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# Economic Growth Strategies: Has the Effect of Development Strategy upon Growth Changed over time?

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# ECONOMIC GROWTH STRATEGIES: HAS THE EFFECT OF DEVELOPMENT STRATEGY UPON GROWTH CHANGED OVER TIME?

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RESEARCH PAPER APPROVAL

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Approved by:

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Structural strategies have been adopted by many developing countries to reduce the income/technology gap between them and advanced countries. Results have been mixed, however; most countries have failed, but a few have succeeded, newly industrialized economies (NIEs) in particular. Lin (2003) divides the structural strategies into two types: the Comparative-Advantage-Defying (CAD) strategy followed by many developing countries and the Comparative-Advantage-Following (CAF) strategy followed by NIEs. He argues that following the CAD strategy has a fixed negative effect on an economy's growth over time. This paper however, which allows for the decadal changes in economic conditions and uses the OLS method on a sample of 105 countries and permanent observations of 49 countries, finds that structural strategies' effects vary over time. Such a finding tempers conclusions from Lin (2003) as less evidence is found that CAD strategies lower growth.

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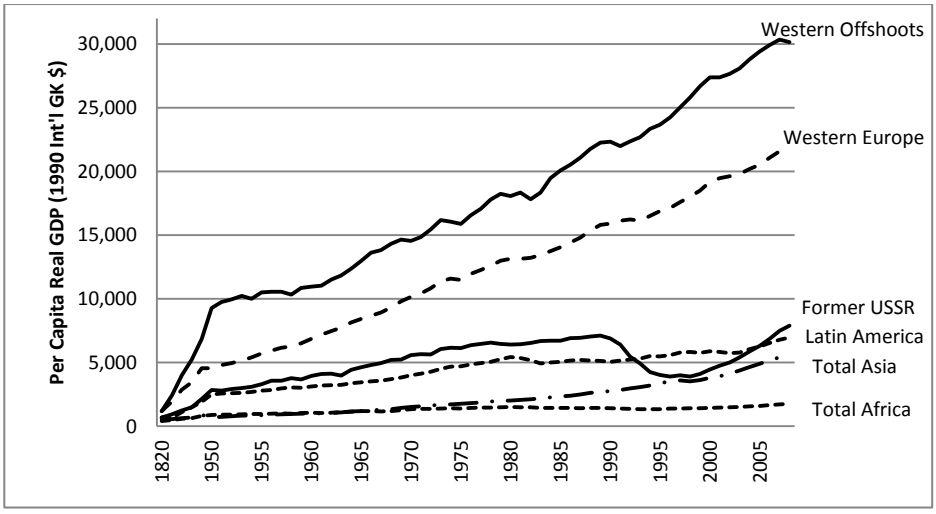
# CHAPTER 1

# INTRODUCTION

Technology has been a major component for economic growth, but without progress, it can-not ensure sustainable development. The industrial revolution at the end of the eighteenth century is characterized by the emergence of technological innovations. Countries who had adopted these technologies were able to produce goods more efficiently and to generate more surpluses, which they reinvested in upgraded technologies, to accumulate even more capital and to continue growth. But those who lacked appropriately progressive technologies were not able to grow as fast, and income (productivity) consequently differs between the rich and poor economies (Maddison, 2006). The current gap between the richest and poorest economies is 1:600[1] (WDI, 2012). Therefore, acquiring technology has been a goal for all economies as a means of growth.

**Figure 1: Historical Real Income per Capita across the World 1820-2008**




Source: Maddison, 2010

[1] In terms of GDP per capita for 2010, at a constant 2005 international $, World Bank Development indicators (WDI, 2012)

However; the way in which technology should be acquired has been a controversial issue for a long time. Economists can be divided into two groups: neoliberals who argue that development and technological innovations prosper in a liberal competitive market, and that the government's role is to maintain macroeconomic stability and market rules, and structuralists who see more role for the government in reducing the technological/income gap between rich and poor countries through industrialization policies (Lall, 2004).

Recently, Lin (2003) proposed a new structural approach in which the government's role is to maintain free market conditions while directing firms toward its ultimate goal, the economy's sustainable development. He argues that a successful development strategy is one that follows the economy's comparative advantage. The failure of most development strategies in less developed economies is rooted in their mistaken choice of technology/industry. This choice has a constant negative effect on the economy's growth rates over time; the further the choice of technology from the economy's comparative advantage, the greater its negative effect (Lin, 2012).

Nonetheless, many developing countries have undergone successful reform plans (mostly in the 1980s) and were able to achieve high levels of growth since then. Also, the world economic conditions have been changing over time; for instance establishing the World Trade Organization (WTO) in 1990s. Therefore; the effects of the technology/industry choice could have varied accordingly. This paper validates this argument by examining the decadal effect of technology choice on per capita GDP growth rate, allowing for the impacts of dynamic local and international economic conditions. In effect, we allow the allocation between development strategy and

economic growth to change over time. We find less support for Lin's arguments. The second section of this paper presents the debate over development strategy in the literature, and the third section presents a short review of types of structural strategy. Methodology and data are described in the fourth section, followed by econometric results and its discussion in the fifth and sixth sections, respectively, with the conclusion in the seventh section.

# CHAPTER 2

## DEVELOPMENT STRATEGY DEBATE

Traditionally, capital, labor, and land are the main factors of economic growth. While Adam Smith asserted that a liberal market in which prices and output are determined by market conditions is the best environment for economic growth (1776). But, the income divergence and economic development in currently developed countries began with the emergence of technological inventions. Therefore, this classic view misses a crucial component in explaining growth divergence (Kuznets, 1955). John Stuart Mill, one of the industrial revolution's acquaintance economists, explained in his *Principles of Political Economy* that delay in growth for any economy is due to a lack of technological progress (1848).

The great depression and the Soviet Union's economic uprising in the 1930s along with the rise of Keynesian economics based on market failure and neoclassical classical growth theory led to the adoption of structural economics (Lin, 2012). The structural economists regard the government as the major determinant of economic growth. Rosenstein-Rodan and others from the structuralist school proposed the "Big Bush Theory," according to which the only way poor economies may narrow the income gap with the rich is to direct all their resources and production factors toward capital-intensive industries, where technology flourishes and generates the highest attainable returns, while abandoning their traditional sectors (Rosenstein-Rodan, 1943; Lewis, 1955; Chenery, 1961; Gershekron, 1962). Moreover, they suggest that developing economies should be inward-looking, adopting a protectionist approach to accelerate technical advancement and an Import Substitution Industries (ISI) policy to overcome

the decline of the terms of trade against their exports of resource-intensive products being exploited by rich economies (Prebishch, 1950 ; Singer, 1950).

