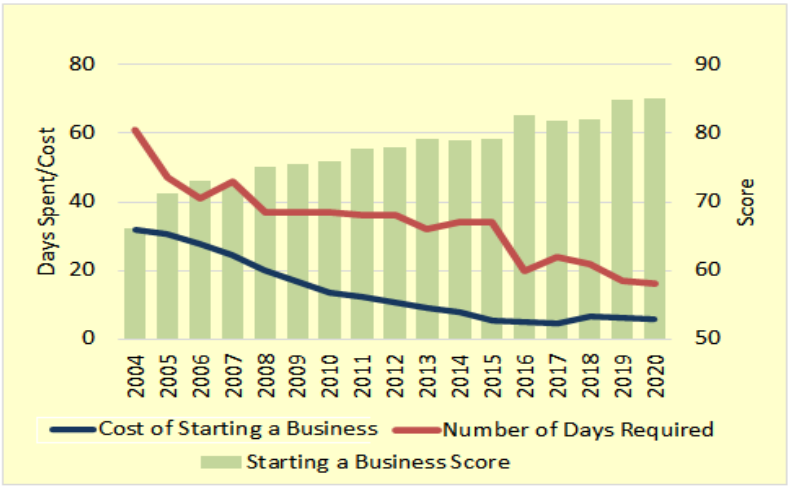
[1] There have been several concerns about the accuracy and objectiveness of the doing business methodology

Figure 6.5 Vietnam: Foreign Direct Investment



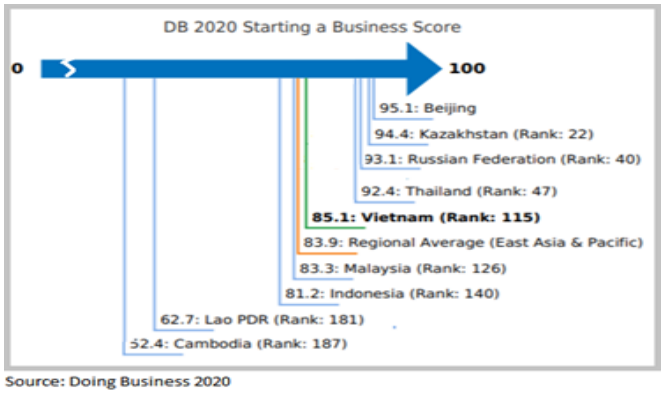
Source: UNIDO Stat

Figure 6.6 Vietnam: Starting A Business Indicators



Source: Doing Business 2020

Figure 6.7 Vietnam: Starting A Business Regional Comparisons

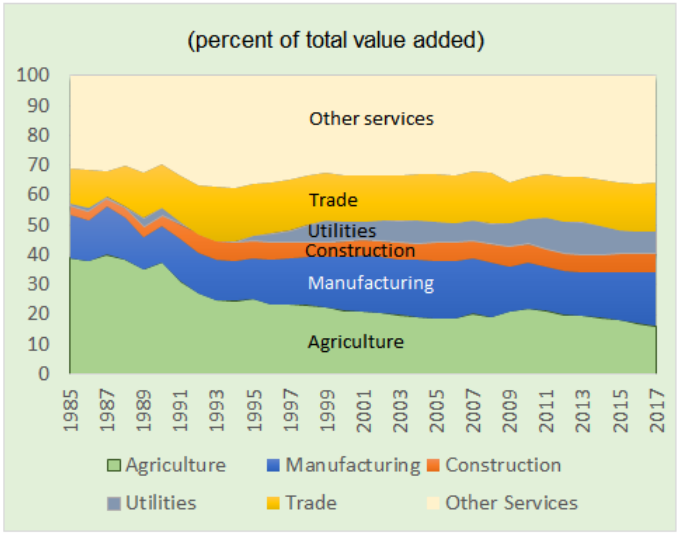


Source: Doing Business 2020

6.2 Shares of Sectoral Value Added in GDP

The rapid economic growth brought along significant changes in the structure of the economy. Since the Vietnamese industrial policy has been comprehensive, covering agriculture and services, all sectors recorded relatively respectable growth rates during the 1991-2019 period. Not unlike other developing countries, a declining share of agriculture gave way initially to industry then to services. (Figure 6.8)

Figure 6.8 Vietnam: Sectoral Breakdown of GDP



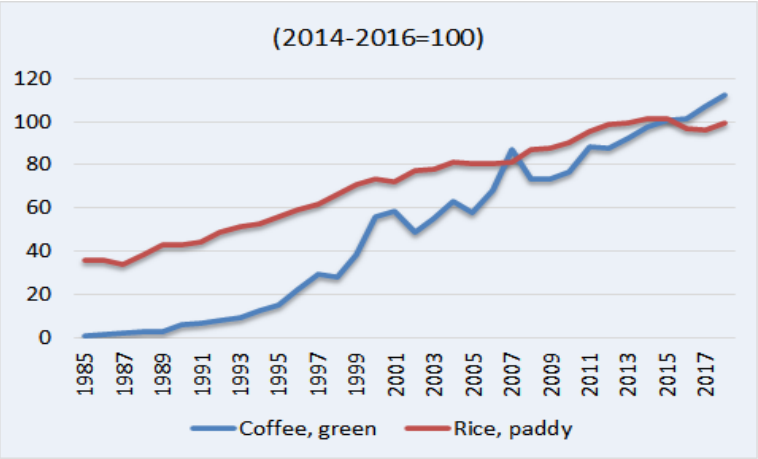
Source: United Nations Statistics Dvision

In agriculture, the state order system was reduced to a system allowing farmers to sell a larger share of their output at market prices, but the state institutions continued to play an important role in introducing new crops (e.g., cashews), new cultivation techniques and supporting a large expansion of coffee production in highlands as well as aquaculture in the Mekong Delta and providing infrastructure including storm management and transportation.

