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Abstract
Economic growth is an extremely complex process, which depends on numerous variables such as capital accumulation, trade price fluctuations, currency exchange rates, political conditions, economic freedom, social conditions, income distribution, natural resource endowment, geographical characteristics, Research and Development, and many other factors. A highly debated prescription for growth - often directed toward Developing Countries (DCs) or "emerging economies" - is the export-led growth hypothesis (ELGH). The export-led growth hypothesis postulates that export expansion is one of the main determinants of growth; it holds that the overall growth of countries can be generated by expanding exports - exports act as an "engine of growth." The previous form of development, which was promoted until the mid-1970s, was the import-substitution model. This model of development encouraged countries to build up their own domestic manufacturing capacity and substitute domestically produced goods for imports. The export-led growth model has become the standard model of development that the International Monetary Fund (IMF) recommends to all its client countries. Developing Countries, in an attempt to emulate the export-led growth model, have been shifting from inward-oriented policies to export promotion strategies. As a part of these new outward-oriented strategies, DCs began to stimulate exports using diverse mechanisms such as subsidies and tax exemptions. Many scholars have attributed the People's Republic of China's (PRC's) rapid growth to the export-led growth model of development. This paper sets out to explore the export-led growth hypothesis and illustrate that, while the PRC has followed the export-led growth model in the past, currently they are shifting away from this model and toward a domestic growth enhancing model of innovation-led growth - while retaining an outward oriented position in the world economy. In addition, this paper will fully develop an original innovation-led growth approach to development and apply the model to the PRC and the country's economic development shift. Due to this shift, China will be able to survive decreasing world demand and the recent problems concerning export safety apprehension regarding food stuffs and toys. Many scholars continue to contend that the export-led growth model is the most effective road to development for DCs; many of these scholars also contend that China is still following an export-oriented model of growth. In a speech at Harvard University in 1943 Winston Churchill said that "the empires of the future will be empires of the mind." In the same respect, the battles of the future will be for talent. The clash for talent will not be limited to companies. Globalization has created a global front line - the "balance of brains" has supplanted the "balance of power." Talent is one of the three-pillars of innovation. The other two are applied or investment-specific research and development and an economic environment with the freedom necessary for entrepreneurs to pursue ground-breaking new technologies, processes, and management techniques. The most striking aspect of innovation-led growth is its reach. All economies of the future will need to pursue the innovation-led growth strategy - Advanced Industrial Nations (AINs) as well as Developing Countries (DCs) and Emerging Markets will have to pursue innovation-led growth or risk falling behind in the global economic race to compete. Thus, while development scholars still debate whether the export-led growth strategy or import-substitution strategy is better for DCs and emerging economies, nations like China are already attempting to implement a new strategy - the innovation-led growth strategy.

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Innovation-Led Growth – A New Approach to Development:
China’s Development Shift –
Away from Export-Led Growth, and Toward the Innovation-Led Model

A Master’s Thesis submitted to

The Faculty of the Master of Science in International Studies Program

In Candidacy for the Degree of

Master of Science in International Studies

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May 2008
Abstract

Economic growth is an extremely complex process, which depends on numerous variables such as capital accumulation, trade price fluctuations, currency exchange rates, political conditions, economic freedom, social conditions, income distribution, natural resource endowment, geographical characteristics, Research and Development, and many other factors. A highly debated prescription for growth – often directed toward Developing Countries (DCs) or “emerging economies” – is the export-led growth hypothesis (ELGH). The export-led growth hypothesis postulates that export expansion is one of the main determinants of growth; it holds that the overall growth of countries can be generated by expanding exports – exports act as an “engine of growth.” The previous form of development, which was promoted until the mid-1970s, was the import-substitution model. This model of development encouraged countries to build up their own domestic manufacturing capacity and substitute domestically produced goods for imports.

The export-led growth model has become the standard model of development that the International Monetary Fund (IMF) recommends to all its client countries. Developing Countries, in an attempt to emulate the export-led growth model, have been shifting from inward-oriented policies to export promotion strategies. As a part of these new outward-oriented strategies, DCs began to stimulate exports using diverse mechanisms such as subsidies and tax exemptions. Many scholars have attributed the People’s Republic of China’s (PRC’s) rapid growth to the export-led growth model of development. This paper sets out to explore the export-led growth hypothesis and illustrate that, while the PRC has followed the export-led growth model in the past, currently they are shifting away from this model and toward a domestic growth enhancing model of innovation-led growth – while retaining an outward-oriented position in the world economy. In addition, this paper will fully develop an original innovation-led growth approach to development and apply the model to the PRC and the country’s economic development shift. Due to this shift, China will be able to survive decreasing world demand and the recent problems concerning export safety apprehension regarding food stuffs and toys. Many scholars continue to contend that the export-led growth model is the most effective road to development for DCs; many of these scholars also contend that China is still following an export-oriented model of growth.

In a speech at Harvard University in 1943 Winston Churchill said that “the empires of the future will be empires of the mind.” In the same respect, the battles of the future will be for talent. The clash for talent will not be limited to companies. Globalization has created a global front line – the “balance of brains” has supplanted the “balance of power.” Talent is one of the three-pillars of innovation. The other two are applied or investment-specific research and development and an economic environment with the freedom necessary for entrepreneurs to pursue ground-breaking new technologies, processes, and management techniques. The most striking aspect of innovation-led growth is its reach. All economies of the future will need to pursue the innovation-led growth strategy – Advanced Industrial Nations (AINs) as well as Developing Countries (DCs) and Emerging Markets will have to pursue innovation-led growth or risk falling behind in the global economic race to compete. Thus, while development scholars still debate whether the export-led growth strategy or import-substitution strategy is better for DCs and emerging economies, nations like China are already attempting to implement a new strategy – the innovation-led growth strategy.
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Innovation-Led Growth – A New Approach to Development:

China’s Development Shift –
Away from Export-Led Growth, and Toward the Innovation-Led Model

Introduction

Economic growth is an extremely complex process, which depends on numerous variables such as capital accumulation, trade price fluctuations, currency exchange rates, political conditions, economic freedom, social conditions, income distribution, natural resource endowment, geographical characteristics, Research and Development, and many other factors. A highly debated prescription for growth – often directed toward Developing Countries (DCs) or “emerging economies” – is the export-led growth hypothesis (ELGH). The export-led growth hypothesis postulates that export expansion is one of the main determinants of growth; it holds that the overall growth of countries can be generated by expanding exports – exports act as an “engine of growth.” The association between exports and growth is attributed to the possible positive externalities for the domestic economy arising from the participation in world markets; examples include the reallocation of existing resources, economies of scale, the transfer of technology (through FDI), and various labor training effects. The previous form of development, which was promoted until the mid-1970s, was the import-substitution model.

This model of development encouraged countries to build up their own domestic manufacturing capacity and substitute domestically produced goods for imports. However, at the time many developing countries, which had prospered under import-substitution, began to experience slower growth and accelerated inflation.\(^1\) The shift from import-substitution to export-led development was brought on by these turbulent times. In addition, the import-

substitution model often required governments to implement tariff and quota protections; economists began to portray these measures as economic distortions that contribute to productive inefficiency – globalization and the era of “ultra” free trade were beginning. An even more important reason for the dramatic shift was the success of Japan in the twenty-plus years after World War II, and the succeeding growth of the four East Asian “tiger” economies of South Korea, Taiwan, Hong Kong, and Singapore. All of these economies relied on increased exports to achieve rapid growth into the mid-1990s.\(^2\) Emilio J. Medina-Smith describes several benefits that developing countries could derive from an export-led strategy: (1) they generate a greater capacity utilization, (2) they take advantage of economies of scale, (3) they bring about technological progress, (4) they create employment and increase labor productivity, (5) they improve allocation of scarce resources throughout the economy, (6) they relax the current account pressures for foreign capital goods by increasing the country’s external earnings and attracting foreign investment, and (7) they increase the “Total Factor Productivity” (TFP) and consequently the well-being of a country.\(^3\)

As a result of these factors, the export-led growth model has become the standard model of development that the International Monetary Fund (IMF) recommends to all its client countries.\(^4\) Developing Countries, in an attempt to emulate the export-led growth model, have been shifting from inward-oriented policies to export promotion strategies. As a part of these new outward-oriented strategies, DCs began to stimulate exports using diverse mechanisms such as subsidies and tax exemptions. Many scholars have attributed the People’s Republic of China’s

\(^2\) Ibid., p. 1-2.
\(^4\) Ibid., p. 2.
(PRC’s) rapid growth to the export-led growth model of development. This paper sets out to explore the export-led growth hypothesis and illustrate that, while the PRC has followed the export-led growth model in the past, currently they are shifting away from this model and toward a domestic growth enhancing model of innovation-led – while retaining an outward-oriented position in the world economy. In addition, this paper will fully develop an original innovation-led growth approach to development and apply the model to the PRC and the country’s economic development shift. Due to this shift, China will be able to survive decreasing world demand and the recent problems concerning export safety apprehension regarding food stuffs and toys. Many scholars continue to contend that the export-led growth model is the most effective road to development for DCs; many of these scholars also contend that China is still following an export-oriented model of growth. Part One of this paper will explore the export-led model of growth’s advantages and disadvantages in “emerging economies,” specifically China – the central argument of this analysis asserts that the export-led growth model for development is advantageous to developing countries in the infant stages of development. However, after a nation has reaped the benefits from export-oriented growth, the government should shift their economic policies toward innovation promotion and the strengthening of the domestic market – this will be explored in Part Two. China is the best example of a nation that has gone through this process successfully and is currently shifting away from export-oriented strategies and toward innovation promotion and the strengthening of the domestic economy. Despite the perceived benefits from the export-led growth model, the empirical research has been seriously mixed.
PART ONE

Theoretical Overview

The notion that export activity leads to economic growth has been subject to considerable debate in the development and growth literature for many decades. Scholars have used a number of empirical models to examine whether exports are the “engine” of economic growth. The central focus of the literature is on whether a country is better served by orienting trade policies to export promotion or to import substitution; the modern literature barleys touches on innovation-led models. The neoclassical view has been that growth can be achieved by export-led strategies; the growth records of Asian newly industrializing countries (NICs) – in particular, Hong Kong, Singapore, Korea, and Taiwan, and second-generation NICs (Malaysia and Thailand) – are cited as such examples (often compared with Latin America and Africa).\(^5\) Amazingly, over the last 30-plus years these DCs (also referred to as NICs) have approximately doubled their standards of living every ten years. China is often considered the newest member of the club; China’s experience during the 1980s and 1990s – after its liberal trade reforms in the late 1970s – tends to support the argument that trade is a mechanism for achieving more rapid and efficient growth and better distribution of domestic resources.\(^6\) The World Bank perceives the experiences of these countries as a model for development, a view also supported by the U.S. Agency for International Development and the International Monetary Fund.\(^7\) The empirical literature on development and growth is extensive. The writing on the export-led growth hypothesis can be placed into three categories: (1) cross-country correlation coefficients, (2) regression applications (typically least squared based) which were also cross-country models,

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\(^6\) Ibid., p. 262.

\(^7\) Ibid., p. 262.
and (3) the most recent group of works which apply various time series techniques and causality models to examine the exports-growth connection. The export-led growth hypothesis is also known as Verdoorn's Law, after P.J. Verdoorn who suggested the concept in 1949. First, Verdoorn believed that export growth may represent an increase in demand for a country’s output and thus serves to increase real output. Second, an expansion in exports may promote specialization in the production of export products, which in turn may boost the productivity level and may cause the general level of skills to rise in the export sector. This can then lead to a reallocation of resources from the relatively inefficient non-trade sector to the higher productivity export sector. This productivity increase may lead to more output growth.\(^8\) In addition, the outward orientated trade policy may also give a country access to advanced technologies, learning by doing gains, and better management practices, which make it easier to import inputs to meet domestic demand, and enable output expansion. Outward expansion also enables a country to use external capital for development and may assist with debt servicing. Export promotion may also eliminate controls that result in an overvaluation of the domestic currency.\(^9\) Export-led growth keeps the currency exchange low, and makes products more attractive to world markets. Two of the most important aspects of export-led growth are the possible attraction of foreign direct investment and economies of scale; these promote the diffusion of technology and access to large foreign markets.

Export development of certain goods based on a country’s comparative advantage may allow the utilization of economies of scale, which lead to increased growth. This argument is very important – domestic markets are often too small for optimal scale to be achieved while

\(^8\) Ibid., p. 262

\(^9\) Ibid., p. 263.
increasing returns will occur with foreign markets.\textsuperscript{10} The export led growth hypothesis is not the end-all-be-all of development. Export-led growth should be seen as a part and a product of the "industry lifecycle hypothesis." This theory suggests that economic growth is a lifecycle that begins with the export of primary goods. Over time, economic growth and knowledge change the structure of the domestic economy, including consumer demand, which propels the more technology intensive domestic industry to begin exporting. As domestic demand fades, economic growth arises from technologically advanced exports.\textsuperscript{11} This paper proposes that China is following the "industry lifecycle hypothesis" and has just passed through the export-led growth phase – which has provided the PRC with amazing and persistent growth. Export-led growth and an outward-oriented strategy of development may provide greater opportunities and rewards for entrepreneurial activity – which some scholars often argue as being the key to extended growth. Talent is king, as will be illustrated in Part Two of this research.

Support for the export-led growth hypothesis is not universal. Critics point out that one cannot rely solely on the experiences of the East and Southeast Asian countries – these countries may be unique in many ways and other countries may not be able to replicate their success. Also, because the world markets can be volatile, some researchers question whether export-led growth can be sustained over long periods of time. One of the most viable critiques is the possibility of overcrowding – developed markets may not be large enough for more exports from developing countries. The most researched contradictory argument to the export-led hypothesis is the import-substitution theory. This counter-strategy involves more protectionist policies than the export-led model. Policy instruments – tariffs, quotas, and subsidies – are used to substitute domestic output for imports; import-substitution can be implemented without impacts from other

\textsuperscript{10} Ibid., p. 263.
\textsuperscript{11} Ibid., p. 263.
economies and the benefits to increased employment and output are immediate.\textsuperscript{12} This strategy fosters domestic firms instead of foreign firms — however, this strategy does not cultivate technological diffusion, comparative advantage (specialization), or attract FDI. Import-substitution is often promoted because it can help develop a variety of industries — export-led strategies may only result in a select number of industries, which may lead a country to be stuck producing goods from which the economic gains have been exhausted.\textsuperscript{13} The use of tariffs can benefit a country with a comparative disadvantage in key sectors and lead to greater growth. Some scholars even contend that both import-substitution and export-led strategies may be complementary; the former may be a necessary prerequisite for the latter.\textsuperscript{14} Nonetheless, export-led growth is easier to implement early in a nation’s development; after significant gains have been made, such nations can shift toward a domestically oriented approach — such as innovation-led growth — successfully entering an elevated stage of development.

There is also potential for a Growth-led export model — in which other factors aside from exports are responsible for output growth. Economic growth, generally, leads to enhancement of skills and technology; this increased efficiency creates a comparative advantage for the country that smooths the progress of exports. The literature on export-led growth is as mixed as the theoretical paradigms.

\textit{Literature Review}

In the 1960s scholars began to place stress on an initial competitive advantage due to an undervalued exchange rate or to low labor costs. From then on scholars began to view exports as the beginning of a virtuous cycle. Successful preliminary statistical research on exports and development set in motion a series of empirical studies which have either confirmed the export-

\textsuperscript{12} Ibid., p. 264.
\textsuperscript{13} Ibid., p. 264.
\textsuperscript{14} Ibid., p. 265.
led growth hypothesis or found that there was no relationship between these two variables. In addition, many development scholars have found several problems with empirical models — forcing scholars to look beyond correlation and into causality.

Between 1977 and 1978, Michael Michaeley, Bela Balassa, Peter S. Heller, Richard C. Porter, and many others began to use empirical models to actually test the modern-day export-led growth hypothesis. Many of the preliminary experiments found statistically significant evidence that ELG did in fact correlate with GDP growth or GDP per capita growth. However, several things must be kept in mind: (1) exports themselves are a part of Gross Domestic Product (or Gross National Product depending on the data of the study) and thus a positive correlation of the two variables is almost inevitable, whatever their true relationship; and (2) the first empirical studies were mostly correlative not causative, thus growth may also cause an increase in exports — causal directionality cannot be judged from these first preliminary studies.\textsuperscript{15} Michaeley found a positive association of growth with export expansion.\textsuperscript{16} Heller and Porter used non-export output growth rate data and tested it against exports; this was to eliminate the first empirical issue noted above. This study also split the sample of developing countries into “rich” and “poor” DCs. These authors found that export and non-export-output growth rates are most highly correlated — and only significantly correlated — for the relatively rich DCs with low export shares. For poor developing countries, higher growth rates of exports did not mean lower growth rates of domestically produced output for internal final demand. Thus, while exports did not produce higher non-export output growth, they also did not hurt the economy as import-substitution scholars would have predicted. The most renowned economist in development economics


literature on export led growth was Bela Balassa; his research in the 1970s and his position at the World Bank, helped the export-led growth hypothesis make its way into mainstream development policy.

Balassa’s sample consisted of Korea, Singapore, Taiwan, Yugoslavia, Israel, Argentina, Brazil, Colombia, Mexico, Chile, and India. Korea, Singapore, and Taiwan adopted export-oriented policies at an early stage of development; they provided essentially free-trade treatment to exports and granted some additional subsidies which equalized, on the average, incentives to exports and to import substitution. Israel and Yugoslavia started early in development with export promotion but these nations’ efforts slacked somewhat afterwards. Argentina, Columbia, Brazil, and Mexico continued further with import-substitution and provided export incentives from the mid-sixties on – in addition, these countries did not generally ensure exporters free access to imported inputs. Finally, Chile and India pursued inward-oriented policies; these nations had weak export promotion policies, if any. Balassa’s period of investigation was between the years 1960-1973 and he employed Spearman rank correlation coefficient (A non-parametric measure of correlation – no empirical assumptions about the sample distribution must be made. Pearson’s R correlation is the parametric counterpart), which was also employed by Michaely. According to his results, Korea’s GNP would have been 37% smaller if its export growth rate equaled the average for the countries in the sample. The corresponding proportion was 25% for Taiwan. At the other extreme, in Chile, India, and Mexico, respectively, the increase in GNP would have been 14%, 12%, and 8% greater if these countries had average export growth rates. Thus, Balassa’s results point to the fact that trade orientation was an important factor contributing to inter-country differences in the growth of incomes. It was also apparent that increased GNP had been achieved at a substantially lower cost in terms of domestic
investment for countries that followed a consistent export orientation policy. Balassa was one of the first development economists – who worked at the World Bank at the time – to find and promote evidence on the benefits of export-orientation as compared to policies oriented toward import-substitution.\(^{17}\) This study encompassed most of what the 1970s research on ELG had to offer.

In 1983, Gershom Feder found evidence supporting the view that "...the success of economies which adopt export-oriented policies is due... to the fact that such policies bring the economy closer to an optimal allocation of resources... on average there are substantial differences in marginal factor productivities between the export and non-export sectors. These differences derive in part from the failure of entrepreneurs to equate marginal factor productivities are in part due to externalities. The latter are generated because the export sector confers positive effects on the productivity in the other sector, but these are reflected market prices."\(^{18}\) Thus, social marginal productivities are higher in the export-sector and economies that shift resources into exports will gain more than inward-oriented economies – there are substantial gains to be made due to externality effects.\(^{19}\) Almost all of the studies based on correlation presented evidence for the export-led growth hypothesis. However, in 1985 Woo S. Jung and Peyton J. Marshall conducted the first causality based study, which paved the way for the ongoing debate which is still enduring today.