However; government intervention through structural strategies in which free market conditions are violated with many distortions while firms are granted monopolies and showered with various subsidies harm innovation while promoting rent-seeking and corruption. Consequently, efficiency and productivity has deteriorated in many developing countries, mainly in Latin America, South Asia and Africa (Krueger, 1974; Krugman, 2009).

The neoclassical growth theory developed by Robert Solow (1956) overcame the classical theory's flaw by adding technology to the economic growth factors. However, technology is determined outside the model (exogenous), and growth comes mainly from capital accumulation (saving). Later, Romer (1986) and Lucas (1988) came up with their endogenous economic growth model, in which technological progress is determined by accumulation of capital (physical and human). These models allow countries to grow at different long run rates.

Baumol (1986) Abramovitz (1986) find that technology will lend backward economies the momentum to catch up. Barro and Sala-i-Martin (1992) and Mankiw, Romer, and Weil (1992) have estimated the speed of conditional[2] convergence for various regions and groups of economies to be around 2%, which is close to the current level of the developed countries. Thus, poor countries will sooner or later catch up with the rich.

Nevertheless, this is not the case in the world's current situation. What we are seeing is that economies that have failed to absorb new technologies are unable to

[2] Conditioned to their endowments: saving, human capital and population growth.

converge to rich countries. Those that have figured out how to obtain new technologies have become the newly industrialized economies (NIEs)[3]. The success of the NIEs revives structural theory, and many economists argue that industrial policies were not themselves a problem, since these policies worked for NIEs. The problem was excessive incorrect government interventions (Rodrik 1994; Lin, 2012; Lall, 2004; Shapiro, 2007).

[3] These economies are South Korea, Taiwan, Hong Kong, and Singapore.

# CHAPTER 3

## TYPES OF STRUCTURAL STRATEGY

In his attempt to explain the reasons behind successful industrial policies in the NIEs and their counterparts' failure in other developing countries, Lin (2003) divided capital intensive technologies/industries' strategies into two types: the Comparative-Advantage-Defying (CAD) strategy followed by many developing countries, and the Comparative-Advantage-Following (CAF) strategy followed by NIEs.

In the first one, the government encourages firms to invest in new technologies/industries that do not match the economy's current comparative advantage of endowments. To encourage them the government offers firms large incentives and subsidies to overcome profitability problems. These incentives distort the free competitive market conditions; labor, financial and international trade markets. Moreover, it creates inefficient firms that depend excessively on government intervention and consume large amounts of the economy's scarce resources. In the second one, the government works as an investment facilitator in the economy's comparative advantage of endowments. In this case the government maintains free competitive market conditions along with efficient business-friendly institutions, coordinates firms' cooperation in technological upgrading, and offers limited financial support for pioneer firms to overcome information externality problems. Once the economy has reached the targeted industrial level, the government upgrades its target to a higher level of technologies/industries (Lin, 2003).

Lin draws a very thin line between the CAF and CAD strategies. Though the first seems more liberal than the second, government intervention in deciding which type of

technologies/industries firms should invest in persists in both strategies. Rodrik (2011) points out that when the government targets certain industries it implies that firms have not yet invested there, which is simply because firms do not see a comparative advantage in those industries. Therefore, governments should not interfere in firms' investment decisions because if the market price is not right for them, government intervention will not be helpful. Governments should focus only on developing human capital and the standard of living while promoting business environment (Krueger, 2011; Stiglitz, 2011).

On the other hand; Lin (2012) finds that "a 10 percent increase from the mean in the Technology Choice Index (TCI)[4] can result in approximately 0.1 of a percentage point reduction in the country's average annual growth rate of per capita GDP for the whole period 1962–99." However; might the association between TCI and economic growth have changed over time? Trade liberalization along with the WTO have allowed for more trade and factor movements, especially technological diffusion, across international borders. These reforms may have changed the association between TCI and growth. Note the different slopes for the regression line in each of the decadal figures 2-6, showing that the unconditional association between TCI and growth has changed. The next section presents the methodology and data used to more carefully examine this idea.

[4] A proxy for a country's strategy proposed by Lin and Liu (2004) which will be discussed further in section 4.