Coffee production which was negligible 30 years ago has become one of the most important export crops. Vietnam's share in global coffee markets increase from 0.1 percent to 20 percent during that period, making Vietnam the second largest coffee producer with 1.7 million tons in the world after Brazil. Vietnam also turned from being a net rice importer of rice in 1988 to a net exporter by 2005. (Van Arkadie and Mellon, 2003). (Figure 6.9) While agriculture grew on average by 3.4 percent a year during the 1991-2019 period, its share in GDP which was as

high as 46 percent in 1988 declined to less than 25 percent in 2000 and 14 percent by 2019. It also had the highest labor productivity increases in the economy at about 3.8 percent a year.

Figure 6.9 Vietnam: Coffee and Rice Production Indices



Source: FAO Stat

The industry sector includes in addition to manufacturing, mining, and quarrying, utilities, and construction. As the restructuring of SOEs after Moi Doi was taking place, the industry's share declined from 14.8 percent in 1985 to 11 percent in 1990. With the rapid growth of foreign investment and the private sector, it increased steadily to 19.4 percent in 2005. After a slowdown during the global financial crisis, the share of industry hovered around 15 percent to 17 percent range since 2010. There was also diversification in the manufacturing sector as the share of traditional sectors such as food processing declined and new products such as machinery and equipment, electronics, et al. developed. The Herfindahl index[2] values on the sub-sectoral value added show an increase diversification from 0.104 in 2000 to 0.055 in 2015. Two rapidly growing other industrial sectors were electricity, water, and gas as well as the construction sector.

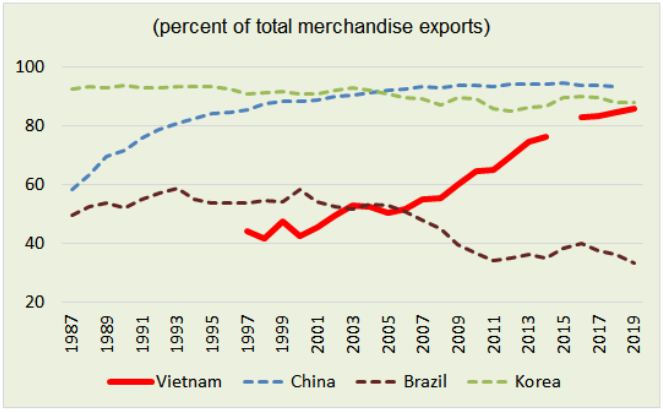
Another indicator of success in developing industry is the change in the composition of exports. The share of manufacturing exports in total exports almost doubled from 44 percent in 1997 to 85 percent in 2019, converged with those of Korea and China and significantly higher than middle-income countries average. (Figure 6.10) Vietnam has managed to increase the share of its high-technology exports in manufactured exports to the levels of China and Korea. (Figure

[2] Hirschman Herfindahl index is a measure of the dispersion of trade value across an exporter's partners. A country with trade (export or import) concentrated in a very few markets will have an index value close to 1. Similarly, a country with a perfectly diversified trade portfolio will have an index close to zero.

6.11) Both of these developments reflect the role of foreign investment in manufacturing and Vietnam's industrial policies that helped the country to integrate itself into global supply chains as well as the movement of production units from China where wages are higher than Vietnam's.

Among the service sectors, financial services grew rapidly in line with private and foreign participation in the economy. Banks that were burdened with the SOEs debts were gradually cleaned up and poorly operated banks exited the market. After the global financial crisis, credit to the private sector grew rapidly and reached 138 percent of GDP in 2018. (Figure 6.12) Along with the banking sector, capital markets saw rapid growth with the market capitalization nearing 75 percent of GDP.

Figure 6.10 Vietnam: Manufacturing Exports



Source: WDI

Figure 6.11 Vietnam: High Technology Exports

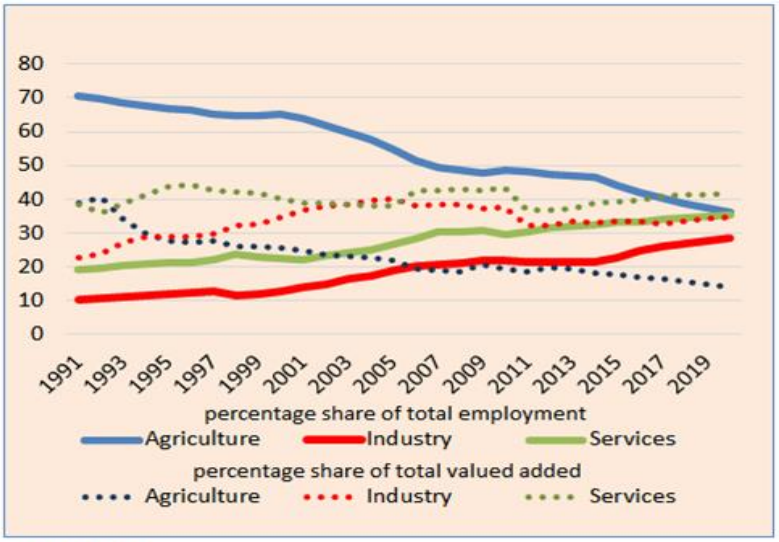
Source: WDI

There was, however, a deterioration in the heath of financial sector as the quality of loans to the SOE sector worsened in recent years and the domestic private sector risked being crowded out.