Jung and Marshall understood that all the past studies in export-led growth relied on international cross-sectional evidence. Almost all of them regressed a growth variable on a contemporaneous export variable. None had considered the direction of the causal relationship


\(^{19}\) Ibid., p. 60.
between exports and growth. The previous evidence was definitely in favor of a relationship, but which causes which – does increased exports cause growth or does increased growth cause exports? Thus, an equally plausible hypothesis is that output growth causes export growth. For example take a growing economy where learning and technical change are proceeding rapidly in a few industries. The learning and technical changes that are taking place may have very little to do with conscious government policy to promote exports or even to promote production in those industries. It may be more related to the accumulation of human capital, cumulative production experience, technology transfer from abroad through licensing or direct investment, or physical capital accumulation. Thus, important primary causal factors behind this unbalanced growth may be unrelated to any special export promoting incentives and may foster growth even in the absence of such incentives.\textsuperscript{20} Jung and Marshall were the first to use Granger-Causality, which is a statistical model which argues that the ability of a variable (X) to improve the prediction of a variable (Y) is an operationally meaningful interpretation of the statement that X causes Y. The authors find that when using causality models, the export-led growth hypothesis fails to provide evidence that exports cause growth – at least in the same strength as cross country correlation data. Out of the entire sample of 37 countries only Indonesia, Egypt, Costa Rica, and Ecuador passed the causality test from export growth to output growth and had export growth coefficients that were significantly positive. In addition, fewer countries supported the export promotion hypothesis than supported the export reducing hypothesis (reduced exports leads to increased growth). Even more interestingly, many of the countries which were most famous for the miraculous growth rates that appeared to arise from export promotion policies – i.e. Korea,

Taiwan, and Brazil – provided no statistical support for the export promotion hypothesis.\(^{21}\) Jung and Marshall’s conclusions went against all the prior research—their time series results for 37 countries provided evidence in favor of export promotion in only four instances — Indonesia, Egypt, Costa Rica, and Ecuador — this strongly suggests that the evidence in favor of export promotion was weaker than previous statistical studies had indicated.\(^{22}\) In 1987 Peter C.Y. Chow used a different model of causality and found very different results.

Chow used Sims’s econometric model of causality. According to Sims, one can regress Y on past and future values of X, and if causality runs from X to Y only, future values of X in the regression should have coefficients insignificantly different from zero, as a group.\(^{23}\) Using this model, Chow was able to find that, “... for most of the small open economies like Hong Kong, Israel, Korea, Singapore, and Taiwan, the development of manufacturing industries and export growth have reciprocal causal relationships... they are mutually interdependent in the development process... export growth in these countries can expand their limited domestic markets, and contribute to the economies of scale necessary for industrial development.”\(^{24}\) These two studies were the building blocks of the debate which is still going on today. In the 1990s and 2000s statistical models continued to get more complex and results continued to produce a dichotomy.

In 1990, Tain-Jy Chen and De-piao Tang studied export performance and productivity growth for the country of Taiwan. Their theoretical bases rested on the belief that, “As exports expand, both the resource reallocation effect and externality effect lead to an economy-wide

\(^{21}\) Ibid., p. 10.
\(^{22}\) Ibid., p. 11.
\(^{24}\) Ibid., p. 60.
productivity increase.”25 They take the argument farther and add that, “competition forced individual firms to reduce their managerial slack and to operate in a more efficient manner. More efficient operations mean higher productivity.”26 The authors demonstrate that in the case of Taiwan’s manufacturing industry both output and export growth are correlated with productivity growth — however, output growth can better explain productivity growth. They found that, “...except for one industry, when the scale of output is held constant, export growth shows no significant impact [causality] on productivity. We presume that exporting forces firms to operate in a more competitive environment, which is conducive to productivity growth. However, exporting to foreign markets requires adjustments in the whole chain of the production process, from product design to after sales service. This imposes an extra burden on production costs and... is detrimental to productivity growth.”27 Nonetheless, export growth and output are highly correlated and output was definitely shown to correlate highly with productivity. Regardless, as the authors concede, “...simply saying that a country that performs well in exporting also achieves an impressive record of economic growth does not convey much information.”28 The authors also find that economies of scale are necessary for economic growth because “scale economies are a reliable factor in explaining the productivity growth... The relatively small size of Taiwan’s domestic market makes expansion into the overseas market indispensable if scale economies are to be exploited. This implies that export growth is also correlated with productivity growth.”29 While no casual impact was demonstrated, the author’s data still found a correlation.

26 Ibid., p. 578.
27 Ibid., p. 583.
28 Ibid., p. 583.
29 Ibid., p. 583.
In 1992, Dalia Marin – an innovator in development economics – set out to perform a causal inspection of exports and productivity in developed market economies – she finds that two variables move together; countries which do well in their export performance seem also to well in their productivity performance and vice versa.\(^{30}\) However, her research goes further and attempts to find a causal link. She uses empirical data from the United States, Japan, United Kingdom, and Germany and takes the cointegration and causality approach called “Granger Causality.” This statistical analysis allows for the study of whether exports and productivity share a common trend so that they can be considered a long-run equilibrium relationship which holds for a stationary stochastic error (short-run deviations).\(^{31}\) Hence, this study comes very close, empirically, to testing whether exports predict movements in productivity. Previous attempts to examine this relationship were based on cross country correlations between exports and GDP. However, correlations are not very informative – this study attempts to find a real casual link and it was exceptionally important to the literature. She concludes, “... that the hypothesis of export-led growth cannot be rejected for the United States, Japan, United Kingdom, and Germany. An ‘outward looking’ regime seems to favor productivity performance of developed market economies as well and seems, therefore, not to be restricted to developing countries only as commonly asserted.”\(^{32}\) Her research also found that the exchange rate is extremely important to the export-led growth hypothesis. She states, “... the positive long-run relationship between the terms of trade and productivity, and the significant causal link from the terms of trade to productivity in the United States and the United Kingdom suggests that the terms of trade (the real exchange rate) has mattered for the productivity performance in these two


\(^{31}\) Ibid., p. 678.

\(^{32}\) Ibid., p. 686.
countries." The exchange rate played an important role in several different ways. Either through devaluations of the real exchange rate boosting productivity via exports, or through revaluations of the real exchange rate improving productivity through rationalization of production of the import competing at the disadvantage of the export sector. The real exchange rate was negatively correlated with productivity growth – as the exchange rate decreased, productivity increased. Lastly, world output proved to “Granger Cause” productivity independently of exports in all countries except the United States – this may have been an indication of international increasing returns to scale in which productivity depends on the size of the world market rather than the domestic market – this would lend support to the export-led growth model and the necessity to seek out economies of scale – as China has successfully done since 1978. While most of the literature has focused on statistical relationships between exports and growth, other studies have examined the negative impact of export shocks.

In 1992, Edward F. Buffie analyzed the impact of economic shocks on export-led strategies. One of the very real threats to an export-led economy concerns the potentially adverse effects of a booming natural resource based export sector – this is often called the Dutch Disease phenomenon. The Dutch Disease literature focuses on a special case – the impact of a rise in export revenues from an inelastically supplied, resource intensive product that uses little capital or labors and is not consumed domestically. This phenomenon tends to make de-industrialization, not aggregate growth, a principal concern. Buffie studies what conditions will produce export-led growth when the main export is a natural resource. The author finds that a sufficient condition for a resource discovery to produce strong export-led growth is that the

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33 Ibid., p. 686.
34 Ibid., p. 687.
importable sector be the most labor-intensive sector in the economy.\textsuperscript{35} In other words, a nation is importing manufactured goods with the capital derived from natural resource exports. If the importables sector is the most capital-intensive sector in the economy, the cost share of labor in the import sector will be smaller than in the export sector, and then a resource discovery will produce weak export-led growth, at best.\textsuperscript{36} In other words, if the nation is importing expensive non-labor intensive goods, and their export sector is natural-resource concentrated, there will be low export-led growth. However, if the export sector is capital intensive compared with the import sector in a value sense then a resource discovery produces strong export-led growth. In other words, if the export sector is made up of expensive non-labor intensive goods and the country exports huge amounts of natural resources, export-led growth will be high. And, in a Dutch Disease economy resource discovery produces strong export-led growth if and only if the non-tradables sector is capital intensive relative to the tradables sector.\textsuperscript{37} Another important finding was that a sufficient condition for a resource discovery to produce at least real export-led growth is that the cost share of labor in the import sector exceeded that in the export sector – however in a Dutch Disease Economy, a resource discovery will always produce at least weak export-led growth. This study is important because it illustrates that not all export-led growth will produce good economic growth. Countries which export mostly natural resources may not reap the benefits of long-term economic growth suggested earlier in this paper – i.e. these countries may not attract FDI and thus, they may not reap the benefits of technological diffusion. This paper takes the stance that natural resource exports are not beneficial to the long-term growth of developing nations. In fact, large amounts of natural resource exports will lead to

\textsuperscript{36} Ibid., p. 218.
\textsuperscript{37} Ibid., p. 219.
deindustrialization. Examples of this can be found in several Middle Eastern and African Nations, that have large oil production and a small domestic manufacturing economy. Saddam’s Iraq and post-Saddam Iraq is a perfect example. Also, a country which focuses on natural resource exports may be more inclined to feel shocks from price changes on the international market – China has avoided the Dutch Disease; but they are still feeling the effects of a slowdown in global demand. Aside from studies which empirically test the export-led growth hypothesis with data from many countries, there are many analyses which concentrate on the export-led growth model for one country – both empirical and non-empirical case studies.

In 1996, Andrea Boltho examined the country often argued to be the archetype for the export-led growth model – Japan. Essentially, Japan’s exceptional economic record this century raises the obvious question of whether growth and exports were primarily propelled by domestic economic and institutional factors or were driven, instead, by external forces. The same question is being asked of China’s exceptional performance presently. Recent focus on the export-led growth model considers openness to external trade as crucial for growth. Foreign competitive pressures improve resource allocation, impose technological progress and managerial efficiency, stimulate adaptability, promote scale economies, and generate externalities for other sectors particularly via skill formation. Boltho found that the export-led growth hypothesis would, “... seem to be rejected for both 1913-37 and 1973-90... only seldom did the country experience an under-valued exchange rate and, through most of the period, it suffered a 'wrong' pattern of specialization. Conversely it benefited from a very rapid growth of domestic demand, from elastic supplies of both labor and capital, from a high degree of internal competition in manufacturing, and... export-promotion policies. Indigenous forces were clearly more than

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sufficient to account for Japan’s exceptional growth record.”39 Thus, Japan’s rate of growth in exports has been high because of the high rate of growth of the domestic economy – not vice versa. Boltho also believes that rapid growth of Japan sparked the “animal spirits” that drove the economy to even more rapid success. Early studies found overwhelming support for the export-led growth hypothesis – but more causality based empirical studies found little to no evidence that exports produced economic growth.

In 1996, Irene Henriques and Perry Sadorsky, studied the export-led growth model for Canada. They wanted to find out if rapid income growth leads to rapid trade expansion, or if it happened the other way around. This study undertook a systems cointegration analysis and examined Granger Causality tests – they used two subsamples for Canada: the period between 1877 and 1945 and the period between 1946 and 1991. Their results favored the one-way Granger causal relationship that suggests that the growth rate of GDP influences export growth. Changes in growth preceded changes in export growth or reduction.40 This study concluded the same thing as Boltho’s study on Japan – it seems that economic growth precedes export growth – at least for Japan and Canada.

As time progressed, developing countries began to utilize export promotion policies to pump up growth, regardless of the empirical data. Recent causality studies have had three outcomes: (1) increased exports causes increased growth; (2) increased growth causes increased exports; and (3) a two-way causal result which is a combination of the first two.41 Shan and Sun used a six-variable vector autoregression (VAR) model on the basis of quarterly time series data in a production function context. In essence, this study was another Granger Causality test –

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39 Ibid., p. 430.
specifically based on Toda and Yamamoto’s 1995 model – to show that out of the sample of Hong Kong, Taiwan, and Korea, only in Taiwan had export-led growth “granger-caused” economic growth. This study did not support the export-led growth hypothesis – and the authors also note that the results of causality models are often a byproduct of the model used; different models continue to produce different results, and thus, the debate continued. Study after study has produced different results. However, the most important literature has come about in the last seven years. The effects of the export-led growth strategies, positive, negative, or neutral, will be revealed in the current data. In addition, modern studies have often focused on one country, illustrating how export-led growth strategies have impacted different countries in several diverse ways.

The Modern Literature – From 2000-Present:

In 2001 Panos C. Afxentiou and Apostolos Serletis used Granger Causality to find that export growth policies are not instrumental in the stimulation of GNP growth, nor are GNP growth policies necessarily effective in fostering economic growth for 17 industrial countries between the time periods of 1950-1985. While this data is not current, nor on developing countries, it does present a very important finding: these authors illustrate that developing countries – such as the U.S., United Kingdom, Finland, Denmark, Canada, Spain, Germany, and many more – did not need export-oriented policies to obtain economic growth. The authors believe that, “export growth is not the magic key to GNP growth and that many of the secrets of growth continue to be hidden among numerous imponderable forces, refusing to reveal themselves in a straightforward quantifiable manner, as desired by economists.”42

One of the most powerful studies was undertaken by Emilio J. Medina-Smith, for the United Nations Conference on Trade and Development in 2001. Medina-Smith concentrated his research on Costa Rica and used an error correction model of cointegration – specifically a Granger Causality model which corrects for common statistical errors which confuse long-term vs. short term data. He found that, “the evidence indicates the strong correlation between the series is not spurious as many empirical studies have found it to be and that the co-movement between these variables reflects much more than an accounting identity. Additionally, the existence of cointegration between export and output through different tests justifies the application of the error correction approach. In fact, both methods... make it possible to distinguish between short-run and long-run effects of exports on growth but also allow further checking for cointegration... The first and most obvious answer is that exports can explain not only cyclical changes and output (short-term) but also the long-term trend of output.”

Titus O. Awokuse, in 2003, recently confirmed the export-led growth hypothesis for Canada, finding “evidence in support of the ELG hypothesis... changes in real exports precede changes in real GDP.”

One of the most recent empirical studies was performed in 2005 by Jim Love and Ramesh Chandra. These authors studied export-led growth in South Asia. The purpose of their study was to test the export-led growth hypothesis for Southeast Asia – including countries such as India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, and Maldives. Their empirical form was, again, a cointegration and error correction model (following Granger Causality), using data

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from the International Financial Statistics of the IMF. Their findings were mixed. First, they did not find any conclusive evidence in favor of export-led growth. India, Maldives, and Nepal exhibited export-led growth; however, Bangladesh and Bhutan showed the opposite result. In Pakistan and Sri Lanka there was no causality found in either direction. These results were very similar to the history of the empirical literature – diverse.45 One of the most recent case studies explores – arguably one of the most successful export-led countries – South Korea and its transformation from a severely poor developing country, to a highly successful industrial powerhouse in technology and other important sectors.

The Korean economy has shown very rapid economic growth for the past four decades with the exception of the period of the economic crisis during 1997-1998. As a result, per capita gross national product (GNP) increased from less than $100 U.S. dollars in 1960 to over $14,000 in 2004.46 Mah believes that the period of rapid economic growth was, in general, accompanied by rapid export growth, which was made possible by active export promotion policies, especially in the early phase of economic development. Korea is often used as an example of rapid economic growth through the export-led growth strategy. In 1964, the government of Korea decided to pursue export promotion policies with the slogan, “Export Number One.” In other words, exports were their number one priority. In the early stages, the government placed emphasis on exports of labor intensive products – i.e. light industries, led primarily by the textiles and clothing industry, in which the Korean economy had a comparative advantage in international trade. Another seriously important aspect of their export promotion strategy was exchange rate devaluation – which contributed to increased exports as well. For instance, in 1961

the exchange rate which was fixed at 65 won/$1 was changed abruptly to 130 won/$1 and again to 255 won/$1 in 1964.\textsuperscript{47} In 1965 the Korean government chose the following light industry products as those appropriate for export-led industrialization: raw silk, cotton fabrics, plywood, leather, craftwork, potteries, rubber products, radio and electric appliances, fisheries and mushroom cans, wood products, and clothes.\textsuperscript{48} These products were carefully chosen based on their effect on the balance of payments, employment, and the linkage with other industries – they also represented the level of economic development of Korea at the time. In addition to various taxation and financial measures to promote exports, the government established institutions to support export promotion such as the Korea Trade and Investment Corporation (KOTRA) to develop foreign markets and the Korea International Trade Association (KITA) to maintain training parameters, research activities, and exhibitions, among others.\textsuperscript{49} The Korean Institute of Science and Technology (KIST) was established in 1966, which helped to establish the advanced technology sector. And the Export Promotion Fund was established in January of 1969, with the sole purpose of promoting exports. In 1967, Korea became a contracting party to the General Agreement on Tariffs and Trade and thus earned the most favored nation status in the global trading system. However, South Korea did not just sit back and continue along the light industry path.

As South Korea began to industrialize they also began to shift their industrial policy from light industries to high value-added heavy and chemical industries. The government chose iron and steel, non-ferrous metal, shipbuilding, electronics, and chemical industries as the most important of the value-added heavy and chemical industries.\textsuperscript{50} The National Investment Fund

\textsuperscript{47} Ibid., p. 154.
\textsuperscript{48} Ibid., p. 154-155.
\textsuperscript{49} Ibid., p. 155.
\textsuperscript{50} Ibid., p. 155.
(NIF) was then established in 1971 to support the new heavy industry exports. The share of heavy industries in all industries increased gradually from 23 percent in 1960 to 39 percent in 1970 to 54 percent in 1980. Overall, the spectacular economic growth of Korea in the 1960s and 1970s was accompanied by rapid export growth. In 1981, the government began emphasizing the importance of research and development (R&D) by establishing the Fifth Five Year Economic Development Plan, which continued along the export-led growth strategy. In the 1990s, taking into account the increasing importance of capital goods in economic development, the government promoted capital goods industries, thus establishing them as the main export industries for the 21st century.\textsuperscript{51} In 1995 the Capital Goods Industries Promotion Plan was announced. It was expected to promote the high value-added capital goods industries by supporting the development of new products and establishing these capital industries as the main export industry. The government currently promotes exports by supporting international marketing activities and exhibitions abroad.\textsuperscript{52} This case study is extremely important because it can be argued that China has followed a similar pattern of development; and currently China is in the final phase of export-led strategies and shifting toward research and development and innovation based growth strategies. Essentially, Mah's conclusion was that, "During the period of rapid economic growth, the Korean government adopted various export promotion measures, including taxation and financial incentives, as well as provision of necessary infrastructure. In the 1980s, the government gradually switched its policy from direct subsidization of selective industries to function-oriented support, such as general support for R&D activities."\textsuperscript{53} This paper takes the stance that China has followed a very similar pattern of development; however, they are currently involved in a deliberate shift from export-led growth to Innovation-led, Talent-led, and

\textsuperscript{51} Ibid., p. 156.
\textsuperscript{52} Ibid., p. 157.
\textsuperscript{53} Ibid., p. 165.
R&D-led growth. Currently, companies such as Samsung are dominating the Korean R&D sector and high technology export sectors – inevitably leading to innovation-led growth. The last empirical study discussed here employs an entirely new experiential model – the bounds testing approach – and it finds strong evidence for export-led growth.