**Figure 2: GDP per Capita and Thechnology Choice 1960s-2000s**

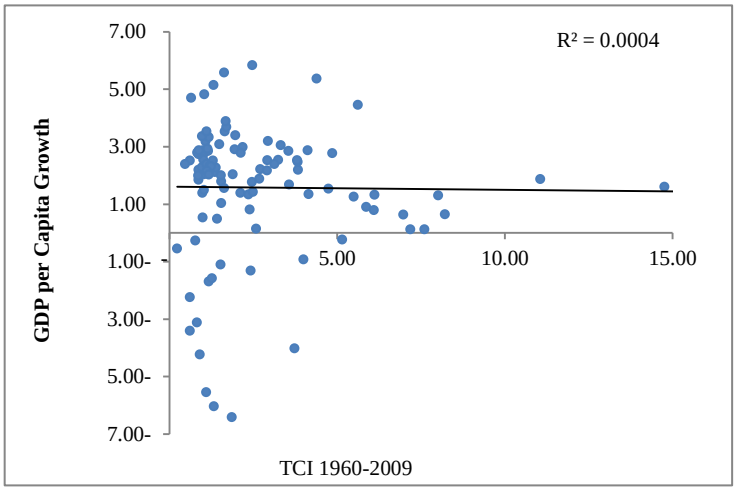



**Figure 3: GDP per Capita and Thechnology Choice 1970s**

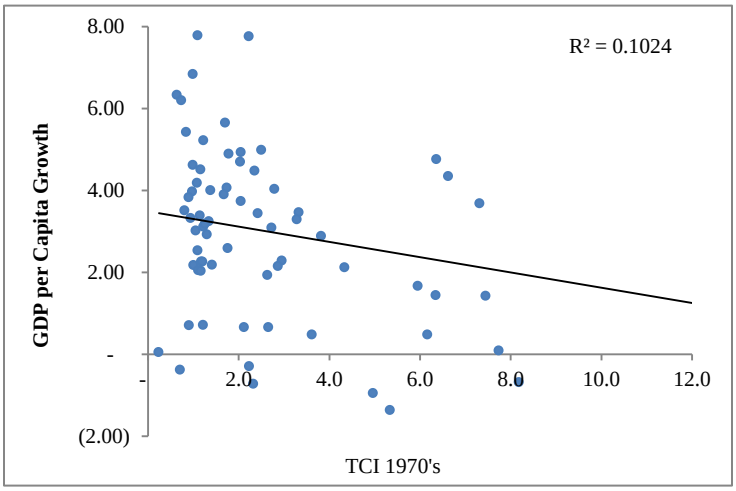



**Figure 4: GDP per Capita and Thechnology Choice 1980s**

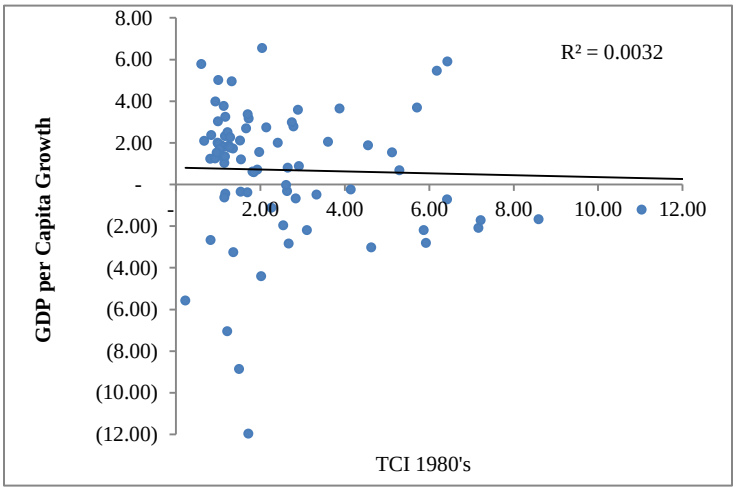


**Figure 5: GDP per Capita and Thechnology Choice 1990s**

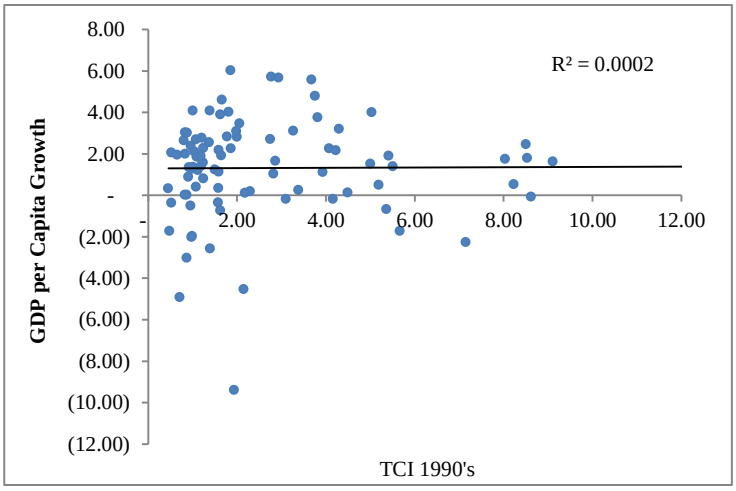
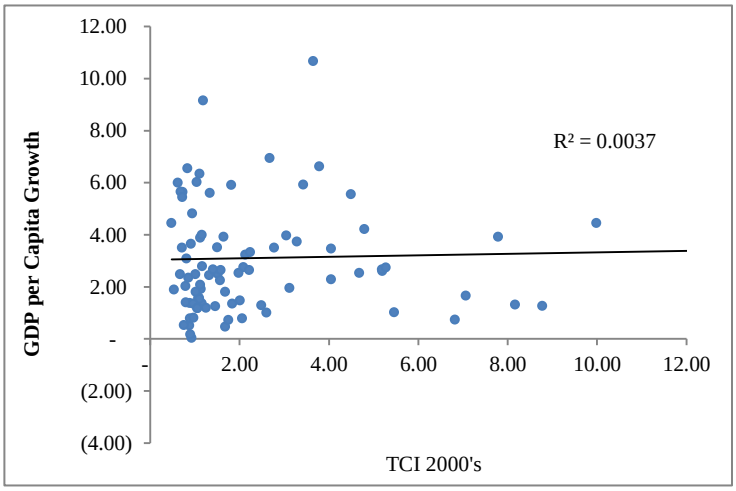



**Figure 6: GDP per Capita and Thechnology Choice2000s**



# CHAPTER 4

# METHODOLOGY

To examine how the effect of the technology choice index (TCI) on economic growth rates can change over time, the OLS regression method is used for cross-sectional data of 105 economies[5]. First, its effect on the average data of the period 1963–2009 is estimated, then on ten-year average data for the decades of the 1970s, 1980s, 1990s and 2000s. The regressions for a permanent observation of 49 countries for which data is available for all variables in all periods are rerun to make sure that the results are robust and not affected by changes in the sample. This estimation model follows Lin's approach (2012), though some of his explanatory variables have been replaced with better indices. The model equation is the following:

$$G_{i,t} = \alpha + \beta\, ln(\, TCI_{i,t}) + \, \delta X + \upsilon \qquad (1)$$

$\mathrm{G_{i,t}}$ is the real GDP per capita growth rate in economy i in decade t, $\mathrm{X}$ is a vector of the other explanatory variables which constitute the initial GDP per capita to reflect the stage of economic development taken from The Conference Board (2012), the share of gross capital formation from the GDP to reflect the effect of capital/investment factor, the population growth rate to capture the impact of the increase in the labor factor and the market size taken from WDI (2012). The openness index from Wacziarg and Welch (2008) is used to capture international integration rather than the trade share to avoid the influence of economy size on trade. For institutional quality, rule of law

[5] Data availability and elimination of economies with outlier data in some variables have reduced the number of observations in the regressions.

index has been replaced with the bureaucratic quality[6] measure from ICRG (2011) because rule of law can be enforced in countries with varying levels of institutional quality. Syria and Tanzania, for example, scored higher on average than South Africa and India in the rule of law index, but much below them in terms of the bureaucratic quality index. Human capital has been considered via multiple measures as an explanatory variable, but all have been highly correlated with other variables, mainly institutional quality; therefore, it has been eliminated to avoid the multicollinearity problem. Unfortunately endogeneity remains if economic growth reallocates resources to or from manufacturing sector or if low growth leads to changes in development strategies.