6.3 Industrial Policies and Structural Transformation

The labor market reflected the changes in the investments and output in various sectors of the economy. The share of employment in agriculture, as has been in most developing countries, declined significantly. Once a predominantly rural society, Vietnam saw a decline in the share of the labor force in agriculture from 71 percent in 1991 to 36 percent in 2019 compared to China which observed a sharper decline. (Figure 6.12) In contrast, Vietnam had a much faster increase in the share of employment in industry than China during the same period. (Table 6.1)

Figure 6.12 Vietnam: Sectoral Shares of Employment and Value Added



Source: WDI

Table 6.1 Sectoral Shares of Employment in Vietnam and China

	1991		2019	
	Vietnam	China	Vietnam	China
Agriculture	71	60	36	25
Industry	10	21	28	28
Services	19	19	35	47

Source: WDI

As in the case of many other developing countries, informal employment is widespread in Vietnam. In 2016, informal economy workers accounted for 57.2 percent of non-agricultural employment, a share that rises to 78.6 percent if agricultural, forestry and fisheries workers are included (ILO, 2018)

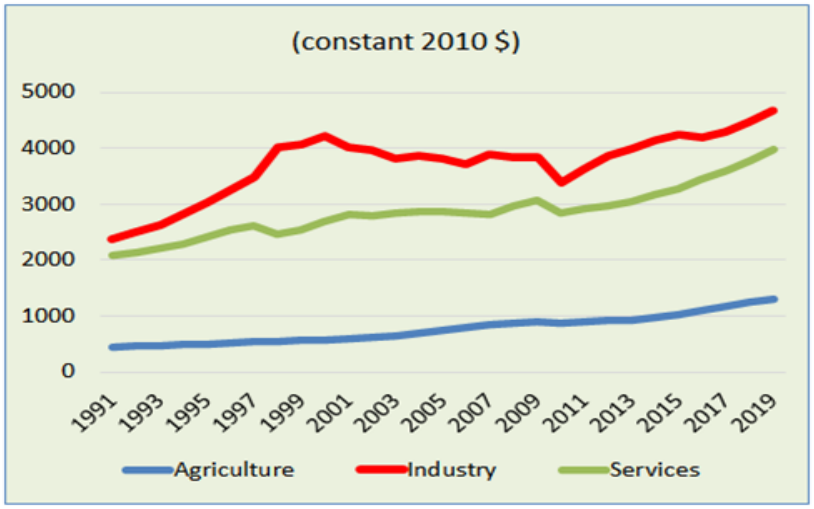
Labor productivity in Vietnam is lower than in Korea or Brazil although it has been increasing robustly during the last ten years. (Table 6.2) While labor productivity grew steadily in the agriculture and services sectors, it declined slightly in manufacturing between 2001 and 2009. (Figure 6.13) During that period, labor intensive sectors were the growth drivers with significant differences between the SOEs, foreign owned companies and domestic private sector factories. During the latter period, the sectors with high labor productivity were mining, utilities, finance, insurance, and real estate. (Das, 2018) (Nguyễn Đắc Thành, 2015)

Table 6.2 Gross Domestic Product per Employed

	(constant 2017 PPP $)			Growth Rate	
				1991/	2000/
	1991	2010	2019	2019	2019
China	2783	16055	30143	8.9	6.5
Brazil	27640	33188	33025	0.6	0.0
Korea	31299	70139	81006	3.5	1.5
Vietnam	3654	8833	13800	4.9	4.6
Lower Middle Income	8016	12768	18127	3.0	3.6
Middle Income	10961	19262	27852	3.4	3.5

Source: WDI

Figure 6.13 Vietnam: Labor Productivity by Sectors



Source: WDI

6.4 Industrial Policies and Human Development Index

One area that Vietnam's development process seems to have lagged is human development as measured by the Human Development Index (HDI). It ranked 118th out of 189 countries and

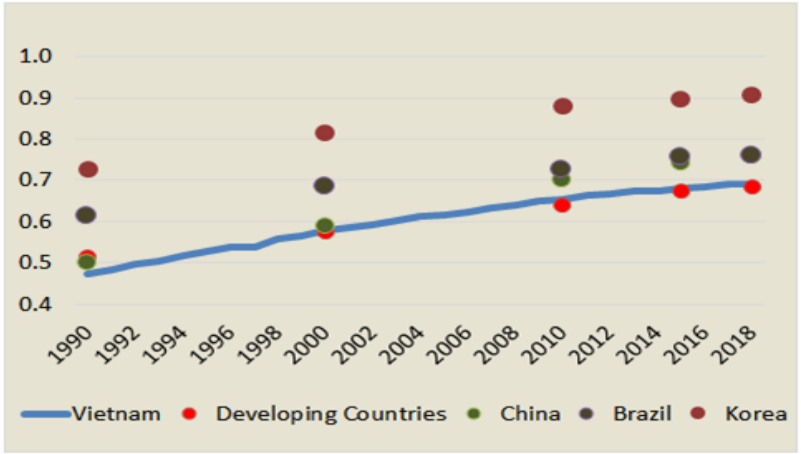
the second among the "Medium Human Development" list. Its score, compared to developing countries average, has improved slightly during the 1990-2018 period. (Figure 6.14)

The HDI is a multidimensional measure covering a wide spectrum from its quality – health, education, and standard of living – to gender gap, environmental and socio-economic sustainability. Therefore, industrial policies interact with each of these areas directly and indirectly. The quality of education and skills has direct consequences on industrial policies.

Vietnam was able to expand access to primary and lower-secondary education and improving learning outcomes. Net primary and lower secondary enrolment rates are now close to universal and increased from 86% and 72% in 1992-1993 respectively. It outperformed many developed and rich countries in PISA results, but these results should be taken with caution regarding its partial coverage of 15-year-olds. Access to upper secondary education and further is limited by entrance exams. Most students after the lower secondary education are left only with basic cognitive skills, creating a serious mismatch of skills supplied by the education system and demands of the economy. (World Bank, 2014)

Only 22.8 percent of the labor force had formal vocational training in 2019 compared to 14.8 percent in 2009 with significant divergences across sectors. The highest proportion of skilled workers was in mining (54 percent) and utilities (76 percent) among production sectors and lowest in agriculture (4 percent) and manufacturing (17 percent) in 2019.