In the Spring of this year, Mohsen Bahmani-Oskooee and Maharouf Oyolola used a bounds testing approach, which found that, “Countries that are more export oriented such as those in Asia, have enjoyed relatively more economic growth, a pattern that is in line with economic theory but at odds with empirical research... The results reveal that in a majority of the countries... there is a short-run effect between export-growth in both directions. However, the short-run effects translate to the long-run in only 60% of the countries in which the export-led growth hypothesis is supported and in 40% of the countries in which output-led exports hypothesis is supported.”\textsuperscript{54} It can be seen from this literature review that the empirical research is mixed – the debate continues to grow and new models are constantly developed. Not only has the literature on the export-led growth strategy been examined, but empirical models of causality have been put to test by many different scholars utilizing many different data sets. Nonetheless, case studies – such as Jai Mah’s article on Korea – illustrates that a country can grow by practicing the export-led growth strategy. The next section of this paper examines China and its use of export-led growth strategies to attain massive amounts of economic growth. However, this paper also sets out to show that, currently, China is shifting from an export-led growth strategy and into an innovation-based or R&D-based model of growth.

Export-Led Growth and China’s Rise to the Top

China’s economic development has in many ways taken the world by storm, and no part of the country has been left unaffected. In 1978, after years of state control of all productive assets China embarked on a major program of economic reform. In an effort to awaken a dormant economic giant, it encouraged the formation of rural enterprises and private businesses, liberalized foreign trade and investment, relaxed state control over some prices, and invested in industrial production and the education of its workforce. By nearly all accounts, the strategy has worked spectacularly. While pre-1978 China had seen annual growth of 6 percent a year (with some painful ups and downs along the way), post-1978 China saw average real growth of more than 9 percent a year with fewer and less painful ups and downs. In several peak years, the economy grew more than 13 percent. Per capita income has nearly quadrupled in the last 15 years, and a few analysts are even predicting that the Chinese economy will be larger than that of the United States in about 20 years. Such growth compares very favorably to that of the "Asian tigers"—Hong Kong, Korea, Singapore, and Taiwan Province of China—which, as a group, had an average growth rate of 7-8 percent over the last 15 years. The most obvious contributor to China’s growth is their liberal reforms. Prior to the 1978 reforms, nearly four in five Chinese worked in agriculture; by 1994, only one in two did. Reforms expanded property rights in the countryside and touched off a race to form small nonagricultural businesses in rural areas. Decollectivization and higher prices for agricultural products also led to more productive (family) farms and more efficient use of labor. Together these forces induced many workers to move out of agriculture. The resulting rapid growth of village enterprises has drawn tens of

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millions of people from traditional agriculture into higher-value-added manufacturing.\textsuperscript{56} Reforms continued from there. It can be seen that economic openness or freedom leads to economic productivity – the Heritage Foundation and their \textit{Index of Economic Freedom} have researched the link between economic freedom and economic productivity – the results are clear – there is a significant correlation between economic openness and economic productivity – part of this link has to do with export promotion and openness. \textsuperscript{57}

Many attempts have been made to explain the sources of this rapid, yet uneven, development, with specific concern for this export-economic growth relationship. The basic empirical question has been whether economic growth is driven by exports as suggested by the Export-Led Growth Hypothesis (ELG) – as discussed earlier in this paper. The relationship between export expansion and economic growth depends on the economic structure and the level of development. Christer Ljungwall has written the best article thus far on ELG and China – on the provincial level. His research includes exports as a control variable, and studied 27 of China’s 31 provinces over the years of 1978 to 2001. His paper attempted to uncover the long-run relationship and the direction of causality between exports and growth. On the surface, China fits the export-led growth model fairly well. They have had amazing growth in exports since the beginning of their reforms in 1978. They have also attracted enormous amounts of FDI and this has created intense technological diffusion – leading to technological change and the creation of a large and desired talent pool. This has allowed them to reallocate resources more efficiently and improve the quality of their products. The rapid growth in employment and real wages are due to increased competition from abroad. However, economic growth may be the cause of exports – not the other way around. This happens when domestic markets become well

\textsuperscript{56} Ibid., p. 5.
developed and higher productivity lowers unit costs and leads to export expansion. Previous empirical studies have been mixed on China's export-led growth. Kwan and Cotsomitis used the standard Granger test for the 1952 to 1985 period and argued in favor of a two-way causal relationship between economic growth and exports. Kwan and Kwok, using the same time period, examined the endogeneity assumptions of the export growth variable in an output growth equation and found instead a one-way causality from exports to economic growth. Their findings support the ELG hypothesis. Lee used a regional growth model in which exports, foreign direct investment, and initial levels of national income by province were used to explain provincial output growth and concluded exports contributed significantly to growth in China between 1984 and 1990. Xue also finds a positive relationship between exports and growth in the reform period, which he views as evidence that the ELG model can be applied in a large developing country setting. Shaun and Sun found a two-way causal relationship between exports and real industrial output, but since a feedback effect was found within the VAR system, the ELG hypothesis had to be statistically rejected. Sun, in 2001, investigated the impact of foreign direct investment on the export performance of China at the provincial level during the 1984-1997 periods. His results suggest that the impact of FDI on exports varies across regions according to the regional economic conditions, the degree of economic openness, and the different market orientation of FDI. Sun concludes that FDI plays a stronger and more significant role in promoting exports from the Eastern Coastal Region than from the Central and Western Regions. There is no real doubt that exports have played a huge role in China's development. Their integration into the global economy has had a significant impact on China's growth.

59 Ibid., p. 111.
60 Ibid., p. 111.
61 Ibid., p. 111.
62 Ibid., p. 111.
Ljungwall’s analysis does support the ELG hypothesis, but only on a weak level. In 13 of the 27 provinces, the results validate the ELG, thus implying a casual relationship running from exports to GDP but not vice versa. This relationship was supported with short-term and long-term causality. However, the results fail to confirm the ELG hypothesis for 14 of the 27 provinces—here there was a relationship running from GDP to exports. In fact, the ELG provinces encompass a geographical cluster covering major areas of the coastal and neighboring provinces. This may be because China has used export-led growth in the coastal regions to create GDP per capita growth in the rest of China. Early in their modern open door policy (1978) the PRC limited economic openness to certain provinces—specifically those closest to nations that desired investment (the coastal provinces). Hence, the unequal distribution that exist in China today, could have been caused by the uneven implementation of liberalization policies.

Despite the empirical evidence, when one compares China to India, it can be seen that China’s growth has been export-led—and that their model has been very effective. China adopted the same export-led growth policies of the successful East Asian economies—South Korea, Taiwan, Singapore, Hong Kong, and Thailand—while India has pursued distinctly laissez-faire policies. The Indian Government has not implemented many “specific” development policies dedicated to exports, import-substitution, or innovation. Instead, India has allowed for a more natural development process as they shifted toward a liberal economy. The East Asian trade paradigm consisted of decisive and immense actions. Purposeful and massive undervaluation of their currency was part of the overall strategy, which while making the ratio of exports to imports higher, provided for simultaneous export growth and import substitution; something not possible in any other models of trade. India’s liberal reforms have resulted in a natural discrimination against the manufacturing enterprises—thus exports have grown more
slowly than otherwise possible for India. The more equal distribution of income in China, and
the difference in the macroeconomic policies explain most of the other observed performance
differences between the two countries on aspects such as inward flow of FDI, investment,
savings, growth of particular industries. The reasons for China’s substantial growth are as
follows: structured undervaluation of the currency, expansionary monetary policy and exchange
rate targeting with only one-way openness to the capital account, if at all.\(^6\) China is an unfair
trading partner – as was South Korea in the case study mentioned earlier. They love to export as
much as possible, but they put up barriers to imports – this is compounded by their blatant failure
to abide by international intellectual property protection. Since 1978, the Chinese policy makers
have been playing the game, of disequilibrium export promotion at great benefit to their
economy. The Chinese economy, starting with a low openness ratio, pressed ahead with their
new “open door policy,” and China became more open than India, and is today significantly
more open than what its structural parameters alone would have determined.\(^6\) When India is
compared to China, it can be seen that India used a hands-off method of natural growth and
China used a forceful export-led growth strategy – much like the South Korean case study earlier
in this paper. The contrast is staggering – as is the difference in performance. Besides China’s
low exchange rates they also implemented institutional mechanisms – such as special export
corporations, export processing zones (EPZs), massive pressure for firms to meet export targets,
tax incentives for transnational corporations, and the massive purchase of land near the coast to
set up EPZs and offshore productions.\(^6\) More importantly, the ELG policy – especially by
China, Japan, and Korea – was influenced by significant policies which sought to restrict

\(^6\) Sebastian Morris, “Understanding Export Led Growth and Late Industrialization to Explain the Difference in the Post Reform
\(^6\) Ibid., p. 4.
\(^6\) Ibid., p. 5.
immediate consumption among skilled and ordinary workers because the wages of such workers tend to rise fairly quickly during the ELG transformation. A delay of consumption spending arising out of current increases in income by as much as three years virtually negates the effect of rising incomes upon inflation and considerably enhances the resources for investment, and helps to realize the benefits of disequilibrium, without, “overheating” the economy.\textsuperscript{66} Only now, as China desires to shift out of ELG, are they desperately trying to increase consumption. According to Sebastian Morris, “On the whole the inflows into China have been of the direct investment variety.”\textsuperscript{67} FDI is one of the most valuable types of inflow because it inspires technological diffusion and knowledge dispersal. China’s amazing feat of becoming one of the world’s top FDI attractors has put its economy on a path of even greater growth – in the realm of 9%-13% annually. Thus, while the empirical research is mixed, it is easy to see that China’s growth was export-led – and the country pursued purposeful strategies to this effect. Since 1978, China has successfully followed and achieved an ELG strategy. But in recent times, the Chinese policy makers have foreseen a global downturn in demand, a weaker dollar, and slowdown in exports. The response has been a shift from an export-led growth model, to an innovation and talent model of growth. The next section of this paper will preliminarily examine innovation-led growth in China; Part Two will fully develop this concept.

\textit{China’s Shift – Innovation not Exports... Eventually}

This paper contends that reforms were first initiated in the coastal regions, closer to nations which required exports, such as Hong Kong and Taiwan, in order to finance growth amongst the rest of China. The long-term plan was to slowly shift away from export-led growth to an innovation-led growth model. This is why the export-led growth on the coastal regions was

\textsuperscript{66} Ibid., p. 6.
\textsuperscript{67} Ibid., p. 10.
accompanied by infrastructure enhancements, technological improvements, and educational advances in science and engineering. Currently, China is in the infant stages of this shift from export-led growth to innovation-led growth. Joseph Stiglitz’s newest article, “The World has Much to Lean From China’s New Economic Model,” states, “Today, China is discussing a “new economic model.” Of course, the old economic model has been a resounding success, producing almost 10% annual growth for 30 years and lifting hundreds of millions of Chinese out of poverty. The changes are apparent not only in the statistics, but even more so in the faces of the people that one sees around the country.”68 China knows that its current growth is not sustainable without drastic changes — these changes range from environmental enhancements, energy consumption, and domestic growth. Stiglitz goes on to state, “Equally interesting, China is attempting to move away from the export-led growth strategy that it and other East Asian countries have pursued. That strategy supported technology transfer, helping to close the knowledge gap and rapidly improving the quality of manufactured goods. Export-led growth meant that China could produce without worrying about developing the domestic market.”69 China has been engaged in what might be called “vendor finance,” providing the money that helps finance the huge U.S. fiscal and trade deficits, allowing Americans to buy more goods than they sell. But this is a peculiar arrangement: a relatively poor country is helping to finance America’s War in Iraq, as well as a massive tax cuts for the richest people in the world’s richest country, while huge needs at home imply ample room for expansion of both consumption and investment. This process is a direct result of the current international currency reserve system. China buys up U.S. bonds in order to build up their currency reserve to hedge against another East Asian currency crisis. Stiglitz has been a staunch critic of the reserve system and believes

69 Ibid.
that the PRC is actually inhibiting their development through their participation. The last part of
the puzzle is getting Chinese people to spend, rather than save. Stiglitz writes, "... to meet the
challenge of restructuring China’s economy away from exports and resource-intensive goods,
China must stimulate consumption. While the rest of the world struggles to raise savings, China,
with a savings rate in excess of 40%, struggles to get its people to consume more."70 China has
done this by providing better social services (public health care, education, and nation-wide
retirement programs), which reduce the need for "precautionary" savings. More access to finance
for small and medium sized businesses is helping too. And, "green taxes" – such as on carbon
emissions – would shift consumption patterns while discouraging energy-intensive exports.71 As
China moves away from export-led growth, it will have to look for new sources of dynamism in
its growing entrepreneurial ranks, which requires a commitment to creating an independent
innovation system. China has long invested heavily in higher education and technology; now it is
striving to create world-class institutions. These institutions will create world-class talent – this
talent will drive the next phase of China’s development – making it strong in-and-of-itself – not
dependent on U.S. consumption. Stiglitz also states, "But if China wants a dynamic innovation
system, it should resist pressure by Western governments to adopt the kind of unbalanced
intellectual property laws that are being demanded. Instead, it should pursue a "balanced"
intellectual property regime: because knowledge itself is the most important input in the
production of knowledge, a badly designed intellectual property regime can stifle innovation – as
has been the case in America in some areas."72 China’s amazing growth stems in part from their
gigantic labor reserve – something the West does not have. So it makes sense for China to focus
its scientific prowess on new technologies that use fewer resources. But it is important to have an

70 Ibid.
71 Ibid.
72 Ibid.
innovation system (including an intellectual property regime) that ensures that advances in knowledge are widely used. That may require innovative approaches, quite different from intellectual property regimes based on privatization and monopolization of knowledge, with the high prices and restricted benefits that follow. This paper disagrees with Stiglitz, however, and argues that the PRC needs a powerful intellectual property rights regime to inspire innovation-led growth domestically. Entrepreneurs in China must feel comfortable that their innovations will be protected; otherwise the best talent will migrate to nations that will provide them with the proper protection. Nonetheless, recent empirical research confirms Stiglitz's postulation, and shows that because of China's shift—which has been occurring for the last few years—the global demand slowdown will not hurt Chinese growth.

Jonathan Anderson's article, "Is China Export-Led" in UBS Research's Asian Focus, states, "...the estimated domestic content in traditional light manufacturing sectors is two to three times higher than for electronics, even after accounting for a trend increase in the latter figure over time. And this helps to explain why the rise in the actual export share of the economy has been much less than the increase in the headline export/GDP ratio; China has been shifting from goods with a high domestic content in favor of new export sectors with a much bigger imported share."73 In addition, rising domestic supply has been displacing import suppliers, reducing the exposure to the global economy. Anderson is essentially arguing that the PRC is still an export led-economy, but is moving toward higher value goods. This is occurring while consumers in the nation are purchasing domestic goods shielding China from higher prices abroad. Thus, while China is currently shifting to an innovation based economy, the shift is still in its infant stages. China is still using the export-led growth model and it can be easily be seen by the effects that the U.S. sub-prime crisis and weak dollar on Chinese exports. Thus, there is

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still recent evidence that China is still pursuing export-led growth, and the global demand downturn is taking a toll.

*Export-Led Growth Can Hurt – Especially When Global Demand Falls*

The American housing downturn has recently entered a more dangerous phase: “one in which the construction disorder deepens, price declines accelerate and wealth effect of falling prices begins to change consumers’ behavior.” The problem will be intensified by a sharp credit crunch – which is obviously getting bigger. Oil prices have also led analysts to believe that a recession is on its way. Since August oil prices have risen 25%. These factors have led to America’s first consumer-led downturn in two decades. The housing recession has been a builder’s bust – and will not lead to a recession all by itself. Most post-war construction busts have been followed by a recession, but only because they were triggered by tighter monetary policies to head off inflation – however, right now the fed is still entertaining cutting of interest rates and is not pursuing tighter monetary policies. In addition to housing, consumers have been taking in more debt for decades as more people have access to more credit. The ratio of household debt to disposable income is now above 130%. More importantly, the credit expansion was made possible by higher housing prices – this no longer exists. Housing prices are falling and credit conditions are tighter. To make things worse, more than 2 million subprime borrowers face markedly higher mortgage payments over the next 18 or so months as their interest rates are adjusted to new levels. Foreclosures will be prominent. The biggest reason for a recession is the fact that these problems discussed above will lead to a consumer spending downturn – and this will be amplified by the credit crunch. Recent research shows that, “…changes in America’s housing wealth affects their spending more than similar changes in

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75 Ibid.
their financial wealth... A $100 fall in financial wealth is traditionally associated with a $3-5 decline in spending. An equivalent fall in housing wealth, it seems eventually reduces spending by $4 and $9.”

A drop in housing prices will cause a drop in consumption growth – consumer spending would slow by almost two percentage points. These circumstances of decreased consumer spending will inevitably lead to a lower percentage of imports – especially from China. A weaker dollar will lead to more U.S. exports abroad – and while it may stay off a recession – China will still be damaged by weaker export output.

The Economist has recently been reporting on America’s weaker economy. The Economist writes, “China and others are putting a smaller share of increases in reserves into the American currency. And Asian and Middle Eastern countries with currencies linked to the dollar are facing rising inflation, but falling American interest rates make it harder to tighten their own monetary policy. They may have to let their currencies rise against the sickly greenback, meaning they will need to buy fewer dollars. More important, as international investors wake up to the relative weakening of America’s economic power, they will surely question why they hold the bulk of their wealth in dollars. The dollar’s decline already amounts to the biggest default in history, having wiped far more off the value of foreigners’ assets than any emerging market has ever done.”

China’s weakness in consumption and loss of exports has signaled some slowdown in their overall growth. The Wall Street Journal Reports, “The latest statistics also show that consumer spending is accounting for a smaller share of Chinese economic growth this year than last, and the dependence on exports has increased. Stronger consumption would help address trade imbalances and increase the chance of China playing a bigger role in helping sustain the

76 Ibid.
world's economic expansion.” 78 Usually when U.S. growth weakened the developing world seemed to be on the verge of collapse – China most affected. However, because of China’s shift from export-led growth, they seem to be only slightly affected. The same article stated, “Previously, when the U.S. would falter, we would see that global growth would evaporate. It seems that there's a little more of a chance of growth being sustained right now... The U.S. is somewhat less important than it was half-dozen years ago because of the dramatic growth of Asia.” 79 China has proven to the world that it can grow fast, but can it grow differently and, ultimately, grow smarter? U.S. Treasury Secretary Henry Paulson said in a speech, "Bold structural policies are needed to shift China's growth away from heavy industry, high energy use and dependence on exports." 80 The Chinese government has responded to this need and has announced that they are creating structural shifts in their economy. Mr. Li Xiaochao, China's head of the National Bureau of Statics, said “preliminary estimates show consumer spending has accounted for 37% of China's economic growth so far this year.” 81 Yet that means consumption is actually becoming relatively less important: It contributed 39% to growth in all of 2006, according to figures previously published by his bureau. And China's dependence on exports, which accounted for 21.4% of economic gains in the first nine months of 2007, as well as on investment, which contributed 41.6%, has increased. 82 The relatively large role of exports, and the relatively smaller role of consumer spending, in China's economy is one reason why its growth hasn't become more of a driver of activity elsewhere. China's construction boom has benefited the world's producers of raw materials and heavy equipment, but its consumers don't buy many other goods from overseas. Essentially, the ELG has put them at a disadvantage in

recent times of global demand shift because they have become too reliant on U.S. and other
developed nations’ consumption. The “decoupling theory” – the notion that the developed world
has lessened their reliance on the developed for exports – has been debunked as the U.S.
slowdown has caused the rest of the world to slow down. The PRC Government understands that
the nation must move away from export-led growth to strengthen their domestic economy and
create sustainable and steady economic growth.