$\mathrm{TCI_{i,t}}$ is a technology choice index, proposed by Lin and Liu (2004) to proxy a country's development strategy, for economy i in a specific time, and it is computed according to the following formula:

$$TCI_{i,t} = \frac{\mathrm{AVM_{i,t}}/\mathrm{LM_{i,t}}}{\mathrm{GDP_{i,t}}/\mathrm{L_{i,t}}} \qquad (2)$$

Where the numerator is the per worker value added in the manufacturing sector; $\mathrm{AVM_{i,t}}$ is the total value added of the manufacturing sector in economy i within a certain time divided by the number of employees in the manufacturing sector $\mathrm{LM_{i,t}}$. The denominator is the per worker value added in the economy as a whole; $\mathrm{GDP_{i,t}}$ is the economy's total value added and $\mathrm{L_{i,t}}$ is the total number of employees in the economy[7]. If a country follows CAD strategy, then it will direct more capital to its manufacturing

[6] In this measure: "High rank is given to low risk countries where the institutions tend to be autonomous from political pressure, whereas in low ranking (high risk) countries a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions." (ICRG, 2011)

[7] The number of employees has been used rather than that of the entire labor force to make accurate comparisons between types of workers' value added and to account for the unemployment effect.

sector which, being capital-intensive, will create fewer jobs relative to other sectors. In the meantime; manufacturing firms will be provided with subsidies and monopoly power that allows them to charge higher prices, consequently they will generate higher value added. Therefore; the higher the per-worker value added in the economy's manufacturing sector, the more capital-intensive the sector becomes, the more aggressive the government intervention, and the further the economy drifts from its comparative advantage (Lin, 2012). Definitions and sources for all variables are summarized in Appendix A.

The effect of the TCI on growth is expected to vary across time. Significant and negative during the 1970s, in later decades it is expected to be insignificant as many countries have undergone economic reform since the 1980s. Initial per capita income and population growth are expected to be inversely correlated with growth, while capital formation (investment), openness, and institutional quality are expected to be significant and positive all the time.

# CHAPTER 5

## ECONOMETRIC RESULTS

Table 1 contains the regressions' estimates. Each pair of columns represents the coefficient estimates for the same period. The first one represents estimates for all available observations and the second for the permanent observations of 49 economies, to be referred to as Type 1 and Type 2 observations respectively throughout the rest of the paper. As we can see from the table, the TCI has a negative effect on growth for the period 1963-2009, but is statistically significant in the Type 1 observations with a coefficient estimate of -0.654 (s.e=.258), which supports concerns about the effect of sample size over long periods of time. For the 1970s, the TCI effect is negative and highly significant in both types of observations, its coefficient estimates ranging from -1.592 (s.e=.497) to -1.924 (s.e=.529). This means that following the CAD strategy as in India, for example, caused India's TCI level to be around 8% above average[8], which could have reduced India's per capita GDP growth rate by approximately 0.14% each year during the 1970s. In general, increasing an economy's TCI by one standard deviation in the 1970s would lower that economy growth by 1.59 standard deviation. Although the TCI levels for the majority of countries do not vary much across decades (see table 3), the TCI effect is not significant at all during the next three decades for either type of observation. These results confirm the view that the TCI effect changes according to surrounding economic conditions and policies.

Table 1 also illustrates the coefficient estimates for the other explanatory variables. Though the initial GDP per capita coefficient estimates are negative as

[8] It had TCI level of 2.7 whereas the average is 2.5, see table 3.

expected for all periods, except for the Type 2 observations in the 1990s, they are highly significant for the periods 1963-2009, the 1970s and the 1980s for both types of observations. Capital formation coefficient estimates are as expected, positive and highly significant, during all periods for both types of observations. Population growth coefficient estimates are significant with the expected negative sign in the 1980s, and for Type 2 observations in the 1990s and Type 1 in the 2000s. The trade liberalization effect is significant with the expected positive sign for the 1970s and 1980s and for Type 2 observations for the period 1963-2009. Institutional quality coefficient estimates are significant with the expected positive sign in the 1980s (the transition period) and for Type 1 observations for the periods 1963-2009 and the 1990s. The convergence between the countries' economic policies in the 1990s and 2000s, probably because of WTO[9], might have reduced openness and institutional quality explanatory variables ability in explaining the variations in economic growth among various countries

[9] In the 1970s only 28 of the total sample of 105 countries were considered open, whereas in the 2000s 94 countries were considered open. The standard deviation for institutional quality is 1.33 in the 1970s and 1 in the 2000s.

Table 1: TCI Effect on Economic Growth Rates over Time

| Period | 1963-2009 | | 1970s | | 1980s | | 1990s | | 2000s | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sample** | All Available | Permanent Observations | All Available | Permanent Observations | All Available | Permanent Observations | All Available | Permanent Observations | All Available | Permanent Observations |
| **TCI** | -0.654** (0.258) | -0.493 (0.363) | -1.924*** (0.529) | -1.592*** (0.497) | -0.328 (0.394) | 0.511 (0.581) | 0.268 (0.519) | 0.266 (0.508) | 0.226 (0.312) | 0.453 (0.418) |
| **Initial GDP** | -0.964*** (0.190) | -0.810*** (0.272) | -1.481*** (0.421) | -1.362*** (0.429) | -1.980*** (0.312) | -1.416*** (0.480) | -0.383 (0.494) | 0.270 (0.427) | -0.511 (0.333) | -0.460 (0.399) |
| **Capital Formation** | 2.212*** (0.635) | 2.929*** (0.959) | 3.269 *** (0.827) | 2.930*** (0.998) | 2.609*** (0.669) | 3.295*** (1.291) | 2.121** (1.06) | 3.672*** (0.876) | 4.731*** (0.981) | 3.627*** (1.155) |
| **Population Growth.** | -0.182 (0.155) | -0.237 (0.169) | 0.125 (0.282) | 0.040 (0.270) | -0.915*** (0.219) | -0.760*** (0.266) | 0.311 (0.295) | -0.481* (0.261) | -1.154*** (0.216) | -0.472 (0.293) |
| **Openness** | 0.379 (0.241) | 0.483* (0.257) | 1.166** (0.519) | 1.174*** (0.438) | 1.926*** (0.428) | 1.577*** (0.509) | 0.817 (0.747) | -0.598 (0.762) | -0.101 (0.535) | 0.488 (0.766) |
| **Institutional Quality** | 0.382** (0.167) | 0.049 (0.204) | 0.071 (0.239) | -0.222 (0.225) | 0.620*** (0.184) | 0.655*** (0.215) | 0.819** (0.380) | -0.220 (0.349) | -0.396 (0.268) | 0.005 (0.304) |
| **Observations** | 76 | 49 | 59 | 49 | 70 | 49 | 80 | 49 | 75 | 49 |
| **R-Square** | 0.55 | 0.56 | 0.50 | 0.53 | 0.68 | 0.61 | 0.17 | 0.33 | 0.62 | 0.35 |

Note: Standard errors are in parentheses.

* Significant at the p<0.10

** Significant at the p<0.05

***Significant at the p<0.01

# CHAPTER 6

# DISCUSSION OF RESULTS

The results show clearly how the TCI effect upon growth changes over time, which may be caused by factors such as technological progress and economic conditions and policies. The transition of the TCI coefficient sign from negative in the 1970s and 1980s[10] to positive beginning in the 1990s might reflect major changes in the economic conditions such as WTO's effect on the global economy[11], and more importantly; the trends in technological development: a slowing in advanced economies since the 1970s with the beginnings of a recovery in the 1990s. Here we discuss how some of these conditions may have affected growth rates, first in developed countries and then in developing countries, taking one country from each group as an example.