Figure 6.14 Vietnam: Human Development Index

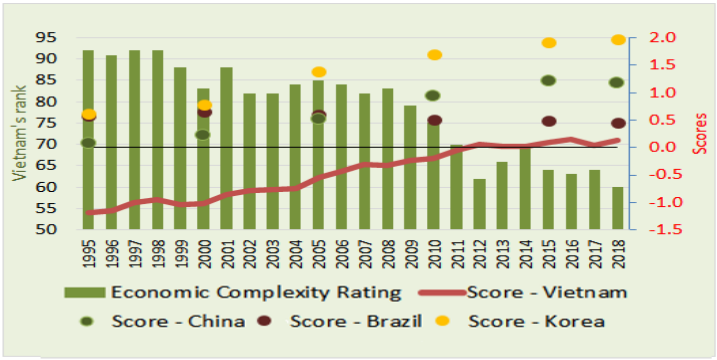


Source: UNDP HDI

6.5 Industrial Policies and Economic Complexity

The structural changes in production and employment discussed above have expanded the productive capacity of the Vietnamese economy since *Doi Moi*. Measured by the Economic Complexity Index (ECI) compiled by the Observatory of Economic Complexity, Vietnam climbed the ranks from 92nd place in 1995 to the 60th place in 2018 by improving the diversity and sophistication of its productive space reflected by is exports structure. (Figure 6.15) While the increase in its score was rapid between 1995 and 2010, it stalled since then. This, in part, was attributed to the SOE-based industrial development losing steam, although the country was effective at "adapting higher-productivity technology and knowhow into the local productive ecosystems." (Growth Lab, 2018)

Figure 6.15 Vietnam: Economic Complexity Index



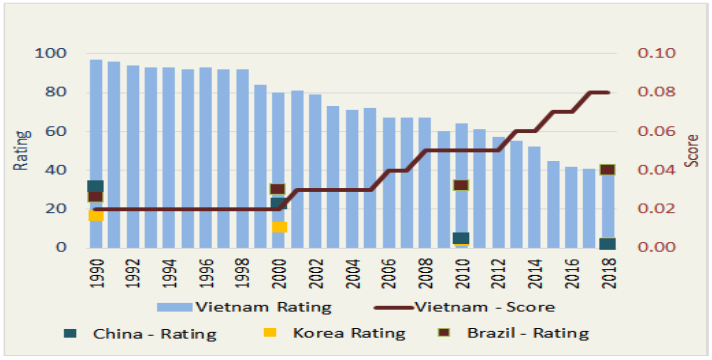
Source: the Observatory of Economic Complexity

6.6 Industrial Policies and UNIDO Competitive Industrial Performance Index

While the ECI evaluates the productive capacity of the country based on its export structure, UNIDO's Competitive Industrial Performance (CIP) Index, which benchmarks the capacity of countries to increase their presence in international and domestic markets whilst developing industrial sectors and activities with higher value added and technological content" (UNIDO 2002)

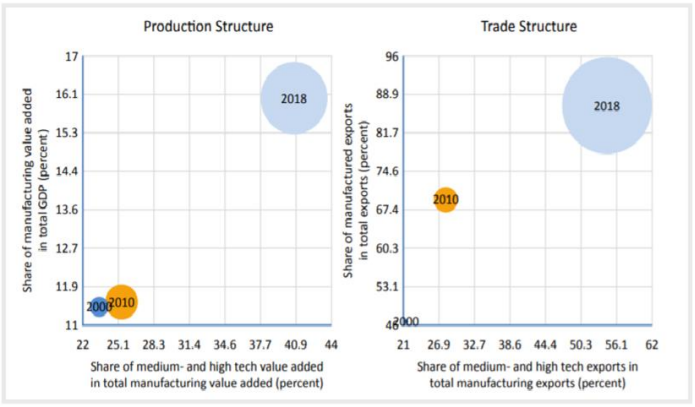
Vietnam's ranking in CIP started to improve in 1999 jumping from 92nd place to 84th place and rose steadily to 38th place in 2018. (Figure 6.16) Changes in the trade structure was more rapid than the changes in production structure. (Figure 6.17) By 2018, the share of medium- and high-technology products in total exports was 54 percent compared to their share in manufacturing value-added of 40.1 percent.

Figure 6.16 Vietnam: Competitive Industrial Performance Index



Source: UNIDO

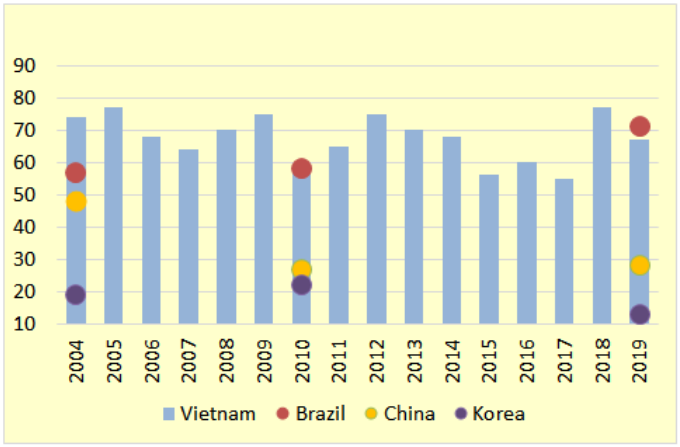
Figure 6.17 Vietnam: Industrial Production and Trade Structure



Source: UNIDO

Another measure of competitiveness is the Global Competitiveness Index (GCI) compiled by the World Economic Forum which evaluates a country's performance more generally than the CIP index which focuses on manufacturing. It uses twelve pillars looking at institutions to policies affecting competitiveness. Vietnam's performance on the GCI has been more checkered and slower. Its rank fluctuated around 70th place. (Figure 6.18) In the 2019 GCI where Vietnam ranked 67th, the weakest areas were skills of the human capital (93rd rank), institutions and business dynamism (89th rank) and labor market (79th rank).

Figure 6.18 Vietnam: Global Competitiveness Index



Source: World Economic Forum

6.7 Industrial Policies and Globalization

6.7.1 Share of Foreign Trade in GDP

With the rapid expansion of trade until 2020, Vietnam has become one of the most open economies in the world and vulnerable to the vagaries of the global trade. Its trade openness ratio was 198 percent of GDP in 2019, more than doubling from 97 percent in 2000. (Figure 6.19) Vietnam generated trade surpluses since 2012 except 2014.

There are several studies which explore relationship between the pace of economic growth and degree of openness and conclude that the more the economy is open, the faster the growth would be.