On November 15, 2007, China’s commerce minister warned that a slowing U.S. economy
would trigger a drop in Chinese exports that would mark a “turning point” for China’s rapid
economic growth.83 Exports still account for more than a third of China’s economic growth and
10 percent of overall GDP – China’s exporters will be utterly devastated by more rapid and
continuous falls. China has escaped over-capacity because, until now, they have been able to
export all of the nation’s excess capacity. China’s central bank estimates that every 1 percent
drop in U.S. economic growth translates into a 6 percent drop in Chinese exports! And this is
taking its toll. Exports to the U.S. have slowed significantly since the start of 2007 and into 2008,
dropping from a 20.4 percent year-on-year rise in the first quarter to a 15.6 percent increase in
the second. Growth fell 12.4 percent in the third quarter following the eruption of subprime loan
problems.84 If China had not planed – and begun – to shift from ELG to innovation, they would
most likely have felt these shocks more intensely. And the entire world may have feared that a
U.S. recession would cause a global recession.

84 Ibid., p. 9.
PART TWO

The Innovation-Led Growth Hypotheses – A New Approach to Development

In 1960, W.W. Rostow, the famous American economic historian, wrote one of the most lasting and insightful texts on economic growth and development – The Stages of Economic Growth: A Non-Communist Manifesto. In 1990, Rostow re-released his discerning book with an updated preface. Rostow predicts, "...looking ahead some sixty years it can be said with reasonable confidence that the world will contain many new nations which have achieved maturity... it is fairly safe to predict that, by 2000 or 2010 – which is not all that far away – India and China, with about two billion souls between them, will be, in our sense, mature powers. They may not be ready for the age of the mass automobile... But is reasonably clear that compound interest has come to be built into those two massive societies; three generations of an environment of growth should produce maturity..."85 This prediction has undoubtedly come to fruition, as have many predictions Rostow formulated as early as 1960. Rostow’s book is a comprehensive definitional manual dedicated to exploring and extrapolating five stages of economic growth and development. He breaks up the stages of growth into five distinct phases – as countries develop they pass through each phase until they have reached the end of the development life cycle – mass-consumption. While Rostow lays out each stage brilliantly, he does not necessarily determine exactly how a nation-state moves from stage to stage. Earlier in this paper, two specific theories on development were defined – the export-led growth hypothesis and the import-substitution growth hypothesis. The statistical literature suggests that neither the export-led growth nor import-substitution strategies are definitive models for economic growth; however, the export-led growth hypothesis has been followed by several countries – including

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China – and has, at least on the surface, proved to be a reliable model for economic development. However, globalization has produced a different playing field for both developed and developing countries. The breakdown between borders has provided Multinational Corporations (MNCs) with the ability to seek out low cost operations anywhere in the world. The business cultures of Six Sigma and Lean Sigma have pushed corporations to find the lowest cost processes with the least amount of defects. Cheap labor, material, and overhead costs in developing countries have led MNCs to invest massive amounts of money to move domestic operations abroad. The ability of any MNC to lower costs by accessing the resources of developing countries has created the need for more companies to pursue more than just low costs. Customers are demanding higher quality products, new technologies and enhanced features, all at even lower prices. Thus, research and development and the fruits of innovation are at the forefront of commerce and competition – not only between corporations, but between nation-states as well. Nation-states are moving toward innovation-led growth strategies necessary to attract the best MNCs, the most talented citizenry, and preeminent technological advances which will lead to long-term economic growth. The People’s Republic of China (PRC) is at the forefront of the new Innovation-Led Growth strategy – it has taken innovation and R&D and put it into policy, with the intention of creating growth based on technological and process innovation. This section of the paper will discuss Rostow’s five stages of economic growth and how each relates to the export-led and innovation-led growth strategy. Then, the paper will explore the innovation-led growth hypothesis – and China’s subsequent embrace of the strategy. Essentially, both developed and developing countries will have to embrace the innovation-led growth strategy to remain competitive in the global economic environment – the next phase of growth will encompass innovation, technological improvement, and the ability to attract the best and brightest talent.
This discussion must begin with Rostow’s historic text; his work is still at the pinnacle of the literature on the stages of economic growth.

*W.W. Rostow’s Stages of Economic Growth*

For Rostow it is possible to identify all societies, in their economic dimensions, as lying within one of five categories: (1) the traditional society, (2) the pre-conditions for takeoff, (3) the take-off, (4) the drive to maturity, and (5) the age of high mass-consumption. Each stage has distinct indicators, and is a necessary condition for the movement into the next phase. First, Rostow discusses the traditional society.

According to Rostow, “A traditional society is one whose structure is developed within limited production functions, based on pre-Newtonian science and technology, and on pre-Newtonian attitudes towards the physical world. Newton is here used as a symbol for that watershed in history when men came widely to believe that the external world was subject to a few knowable laws, and was systematically capable of productive manipulation.”86 The traditional society is far from stable or stagnant; it is ever-changing and can be turbulent. The key to understanding the traditional society rests in the fact that modern technologies have not diffused to its citizenry. For Rostow, “The central fact about the traditional society was that a ceiling existed on the level of attainable output per head. This ceiling resulted from the fact that the potentialities which flow from modern science and technology were either not available or not regularly and systematically applied.”87 Traditional societies are thus usually economically focused on agriculture and in many circumstances, politically focused on government stability. Even in the field of agriculture, technological lag limits output. The family unit plays a vital role in the economy of the traditional society and there is only room for very little vertical movement

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86 Ibid., p. 4.
87 Ibid., p. 4.
in commerce. In 1960 Rostow wrote, "In terms of history then, with the phrase 'traditional society' we are grouping the whole pre-Newtonian world: the dynasties in China; the civilization of the Middle East and the Mediterranean; the world of medieval Europe. And to them we add the post-Newtonian societies which, for a time, remained untouched or unmoved by man's new capability for regularly manipulating his environment to his economic advantage."\textsuperscript{88} In modern day, many parts of Africa can still be considered to be in the traditional society stage. However, globalization – and the diffusion of technology it brings – has allowed nation-states to climb out of the traditional society stage of growth. Countries still in this stage must focus on infrastructure, political stability, economic and investment freedom, and basic necessities such as education, infrastructure, and the health of its citizenry. Strengthening these elements of a society and its economy can bring a nation-state into the next stage of development – The Preconditions for Take-Off.

Rostow comments on the preconditions for take-off stage, "The second stage of growth embraces societies in the process of transition; that is, the period when the preconditions for take-off are developed; for it takes time to transform a traditional society in the ways necessary for it to exploit the fruits of modern science, to fend off diminishing returns, and thus to enjoy the blessings and choices opened up by the march of compound interest."\textsuperscript{89} Countries that enter this stage of economic development begin to exploit modern science and tear through the ceiling keeping it in the traditional society phase. Among the Western European states, Britain, favored by geography, natural resources, trading possibilities, social and political structure, was the first to develop fully the preconditions for take-off. Rostow writes extensively about this stage, "The idea spreads not merely that economic progress is possible, but that economic progress is a

\textsuperscript{88} Ibid., p. 5.  
\textsuperscript{89} Ibid., p. 6.
necessary condition for some other purpose, judged to be good: be it national dignity, private profit, the general welfare, or a better life for the children. Education, for some at least, broadens and changes to suit the needs of modern economic activity. New types of enterprising men come forward – in the private economy, in government, or both – willing to mobilize savings and to take risks in pursuit of profit or modernization. Banks and other institutions for mobilizing capital appear. Investment increases, notably in transport, communications, and in raw materials in which other nations may have an economic interest. The scope of commerce, internal and external, widens. And, here and there, modern manufacturing enterprise appears, using the new methods. But all this activity proceeds at a limited pace within an economy and a society still mainly characterized by traditional low-productivity methods, by the old social structure and values, and by the regionally based political institutions that developed in conjunction with them.⁹⁰ Many modern nation-states are in this stage of economic growth. Many newly freed, Eastern European nation-states may fall within this stage, along with select African nations. This stage is vital to economic development. It is in this stage that countries can begin to use growth strategies to move its citizenry into rapid economic development. The export-led growth strategy is ripe for nation-states in this stage of growth. As modern manufacturing enterprise appears and the citizenry becomes more educated, MNCs will be attracted to the nation for cost reduction manufacturing – more commonly known as efficiency seeking Foreign Direct Investment (Investments which firms hope will increase their efficiency by exploiting the benefits of economies of scale and scope, and also those of common ownership.) As MNCs begin to invest in a fledgling economy, export-processing zones organically spring up and the host economy begins to experience forward vertical foreign direct investment (FDI). From this stage an economy can finally enter the take-off.

⁹⁰ Ibid., p. 6-7.
The take-off stage of economic development is the pinnacle of development – economies in this stage begin to fully utilize modern science to create an environment of rapid growth. Rostow explains, "The take-off is the interval when the old blocks and resistances to steady growth are finally overcome. The forces making for economic progress, which yielded limited bursts and enclaves of modern activity, expand and come to dominate the society. Growth becomes its normal condition. Compound interest becomes built, as it were, into its habits and institutional structure." In this stage the domestic economy begins to take root. Entrepreneurs begin to take risks and invest in the economy. Modern science begins to take the economy in a new direction. Rostow writes, "During the take-off new industries expand rapidly, yielding profits a large proportion of which are reinvested in new plant; and these new industries, in turn, stimulate, through their rapidly expanding requirement for factory workers, the services to support them, and for other manufactured goods, a further expansion in urban areas and in other modern industrial plants. The whole process of expansion in the modern sector yields an increase of income in the hands of those who not only save at high rates but place their savings at the disposal of those engaged in modern sector activities. The new class of entrepreneurs expands; and it directs the enlarging flows of investment in the private sector. The economy exploits hitherto unused natural resources and methods of production." The revolutionary changes in agricultural productivity are an essential condition for successful take-off; for modernization of a society increases radically its bill for agricultural products. In a decade or two both the basic structure of the economy and the social and political structure of the society are transformed in such a way that a steady rate of growth can be, thereafter, regularly sustained. In modern times, many nation-states are currently in this stage of growth. Globalization has rapidly placed

91 Ibid. p. 7.
92 Ibid., p. 8.
emerging economies in this stage of growth. India, China, South Korea, Mexico, Brazil, Argentina, and others have currently passed this stage of growth and entered the next, and most important stage—the drive to maturity. The drive to maturity is also the most important stage of growth for the innovation-led growth hypothesis. It is in this stage that counties strive to enter the age of mass consumption. Globalization has also changed the ability of emerging markets to rapidly leapfrog into new technological realms and use innovation and R&D to spur economic growth. The drive to maturity is the stage where emerging economies and developing nations make the transition to the age of mass consumption—and even then, nations must continue to pursue innovation-led growth strategies to compete internationally.

Rostow describes the drive to maturity as follows, “After take-off there follows a long interval of sustained if fluctuating progress, as the now regularly growing economy drives to extend modern technology over the whole front of its economic activity. Some 10-20% of the national income is steadily invested, permitting output regularly to outstrip the increase in population. The make-up of the economy changes unceasingly as technique improves, new industries accelerate, older industries level off. The economy finds its place in the international economy: goods formerly imported are produced at home; new import requirements develop, and new export commodities to match them. The society makes such terms as it will with the requirements of modern efficient production, balancing off the new against the older values and institutions, or revising the latter in such ways as to support rather than to retard the growth process.”93 Rostow expands on this definition and literally introduces the basic building blocks of innovation-led growth. He writes, “Formally, we can define maturity as the stage in which an economy demonstrates the capacity to move beyond the original industries which powered its take-off and to absorb and to apply efficiently over a very wide range of its resources—if not the

93 Ibid., p. 9.
whole range – the most advanced fruits of (then) modern technology. This is the stage in which an economy demonstrates that it has the technological and entrepreneurial skills to produce not everything, but anything that it chooses to produce." The PRC is definitively in the drive to maturity stage. As already demonstrated in the first half of this paper, China has used an export-led growth strategy to continue its powerful economic expansion. While China has not yet reached the age of mass consumption, it has come to the point where it must change its strategy for economic growth. After a brief discussion of the age of mass consumption, this paper will fully develop the innovation-led growth hypothesis and apply it to modern day China and its new political-economic policy.

In the age of mass consumption, the nation-state has developed the ability to purchase goods beyond basic needs. Rostow states, “As societies achieved maturity in the twentieth century two things happened: real income per head rose to a point where a large number of persons gained a command over consumption which transcended basic food, shelter, and clothing; and the structure of the working force changed in ways which increased not only the proportion of urban to total population, but also the proportion of the population working in offices or in skilled factory jobs-aware of and anxious to acquire the consumption fruits of a mature economy." Thus, once a nation reaches mass consumption, they begin to import goods to feed their cravings for the fruits of modern technology. The United States and most of the E.U. is currently in this stage. While Rostow does not extrapolate beyond this stage, this paper postulates that innovation-led growth may also be the stage beyond mass consumption. Globalization has made mass produced goods available to more people on earth than ever before in history. The ability to move operations into low cost nations has created cheap goods for mass

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94 Ibid. p. 10.
95 Ibid., p. 10-11.
consumption societies – thus, these societies are no longer the sole producer of these goods; instead China and others have been using export-led strategies to develop their own economy and provide the mass consumption economies with the product they need. Hence, in order to compete in the global economy developed countries also need to implement innovation-led growth to remain competitive. The innovation-led growth (ILG) strategy is quickly becoming the primary path to competitive international trade for both developing and developed countries. ILG can only be implemented during the take-off, drive to maturity, or age of mass consumption stages of growth – any stage prior to these will not have the factors necessary for such a strategy. In addition, ILG cannot and should not replace export-led growth policies early in a nation’s development; the ILG approach is reserved for nation-states capable of its implementation.

The Innovation-Led Growth Strategy:
"Empires of the Mind"

In a speech at Harvard University in 1943 Winston Churchill said that "the empires of the future will be empires of the mind."\(^{96}\) In the same respect, the battles of the future will be for talent. The clash for talent will not be limited to companies. Globalization has created a global front line – the "balance of brains" has supplanted the "balance of power." Talent is one of the three-pillars of innovation. The other two are applied or investment-specific research and development and an economic environment with the freedom necessary for entrepreneurs to pursue ground-breaking new technologies, processes, and management techniques. The most striking aspect of innovation-led growth is its reach. All economies of the future will need to pursue the innovation-led growth strategy – Advanced Industrial Nations (AINs) as well as Developing Countries (DCs) and Emerging Markets will have to pursue innovation-led growth or risk falling behind in the global economic race to compete. Thus, while development scholars

still debate whether the export-led growth strategy or import-substitution strategy is better for DCs and emerging economies, nations like China are already attempting to implement a new strategy – the innovation-led growth strategy.

The innovation-led growth hypothesis is based on three pillars. The strategy postulates that nation-states that implement policies intended to attract and retain talent, construct an atmosphere that inspires applied or investment-specific research and development, and employ laws and regulations dedicated to a free and open economy spark economic growth in the sectors necessary to be competitive in the global economy. The development of a strong enterprise-based innovation system will allow DCs – such as China – to utilize a growth path that is less dependent on low-cost, resource-intensive manufacturing and assign the key role to innovation, through research and development (R&D) and science and technology (S&T) research. Innovation-led growth entails organizational as well as changes in the rules of the game. Business environments once characterized by export processing zones (EPZs) will be replaced by high-tech R&D facilities dedicated to creating patents. Joint Venture, Formal Cooperative Alliance, and Informal Cooperative Alliance contracts will be contingent on R&D, not just resource-seeking FDI. MNCs will be attracted to strong intellectual property rights regimes and highly educated talent, not just cheap labor. Transitions to a national innovation system will be the fundamental determinant of long-run economic growth and development. The interdependent environment of globalization has created a system where innovation in one part of the world must be recognized across the board – companies and nation-states can no longer procrastinate when it comes to the adoption of new technologies. Companies and nation-states alike are converging, creating intense competition in the realm of innovation, not cheap labor. According to Lakhwinder Singh, "Two distinct patterns of economic transformation and systems of
innovations [have] evolved over time – one, based on building a strong industrial sector as an engine of innovations and growth; two, the engine of growth is the service sector and the innovation system is heavily dependent on foreign capital.”

Building a strong industrial sector dedicated to research and development and science and technology research is the best strategy when a nation-state pursues an innovation-led growth approach. The second pattern relies heavily on foreign funds and the service sector. Many DCs and emerging markets have already pursued some type of export-led growth strategy and thus have a strong industrial infrastructure – China is a prime example. For these countries, the aggressive pursuit of talent; the transformation of the industrial sector from simple manufacturing to R&D and S&T research; and the formulation of a free and open economic environment is the best innovation-led growth path. However, for economies – such as India – where a strong service sector has been established, the second path may be more appropriate. However, the second path will keep the nation-state heavily dependent on foreign investment and could prevent the domestic economy from organic growth. This paper explores the innovation-led growth hypothesis based on three distinct pillars necessary to formulate a successful strategy. The first, and most important, pillar of the innovation-led growth (ILG) strategy is the aggressive pursuit of talented individuals; without the best and brightest talent, the other two pillars of the ILG hypothesis cannot be present.

The Cultivation and Attraction of Talent:

*Only the Best and Brightest Need Apply*

Innovation is based on brainpower, which in turn creates fantastic new technologies through R&D and S&T research. These new technologies give domestic companies the edge in

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the global marketplace – the export of information technology goods and services will be much more lucrative than the export of manufactured goods in the long-term. Thus, the war for talent is at its fiercest in high-tech industries. The arrival of companies such as Google has made the race for talent even more intense. Google has experimented with clever new recruiting tools, such as online billboards featuring complicated mathematical problems. Other companies have responded by supercharging their own talent machines – training has become vital to growing a workforce in an ever-changing world. 98 However, it would be a mistake to assume that the talent hunt is limited to only the information technology industry. A large number of businesses – from consulting to hedge funds – also run on “brainpower.” According to an Economist survey on talent, “When the Corporate Executive Board (CEB), a provider of business research and executive education based in Washington, D.C., recently conducted an international poll of senior human-resource managers, three-quarters of them said that ‘attracting and retaining’ talent was their number one priority.” 99 In the same survey it was found that 62% worried about companywide talent shortages. The CEB also surveyed approximately 4,000 hiring managers in more than 30 companies, and found that they believed that the average quality of candidates has declined by 10% since 2004 and the average time to fill a vacancy has increased from 37 days to 51 days. 100 More than a third reported that they had to hire below-average candidates just to “fill a position quickly.” Moreover, the CEB found that one in three employees has recently been approached by another firm hoping to lure them away from their current position. In the context of the ILG hypothesis talent is defined as the “entire workforce” – not just those at the top of the bell curve. Essentially nation-states must implement policies and create the infrastructure needed to cultivate their own talent and retain that talent – the cultivation of talent is not enough because

99 Ibid.
100 Ibid.
in the global economy the nation that has produced the talent can lose it to the nation that has the most to offer in terms of employment; this has been dubbed the “brain drain.” The idea of cultivating and retaining talent cannot be overstated. In the up-coming years many scholars are predicting a shortage of talent due to aging populations – especially in the AINs.