Technical progress was the main growth factor in the western "Golden Age" of the 1950s and 1960s. In the United States, which exists on the technological frontier, about 67% of the growth rate in the 1950s and 1960s was caused by the total factor of productivity (TFP)[12], as shown in Table 2. However; the energy price shock in the 1970s, along with other changes in the world/local economic conditions[13], might have slowed down technical progress and then lessened the total global demand in the 1980s, which in turn caused the TFP's contribution to fall to its lowest level. Later, the development in information technology beginning in the 1990s revived both the growth rate and the TFP's contribution to the growth rate and, in addition, increased labor

[10] For type 1 observations.

[11] WTO regulations have reduced the trade barriers and limited governments' ability in supporting their national firms.

[12] TFP is defined as a "measure of the joint influences of technological change, efficiency improvements, returns to scale, reallocation of resources, and other factors on economic growth, allowing for the effects of capital and labor." (BLS, 2012).

[13] Like the collapse of the Bretton Woods system in 1971, and the Latin American debt crisis in the 1970s and 1980s.

productivity (Figure 7), after two decades of a downward trend, which it resumed in the 2000s. Two of the possible reasons for the labor productivity downtrend in the 2000s are increasing competition from developing countries, and the energy price shock. Under these conditions of rising competition and operating costs, higher wages and energy prices, and slow technological development, firms resorted to physical capital investments as compensators. Thus, capital substitutes for technological progress as the main factor of growth in advanced economies since the 1980s.

**Table 2: Source of Growth in the US' and China's Economy**

| | Period | Output Growth | Contribution of Labor % | Contribution of Capital % | Contribution of TFP % |
|---|---|---|---|---|---|
| US | 1950s | 2.85 | 0.09 | 0.23 | 0.68 |
| | 1960s | 2.88 | 0.05 | 0.28 | 0.67 |
| | 1970s | 1.97 | 0.01 | 0.42 | 0.57 |
| | 1980s | 1.46 | 0.21 | 0.60 | 0.19 |
| | 1990s | 1.98 | 0.18 | 0.43 | 0.39 |
| | 2000s | 2.48 | 0.11 | 0.53 | 0.36 |
| | | | | | |
| China | 1952-1965 | 12.38 | 0.04 | 0.79 | 0.17 |
| | 1966-1978 | 7.85 | 0.23 | 0.76 | 0.01 |
| | 1979-1992 | 8.57 | 0.10 | 1.21 | -0.31 |
| | 1993-2005 | 10.46 | 0.01 | 0.71 | 0.28 |

Source: US data (BLS, 2012). China data (Ozyurt, 2009)

On the other hand, after World War II many developing countries followed structural strategies aggressively to speed up industrialization. Indeed, these strategies brought about some technical development until the 1970s, but those countries have been unable to upgrade these technologies to a higher level. Therefore, their growth rate has been depending on capital.

There are many different reasons, for the slow growth and technical development in those countries, but in general it may be attributed to the following factors which are

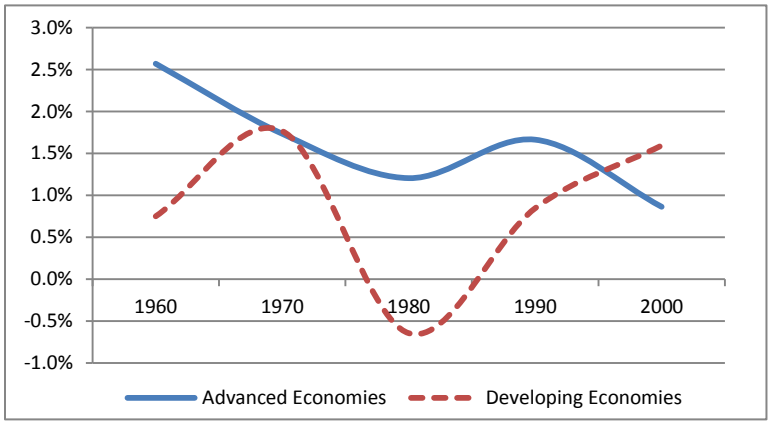
mentioned in most development literature: First, the lack of appropriate human capital, the engine of innovations and management skills. Second, the lack of business-friendly environment in terms of infrastructure, regulations and institutions. Third, the technological slowdown in the advanced economies, which are the source of imitation. Fourth, the increase in their industries' operation costs. Most of their technologies have been energy-intensive, and as energy prices rose in the 1970s these technologies did not add much to their economic growth. However, in the 1980s the world demand fell and at the same time many developing countries started a gradual opening up of policies and economic reforms. The timing of this transition was very important for replacing and upgrading aging technologies with new ones at lower prices and for lowering the costs of economic reforms in general.

Another reason for spending on new technologies during times of recession is to stimulate the economy. For example, the TFP contribution to China's growth rate for the period of 1952-1965 was about 17%. However, it fell to 1% in the 1970s, then; it reduced the growth by 31% in the 1980s which might be associated with the reform costs. It took off during the last two decades where it contributed 28% of China's growth rate, as shown in Table 2, arguably as a result to the economic reforms and joining WTO.

Labor productivity growth in developing countries also moved along with the technological development trend, reaching its peak in the 1970s. It fell below zero in the 1980s, but then overlapping labor productivity growth in the advanced economies in the 2000s, as illustrated in Figure 7. However, labor's contribution to growth in developing countries is far below the levels of the advanced economies (except in the 1970s) since

their wages are still low as compared with their counterparts in advanced economies. These low wages along with the adopted new technologies of production could have cushioned the shock energy prices delivered in the 2000s. However, capital is still the major growth factor for developing economies.

**Figure 7: Labor Productivity Growth Trend**




Source: Total Economy Database (TCB, 2012)

It can be seen that technological progress increases labor productivity, accelerates growth rates, and lowers reliance on capital and labor as means of growth. Therefore, the changes in the TCI coefficient sign follow the changes in the TFP. It had a negative sign during the 1970s and 1980s when the TFP deteriorated, then become positive as the TFP turned around in the 1990s and 2000s. In fact, a large part of the changes in the TFP in developing countries can be linked to gradual economic reforms and openness policies, which allow for the adoption of new methods of source allocation, production, and management. In Table 3 we can see that many of the developing countries who achieved high growth rates still have high TCI levels and in some cases (as with India and Korea) it has increased. We may infer that they have not abandoned the capital-intensive technology/industry strategy, but that they are managing it differently.