Box 6.1 Phone Production in Vietnam

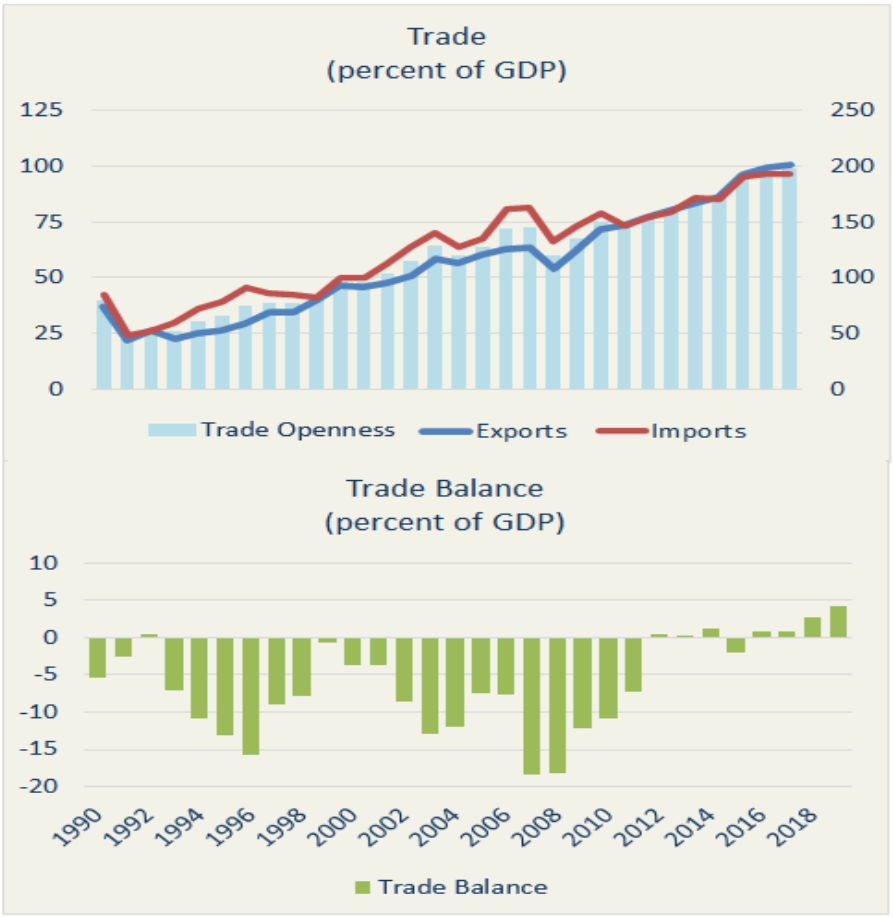
Around 2009, Vietnam started assembling mobile phones for Samsung and Nokia. seeking lower labor costs than what Korea and China could offer. Mobile phone exports went up from $593 million in 2019 to $51.4 billion in 2019. Ten years ago, the local content of the electronics made in Vietnam was about 2 percent. Since then, electronics production and exports have taken off. Electronics exports reached $36 billion in 2019.

*In addition to global brands like Samsung which produces half of its mobile phones in Vietnam, Apple is already producing some Airpod models in Vietnam and planning to move more there next year. There are reports that building assembly lines for Apple's iPad tablet and MacBook laptop at a facility in Vietnam's northeastern Bac Giang province. Google has converted an old Nokia factory in Vietnam to manufacture some of its new Pixel handsets**

Vietnamese companies have also started to produce their own brands using local supply chains as well as imported components.

**https://www.phonearena.com/news/apple-wants-some-ipad-macbook-production-moved-to-vietnam_id128620*

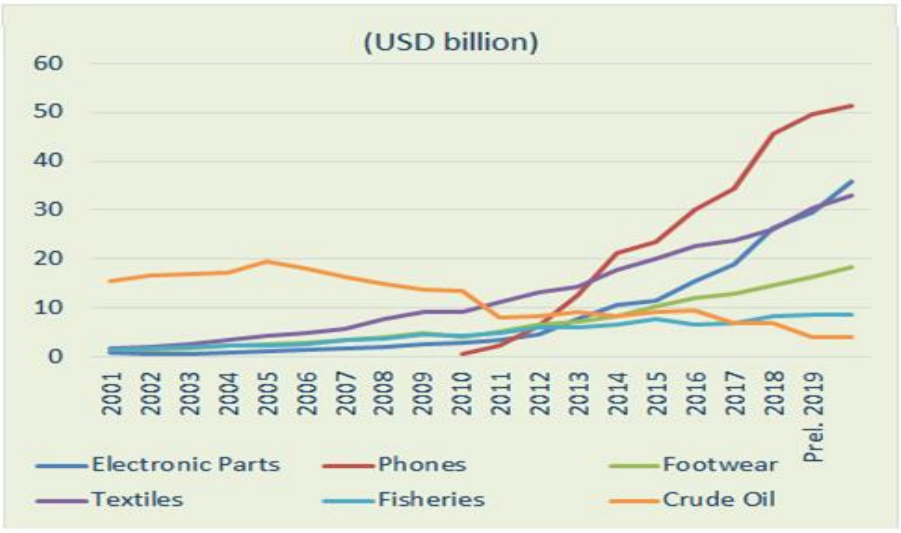
Figure 6.19 Vietnam: Trade and Trade Balance



Source: General Statistics Office (GSO) of Viet Nam

Oil exports from the Bạch Hổ oil field which tied over Vietnam during the transition from the Soviet assistance to the assistance from the West has been declining while traditional manufactured exports like textiles and footwear continued to expand. (Figure 6.20) With the foreign investment coming for assembling electronics and mobile phones, exports of these product groups have increased very rapidly. (Box 1.1)