Talent is directly correlated with intangible and “talent-intensive” assets. These range from a skilled workforce and know-how to patents. Baruch Lev argues that these intangible assets account for more than half of the market capitalization of America’s public companies. Accenture, a management consultancy, calculates that intangible assets have shot up from 20% of companies in the S&P 500 in 1980 to around 70% today.\textsuperscript{101} The Economist and the McKinsey consultancy divide jobs into three categories: (1) “Transformational” – extracting raw materials and converting them into finished goods; (2) “Transactional” – interactions that can easily be scripted or automated; and (3) “Tactic” – complex interactions requiring a high level of judgment. The company argues that over the past six years the number of American jobs that emphasize “tactical interactions” has grown two and a half times as fast as the number of transactional jobs and three times as fast as employment in general. These jobs now make up 40% of the American labor market and account for 70% of the jobs created since 1998.\textsuperscript{102} More importantly, as DCs get richer the same exact thing is bound to happen – in fact, nation-states like China are making it happen through the use of the ILG strategy. Another change in the global economy which makes talent so valuable is the aging population.

The most dramatic changes will occur in Europe and Japan. By 2025 the number of people aged 15-64 is projected to fall by 7% in Germany, 9% in Italy, and 14% in Japan.\textsuperscript{103} In America the retirement of the Baby Boomers will produce similar changes in the talent pool.

\textsuperscript{101} Ibid.
\textsuperscript{102} Ibid.
\textsuperscript{103} Ibid.
China, with its “one child policy” will also be marginally affected by steady and non-growth birthrates. This means that everyone – on the nation-state level – will have to fight harder for young talent, as well as learn to tap into and manage new sources of talent. Moreover, loyalty to employers is fading fast. Thanks to years of downsizing, the old social contract – job security in return for commitment – has been breaking down. A 2003 survey by the Society for Human-Resource Management suggested that 83% of workers were “extremely” or “somewhat” likely to search for a new job when the economy recovered.\textsuperscript{104} Even more important, globalization has changed the structure of employment. Workers can telecommute through satellite communications. The breakdown of borders within the EU allows workers to get cheaply trained in one nation and search for a job in another. The global supply chain keeps the process going 24 hours a day. Managers not only need to deal with lots of different sorts of people, but also to manage workers in different countries and often across different functions – matrix organizations have become the standard for global business. Thus, managers must also be the best and the brightest in order to deal with the global structure. These structural changes are no longer confined to the blue-chip industries such as Goldman Sachs and General Electric – they are affecting every company in the corporate world, from credit-card companies to hotel chains to the retail trade. Productivity must be raised by harnessing and managing better talent. And with opportunities running dry at home the hunt for talent has gone completely global. Over the past decade multinational corporations (MNCs) have shipped back-office and IT operations to the developing world, particularly India and China. More recently MNCs are moving better jobs offshore, capitalizing on DCs attempt to cultivate high-grade workers with local knowledge. However, as domestic industries organically spring up MNCs have to compete with local companies in the developing world as shortages begin to appear there as well. These changes

\textsuperscript{104} Ibid.
have inspired governments to pursue the first pillar of the ILG hypothesis as countries have progressed from simply relaxing their immigration laws to actively luring highly qualified people. The university has become the engine of talent growth. Universities are magnets for talent – China and India are trying to entice back some of their brightest people from abroad using university scholarships and employment opportunities. Singapore’s Ministry of Manpower even has an international talent division. The race for talent is the most important pillar of the ILG hypothesis because talent is necessary to construct the other two pillars. The competition for talent creates several benefits. There is a boost in productivity, increased opportunities, increased job satisfaction, and the rapid advancement of scientific progress. All of which will lead to long-term economic growth for nation-states that pursue the ILG strategy. Thus, a very important part of this paper is demonstrating how nation-states can cultivate and retain a talented workforce. The key to this portion of the strategy does not rest solely with the government. The companies within the nation must play a vital role in the cultivation, attraction, and retention of talent.

*How to Implement Pillar Number One: Talent Attraction*

The first line of attack for talent cultivation starts with government policies that attract the best and brightest individuals. The second wave of attack must come from the domestic companies themselves – if talent has nowhere to go in the domestic economy it will emigrate to where it is needed and appreciated the most. One policy governments often implement to attract talent is immigration relaxation policies. Regardless of the bad press immigrants tend to receive, many economies would be lost without them, and many governments are desperate to attract them. The most mobile people are not the poor but the educated and they are sought after as never before. Most governments are easing restrictions on the entry of skilled workers. Germany has made it easier for skilled workers to get visas. France has introduced the “scientist” visa. The

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105 Ibid.
U.S. has implemented the H-1B visa program for skilled workers. Singapore is a pioneer in the talent war. Lee Kuan Yew, the city-state’s elder statesman, has long argued that, “trained talent is the yeast that transforms a society and makes it rise.” First Singapore went after their émigrés. Now they are going out of their way to import foreign talent. Only 3% of companies experienced problems with immigration authorities, compared with 24% in China and 46% in the United States. Singapore is especially good at attracting scientific talent, mainly in biotechnology. Of the 170 staff working in the country’s Genome Institute, about 120 are foreigners. These types of governmental policies are essential to the ILG strategy.

Many countries regard universities as ideal talent-catching machines, not only because they select students on the basis of ability but because those students bring other positive benefits – including spending money in the form of tuition and cheap research labor. Currently, China, which temporarily flirted with entrance examinations during the Cultural Revolution, is focusing resources on its elite universities. In addition, talent cultivation and attraction can only be successful if the efforts are backed by a vibrant and open economy – firms must be willing to hire foreigners and promote them to senior positions and these senior positions must exist in the domestic economy to retain the cultivated talent. China is a great example of a nation-state that is combating the “brain drain” and going to great lengths to attract talent. The combination of sensible government policies and economic liberalization has worked wonders for the PRC. China has implemented a range of talent attraction policies. The country offers the best talent bigger apartments, access to the best schools, fancy titles, and even chauffeur-driven cars. The Chinese Academy of Sciences has established a program of generous fellowships for expatriates – this program is called the “hundred talents program.” Beijing has an office in Silicon Valley,

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107 Ibid.
108 Ibid.
and Shanghai has established a "human talent market." China is literally littered with new edifices labeled "returning-student-entrepreneurial building." China’s strategy coincides with a new flow of people. For decades returnees were rare, but numbers began to shoot up in 2000 – just when the bursting of the Silicon Valley bubble coincided with rapid growth in China. Thus, the PRC has entered the first stage of the talent war. China is going in the same direction as South Korea and Taiwan – first tempting back the émigrés and then beginning to compete in the global talent market. Thus, the ILG model of economic development must begin with the ability to attract talent to the nation-state – whether that means talented émigrés or foreigners. Second, the nation must also cultivate their domestic talent though universities and elite educational systems. Creating an elite education system is vital to the ILG model – this means that governments must spend considerable amounts of money in high-education, as well as primary education. Creating an education system that is science, math, and technology intensive is also important. China has demonstrated a commitment to these ILG strategies. The issue that remains is the retention of talent – this must be done though the domestic business environment. Companies must be able to keep the talent that the government has gone through great lengths to attract.

Companies all over the world are beginning to gain insights into managing talent that will allow them to tackle the problem in a more organized way. The first rule is that companies must think more carefully about their critical talent. Turnover rates must be reduced and companies must have the resources necessary to retain their primary talent through tough economic times. Some companies have tried outsourcing menial jobs to part-timers who are much easier to find than core talent. For example UPS had to reduce the turnover rate among the people who drive their trucks and deliver their packages – this process actually involves a lot of technical

109 Ibid.
knowledge regarding UPS’s proprietary shipping system. UPS found that even though it selected its drivers with great care, turnover was high because drivers hated the back-breaking work of loading the truck in the morning. So the company contracted this job out to part-timers who are much easier to find than drivers.\textsuperscript{110} Next, it is essential that companies plan ahead and build a global skills workforce. Companies must compare their current workforce with its future needs and set about filling the gaps by encouraging workers to acquire the relevant skills. Third, it is up to companies to be more imaginative about recruiting and retaining talent. That includes paying more attention to “passive candidates” – those that are not actively looking for a job but might be influenced by seduction. Popular techniques include going through lists of people attending conferences, buying information about competing firms, and searching the web for people that have created new patents. Lastly, companies must create internal markets for talent. Too many firms continue to look outside the company. Deloitte calculates that the typical American company spends nearly 50 times more to recruit a professional on $100,000 pay scale, than it spends on his or her future training every year.\textsuperscript{111} And these new recruits can take over a year to learn the job. The solution is an internal talent market, encouraging workers to apply for jobs across the company.

Essentially talented people need organizations less than organizations need talented people – the shortage is real. At the same time companies are losing their bargaining chips – job security and stability has been fading in recent years. In fact talented “free agents” may actually enjoy more security than people with regular jobs. The shift in the balance of power between workers and organizations is particularly noticeable among top talent and young professionals. These individuals have access to web sites and a vast array of information regarding job

\textsuperscript{110} “Everybody’s Doing It,” The Economist Vol. 381, no. 8498, (Oct 7\textsuperscript{th} 2006), p. 6.
\textsuperscript{111} Ibid.
openings and exactly what they expect to earn at these new endeavors. Thus, companies must nurture their talent and allow individuals to continue to grow within the organization. The *Economist* states, “What should companies do to convince brainy people to work for them? The Corporate Executive Board argues that rewards for managing an employment value proposition (EVP) effectively are huge, increasing a company’s pool of potential workers by 20% and the commitment of its employees fourfold. It can even reduce payroll: companies with well-managed EVPs get away with paying 10% less than those with badly managed EVPs.”

The concept of the EVP is very important – it is what the employee gets out of the organization – pay and benefits are a big part of the equation; however, to retain talent the ability to continue to develop their skills is a vital aspect of an individual’s desire to remain at a company. The *Economist* states, “Companies need to put more effort into defining their EVP… Most human-resources departments put the emphasis on the company’s ethos, but potential employees are more concerned about rewards and opportunities. Companies also need to fine-tune their EVPs for different segments of the talent market, and particularly for different geographies, which account for most of the differences in what employees are looking for. Americans are keenly interested in health and retirement benefits, whereas Indians emphasize growth rates and innovation.” Simply put, the most important thing companies can do to attract talented people is to boost their workers’ long-term employability. Employers no longer expect job security; they do expect their companies to keep their skills up to date. Thus, once the government has done its job to attract foreign and cultivate domestic talent, companies inside the domestic economy must be able to retain the new human capital. Thus, the success of advanced economies and emerging markets is increasingly dependent not on their physical capital but on their capacity to mobilize

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113 Ibid.
their citizen’s brainpower. The rise of global meritocracy offers all sorts of benefits, from higher growth in productivity to faster scientific progress. It can boost social mobility and allow all sorts of talent to bloom. Thus, whether a nation-state is in the age of mass consumption, the drive to maturity, or the take-off stages of economic growth, they must pursue talent in order to compete in the global economy. The first pillar of the innovation-led growth hypothesis is so important that the other two could not exist without it. The second pillar of the ILG model is built around the concept of constructing an atmosphere that inspires research and development. Of course talent is a vital portion of this pillar – without it R&D and S&T research would fail. However, there is much more that goes into the R&D pillar of the ILG model.

Research and Development and Science and Technology – The Second Pillar

*The Road to Economic Growth*

North America still leads the world in research spending, but the big labs’ advantage over its smaller rivals is being eroded by two powerful forces. The first is globalization, especially the rise of China and India as both consumers and increasingly suppliers of innovative products and services. The second is the rapid advance of information technologies, which are spreading far beyond the internet and into older industries such as steel, aerospace, and car making. It is also important to define innovation. Although the term is used to narrowly define new technology, many innovations are neither new nor involve technology. For example, the concept of fast-food popularized by McDonalds involved running a restaurant in a different way rather than making a technological breakthrough. Innovation is not only invention, new patents, and novelties. Innovation includes new processes, managing techniques, products, technologies, and any other improvements mankind has to offer thorough research and ingenuity. The Organization for

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Economic Co-Operation and Development define innovation as “new products, business processes, and organic changes that create wealth or social welfare.” Richard Lyons, the Chief Learning Officer at Goldman Sachs investment banks describes it as, “fresh thinking that created value.” There are several paths to innovation through R&D and S&T research. The first approach has companies set up vertically integrated R&D organizations and governments specifically create innovation policies to help them succeed. According to the Economist, “This approach has had successes and many companies still spend pots of money on corporate research. But firms are growing increasingly disenchanted because the process is slow and insular. A global study across industries by Booz Allen Hamilton, a consultancy, concluded that “higher R&D spending doesn’t ensure better performance in terms of growth, profitability or shareholder returns.” Studies show that a large and rising share of growth — and with it living standards — over recent decades is the result of innovation. Analysis done by the McKinsey Global Institute shows that competition and innovation (not information technology alone) led to the extraordinary productivity gains witnessed in the 1990s. The Institute writes, “Those innovations — in technology as well as products and business processes — boosted productivity. As productivity rose, competition intensified, bringing fresh waves of innovation.” The second approach to innovation creation is an organic, democratic, and even archaic process. The Economist states, “The centrally planned approach is giving way to the more democratic, even joyously anarchic, new model of innovation. Clever ideas have always been everywhere, of course, but companies were often too closed to pick them up. The move to an open approach to innovation is far more promising.” The consensus, however, is that “With manufacturing now

115 Ibid., p. 4
116 Ibid., p. 4
117 Ibid., p. 4
118 Ibid., p. 4
119 Ibid., p. 4
barely a fifth of economic activity in rich countries, the “knowledge economy” is becoming more important. Indeed, rich countries may not be able to compete with rivals offering low-cost products and services if they do not learn to innovate better and faster... the well of human ingenuity is bottomless, innovation strategies that tap into hitherto neglected intellectual capital and connect it better with financial capital can help both rich and poor countries prosper. That is starting to happen in the developing world.”120 This is precisely what the ILG model postulates: in the age of globalization, innovation-led growth is just as important for developing counties as it is in the advanced industrial nations. China has harnessed R&D and S&T research and a host of other innovation based strategies in order to situate the nation to become the hub of innovation in the long-term.

One good example of how China is sparking innovation comes from the implementation of a business practice known as “localized modularization.” This example can be illustrated by the Chinese motorcycle industry. According to the Economist, “Unlike state-run firms, the city's private-sector upstarts, such as Longxin and Zongshen, do not have big foreign partners like Honda or Suzuki with deep pockets and proven designs. So they came up with a different business model, one that was simpler and more flexible. Instead of dictating every detail of the parts they want from their suppliers, the motorcycle-makers specify only the important features, like size and weight, and let outside designers improvise.”121 The “Localized Modularization” approach has been very successful and delivered big cost reductions and quality improvements. It is one example of the sort of business-model innovation which is far more radical than conventional product or process innovation. Examples of these business-model innovations are now coming from the developing economies to threaten the establishment of the global giants in

120 Ibid., p. 4
North American and Europe. In a report with John Hagel, of Deloitte, a consultancy firm, John Seely, an innovation expert and the former head of Xerox PARC research centre, argues that “China is rapidly emerging as the global centre of management techniques that most U.S. companies are struggling to understand.” These new business models are a part of the second pillar of the ILG model. Low labor costs have given China and other DCs a head start and a transitory advantage. Innovation can also arise out of necessity. Entrepreneurs in China must compete with privileged state firms with access to cheap credit as well as the local arms of multinationals. That makes China’s “third sector,” as Seely Brown and Hagel call it, extraordinarily resourceful in trying to reach global markets. Most Chinese and Indian innovators are not well known, but it is only a matter of time before some will be. There are now over 400 firms designing chips in China. So far they produce “very pragmatic, fit for use” designs but they will quickly become world-class innovators. As the knowledge component of industries continues to grow, it will lower even further the barriers to entry in many businesses. Yet the same democratization of innovation that empowers the new firms can be used to generate much greater innovation from within established companies. Some multinationals are already doing this in Asia to keep up with their local competitors. Thus, much of the innovation in China has come from small firms that are developing new business models and cheaper processes. However, the PRC has gone to great lengths to establish a world class R&D sector. Later sections of this paper will explore in depth the PRC’s attempt to implement the innovation-led growth model. The next section will specifically address the research and development pillar of the innovation-led growth hypothesis and how it spurs economic growth.

122 Ibid., p. 6.
123 Ibid., p. 6-7.
Research and Development – A Vehicle of Growth

Numerous scholars have attempted to untangle the link between research, innovation, and economic growth. Three different approaches to this relationship predominate. The first is called the linear model, in which basic research leads to applied research and to inventions that are then transformed into innovations, which in turn, lead to greater growth. Empirically, the relationship has been demonstrated through the link between R&D and patents, followed by the link between patents and growth.\textsuperscript{124} The second approach can be labeled the “systems of innovation” or “learning region” models. These approaches – usually associated with evolutionary economics – concentrate on the study of territorial-embedded institutional networks that favor or deter the generation of innovation. The capacity of these networks to act as a catalyst for innovation depends, in turn, on the combination of social and structural conditions in every territory – this process has been termed the “social filter.”\textsuperscript{125} These approaches tend to be fundamentally qualitative and conducted by geographers, evolutionary economists, and economic sociologists. Finally, there is a large group of scholars who has mainly concentrated on the diffusion and assimilation of innovation. This is a “knowledge spillovers” approach, and has been adopted by economists and geographers, using both quantitative and qualitative methods.\textsuperscript{126} The innovation-led strategy proposed here concentrates on the “linear model” and the “Knowledge spillovers model” as each has been tested and can be tested in future empirical studies. However, all three models contribute to the link between R&D, innovation, and economic growth.

According to the linear model of innovation, local initiative activities are crucial for the production of new knowledge and the economic exploitation of existing knowledge, given the

\textsuperscript{125} Ibid., p. 2.
\textsuperscript{126} Ibid., p. 2.
presence of a minimum threshold of local innovation capabilities. Such activities are not geographically evenly distributed and thus are localized sources of competitive advantage for some areas rather than others. This same concept can be illustrated in the PRC; when the Chinese introduced their new open door policies in the late 1970s, the government only opened up some provinces/regions, mostly along the coastline. These regions flourished and became economic hotspots of foreign direct investment. These regions advanced further economically than other regions creating the regional wealth divide that exists in the PRC today. Regional innovation can have the same results as some regions experience the benefits of innovation while others do not. However, these new innovation capabilities are not automatically equivalent to economically useful knowledge. A successful process of innovation depends on “localized structural and institutional factors that shape the innovation capacity of specific geographical contexts.”  

This is indicated by the “regional systems model” of innovation and learning regions model approaches. Knowledge spillovers must occur across regions – this can be accomplished using the new technological advances in telecommunications. However, technological improvements in communications infrastructures have not affected all types of information in the same way. While codified information can be transmitted over increasingly large distances, tacit knowledge is geographically bound thus determining the increasing concentration of innovation and the geographical boundaries of knowledge spillovers. The technological diffusion of R&D and innovations across regions can still be difficult.