# CHAPTER 7

# CONCLUSION

TCI effect changes owing to many factors, both locally and internationally. However, technological progress has a clear effect on it and on growth rates and productivity. Therefore, the intensive capital technology/industries strategy alone is not enough to ensure sustainable growth, since technologies always need to be upgraded. On the other hand, the interaction between local policies and global economic conditions could also influence how the reliance on manufacturing affects growth rates, and so economic policies need to be adjusted while maintaining free competitive market conditions, which is not an easy task.

The gradual economic reforms and removing of barriers that hindered economic growth in many developing countries (in other words, switching from a CAD to a CAF strategy) could have been crucial in promoting sustainable development during 1970s. This gradual-transition approach has enabled many developing countries to achieve high growth rates. However, after the completion of the reforms with all available production factors being fully utilized, only technological progress will provide the means for sustainable development. Perhaps that is why, since 1970s I find less support that the choice of development strategy as proxied by TCI is important.

Table 3: TCI Level and GPD per Capita Growth Rate for Different Periods.

| Economy | 1963-199 | | 1970s | | 1980’ | | 1990s | | 2000s | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TCI | GDP per capita growth rate | TCI | GDP per capita growth rate | TCI | GDP per capita growth rate | TCI | GDP per capita growth rate | TCI | GDP per capita growth rate |
| Albania | 1.01 | 2.87 | | 1.91 | 1.82 | 0.61 | 1.14 | 1.85 | 0.83 | 6.55 |
| Algeria | 2.12 | 1.39 | 2.35 | 4.48 | 1.54 | (0.36) | 1.63 | (0.73) | | 2.30 |
| Argentina | 2.36 | 1.34 | | 1.64 | 3.11 | (2.20) | 2.00 | 2.83 | 1.84 | 1.35 |
| Armenia | 1.18 | 3.22 | | | | | | (2.73) | 1.18 | 9.16 |
| Australia* | 0.88 | 2.20 | 1.00 | 2.17 | 1.08 | 1.87 | 0.52 | 2.07 | 0.54 | 1.89 |
| Austria* | 1.05 | 2.77 | 0.97 | 3.97 | 0.99 | 1.99 | 1.04 | 2.12 | 1.07 | 1.56 |
| Azerbaijan | 2.42 | 2.80 | | | | (1.05) | | (7.66) | 2.42 | 14.80 |
| Bangladesh | 2.46 | 1.77 | 2.33 | (0.73) | 2.65 | 0.79 | 1.98 | 3.10 | | 4.04 |
| Barbados | 1.03 | 2.24 | 0.81 | 3.51 | 0.82 | 1.22 | 1.58 | 0.35 | | 0.81 |
| Belgium* | 1.02 | 2.55 | 0.94 | 3.33 | 1.02 | 1.92 | 1.10 | 1.87 | 1.15 | 1.36 |
| Bolivia* | 6.12 | 1.33 | 2.95 | 2.28 | 7.18 | (2.09) | 8.04 | 1.76 | 7.06 | 1.66 |
| Brazil | 3.84 | 2.20 | | 5.54 | | 0.76 | 4.49 | 0.13 | 3.12 | 1.95 |
| Bulgaria | 0.62 | 2.52 | | 3.25 | | (0.02) | 0.48 | (1.72) | 0.73 | 5.64 |
| Burkina Faso | 31.75 | 1.42 | 32.76 | (0.10) | 30.23 | 1.51 | | 1.59 | | 1.72 |
| Cambodia | 4.13 | 2.87 | | 2.39 | | 1.01 | 4.29 | 3.21 | 3.79 | 6.62 |
| Cameroon* | 6.10 | 0.79 | 7.45 | 1.42 | 5.12 | 1.53 | 5.67 | (1.72) | 5.46 | 1.02 |
| Canada* | 1.36 | 2.11 | 1.22 | 3.11 | 1.36 | 1.71 | 1.50 | 1.24 | 1.46 | 1.25 |
| Chile* | 3.83 | 2.47 | 3.62 | 0.48 | 4.55 | 1.86 | 3.76 | 4.80 | 5.20 | 2.61 |
| China | 4.39 | 5.37 | | 3.91 | 6.44 | 5.89 | 2.94 | 5.68 | 3.65 | 10.67 |
| Colombia* | 3.82 | 2.53 | 3.32 | 3.46 | 3.89 | 3.63 | 3.93 | 1.13 | 4.68 | 2.54 |
| Costa Rica | 1.39 | 2.27 | | 3.21 | 1.18 | (0.46) | 1.21 | 2.78 | 1.32 | 2.44 |
| Cote d'Ivoire | 7.19 | 0.13 | 6.35 | 1.44 | 5.93 | (2.82) | 8.62 | (0.07) | | (1.83) |
| Croatia | 0.99 | 0.54 | | | | | 0.99 | (1.96) | | 3.03 |
| Cyprus | 1.08 | 3.18 | 2.05 | 3.74 | 1.01 | 5.00 | 0.87 | 0.03 | 0.88 | 1.38 |
| Czech | 0.88 | 1.85 | | | | | 0.82 | 0.04 | 0.91 | 3.65 |
| Denmark* | 1.03 | 2.04 | 1.11 | 2.05 | 1.14 | 1.79 | 0.83 | 2.01 | 0.87 | 0.51 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dominican Rep. | 1.95 | 2.91 | 2.03 | 4.70 | 1.98 | 1.54 | | 3.17 | | 3.56 |
| Ecuador* | 3.57 | 1.68 | 2.79 | 4.03 | 2.64 | (0.33) | 4.16 | (0.18) | 5.19 | 2.67 |
| Egypt, Arab Rep.* | 2.19 | 2.99 | 2.05 | 4.93 | 2.79 | 2.77 | 1.86 | 2.27 | 2.09 | 2.76 |
| Estonia | 0.62 | 2.65 | | | | | 0.53 | (0.36) | 0.68 | 5.66 |
| Ethiopia | 14.76 | 1.61 | | 0.90 | | (0.36) | 13.61 | (0.41) | 15.90 | 4.84 |
| Finland* | 1.16 | 2.85 | 1.15 | 3.39 | 1.18 | 3.24 | 1.12 | 1.22 | 1.14 | 1.92 |
| France | 0.98 | 2.28 | 1.05 | 3.02 | 1.05 | 1.69 | 0.92 | 1.35 | 0.89 | 0.79 |
| Georgia | 1.11 | (0.83) | | | | | | (7.99) | 1.11 | 6.34 |
| Ghana | 8.22 | 0.64 | 8.19 | (0.69) | 11.04 | (1.23) | 8.54 | 1.80 | 12.37 | 3.26 |
| Greece* | 1.17 | 3.33 | 1.16 | 4.51 | 1.13 | 1.29 | 1.20 | 1.41 | 1.16 | 2.79 |
| Guatemala | 2.50 | 1.43 | 2.42 | 3.44 | 2.55 | (1.98) | | 1.78 | | 1.40 |
| Hong Kong SAR,* China | 0.66 | 4.70 | 0.64 | 6.33 | 0.61 | 5.76 | 0.65 | 1.96 | 0.72 | 3.50 |
| Hungary | 1.55 | 1.80 | 2.87 | 2.15 | 1.16 | 1.02 | 0.96 | (0.50) | 1.01 | 2.48 |
| Iceland | 0.87 | 2.73 | 0.84 | 5.42 | 0.67 | 2.08 | 0.96 | 1.33 | 1.12 | 2.08 |
| India | 3.32 | 3.05 | 2.65 | 0.66 | 2.90 | 3.58 | 3.82 | 3.76 | 4.49 | 5.55 |
| Indonesia | 2.94 | 3.19 | 2.50 | 4.99 | 2.75 | 2.98 | 3.27 | 3.11 | 3.28 | 3.73 |
| Iran, Islamic Rep.* | 2.92 | 2.52 | 1.76 | 2.59 | 1.36 | (3.27) | 4.07 | 2.26 | 4.79 | 4.21 |
| Iraq | 1.43 | 0.49 | 0.99 | 6.84 | 1.50 | (8.88) | | (4.24) | | 4.92 |