Figure 6.20 Vietnam: Principal Exports of Vietnam



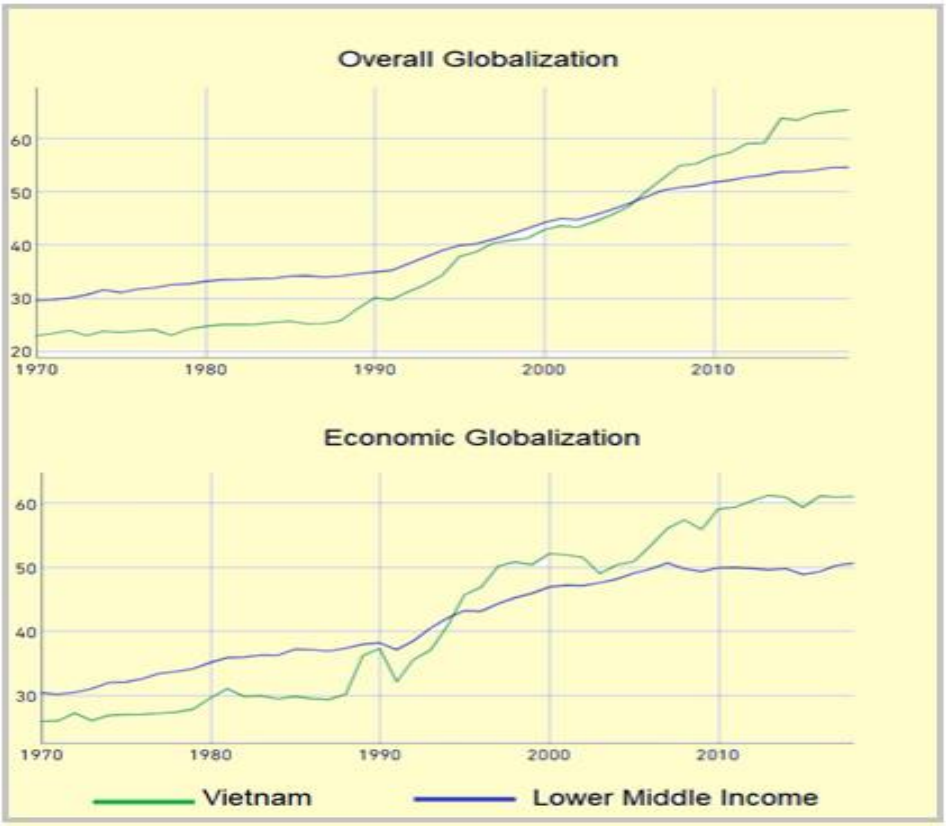
Source: General Statistics Office (GSO) of Viet Nam

6.7.2 KOF Globalization Index

Notwithstanding Vietnam's trade openness, it has lagged in the globalization metrics measured by the KOF Globalization Index. In 2020, Vietnam ranked 86th place for economic globalization and 76th for overall globalization. It outpaced other low-income countries for economic globalization in the early 1990s and overall globalization in the mid-2000s. Interestingly, Vietnam scored better than China for economic globalization throughout and caught up with it around 2015. (Figure 6.21)

The pattern of globalization also reflects the periods of Vietnam's economic and industrialization policies. There was not much movement until the early 2000s when Doi Moi was revived and the flow of FDI started. Except for a few hiccups along the way, Vietnam's efforts to mount itself on the global supply chains are reflected on the KOF index.

Figure 6.21 Vietnam: KOF Globalization Index



Source: Gygli, Savina, Florian Haelg, Niklas Potrafke and Jan-Egbert Sturm (2019): The KOF Globalisation Index – Revisited, Review of International Organizations, 14(3), 543-574
https://doi.org/10.1007/s11558-019-09344-2

6.8 Conclusions

As the Vietnam experience shows, there is not a single path to industrialization and economic growth. What made Vietnam unique was transitioning from being a centrally planned economy to a market-based economy while keeping the basic tenets of Marxism-Leninism and embracing the role of a cog in the wheels of global supply chains.

There are, however, several lessons to draw from Vietnam's experience. The first is the importance of education and skills development in designing industrial policies. An abundance of unskilled workers with low wages may initially seem attractive to foreign investors, but the need for skilled workers catch up quickly and starts putting pressure on skilled wages.

The second lesson is the need to be extremely careful in leveling the playground for private domestic, foreign-and public sector entities. Vietnam wanted to replicate the Korean *chaebols* model based on private ownership and limited protection while the bureaucrat-run mega SOEs

managed to prolong their protection from imports. As a result, they have had difficulties in achieving cost and quality competitiveness.

The third is the financial sector's role in ensuring that new entrants particularly in the domestic private sector are not crowded out by loss-making SOEs' credit requirements.

There are also serious concerns about increasing corruption with the rapid transition the economy is undergoing. There seems to be a relative improvement over time, measured by the Corruption Perception Index by the Transparency International. Vietnam which ranked 43rd out of 52 countries in 1997 and 76th out of 90 countries in 2000 showed a significant improvement since 2010 when it ranked 127th of 178 countries and 104th out of 180 countries in 2020.

Following rapid economic and export growth, Vietnam is now at a point to consolidate its gains and carry out a series of structural reforms to ensure the sustainability of growth and improve the living standards of its population. Its remarkable success[3] in managing the Covid-19 pandemic with minimal infections and deaths should bode well its prospects during the eventual global recovery.

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[3] According to the official data reported by WHO, the number of cumulative infections was 2501 and cumulative deaths was 36 as of March 6, 2021.

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7 Methodological Appendix

Two distinct approaches may be followed to test the significance of industrial policies. The first approach assumes no prior knowledge of specific periods. The second approach assumes that specific periods of policies are known to the researcher, and it is to be checked if trends are different in different periods.

7.1 Trends in Indicators

Both deterministic and stochastic trends may be studied. After the selection of countries with relatively higher trends, trends in individual countries for various periods are to be studied. This may help to see if there are any structural changes in terms of coefficients (also see, Kaytaz, Ozmucur, Yurukoglu, 2017, 2018).

The basic linear trend equation:

$Y_t=\alpha_0+\alpha_1 t+\varepsilon_t$

Y is the indicator, say Log (Productivity), Economic Complexity Index (ECI), or Human Development Index (HDI), and t is time (0 for the beginning year, 1.2, ..).