This paper looks specifically at the linear model, more commonly known as the neoclassical model of R&D and innovation. Factors such as the percentage of investment in research and development or where the actual research is conducted do not matter – what matters more is

\(^{127}\) Ibid., p. 4.
that the research is investment-specific. In other words R&D that can be applied to the market is the best performer for economic development. Knowledge is a public good available everywhere and to everybody simultaneously – innovation can flow frictionless from producers to a full set of intended and unintended beneficiaries. This contributes to long-term convergence between countries and regions. This can be seen as globalization spreads technology all over the world and as emerging markets begin to invest heavily in R&D. However, Research and development must also be an instrument of policy. Innovation is not only considered the key source of progress, but it is also a weapon in development policy. Differences in innovation capacity and potential form an “endogenous growth” perspective – this is organically created growth from within the domestic economic sphere; much like the import substitution model, but highly effective. By bringing innovation to the forefront of policy, it can be assumed that greater investment in basic R&D will lead to greater applied research and to an increase in the number of inventions, that when introduced in the production chain, become growth-enhancing innovations.\textsuperscript{128} Thus, the linear model places localized R&D investment as the key factor behind technological progress and, eventually, economic growth. In essence, the implications of this approach are that the higher the investment in R&D, the higher the innovative capacity, and the higher the economic growth. The math is simple, nations and regions that invest more in R&D, generally tend to innovate more, and often grow faster. While this model is simple it does not account for all of the factors of R&D’s link to economic growth. Simply spending more money on R&D and S&T research will not suffice, certain other conditions are necessary for R&D to link to growth.

\textsuperscript{128} Ibid., p. 5.
The conditions of the territory, region, or nation-state are directly related to its innovation potential. According to Rodriguez-Pose and Crescenzi, “Innovation is considered a territorially-embedded process and cannot be fully understood independently of the social and institutional conditions of every space.”¹²⁹ The territorially-embedded factors influencing the process of innovation have become the focus of the other theoretical perspectives, other than the linear model (i.e. systems of innovation model and learning regions model). The other approaches are necessary to fully understand the link between innovation and growth – they help us understand how and under what conditions the process of innovation takes place. According to Rodriguez-Pose and Crescenzi, “Some of the most relevant findings related to these approaches are the relevance of proximity, local synergies, interaction, interaction and the importance of “inter-organizational networks,” financial and legal institutions, technical agencies and research infrastructures, education and training systems, governance structures, innovation policies’ in shaping innovations.”¹³⁰ These other approaches are necessary to understand how to implement the innovation-led strategy. It is not enough for a nation to just spend more on R&D. Developing countries must also look at their education system in the aggregate, the legal framework surrounding intellectual property protection, the taxation system for research intensive firms, and the ability of some R&D intensive regions to transfer technology across the nation as a whole. In addition, nation-states rely not just on their internal capacity to produce innovation, whether through direct inputs in the research process or through the creation of innovation prone systems in the local environment, but also on the capacity to attract and assimilate innovation produced elsewhere. The PRC has done a renowned job of attracting FDI, and with FDI inflows comes technological diffusion and the transfer of innovation from MNCs to the local economy.

¹²⁹ Ibid., p. 6.
¹³⁰ Ibid., p. 7.
According to Rodriguez-Pose and Crescenzi, "At the micro-level, innovative units (R&D departments within firms, universities, research centers, etc.), as well as local institutions and individuals, interact with each other and with their external environment through [territorially embedded networks]." These interactions are important because they produce the transmission of knowledge in the form of "knowledge spillovers" that are obtained by local actors. The origin of these spillovers can be local, but they can also be generated outside of the borders locality or region. There is no reason that knowledge should stop spilling over because of borders, such as a city limit, state line, or national boundary. However, there is a debate in the literature about what type of knowledge that can be transferred easily and what type of knowledge can only be transferred face-to-face. The neo-classical or linear model would assume that all knowledge can be transferred anywhere and to anyone. However, more modern models realize that "codifiable" information is cheap to transfer because its underlying symbol systems can be widely disseminated though information infrastructure. Hence, codifiable information can be disseminated relatively at almost no cost, over large distances and does not suffer from strong distance decay effects. All information is not completely codifiable – specifically tactic information. The presences of some specific features make, in some cases, codification impossible or too expensive. If the information is not codifiable, merely acquiring the symbol system or having the physical infrastructure is not enough for the successful transmission of a message. In this case there is need to disseminate tactic knowledge by an intrinsically spatial communication technology. In other words, face-to-face interaction is key to the transfer of tactic information. Not only must the knowledge be communicated, but other functions must be pursued to generate trust and incentives in relationships, screening processes, and socialization processes, which are all necessary to make communication possible but also more effective, and

131 Ibid., p. 8.
ultimately produce the innovation process. Tactic knowledge is sometimes the lifeblood of innovation. However, in contrast to codifiable information, the process of transmission of tactic knowledge is costly and suffers from strong distance decay effects. Face-to-face contacts are maximized within relatively small territories, due to a combination of proximity and the presence of common socio-institutional infrastructures and networks. Spillovers will be limited to and maximized within regions. Nevertheless, some of the tactic knowledge will spillover depending on the interconnectedness of regional networks. Flows of interregional knowledge are essential to the innovation-led growth hypothesis. Inter-region networks are important agents of innovation. Countries should ensure that highly innovative regions have substantial contact with the rest of the nation-state.

Therefore, while funding for R&D and S&T is the fundamental action a nation state should pursue, it also must be sure that the infrastructure, education system, regional-information networks, FDI attraction policies, and other policies are in place to diffuse the technological innovations produced by the new innovation. R&D without a regional system of innovation or the conditions conducive to the transfer of technology will not be as effective on GDP – without a regional system of innovation regional GDP will be highly divided; regions with intense R&D spending will grow faster than regions with little R&D spending, creating regional wealth divides. The empirical data gives positive reinforcement to each of the theoretical model presented above (linear, systems of innovation and learning region model, and the knowledge spillover model).

Rodriguez-Pose and Crescenzi developed a model which takes each of these models into account. Using several linear regression models for countries in Europe, they found that “local
R&D expenditure generally shows a positive and significant relationship with economic growth in all regressions... For the European regions considered, investing in R&D seems to be a more important source of economic growth than relying on knowledge spillovers from neighboring regions... Relying exclusively on local R&D inputs is, however, not a guarantee for achieving greater growth, as such relationship proves to be not always robust when controlling for social conditions (the social filter variable)... the sociological conditions are a better predictor of economic growth than investment in R&D. The social filter variable is always positively associated with economic growth and statistically significant... these results highlight that while investing in R&D locally enhances economic growth – relying on knowledge spillovers is a viable alternative for regions with adequate socio-economic structures that would guarantee the reception and assimilation of those spillovers. Thus, the importance of the traditional linear model cannot be overstated. However, the socio-economic conditions for the genesis and assimilation of innovation and its transformation into economic growth must not be understated. Lastly, these authors’ results illustrate that not only knowledge flowing from neighboring regions improves regional growth performance, but also that spillovers are geographically bounded and that there is a strong distance decay effect – close proximity of tacit knowledge is necessary for technological diffusion. In fact, the empirical evidence – despite controlling for regional differences, the social filter, and knowledge spillovers – illustrates that increasing expenditure in R&D creates the innovation necessary to create economic growth. Nonetheless, this paper recommends that nations not only spend more money on R&D, but also create the other regional, social, political, and environmental factors necessary to encourage regional-innovation systems and the spread of knowledge spillovers. Despite this empirical study, the literature is still divided

132 Ibid., p. 23.24.
133 Ibid., p. 32.
on the link between R&D and economic growth. The next section of this paper will survey the literature on economic growth as it pertains to R&D.

*The R&D and Economic Growth Link – The Literature*

The endogenous growth literature has turned to a class of models in which growth is driven by technological change that results from the research and development efforts of profit-maximizing agents, with the implication that subsidies to R&D, and perhaps other government policies, may influence the long-run rate of economic growth. Growth is endogenous in the sense that technological progress, which generates long-run growth, results from R&D undertaken by profit-maximizing agents. Romer and Lucas are the two most prominent scholars in the R&D and growth literature. Romer’s model is as follows, “Growth in this model is driven by technological change that arises from intentional investment decisions made by profit-maximizing agents. The distinguishing feature of the technology as an input is that it is neither a conventional good nor a public good; it is a non-rival, partially excludable good…. The main conclusions are that the stock of human capital determines the rate of growth, that too little human capital is devoted to research in equilibrium, that integration into world markets will increase growth rates, and that having a large population is not sufficient to generate growth.”

Romer’s model is often used as the basis for the literature on R&D and growth. He believed that improvement in the instructions for mixing together raw materials—lies at the heart of economic growth. Technological change arises in large part because of intentional actions taken by people who respond to market incentives. Thus the model is one of endogenous rather than exogenous technological change. Market incentives, nonetheless, play an essential role in

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the process whereby new knowledge is translated into goods with practical value. Instructions for working with raw materials are inherently different from other economic goods. Once the cost of creating a new set of instructions has been incurred, the instructions can be used over and over again at no additional cost. Developing new and better instructions is equivalent to incurring a fixed cost. This property is taken to be the defining characteristic of technology. Most models of aggregate growth, even those with spillovers or external effects, rely on price-taking behavior. But once these three premises are granted, it follows directly that equilibrium with price taking cannot be supported.\(^\text{135}\) In addition, Romer’s empirical model found that, “The most interesting positive implication of the model is that an economy with a larger total stock of human capital will experience faster growth. This finding suggests that free international trade can act to speed up growth. It also suggests a way to understand what it is about developed economies in the twentieth century' that permitted rates of growth of income per capita that are unprecedented in human history. The model also suggests that low levels of human capital may help explain why growth is not observed in underdeveloped economies that are closed and why a less developed economy with a very large population can still benefit from economic integration with the rest of the world.”\(^\text{136}\) Thus, even in one of the earliest models of R&D and growth, human capital – or what this paper refers to as talent – is of vital importance for the ability to innovate and produce economic growth.

Joseph Schumpeter’s “creative destruction’ has also been used as model for economic growth through innovation. Creative destruction occurs when R&D and innovation for new products, essentially destroys older technologies and creates growth through continuous development. According to Philippe Aghion and Peter Howitt, “Growth results exclusively from

\(^{135}\) Ibid., p. S72.
\(^{136}\) Ibid., p. S99.
technological progress, which in turn results from competition among research firms that generate innovations. Each innovation consists of a new intermediate good that can be used to produce final output more efficiently than before. Research firms are motivated by the prospect of monopoly rents that can be captured when a successful innovation is patented. But those rents in turn will be destroyed by the next innovation, which will render obsolete the existing intermediate good.\textsuperscript{137} Thus, the competition that results from creative destruction inspires more innovation and this process leads to economic growth. Other research has focused on the limits of R&D research.

Some scholars believe that there are scale effects to R&D-led growth. According to Charles I. Jones, "In brief, virtually all the R&D-based models in the literature share a prediction of 'scale effects': if the level of resources devoted to R&D-measured, say, by the number of scientists engaged in R&D-is doubled, then the per capita growth rate of output should also double, at least in the steady state. Empirically, of course, such a prediction receives little support. The number of scientists engaged in R&D in advanced countries has grown dramatically over the last 40 years (because of population growth and an increase in the intensity of R&D), and growth rates either have exhibited a constant mean or have even declined on average. For example, according to the National Science Foundation (1989), the number of scientists and engineers engaged in R&D in the United States has grown from under 200,000 in 1950 to nearly 1 million by 1987; per capita growth rates in the United States exhibit nothing remotely similar to this fivefold increase. The prediction of scale effects is clearly at odds with empirical evidence. Therefore, virtually all the R&D-based growth models in the literature are inconsistent

with this simple observation.”\textsuperscript{138} Thus, the empirical research suggests that simply adding more talent (in terms of scientists) does not correlate with increased economic growth. But as the paper has already explored, while talent is one of the most important elements of ILG, it cannot produce growth by itself.

When controlling for these “scale effects” – the literature has found that the steady-state growth rate depends on the growth rate of inventions, which in turn depends on the (exogenous) rate of population growth, reflecting an intuitive link between innovations and scientists: inventions require inventors. Population growth has been found to be essential in R&D growth models. In other words, population growth and exogenous growth are correlated and this amplifies the positive externalities of R&D. Charles Jones, in his empirical model, found evidence that supports the ILG strategy, he states: “Growth in the economy is tied directly to growth in productivity, which in turn depends on the discovery of new designs through R&D. Individuals are the critical input into the discovery of new designs, and the growth rate of the economy depends crucially on the growth rate of the labor force, an exogenous variable.”\textsuperscript{139}

Thus, this empirical model is almost identical to the model presented here, universities or profit-seeking companies invest in R&D and the discovery of new designs, which are linked to an increase in productivity. However, for the innovation-led growth to take place there must a talented and growing workforce in place. The workforce, including the scientists which are crucial to the R&D and S&T, are the exogenous variable necessary for the process to produce growth. Benat Bilbao-Osorio and Andres Rodriguez-Pose, using a linear model for the European Union region, found that, “the results indicate the presence of a positive link between R&D activities and the genesis of innovation. However, not all research sectors are equally productive

\textsuperscript{139} Ibid., p. 779.
in terms of innovation production. Research activities performed by the private sector have higher rates of return than research conducted by other sectors. These results were expected as privately funded research tends to be more applied – more commercially oriented – and because innovation was measured by the number applications for patents, which by nature have strong commercial orientation.⁴⁴⁰ These researchers found that not only did R&D activities generate innovation and growth, but profit-seeking sectors were better at producing growth than other sectors – i.e. universities. The ILG strategy recommends that applied research is to be pursued intensely, and for that to happen the economic environment must be ripe for R&D in the private sector. However, this does not discount universities. In order for the private sector to have the talent necessary for applied research, the education system of a nation must be heavily invested in. There is a cycle, increased investment in universities will increase the talent pool and attract profit-seeking companies, which will in turn create more R&D and innovation, which will lead to increased economic growth. Thus, the economic structure of a region will play an important part in the genesis and assimilation of innovation. A predominately agricultural region is less likely to generate large numbers of patents, as agriculture – and especially traditional agriculture – does not tend to be as innovative as other sectors. Conversely, certain sub-sectors within the manufacturing and service sectors may be more prone to foster innovation. Regions which rely on technologically advanced sub-sectors have a greater tendency toward innovation. Other studies have focused on the empirical kink – or lack thereof – between R&D and total factor productivity.

Much of the research on R&D-led growth has focused on measures of knowledge and total factor productivity (TFP). These models are often called ideas-based growth models – the

innovation-led growth strategy is not an ideas-based model. Ideas are only one part of the ILG model and ideas should not be pursued in and of themselves. Applied R&D may be ideas-based, but innovations lead to economic growth though the ability to patent, market, and sell the fruits of the ideas. Ideas must be investment-specific. In this case, the ideas contribute to economic growth through the factor accumulation process, and do not enter TFP directly. Measured TFP may then display only a weak relationship with indicators of new knowledge, even if technical knowledge is the predominant factor in economic growth.\textsuperscript{141} Robert M. Samaniego develops a model which takes ideas-based growth and uses investment-specific ideas to determine their effect on economic growth. If ideas lead to growth through investment-specific technical change, this is itself an indicator of the quantity of economically relevant knowledge in use. Samaniego uses price data to construct an implicit series for the knowledge of stock, and compare it to a measure derived from a more traditional indicator: patent activity. Using this model, he found that, “the empirical evidence is in fact consistent with a simple aggregate framework in which economic growth is driven by the production and implementation of new knowledge.”\textsuperscript{142} Investment-specific R&D does drive economic growth, while research for the sake of research lacks the statistical connection. Nations must seek applied research, and applied research is usually derived by profit-seeking entities. The brief account of the literature presented here demonstrates that in many cases empirical evidence does exist to affirm the link between R&D and economic growth. First, there is evidence in many cases to suggest that any investment in R&D can lead to economic growth, if only minimal – but generally statistically significant. In addition, the research demonstrates that applied research is much more conducive to economic


\textsuperscript{142} Ibid., p. 4.
growth than other forms of research. There is some dissent, however, when it comes to “scale effects” discussed above. In the aggregate the research on R&D and economic growth presents a positive correlation between increased spending and investment on R&D and economic growth, with the caveat that the research is focused on investment-specific or applied innovation – which can be used in a market context to contribute to GDP, mostly through patents.

This paper argues that investment-specific R&D must be the second pillar of the innovation-growth hypothesis. Developing nations and Developed nations must implement policies which inspire the private sector to conduct applied research and churn out patents. In essence, the implications of this approach are that the higher the investment in R&D, the higher the innovative capacity, and the higher the economic growth. Nations and regions that invest in more R&D, generally tend to innovate more, and often grow faster. Creative destruction will naturally take place in the domestic economy as foreign and domestic firms compete against each other in innovation, creating more patents and more economic growth. Thus far this report has argued that, in order to pursue the innovation-led growth strategy, nations should: (1) cultivate domestic talent and attract the best talent from all over the world; and (2) invest heavily in R&D (government spending and private firms) and create an environment that generates profit-seeking, private, and investment-specific R&D that has market specific uses – patents that translate into economic growth. The final section pertaining to the development of the ILG strategy will discuss the last element necessary to ensure economic growth. The third pillar of the innovation-led growth hypothesis is the pursuit of economic freedom – specifically, the correlation between economic freedom and economic growth, monitored by the Heritage Foundation.
The Link between Economic Freedom and Economic Growth:
The Index of Economic Freedom

The third pillar of the innovation-led growth strategy is not related to innovation in the traditional context and has not been explored in the literature on R&D and growth. However, economic freedom is vital to innovation-led growth. The Heritage Foundation's report on Economic Freedom / Index of Economic Freedom states, “Over the past years, the Index has documented the link between economic opportunity and prosperity, researching and analyzing economic policies in countries around the world. That trend continues in the 2008 Index, which paints a portrait of economic freedom around the world and establishes a benchmark by which to gauge a country’s chances of economic success.”¹⁴³ Freedom is directly correlated with economic prosperity and growth. The Index of Economic Freedom uses several indicators to rate the countries of the world. Yet the Index is more than a simple ranking based on economic theory and empirical study. It also identifies the variables that comprise economic freedom and analyzes the interaction of freedom with wealth. The 2008 Index of Economic Freedom covers 162 countries across 10 specific factors of economic freedom: (1) Business Freedom, (2) Trade Freedom, (3) Fiscal Freedom, (4) Government Size, (5) Monetary Freedom, (6) Investment Freedom, (7) Financial Freedom, (8) Property Rights, (9) Freedom from Corruption, and (10) Labor Freedom.¹⁴⁴ Each of these elements make up the economic freedom score in the aggregate and each effects the ability to (1) attract and cultivate the best talent and (2) develop an environment conducive to private, investment-specific R&D. According to the Heritage Foundation, “A systematic analysis of the 10 freedoms has demonstrated again this year that economic freedom is the key to creating an environment that allows a virtuous cycle of

¹⁴⁴ Ibid.
entrepreneurship, innovation, and sustained economic growth and development to flourish. Economies with higher levels of economic freedom enjoy higher living standards. According to the Index of Economic Freedom report, economic freedom is strongly related to good economic performance. The world’s freest countries have twice the average per capita income of the second quintile of countries and over five times the average income of the fifth quintile. The freest economies also have lower rates of unemployment and lower inflation. These relationships hold across each quintile, meaning that every quintile of less free economies has worse average rates of inflation and unemployment than the preceding quintile has. Thus, economic freedom is the perfect final component to the innovation-led growth strategy. The report goes on to state, “There are clear relationships between economic freedom and numerous other cross-country variables, the most prominent being the strong relationship between the level of freedom and the level of prosperity in a given country. Previous editions of the Index have confirmed the tangible benefits of living in freer societies. Not only is a higher level of economic freedom clearly associated with a higher level of per capita gross domestic product, but those higher GDP growth rates seem to create a virtuous cycle, triggering further improvements in economic freedom.”

The scatter plot with the line of best fit below demonstrates the strong link between economic freedom and economic growth, mainly GDP per capita. Essentially, a good theory of economic growth should include an economic freedom component. Moreover, the innovation-led growth model necessitates an economic freedom component. The next section will discuss each constituent of economic freedom and how it relates to the innovation-led growth strategy.