| Ireland* | 1.66 | 3.53 | 1.35 | 3.25 | 1.67 | 2.69 | 1.86 | 6.04 | 2.00 | 1.47 |
| Israel* | 1.14 | 2.93 | 1.26 | 3.18 | 1.26 | 1.85 | 0.96 | 2.39 | 1.09 | 1.58 |
| Italy* | 1.11 | 2.39 | 1.30 | 2.92 | 1.17 | 2.31 | 1.00 | 1.27 | 0.93 | 0.04 |
| Jamaica | 2.40 | 0.81 | 2.23 | (0.29) | 2.92 | 0.87 | 2.30 | 0.20 | | 0.07 |
| Japan* | 1.70 | 3.69 | 1.74 | 4.07 | 1.73 | 3.15 | 1.59 | 1.14 | 1.68 | 0.46 |
| Jordan* | 1.90 | 2.04 | 1.67 | 3.90 | 1.93 | 0.69 | 2.18 | 0.12 | 2.13 | 3.24 |
| Kenya* | 5.88 | 0.90 | 5.96 | 1.67 | 5.30 | 0.67 | 5.37 | (0.66) | 6.82 | 0.74 |
| Korea, Rep.* | 2.48 | 5.84 | 2.22 | 7.76 | 2.05 | 6.54 | 2.77 | 5.73 | 3.04 | 3.97 |
| Kuwait | 1.53 | (1.11) | 0.71 | (0.38) | 1.22 | (7.06) | 2.75 | 2.71 | 1.52 | 2.49 |
| Kyrgyz Republic | 3.73 | 0.15 | | | | 4.65 | 2.15 | (4.52) | 4.05 | 3.46 |
| Latvia | 0.83 | 1.72 | | | | | 0.98 | (2.00) | 0.72 | 5.44 |
| Lithuania | 0.62 | 1.42 | | | | | | (3.16) | 0.62 | 6.00 |
| Luxembourg | 0.84 | 2.80 | | 2.00 | 0.94 | 3.97 | 0.84 | 3.04 | 0.79 | 2.03 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Madagascar | 4.00 | (0.92) | 4.96 | (0.95) | 4.63 | (3.03) | | (1.33) | 0.90 | 0.17 |
| Malawi | 8.02 | 1.30 | 7.32 | 3.69 | 8.60 | (1.69) | 9.11 | 1.63 | 8.17 | 1.32 |
| Malaysia* | 1.68 | 3.89 | 1.70 | 5.65 | 1.71 | 3.36 | 1.66 | 4.61 | 1.58 | 2.64 |
| Malta | 1.05 | 4.82 | 1.07 | 11.00 | 1.14 | 3.75 | 1.01 | 4.09 | 0.97 | 0.80 |
| Mexico | 2.69 | 1.88 | | 3.63 | 2.61 | (0.03) | 2.86 | 1.66 | 2.06 | 0.78 |
| Moldova | 1.86 | (1.74) | | | | | 1.94 | (9.40) | 1.81 | 5.92 |
| Morocco* | 2.71 | 2.22 | 2.73 | 3.08 | 2.42 | 1.98 | 2.82 | 1.05 | 2.78 | 3.50 |
| Netherlands* | 1.21 | 2.33 | 1.10 | 2.54 | 1.17 | 1.33 | 1.37 | 2.55 | 1.25 | 1.19 |
| New Zealand* | 0.99 | 1.39 | 0.91 | 0.70 | 0.93 | 1.23 | 1.24 | 1.59 | 1.10 | 1.53 |
| Nigeria | 11.06 | 1.87 | 6.36 | 4.76 | 13.00 | (1.78) | 18.58 | (0.65) | | 5.89 |
| Norway* | 0.88 | 2.87 | 0.90 | 3.83 | 0.84 | 2.36 | 0.87 | 3.03 | 0.80 | 1.40 |
| Oman | 1.64 | 5.57 | | 1.12 | | 5.31 | 1.25 | 0.81 | 1.98 | 2.53 |
| Pakistan* | 4.86 | 2.77 | 4.34 | 2.12 | 5.72 | 3.69 | 5.41 | 1.91 | 5.27 | 2.74 |
| Peru | 4.75 | 1.54 | | 1.33 | 5.88 | (2.21) | 5.51 | 1.40 | 1.12 | 3.89 |
| Philippines* | 4.15 | 1.35 | 3.82 | 2.89 | 3.34 | (0.50) | 5.19 | 0.52 | 4.05 | 2.29 |
| Poland | 1.31 | 2.52 | | 3.47 | 1.70 | (0.40) | 1.24 | 2.28 | 1.16 | 4.00 |
| Portugal* | 0.98 | 3.36 | 0.99 | 4.62 | 1.00 | 3.02 | 0.81 | 2.65 | 0.76 | 0.52 |
| Qatar | 1.27 | (1.59) | | (1.55) | 1.72 | (11.98) | 1.59 | 2.19 | 0.85 | 2.34 |
| Romania | 1.17 | 2.10 | | 3.97 | | (0.49) | 1.39 | (2.56) | 0.94 | 4.82 |
| Russian | 0.91 | 0.55 | | | | | 0.71 | (4.92) | 1.04 | 6.02 |
| Saudi Arabia | 1.24 | 2.32 | 0.74 | 6.20 | 2.02 | (4.42) | | 0.89 | 0.96 | 1.35 |
| Senegal* | 7.60 | 0.12 | 7.74 | 0.09 | 6.43 | (0.73) | 8.23 | 0.54 | 8.78 | 1.27 |
| Singapore* | 1.32 | 5.15 | 1.10 | 7.79 | 1.33 | 4.94 | 1.39 | 4.10 | 1.41 | 2.67 |
| Slovak Republic | 0.47 | 2.39 | | | | | 0.45 | 0.34 | 0.48 | 4.44 |
| Slovenia | 0.86 | 1.99 | | | | | 0.90 | 0.89 | 0.82 | 3.09 |
| South Africa* | 1.55 | 1.04 | 1.21 | 0.71 | 1.16 | (0.63) | 1.57 | (0.35) | 2.22 | 2.64 |
| Spain* | 1.11 | 3.53 | 1.08 | 4.19 | 1.23 | 2.49 | 1.08 | 2.70 | 1.06 | 1.18 |
| Sri Lanka | 2.13 | 2.78 | 2.63 | 1.94 | 2.15 | 2.72 | 1.82 | 4.03 | 1.64 | 3.91 |
| Sudan | 6.98 | 0.64 | 6.16 | 0.48 | | (1.04) | | 0.54 | 7.79 | 3.92 |
| Sweden* | 1.12 | 2.16 | 1.17 | 2.04 | 1.28 | 1.76 | 1.01 | 1.37 | 1.02 | 1.81 |
| Switzerland | 1.04 | 1.50 | | 1.24 | 0.97 | 1.51 | 1.08 | 0.42 | | 1.26 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Tanzania | 5.50 | 1.25 | | 1.03 | 2.27 | (1.13) | 3.10 | (0.17) | 9.99 | 4.45 |
| Thailand* | 5.63 | 4.45 | 6.62 | 4.34 | 6.18 | 5.45 | 5.03 | 4.01 | 2.24 | 3.33 |
| Trinidad and Tobago* | 1.50 | 3.09 | 1.38 | 4.01 | 0.83 | (2.68) | 1.63 | 3.91 | 2.67 | 6.94 |
| Tunisia* | 1.97 | 3.39 | 1.78 | 4.89 | 1.55 | 1.19 | 2.06 | 3.47 | 1.50 | 3.52 |
| Turkey* | 3.24 | 2.54 | 3.28 | 3.29 | 3.61 | 2.04 | 4.22 | 2.18 | 1.56 | 2.24 |
| Uganda | 21.64 | 1.04 | 5.45 | (3.60) | 4.15 | (0.25) | 39.01 | 2.75 | 43.21 | 3.90 |
| Ukraine | 1.33 | (1.34) | | | | | | (8.30) | 1.33 | 5.61 |
| United Arab Emirates | 0.23 | (0.55) | 0.24 | 0.05 | 0.23 | (5.59) | | (0.89) | | 1.90 |
| United Kingdom* | 1.18 | 2.02 | 1.18 | 2.26 | 1.29 | 2.25 | 1.19 | 1.90 | 1.06 | 1.18 |
| United States* | 1.54 | 2.00 | 1.42 | 2.18 | 1.53 | 2.10 | 1.65 | 1.92 | 1.75 | 0.72 |
| Uruguay* | 1.63 | 1.56 | 1.21 | 2.26 | 1.85 | 0.58 | 1.78 | 2.84 | 1.68 | 1.81 |
| Venezuela, RB | 2.59 | 0.14 | 2.12 | 0.66 | 2.68 | (2.86) | 3.38 | 0.27 | | 2.33 |
| Vietnam | 3.55 | 2.85 | | 0.92 | | 2.33 | 3.68 | 5.59 | 3.43 | 5.93 |
| Yemen, Rep. | 3.14 | 2.40 | | 8.56 | | 0.07 | 5.00 | 1.53 | 2.60 | 1.00 |
| Zambia | 5.16 | (0.24) | 5.34 | (1.37) | 7.23 | (1.72) | 7.15 | (2.25) | | 2.50 |
| Mean (All data) | 3.03 | 2.02 | 2.96 | 2.86 | 3.03 | 0.72 | 3.26 | 0.88 | 3.00 | 3.00 |
| Standard Deviation (All data) | 4.11 | 1.46 | 4.11 | 2.34 | 3.87 | 3.02 | 4.78 | 2.83 | 5.06 | 2.33 |
| Mean (without outliers) | 2.59 | 2.33 | 2.46 | 2.95 | 2.47 | 1.37 | 2.52 | 1.38 | 2.14 | 2.83 |
| Standard Deviation (without outliers) | 1.90 | 1.25 | 1.85 | 2.05 | 1.78 | 2.26 | 2.15 | 2.31 | 1.85 | 2.07 |