According to this specification, the estimated value of α_0 is the value at the beginning of the period, and estimated value of α_1 is average annual increase in that variable. Since the main interest is the trend, the problem is to test if the slope is positive or not. H_0: $\alpha_1=0$, H_1: $\alpha_1>0$.

The trend may also be stochastic. The following model is also implemented here:

$Y_t=\beta_0+\beta_1 Y_{t-1}+\varepsilon_t$

In this model, $\beta_1>1$ indicates that Y_t will increase in time. The test should be: H_0: $\beta_1=1$, H_1: $\beta_1>1$. Subtracting Y_{t-1} form both sides: $D(Y_t)=\beta_0+(\beta_1-1)\ Y_{t-1}+\varepsilon_t$ or $D(Y_t)=\delta_0+\delta_1\ Y_{t-1}+\varepsilon_t$

Then the test will be: H_0: $\delta_1=0$, H_1: $\delta_1>0$.

However, Dickey and Fuller indicated that the standard t test is not appropriate for values near one, and created values based on bootstrapping. Test statistics for unit root tests are provided in standard statistical and econometric software.

7.2 Trends with Unknown Breaks

The question to be asked is:

Are there structural breaks in the trend or general tendency of a variable which measures performance? For example, is there a single trend of productivity for the period under investigation, 1960 to 2019? Or are there varying trends during that period? If there are varying trends, do they coincide with periods of different industrial policies? Based on these, it may be possible to draw conclusions about the effectiveness of policies (Kaytaz, Özmucur, and Yürükoğlu, 2017, 2018). For example, if import substitution was implemented during 1960-1989 period, and if that period has a higher growth in productivity, then that may support the positive view of import substitution on productivity. One must be careful in drawing definite conclusions because of possible lags in effect. It should be noted that, all policies may have some lagged effects. The effect may come a few years later.

The least squares with breaks may be used to check if there is a structural change. It should be noted that the concept of structural change used here is limited to econometric estimation. A statistically significant change in the coefficient in an equation is regarded as a structural change. In other words, if the basic linear trend equation $Y_t=\alpha_0+\alpha_1 t+\varepsilon_t$ has different estimated coefficients in two distinct periods, then it is an indication of structural change. The same equation will be estimated for the entire period will have different coefficients for different periods. The tests will guide in number of distinct periods and have estimations accordingly. In a simplified representation for three periods, the equation will look like the following (D_1=1 for the first period, and zero for other periods, D_2=1 for the second period, and zero for other periods, D_3=1 for the third period, and zero for other periods):

$$Y_t = D_1 (\alpha_{01}+\alpha_{11} t) + D_2 (\alpha_{02}+\alpha_{12} t) + D_3 (\alpha_{03}+\alpha_{13} t) +\varepsilon_t$$

This will help us to see if there are structural changes (changes in coefficients).

Once these equations help to identify countries performing better, we can check if there are any significant policy decisions made during the period. If there are some policies implemented for a period when a country does "look better" than others, then that may be an indication of a "successful implementation" of industrial policies.

7.3 Trends With Known Breaks

If there are four distinct periods (for example, in the case of South Korea)

D1=1, for 1960-1972, D1=0, for other years

D2=1, for 1973-1979, D2=0, for other periods

D3=1, for 1980-1989, D3=0, for other periods

D4=1, for 1990-2020, D4=0, for other periods

The equation which allows varying intercepts and slopes may be given as:

$$Y_t = \gamma_1 D1_t + \gamma_2 D2_t + \gamma_3 D3_t + \gamma_4 D4_t + \delta_1 D1_t *t + \delta_2 D2_t *t + \delta_3 D3_t *t + \delta_4 D4_t *t + \varepsilon_t$$

7.3.1 Varying Intercepts

If it is assumed that slopes for different periods are the same ($\delta_1 = \delta_2 = \delta_3 = \delta_4$), but intercepts are varying, the equation to be estimated is:

$$Y_t = \gamma_1 (D1_t + D2_t + D3_t + D4_t) + \delta_1 D1_t *t + \delta_1 D2_t *t + \delta_1 D3_t *t + \delta_1 D4_t *t + \varepsilon_t$$

Since $(D1_t+D2_t+D3_t+D4_t) = 1$, the equation to be estimated is:

$$Y_t = \gamma_1 + \delta_1 D1_t *t + \delta_1 D2_t *t + \delta_1 D3_t *t + \delta_1 D4_t *t + \varepsilon_t$$

After the estimation, equations for individual periods can easily be derived:

For the first period (D1=1, D2=0, D3=0, D4=0), the derived equation is:

$$Y_t = \gamma_1 D1_t + \delta_1 (D1_t + D2_t + D3_t + D4_t) *t + \varepsilon_t$$

$$Y_t = \gamma_1 + \delta_1 *t + \varepsilon_t \quad (\text{since } D1_t + D2_t + D3_t + D4_t = 1)$$

For the second period (D1=0, D2=1, D3=0, D4=0), the derived equation is:

$$Y_t = \gamma_2 D2_t + \delta_1 (D1_t + D2_t + D3_t + D4_t) *t + \varepsilon_t$$

$$Y_t = \gamma_2 + \delta_1 *t + \varepsilon_t$$

For the third period (D1=0, D2=0, D3=1, D4=0), the derived equation is:

$Y_t = \gamma_3 D3_t + \delta_1 (D1_t + D2_t + D3_t + D4_t) * t + \varepsilon_t$

$Y_t = \gamma_3 + \delta_1 * t + \varepsilon_t$

For the fourth period (D1=0, D2=0, D3=0, D4=1), the derived equation is:

$Y_t = \gamma_4 D4_t + \delta_1 (D1_t + D2_t + D3_t + D4_t) * t + \varepsilon_t$

$Y_t = \gamma_4 + \delta_1 * t + \varepsilon_t$

7.3.2 Varying Slopes

If it is assumed that intercepts are the same ($\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5$), but slopes are varying, the equation to be estimated is:

$Y_t = \gamma_1 (D1_t + D2_t + D3_t + D4_t) + \delta_1 D1_t * t + \delta_2 D2_t * t + \delta_3 D3_t * t + \delta_4 D4_t * t + \varepsilon_t$

After the estimation, equations for individual periods can easily be derived:

For the first period (D1=1, D2=0, D3=0, D4=0), the derived equation is:

$Y_t = \gamma_1 (D1_t + D2_t + D3_t + D4_t) + \delta_1 D1_t * t + \varepsilon_t$

$Y_t = \gamma_1 + \delta_1 * t + \varepsilon_t$

For the second period (D1=0, D2=1, D3=0, D4=0), the derived equation is:

$Y_t = \gamma_1 (D1_t + D2_t + D3_t + D4_t) + \delta_2 D2_t * t + \varepsilon_t$

$Y_t = \gamma_1 + \delta_2 * t + \varepsilon_t$

For the third period (D1=0, D2=0, D3=1, D4=0), the derived equation is:

$Y_t = \gamma_1 (D1_t + D2_t + D3_t + D4_t) + \delta_3 D3_t * t + \varepsilon_t$

$Y_t = \gamma_1 + \delta_3 * t + \varepsilon_t$

For the fourth period (D1=0, D2=0, D3=0, D4=1), the derived equation is:

$Y_t = \gamma_1 (D1_t + D2_t + D3_t + D4_t) + \delta_4 D4_t * t + \varepsilon_t$

$Y_t = \gamma_1 + \delta_4 * t + \varepsilon_t$

7.3.3 Varying Intercepts and Slopes

If both varying intercepts and varying slopes is allowed, it is possible to derive the equation for each period using the general specification:

$$Y_t = \gamma_1 D1_t + \gamma_2 D2_t + \gamma_3 D3_t + \gamma_4 D4_t + \delta_1 D1_t *t + \delta_2 D2_t *t + \delta_3 D3_t *t + \delta_4 D4_t *t + \varepsilon_t$$

For the first period (D1=1, D2=0, D3=0, D4=0), the derived equation is:

$$Y_t = \gamma_1 D1_t + \delta_1 D1_t *t + \varepsilon_t$$

or

$$Y_t = \gamma_1 + \delta_1 *t + \varepsilon_t$$

For the second period (D1=0, D2=1, D3=0, D4=0), the derived equation is:

$$Y_t = \gamma_2 D2_t + \delta_2 D2_t *t + \varepsilon_t$$

or

$$Y_t = \gamma_2 + \delta_2 *t + \varepsilon_t$$

For the third period (D1=0, D2=0, D3=1, D4=0), the derived equation is:

$$Y_t = \gamma_3 D3_t + \delta_3 D3_t *t + \varepsilon_t$$

or

$$Y_t = \gamma_3 + \delta_3 *t + \varepsilon_t$$

For the fourth period (D1=0, D2=0, D3=0, D4=1), the derived equation is:

$$Y_t = \gamma_4 D4_t + \delta_4 D4_t *t + \varepsilon_t$$

or

$$Y_t = \gamma_4 + \delta_4 *t + \varepsilon_t$$

$$Y_t = \alpha + \beta t + \gamma_1 D1_t + \gamma_2 D2_t + \gamma_3 D3_t + \gamma_4 D4_t + \delta_1 D1_t *t + \delta_2 D2_t *t + \delta_3 D3_t *t + \delta_4 D4_t *t + \varepsilon_t$$

After estimating the equation which allows for varying intercepts and varying slopes, it is possible to derive the equation for each period:

For the first period (D1=1, D2=0, D3=0, D4=0), the derived equation is:

$$Y_t = \alpha + \beta t + \gamma_1 D1_t + \delta_1 D1_t *t + \varepsilon_t$$

Or

$$Y_t = \alpha + \beta t + \gamma_1 + \delta_1 *t + \varepsilon_t$$

$Y_t = (\alpha + \gamma_1) + (\beta + \delta_1)*t + \varepsilon_t$

Also test for varying intercepts, i.e. test the null hypothesis

$H_o: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$

by comparing residual sum of squares (or alternatively, determination coefficients) in two equations:

$F_{(k_u - k_r,\ n-k_u)} = [(RSS-URSS)/(k_u - k_r)]/[URSS/(n-k_u)]$, where restricted sum of squares (RSS) is the residual sum of squares from the equation under the assumption that the null hypothesis holds, and unrestricted sum of squares (URSS) is the residual sum of squares from the equation where the null hypothesis is assumed to be rejected, n is the number of observations, k_r, and k_u are the total number of parameters including the intercept term to be estimated in restricted and unrestricted equations, respectively.

The same statistic can be calculated using determination coefficients ($R2_u$ and $R2_k$), if the dependent variables are the same in both equations:

$F_{(k_u - k_r,\ n-k_u)} = [(R2_u - R2_r)/(k_u - k_r)]/[(1-R2_u)/(n-k_u)]$,

$Y_t = \alpha + \beta\, t + \varepsilon_t$

$Y_t = \alpha + \beta\, t + \gamma_1\, D1_t + \gamma_2\, D2_t + \gamma_3\, D3_t + \gamma_4\, D4_t + \varepsilon_t$

Also test for varying slopes and intercepts

$H_o: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$

by comparing residual sum of squares (or alternatively, determination coefficients) in two equations:

$F_{(k_u - k_r,\ n-k_u)} = [(RSS-URSS)/(k_u - k_r)]/[URSS/(n-k_u)]$, or

$F_{(k_u - k_r,\ n-k_u)} = [(R2_u - R2_r)/(k_u - k_r)]/[(1-R2_u)/(n-k_u)]$,

$Y_t = \alpha + \beta\, t + \varepsilon_t$

$Y_t = \alpha + \beta\, t + \delta_1\, D1_t*t + \delta_2\, D2_t*t + \delta_3\, D3_t*t + \delta_4\, D4_t*t + \varepsilon_t$

For the problem at hand, it makes more sense to test for varying slopes.

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