145 ibid.
146 ibid.
Business freedom measures how free entrepreneurs are to start businesses, how easy it is to obtain licenses, and the ease of closing a business. Impediments to any of these three activities are deterrents to business and therefore to job creation. Globally, starting a business takes an average of 43 days, while getting necessary licenses takes an average of 19 procedures and 234 days. Bankruptcy proceedings take an average of three years. Business freedom is very important to ILG. Businesses have to be persuaded to settle in a country — globalization allows for MNCs to move anywhere in the world. In order to attract private, investment-specific R&D, a nation must have sufficient levels of business freedom. In addition, having the best talent will be

\[147\] Ibid.

\[148\] Ibid.
useless if businesses are reluctant to invest in a nation. Entrepreneurs are the basis of innovation and they must be able to freely and easily invest. Thus, business freedom will result in new businesses, more jobs, increased R&D, more innovation, and thus increased economic growth.

Trade freedom is also a very important element to the ILG strategy. According to the Index of Economic Freedom, “Tariffs are the primary obstacle to free trade among nations, but non-tariff barriers (NTBs) such as quotas and bureaucratic delays are also significant impediments. The overall trade freedom score is composed of these two elements. The first component is a score calculated from each country’s weighted average tariff rate and ranges from 0 to 100 percent – the higher the score, the lower the tariff rate. The mean worldwide tariff rate is 11.1 percent. A country with that rate would receive a score of 80 percent. Depending upon the severity of a country’s NTB barriers, a penalty of 5, 10, 15, or 20 percentage points is subtracted from the weighted average tariff rate score to arrive at each country’s overall trade freedom score. The global average trade freedom score for 2008 is 72 percent.” Trade freedom does not seem as if it directly relates to the ILG strategy. However, free trade in goods and services provides an outlet for the market based, investment-specific innovation. When nations develop new technologies and apply for patents in a series of countries, such nations will be able to export their new technologies to promote economic growth. Part of the benefits associated with ILG is the ability for nations to export the innovations and take advantage of economies of scale. Homegrown R&D will not only lead to economic growth through sales in the domestic economy, but expanding the scale of operation through trade will allow for even greater economic advances – especially for developing nations whose populations may not always be able to afford innovations created in their home country. Thus, the ability to trade freely with other nations is vital to the ILG strategy.

\textsuperscript{49} Ibid.
Fiscal freedom – or keeping corporate taxes low – is also important to attract investment and keep businesses happy. However, fiscal freedom is not a vital element to the ILG strategy. A nation can have high tax rates and still have large private investment in R&D. However, these nations tend to be in the EU and North America – they tend not to be developing nations, they can afford higher taxes as businesses receive other benefits from operation in developed countries. However, developing countries may want to offer tax incentives to MNCs in order to attract their investment. And developed countries, while they have an advantage, should also be aware of the fact that developing nations that offer significant cost reduction in labor, taxes, loans, and other incentives may begin to take more share of global investment in up-coming years. Thus, both developing and developed nations should be aware of fiscal freedom. Although government spending is used as an economic freedom indicator – the lower the spending the better the score – this paper actually recommends that the government increase spending on the education system (i.e. from primary education to universities), infrastructure, and all public goods necessary to create a positive business environment. In addition, the Heritage Foundation also recommends that nations spend only on truly public goods – this dovetails with the ILG strategy as nations must have solid infrastructure to implement the ILG strategy; and thus, only nations that are in the economic stages of take-off, drive to maturity, or age of mass consumption may be able to implement the ILG strategy.

Monetary freedom, investment freedom, and financial freedom are all crucial to the ILG theory. According to the Index of Economic Freedom, “Price stability explains most of the monetary freedom score, although there is a penalty of up to 20 percentage points for countries that use price controls. Price controls and wild inflation are devastating to the business environment and detrimental to the ILG strategy. Monetary policy must be in order before
businesses will invest heavily in R&D – otherwise businesses that do invest will be resource-seeking investors. R&D investment requires a long-term agenda. Investment freedom is even more important; countries with high investment freedom impose few or no restrictions on foreign investment, which promotes economic expansion and enhances overall economic freedom. Financial freedom is also extremely important. The more that banks are controlled by the government, the less free they are to engage in essential financial activities that facilitate private sector-led economic growth. Regrettably, most countries continue to impose a heavy burden of bank regulation on the private sector, reducing opportunities and restricting economic freedom.\textsuperscript{150} In order to attract investment-specific R&D, businesses must have the ability to borrow money and invest money freely. In addition, the promotion of foreign direct investment is necessary to attract foreign R&D, which will diffuse technology and the innovation capability across national borders.

The last three economic freedom indicators used by the \textit{Heritage Foundation} are property rights, freedom from corruption, and labor freedom. Property rights, including intellectual property rights (IPR), are a key element in the ILG theory. Businesses must feel comfortable that the innovative new products they invent will be safe – if no intellectual property rights regime exists, then the ILG strategy will be ineffective. Businesses will shy away from investment in nations that do not protect IPR. Corruption is still rampant among many developing countries and developed countries. Nations should try to diminish corruption; however, it is not substantially vital to the ILG strategy. Corruption is never good and all nations should combat its consequences. Lastly, labor freedom is vital to the ILG strategy. According to the Index, “Labor market flexibility is essential to enhancing employment opportunities and overall productivity growth. The rigidity of hiring and firing a worker creates a risk aversion for companies that

\textsuperscript{150} Ibid.
would otherwise employ more people and grow."\textsuperscript{151} Also, labor freedom is essential to keeping the best and the brightest in the nation. People must have the freedom and employment opportunities necessary to keep them happy – as discussed in terms of pillar one of the ILG strategy.

The three pillars of the innovation-led growth hypothesis are (1) the cultivation and attraction of talent, (2) the pursuit of large quantities of private, investment-specific R&D, and (3) the implementation of policies that equate to economic freedom as defined by the \textit{Heritage Foundation’s} Index of Economic Freedom. These three components combined are conducive to economic growth for developing and developed nations. However, one caveat is that the developing nation must be in one of Rostow’s final stages of economic growth: the take off, the drive to maturity, or the age of mass consumption. Utilizing the innovation-led growth strategy, nations will be able to growth their economies faster and better than nations stuck pursuing the export-led growth hypothesis or the import-substitution model of growth. This is because the future of global economics rests in the “empires of the mind.” Thus, the nations that harness innovation-led growth the best will be able to compete in the ever integrating global economy. The next section of this paper uses the People’s Republic of China as an example of a nation, which has pursued the export-led growth strategy with massive success, shifting to an innovation-led growth strategy to continue their economic growth in future.

\textit{The PRC’s Shift – Innovation-Led Growth in China}

The People’s Republic of China has pursued an export-led growth strategy since the country’s economic opening in the late 1970s. Despite the mixed research on China and the export-led growth hypothesis – as discussed in the first half of this paper – many scholars accept the fact that the PRC has pursued, at least in policy, an export-led growth approach to economic

\textsuperscript{151} Ibid.
development. This report postulates that the PRC is shifting from an export-led growth strategy to an innovation-led growth strategy. The transformation began in the early 2000s. By 2005, the shift was beginning to take root among the companies of the PRC. In December 2005, Xinhua, the official press agency of the PRC, stated that “In South China’s booming city of Shenzhen, 93 innovative companies have set up their own research and development labs... In Shenzhen, local companies have become the incubator for home-bred innovation... Of the 727 research labs and centers, 697 are in high tech companies specializing in electronics, medical equipment, new materials, computers, and biological products. Local companies have played a key role in promoting home bred innovation... In Shenzhen, 9 percent of the research institutes, research staff and research funds are from local companies and 90 percent of the patents are applied for by companies... In total, the city will have 60 key state labs and research centers... Companies are market oriented so combining research and production is beneficial... A company called Skyworth is a fine example of how research and development pays off. Its self developed technology not only saves the company from having to purchase advanced technology from foreign companies it also sells its own technology to overseas companies.”

The companies in Shenzhen are a primary example of the second pillar of the ILG strategy. The local companies are performing investment-specific R&D and exporting it overseas, contributing to Gross National Product. Essentially, the ILG strategy combines the export-led growth approach and the import-substitution approach, as innovative companies do not need to rely on foreigners for advanced technology (import-substitution) and the same companies are exporting their new technologies abroad (export-led). The so called “home-bred” innovation is exactly what the ILG approach necessitates. While innovation must come from investment-specific R&D for the ILG

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approach to be successful, the government must also lead the nation in an appropriate economic
direction. The PRC national government has strongly pushed for a national innovation-led
growth strategy and it has pursued several nationwide policies in the direction of ILG.

Hu Jintao, the current president of the PRC, has stated that innovation holds the key to
progress. In January 2006 he officially called upon his country to “Turn China into an
innovation-oriented country in 15 years.”\textsuperscript{153} He went on to tell a national conference on Science
and Technology that, “To do so would require arduous efforts and broad, profound social
reform.” This statement encompasses pillar number three of the ILG approach. Social reform
will be necessary to both attract the best foreign talent and give entrepreneurs the freedom to
invest in innovation. The conference where Hu Jintao made his speech was the first of its kind in
more than a decade. The President went on to explain that, “Enhancing the country’s innovation
capability would benefit the Chinese people by improving their living standards... Innovation is
the core of the nation’s competitiveness and the strategic motif of China’s science and
 technological development.”\textsuperscript{154} In this ground breaking speech, Hu Jintao discussed some of the
key elements of China’s new innovation-led growth strategy. The key elements in building an
innovation-oriented society are as follows: (1) enhancing science technology innovation
capabilities, (2) using innovation to readjust industrial structures, (3) shifting growth modes, (4)
building a conservation-minded and environmentally friendly society, and (5) making “enhanced
innovation capabilities” a national strategy.\textsuperscript{155} Currently, there are only a few innovation-
oriented countries, such as the United States and Japan, whose research and development (R&D)
expenditures constitute more than 2 per cent of their gross domestic product (GDP), and less than

\textsuperscript{153} Zhang Lihong, “Innovation ‘Holds Key To Progress,’” \textit{China Daily}, (January 10, 2006), Accessed: February 20, 2008, Online:
\textsuperscript{154} Ibid.
\textsuperscript{155} Ibid.
one-third of their technologies are reliant on imports. According to Wang Yuan, the director of the Chinese Institute for Promotion and Development of Science and Technology, in China the share of GDP devoted to R&D was 0.69 percent in 1998 and 1.23 percent in 2004; and the country relies on imports for many key technologies. Wang, who took part in drafting China's medium-and-long-term scientific and technological development program, said that without significant scientific and technological progress and a fundamental shift in the mode of economic growth, it will be hard for the nation to achieve the target of quadrupling its 2000 gross domestic product by 2020. President Hu said China would embark on a new path of innovation, seeking to leapfrog development in vital areas and making breakthroughs in key technologies to achieve the urgent requirement of sustained and coordinated economic and social development. He urged all related departments of the central and local governments to consider the development of science and technology; especially by raising innovation capability, as a strategic investment by increasing financial input. More importantly, Hu acknowledged that in order to truly embrace innovation-led growth, China would need to step up intellectual property rights by improving the protection system and laws and regulations while severely cracking down on violations. Most importantly, Hu Jintao strongly noted that, “Highly-skilled people are the key to scientific innovation,” and he added that, “the country would train world class scientists, especially young and middle aged [individuals].” Lastly, the speech specified that, “The country should not only inherit and develop traditional culture but also absorb the advantages of the cultures of other countries,” – here Hu was specifically acknowledging the fact that foreign talent must be acquired, in addition to the cultivation of domestic skilled labor. In this ground breaking 2006 speech Hu Jintao laid out the PRC’s innovation-led growth strategy to economic development –

\[150\] Ibid.  
\[157\] Ibid.
it has all the elements of the ILG approach described above, (1) the cultivation and attraction of “highly-skilled people key to scientific innovation,” (2) enhancing science and technology innovation capabilities, and (3) Social reform. By far, China’s biggest challenge will rest in the third pillar of the ILG approach. However, they are currently succeeding in the first and second pillars. The PRC calls their ILG approach a shift toward an “innovation-oriented country” and has been developing the nation-states medium-and-long-range scientific and technological development program since 2003. Hundreds of experts formulated the policy and the Premier, Wen Jiabao, and the President, Hu Jintao, have stated that the program should be followed to the letter to push forward the country’s scientific progress.\(^{158}\) Immediately after the government released this new national strategy the Chinese Academy of Sciences (CAS) was given the job of building a cluster of technological innovation bases over a five year period to meet the surging construction demand in the country. The innovation bases covered a wide range of academic subjects including information technology, space science, advanced energy, manufacturing and new materials, health and medicine, agriculture, biology, and the environment. The CAS has stated that the innovation bases will break through the barriers set by different research categories and institutes and make a better use of current research resources. Most importantly, the CAS will strengthen cooperation with local universities and colleges to promote education in science and research. It will also join hands with enterprises and local governments to boost the regional economy and social development. Prior to the new innovation bases initiative the CAS had already come up with some interesting research results, including application systems for manned space programs, the key technology for the construction of the Qinghai-Tibet Railway,

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genome and nanometer research findings. The PRC has begun to transform its current growth mode – export-led development – to its new growth mode – innovation-led development. Both the government – with its new National Strategy – and private enterprises – with their home-bred innovation – are attempting to make the Chinese society innovation-oriented.

The PRC believes the most critical factor in building an innovation-oriented country is to improve independent or private investment specific innovation capacity. Professor Bai Chunli, Executive Vice President of the CAS, has stated: “Enhancement of the independent innovation capability is key to success in the effort to develop China into an innovation-oriented country. Scientific and technological personnel must be confident in their ability of making original innovations. On no account must we limit ourselves to following what has been done outside China and dare not to do things not yet done by foreign countries... an innovation-oriented country has the following characteristics. First of all, such a country takes scientific and technological innovation as the point of consideration. Second, its overall competitiveness is strong. Third, it has high indices for comprehensive measurement of innovation capacity, including the number of invention patents registered with major developed countries such as the United States, Japan and those in Europe, as well as the number of qualified engineers and scientists. Fourth, science and technology are responsible for not less than 70% of the economic growth achieved by such a country. Fifth, the country should have low dependency on imported technologies. Sixth, the input for R&D should account for not less than two percent of the country's annual GDP... By "independent innovation capability," we mean three things. It means, first of all, original innovations in science and technology, which constitute the foundation and source of all other innovations. Then comes integrated innovation for

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development of key technologies, a process in which many technological innovations are integrated, culminating in the production of a new product. Third, it means re-innovation on the basis of acquiring and absorbing imported technologies... Enterprises should be given the main role to play in integrated innovation and innovations on the basis of importing and absorbing foreign technologies. This means that enterprises should be made the main investors and players in R&D while the main force for industrial application of research achievements... To develop into an innovation-oriented country... China should, first of all, strive to accelerate the reform of its scientific and technological system, in particular the development of a national innovation system. To achieve the purpose, it is necessary to bring into full play the leading role of the Government, the fundamental role of the market in distribution of the resources, and the role of enterprises as the main players in technological innovations. At the same time, there is the need to allow a still bigger role to national research institutions as the backbone force and leader of the entire state innovation system and let the universities be the foundation and a vital new force in the country's innovation-oriented endeavor. Work should be done to ensure joint effort and coordination among these forces to achieve the objective. Second, the Government, on its part, should attach still greater importance to the development of basic research, universally applicable technologies and key technologies. Third, more work should be done in energy resources and environmental development. Four, protection of intellectual property rights should be strengthened. By this, we mean to abide by those international rules but more importantly, to place our own innovation achievements under sufficient protection. The initiative for independent innovations will be dampened in the absence of legal environment conducive enough to protection of intellectual property rights."

160 Zhang Lihong, “Pool Efforts to Build up National Innovation System,” CAS.cn. (January 23, 2006), February 20, 2008,
As soon as the PRC government released its 15 year strategy for an innovation-oriented society, the nation began to react. In a matter of a few months – from December 2005 – February 2006 – the PRC began to implement innovation incentive policies. China’s State Council in Beijing began to implement the medium-and-long-term plan for science and technology development from 2006-2020 by implementing incentives that include: (1) promised increases of research and development expenditures, (2) favorable taxation policies towards innovation-oriented enterprises, and (3) financial supports and government procurement. In addition, specific policies will also be worked out for licensing of alien technologies, intellectual property protection, human resources, improvement of public science awareness, and favorable policies for state key research labs. The state has begun to implement the necessary incentives required to inspire innovation in the private sector, as well as the various state research centers. With China’s economy still being about 50% state owned (communist), state R&D centers can act in a similar manner to investment-specific R&D because much of the investment goes into market-based activities. Also the protection of intellectual property rights is necessary for the PRC to implement the ILG approach. In order to encourage innovation, intellectual property rights (IPR) must be secure. China is a member of the World Trade Organization; however, it continues to have a horrible record on protecting IPR. The social environment must be changed to respect IPR, as many small business owners still disregard IPR and continue to produce and sell bootlegs and knockoffs in astounding quantities and at astounding rates. Nonetheless, on the local level some progress is being made. Huang Huahua, governor of Guangdong has stated that his Province is, “Vowing to create a social environment encouraging and protecting independent

innovation... The province will improve policies to encourage and support self-innovation initiatives and help the cities of Guangzhou and Shenzhen turn into innovation pilot cities of the nation this year... And the province will redouble efforts to improve the system for technological innovations while improving measures to protect intellectual property rights (IPR)... companies themselves had to take more responsibility as well... Innovation is by no means empty talk. It requires the endeavors of domestic enterprises to carry it out, as well as the efforts of the government to create a good environment ranging from policies and service systems, to IPR protection for self-innovation... hinges heavily on R&D work, which entails major capital input... Without enough IPR protection, very few enterprises, if not none, will choose to be innovative.”

Professor Yang Yonghua, Director of South China Normal University’s National Economy Research Institute stated that, “self-innovation will be a breakthrough for the upgrade of the economy in Guangdong and a possible solution to the problem of energy shortages in the province. In addition, he insists that, “the province should also make greater efforts to cultivate and secure high-calibre scientific and technological professionals and expand the scale of higher education, basing his idea on the fact that innovation needs an ample supply of well-educated professionals.”

In 2001 China ranked 28th of 49 major countries in terms of comprehensive scientific and technological innovation capability. The Minister of Science and Technology, Xu Guanhua stated that “We have to move 10 places ahead and enter the ranks of the first 20 before we can say that we have succeeded in achieving the target.”

In addition, he believes that China must maintain at least an annual growth of 7 percent for 40 years in order to meet the target of building a moderately prosperous society across the country by 2020.

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163 Ibid.
The Chinese government allocated over 70 billion yuan, or more than 8 and a half billion U.S. dollars (2006 exchange rate) in 2006 for investment in science and technology; this was an increase of nearly 20 percent from the previous year. In 2006 China had about 38.5 million scientific and technological personnel, including 1.09 million research and development staff, ranking first and second in the world respectively. Xu Guanhua states that these people are “the most precious assets that other countries don’t possess.”\textsuperscript{165} China is on its way to developing strong scientific and technological power – its research and development capability has reached the world’s advanced level in some sectors, such as biology, nanotechnology, and space flight. China’s cultural tradition, emphasis on education, dialectics, collectivism, and knowledge accumulation are all favorable to promoting innovation. The CAS has been the backbone of the entire transition. The Chinese Academy of Sciences’ efforts to reinvent itself through the “Knowledge Innovation Program” (KIP) helps ensure a central role for CAS in China’s emergence as a major player in international research and innovation.\textsuperscript{166} However, the Provinces also play a huge role in innovation development – it is the Provinces that will lead the way toward home-bred or indigenous innovation. In addition, it is the Provinces that bring the peasants into the fold.