Note: * This economy is among the 49 permanent observations. Negative values in parentheses.

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APPENDICES

## Appendix A: Data and Sources.

| Variable | Definition | Sources |
|---|---|---|
| TCI | Technology Choice Index. This is a proxy for a country's development strategy. | Lin And Liu (2004). |
| GDP | Gross Domestic Production (Current US$) | World Bank Development Indicators (WDI,2012) |
| Total Employment | Total Employment in the Economy | Total Economy Database, The Conference Board (TCB,2012) |
| Manufacturing, Value Added | Gross Domestic Production in the Manufacturing Sector (Current US$) | United Nations Industrial Development Organization's Industrial Statistics (UNIDO, 2012) |
| Manufacturing, Employees | Number of Employees in the Manufacturing Sector | United Nations Industrial Development Organization's *Industrial Statistics* (UNIDO, 2012) |
| Real GDP Per Capita | GDP Per Capita in 1990 US$ (Converted at Geary Khamis PPPs) | Total Economy Database, The Conference Board (TCB,2012), Derived from Maddison (2007). |
| GDP Per Capita Growth Rate | % of Annual Growth Rate in Real GDP per Capita. | Total Economy Database, The Conference Board (TCB,2012), Derived from Maddison (2007). |
| Capital Formation | Gross Capital Formation (% of GDP) | World Bank Development Indicators (WDI,2012) |
| Population Growth | % of Annual Growth Rate of Population | World Bank Development Indicators (Wdi,2012) |
| Openness | Index of Trade Liberalization | Trade Liberalization And Growth (Wacziarg And Welch, 2008), According To Sachs And Warner (1995). |
| Quality of Institutions | Bureaucracy Quality Measure | International Country Risk Guide (ICRG, 2011) |
| Labor Productivity | Per Person Employed in 1990 US$ (Converted at Geary Khamis PPPs) | Total Economy Database, The Conference Board (TCB,2012) |

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