Shanghai has been China’s economic hub since its opening in 1978. More importantly, villages in Shanghai – such as Langxia – are modern and well developed compared to other Chinese Provinces located further inland. In order for China to truly succeed the countryside will have to catch up with the cities – in terms of development and industry. Many scholars believe that Shanghai and its focus on indigenous innovation have contributed – to some extent – to the


prosperity of the villages in the Province. However, there are other factors, such as the fact that Shanghai was one of the first regions opened up during the beginning of China's economic opening in the 1970s. Regardless, greater R&D investment in the Province of Shanghai has contributed to its aggregate prosperity.\(^{167}\) The provincial and regional level will play an integral part in the innovation-led approach. The PRC Government has also developed a package of policy incentives and increased public funding to bolster research and development in 103 innovation-driven companies. China Aerospace Science and Technology Corporation and 14 other key state-owned enterprises, 77 private companies, and 11 research institute businesses are on the Ministry of Science and Technology (MOST) list for state support. Li, Vice Minister of Science and Technology, stated, "By nurturing China's innovative companies, the government aims to help sharpen their competitive edges. These companies are expected to set an example for other Chinese enterprises that wish to profit in the knowledge-based economy. The list will be extended to about 500 firms in the next three to five years... The 103 innovation-driven companies are not permanently on the list and those lacking momentum in further developing new technologies will be removed... The ministry would help in the establishment of research and development centers at the companies as well as offer financial advice, technical training, and support in protecting intellectual property rights."\(^{168}\) Although, it is clear that the PRC is shifting their modus operandi for growth, they still have a long way to go. Aside from domestic funds, the PRC is also using foreign capital to encourage innovation.

In October of 2006 China's Ministry of Commerce began changing its strategy on foreign investment. They wanted to lure foreign capital through market forces rather than administrative


industry should maximize its advantages in science and technology, as well as human talent, to contribute to the sustainable development of the economy. Shaanxi is one of China’s traditional bases for the defense industry, and the province aims to build an industry chain that centers upon space technology. Shaanxi also wants to expand its expertise to information technology, new materials, new energy, software and equipment manufacturing. The defense industry has become an economic engine for the province as more military manufacturers add profit-making civilian product lines. Statistics from the Provincial Commission of Science, Technology and Industry for National Defense (CSTIND) showed that 20 of the 300 civilian products in mass production each generated more than 100 million yuan (about 13.51 million U.S. dollars) in 2006. The aggregate output generated by civilian products manufactured by the local defense industry has risen 11 percent annually since 2000, when it stood at from 5.6 billion yuan (about 757 million U.S. dollars) to 10.2 billion yuan in 2005 (1.38 billion U.S. dollars). Overall, the output of civilian-use products as a percentage of the total output of the national defense industry jumped from less than 10 percent in 1978 to 65 percent in 2006. Nearly 200 civilian products each have yearly sales of more than 100 million yuan, and there are 20 products that generate at least 1 billion yuan a year.\(^{170}\) China has an advantage in its ILG approach as the country is able to pool together all of its resources, from the CAS to the Department of Defense, to collectively pursue innovation as a national strategy. Hu Jintao has not only devised an ILG strategy, but he has placed it at the top of his economic agenda.

At the 17\(^{th}\) National Congress of the Communist Party (CPC) Hu stated that, “This [innovation] is the core of our national development strategy and a crucial link in enhancing the overall national strength.” While delivering the report on behalf of the 16th CPC Central

Committee, Hu made it clear that innovation was the new economic development approach. He pledged to increase spending on independent innovation and make breakthroughs in key technologies vital to economic and social development, saying China will speed up forming a national innovation system and support basic research, research in frontier technology and technological research for public welfare. He said the country will step up efforts to establish a market-oriented system for technological innovation, in which enterprises play the leading role, and encourage formation of internationally competitive conglomerates. He went on to say, China will “support domestic enterprises in carrying out international operations of R&D, production and marketing, and accelerate the growth of Chinese multinational corporations and Chinese brand names in the world market.” 171 Hu also vowed to deepen reform of the system for managing science and technology, implement the strategy for intellectual property rights, and make the best use of international resources of science and technology. In December 2007 China’s State Council, or the cabinet, approved three national technological projects in the fields of telecommunications, water pollution control, and pharmaceutical manufacturing innovation – specifically, a next-generation broadband wireless mobile communication networking, water pollution control and treatment, and the manufacture and innovation of key new drugs. All three projects are a part of the Medium-and-Long-Term 15 Year R&D Plan. The next-generation communication network represents the main direction of communications development. Applying it will greatly enhance the overall competitiveness and innovative capacity of China’s wireless mobile communication, and lift the industry to a more advanced world level. The water pollution control project would provide solid technological support to address environmental woes of major water sources including the Yangtze River and Yellow River, to achieve an

“energy saving and emission reduction” goal. Finally, the drug innovation project would target the treatment and prevention of serious diseases and innovation of key drugs so as to offer the public safe, effective and cheap medical products.\textsuperscript{172} In addition, China has set up a pioneering approach to technological transfer and diffusion. CAS President Lu Yongxiang, stated, “It is of importance for Chinese Academy of Sciences (CAS) to join forces with local governments and enterprises to set up technology transfer centers so as to convert scientific findings from research laboratories into productivity.”\textsuperscript{173} Taking research and producing productivity is very important – it is the reason why investment-specific R&D is highly correlated with economic growth. In order to promote technological transfer and diffusion, the CAS has established nine technology transfer centers. They play a vital role as a platform for communication and transmission of CAS technologies into the private sector – where innovation can be utilized to produce market based productivity – R&D can become applied R&D.

Vice Premier Zeng Peiyan sums it up well, “In promoting economic growth, the focus of our efforts will be shifted from relying mainly on investment and export to stimulating consumption and steadily increasing the consumption rate; from relying mainly on manufacturing industry to promoting the growth of agriculture and services industries and increasing the share of the service sector in economic output.”\textsuperscript{174} The export-led growth strategy cannot produce long-term sustainable economic development. Only consumption and innovation can allow nations to compete in the new global economy. It can be illustrate through Chinese economic development policies, speeches made by the PRC leaders, and the actions of the CAS

that China is attempting to make a shift from export-led growth to innovation-led growth. China’s investment in the cultivation, attraction, and retention of highly-skilled labor reflects the first pillar of the ILG growth model discussed earlier in this paper. In addition, China’s increased investment in R&D and S&T – especially investment-specific and productivity enhancing R&D – fulfills the second pillar of the ILG model. However, despite claims from the PRC of an open society, China is still lacking on the final pillar – economic freedom.

China currently ranks only 126 out of 157 on the Heritage Foundations’ 2008 “Index of Economic Freedom.” Regionally they rank 23 out of 30. However, China’s economic freedom is increasing from year to year. Nonetheless, they have a long way to go before they have reached the level of the top performers – Hong Kong, Singapore, Ireland, Australia, and the United States being the top five, respectively. Interestingly, while Hong Kong (which is a part of China, but still very separate) is 90.3 percent free, China is only 52.8 percent free. According to the Heritage Foundation, “China scores well in government expenditures and equals the world average in trade freedom, monetary freedom, and labor freedom. Formal central government expenditures equal less than 20 percent of GDP, which is low compared to other major economies. China severely restricts many areas of its economy and consequently scores lower than average in seven of the 10 economic freedoms. Investment freedom, financial freedom, and property rights are very weak. Foreign investment is highly controlled and regulated, and the judicial system is highly politicized. The state maintains tight control of the financial sector and directly or indirectly owns all banks.”

China is a one-party state ruled by the Chinese Communist Party. Despite rhetoric about democratic development, the party maintains strict control of political expression, speech, assembly, and religion. Since opening up to foreign trade

in the early 1980s, China's economy has expanded rapidly. It is now the world's second-largest economy in absolute terms, although per capita income remains low. Most workers are employed in the agricultural sector. The financial sector is largely opaque and state-controlled, raising concerns about lending practices. Since joining the World Trade Organization in 2002, China has liberalized many sectors of its economy, but it still suffers from the lack of a rule of law, poor protection of intellectual property rights, and corruption, among other hurdles.\textsuperscript{176} Despite its problems China’s score has risen by 1 percentage point from 2007.

China has 50\% business freedom. The overall freedom to start, operate, and close a business is constrained by China's national regulatory environment. Starting a business takes an average of 35 days, compared to the world average of 43 days. Obtaining a business license requires more than the world average of 19 procedures and 234 days. China lacks legal and regulatory transparency.\textsuperscript{177} China is 70.2\% free on Trade Freedom. China's weighted average tariff rate was 4.9 percent in 2005. The government has reduced its non-tariff barriers pursuant to WTO accession, but severe import bans and restrictions, inconsistent customs valuation, non-transparent tariff classification, inefficient and corruption-prone customs administration, and issues involving the protection of intellectual property rights add to the cost of trade. An additional 20 percentage points is deducted from China's trade freedom score to account for these non-tariff barriers.\textsuperscript{178} China was rated 66.4\% free on Fiscal Freedom. It has a high income tax rate and a moderate corporate tax rate. The top income tax rate is 45 percent, and the top corporate tax rate is 33 percent. Other taxes include a value-added tax (VAT) and a real estate

\textsuperscript{176} Ibid.
\textsuperscript{177} Ibid.
\textsuperscript{178} Ibid.
tax. In the most recent year, overall tax revenue as a percentage of GDP was 15.8 percent.\(^{179}\) China was rated 89.7\% on Freedom from Government. Government expenditures, including consumption and transfer payments, are relatively low. In the most recent year, central government spending equaled 18.5 percent of GDP. Consolidated government spending (including local government spending and other expenditures on social security) is estimated to be more than 30 percent of GDP. The state still guides and directs much economic activity.\(^{180}\) China is rated 76.5\% on Monetary Freedom. Inflation is relatively low, averaging 1.8 percent between 2004 and 2006. Relatively stable prices explain most of the monetary freedom score. The market determines the prices of most traded products, but the government maintains prices for petroleum, electricity, pharmaceuticals, coal, agricultural products, and other "essential" goods. Subsidies allow state-owned enterprises to produce and sell goods to wholesalers and retailers at artificially low prices. An additional 15 percentage points is deducted from China's monetary freedom score to adjust for measures that distort domestic prices.\(^{181}\) China was rated 30\% on Investment Freedom. Weak rule of law, lack of transparency, domestic favoritism, and a complex approval process remain major obstacles. Legally, foreign investment is allowed only in specific sectors. Government "encouragement" of foreign investment in certain geographic and high-value-added areas constitutes state action that could violate WTO rules. The central bank regulates foreign exchange, and the government controls investment in the stock market. There are extensive controls on foreign exchange, current transfers, and capital transactions.\(^{182}\) On Financial Freedom China scores 30\%. China's complex financial system is tightly controlled by the government. Roughly 35,000 financial institutions were operating in early 2006. The banking

\(^{179}\) Ibid.
\(^{180}\) Ibid.
\(^{181}\) Ibid.
\(^{182}\) Ibid.
sector is the largest part of the system and is almost entirely state-owned. Four state-owned banks account for over 53 percent of assets. The state directs the allocation of credit, and the big four state-owned banks lend primarily to state-owned enterprises. Numerous foreign banks have opened branches but face burdensome regulations, though progress has accelerated since China joined the WTO. Foreign participation in capital markets is limited. A weak social security net has encouraged a competitive, market-driven insurance sector to emerge from a state-run monopoly. The lack of a social security net has also infringed upon consumer spending, as the citizenry horde their money in case of emergency and/or retirement. When it comes to Property Rights China has its lowest score, 20% free. China's judicial system is weak, and many companies resort to arbitration. Even when courts try to enforce decisions, local officials often ignore them with impunity. All land is state-owned, but individuals and firms, including foreigners, can own and transfer long-term leases for land use (subject to many restrictions), as well as structures and personal property. Under a new Property Law, residential property rights will be renewed automatically, and commercial and industrial grants should be renewed absent a conflicting public interest. Intellectual property rights are not enforced effectively. Copyrights, patents for inventions, brands and trademarks, and trade secrets are routinely stolen. This is a big problem for ILG – companies must feel secure that their innovations will not be stolen; if profit cannot be made from innovation, no one will be inspired to provide monetary support for investment-specific R&D. China's third lowest score was in Freedom From Corruption, it was only 33% free. Corruption is perceived as significant. China ranks 70th out of 163 countries in Transparency International's Corruption Perceptions Index for 2006. Corruption limits foreign direct investment but affects banking, finance, government procurement, and construction most

\[183\] Ibid.

\[184\] Ibid.
severely. China ratified the U.N. Anti-Corruption Convention in 2005 but still lacks independent investigative bodies and courts.\(^{185}\) Lastly, China is 62.4\% free on Labor Freedom. Restrictive employment regulations hinder employment and productivity growth. The non-salary cost of employing a worker is high. Dismissing a redundant employee can be relatively costly and may require prior consultation with the local labor bureau and labor union. In general, the capacity to end employment varies according to the location and size of the enterprise.\(^{186}\) From the Heritage Foundation’s analysis it can be seen that China has a ways to go before economic freedom – the third pillar of ILG – is anywhere close to the levels of the top nations. Economic freedom is essential to any growth strategy. If China is serious about attracting high skilled foreign workers and cultivating indigenous R&D they must work on creating a more open economy and also on their political and civil freedoms. If China desires to attract and retain the best foreign talent they will have to democratize – or at least open up politically to the point where non-Chinese skilled workers feel comfortable living in their society. In addition, skilled Chinese also have various opportunities across the globe. China will have to open up socially to retain these skilled workers – who may desire a more open society. China scored highly when it comes to the first and second pillars of innovation-led growth; however, the nation scores low on the third. The Chinese government produces a lot of rhetoric when it comes to increasing their economic, political, and civil openness – however, the rhetoric does not seem to translate into policy, such as in other areas like talent cultivation and increased R&D spending. The next section of this paper will explore the research on the PRC’s innovation led growth approach to economic development. Currently, the research is mixed. In addition, there have not been many studies

\(^{185}\) Ibid.

\(^{186}\) Ibid.
statistically demonstrating the link between China’s innovation-led economic policies and economic growth.

*Literature Review: The PRC, Innovation-Led Growth, and Economic Development*

China’s “open door policy” adopted in the 1970s, has allowed China to evolve as a major trading nation and export platform for multinational enterprises, specifically manufactured products. Obviously an export-led approach has been used to bring China back into the ranks of the economic superpowers of the world. These policies have relied on the foreign supply of advanced industrial technologies. However, as stated previously in this paper, China has been taking up the challenge to foster its own technological capability which it expects to hold large benefits – mainly sustained economic growth. China has been steadily boosting investment in R&D and S&T and has taken steps to build a strong “enterprise-based innovation system.” While the bulk of Chinese enterprises are still far from being leaders in innovation some of them – such as Heier or Lonovo – are developing their innovative capabilities and global Chinese brands. Gernot Hutschenreiter and Gang Zhang analyzed the policy dimensions of Chinese Innovation-Driven Growth in their article, “China’s Quest for Innovation-Driven Growth – The Policy Dimension.” In the first part of their paper they analyze the emerging innovation policy in China which is expected to complement more traditional industrial policies. Section two of their paper outlines the emergence of China as an export platform for high-tech products and Section three outlines its current innovative capabilities. Section four addresses China’s innovation policies including rent-seeking (FDI) initiatives. Major issues that need to be addressed if China is to meet the challenges of developing a more innovation-driven economy are outlined in Section five.
China’s initial openness to foreign trade and investment played an important role in China’s initial economic development. Overall, openness has helped China make better use of its comparative advantage. Openness to foreign trade and FDI has – in general – led to a high degree of competition in product markets, and increasingly also in markets for services. More vigorous competition also tends to exert discipline on Chinese firms. Competition has contributed to falling prices and to increasing quality of a variety of goods, and is likely to have spurred innovation in the Chinese economy.187 China’s open-door policy has greatly improved China’s access to advanced technologies. The role of FDI in technological transfer to China has been significant. Technological knowledge has been transferred through the import of intermediate and capital goods but also more directly through the transfer of technology, know-how, and advanced management practices related to the implementation of FDI projects and the operation of foreign-invested firms. Before China’s accession into the WTO, FDI was made conditional on some disclosure of technology. Along with FDI, exports have played a serious role in China’s economic development. However, over the last 25 years the structure of the export sector has changed. The share of high-tech exports rose from 5% in the early 1990s to over 30% in 2005. These are heavily concentrated in two products categories: office machinery as well as TV and radio sets and communication equipment which accounted for 88% of total high-tech exports in 2005.188 Since 2004 China is the largest exporter of Information Communication Technology (ICT) goods in the world. Right now high-tech exports are mainly originating from foreign-owned enterprises and joint ventures, including many controlled from Hong Kong. Thus, China’s high-tech exports must be qualified – as they are not indigenous exports. Moreover, high-tech industries in China are much less R&D-intensive than the same

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188 Ibid., p. 247.
industries in advanced OECD countries. Thus, many key technologies still remain under foreign control – which makes many scholars question the true state of China’s innovation-led approach. Currently, China is mainly a low-cost export platform for much of the world – following the export-led growth strategy. However, as can be illustrated above, the nation is attempting a shift in economic policy. But it may be too early to truly judge their innovation-led growth progress. Nonetheless, it is viable to study China’s potential innovation capabilities.

In the 1990s China had a low overall R&D intensity (the ratio of R&D expenditure to GDP). However, that trend began to turn around at the end of the decade and into the 2000s. China has made substantial progress in developing the country’s capabilities in S&T – now China is a major global player in S&T. The expansion of the Chinese innovation system as measured by various input and output indicators now exceeds the rate of economic growth.189 In absolute terms China has emerged as a major global spender on R&D. Aggregate R&D intensity (the ratio of gross expenditure in R&D on GDP) has more than doubled in a decade, reaching 1.3% in 2005 – which exceeds the R&D intensity of some major European countries such as Italy and Spain – as compared to only 0.6% in 1995.190 With almost 1 million researchers in 2004, China ranked second in the world, just behind the United States, in terms of human resources devoted to R&D.191 In addition, Chinese-authored S&T papers published internationally have grown rapidly, placing China 5th in rank in the Science Citation Index and 2nd in the Engineering index in 2005. Domestic applications for patents have increase nine fold and eightfold, respectively, between 1995 and 2005. Chinese application for foreign patents have also increased rapidly, accounting for 3% of all applications filed with the World Intellectual

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189 Ibid., p. 247.
190 Ibid., p. 247.
191 Ibid., p. 247.
Property Organization (WIPO) Patent Corporation Treaty (PCT), making China the 8th largest user of PCT. The most important capability China has is that the business sector has risen up to be the main actor in R&D. Business enterprises now account for over two thirds of total R&D expenditure (a share typical for the advanced OECD countries), as compared to just 40% in 1991. In addition, as China increases the number of foreign R&D centers, it is increasing the number of domestic R&D centers. While China’s innovation capabilities are still limited, it has grown leaps and bounds since it began implementing the medium-and-long-term R&D and S&T program. Interestingly, the PRC has attempted to implement several innovation-based approaches in the past; however, until China became and economic power house – using the export-led strategy – it has had trouble getting an innovation-led approach to work.

During 1976-1977 the Chinese government embarked on an ambitious effort to import large scale industrial equipment for the modernization of China’s industry – the so-called foreign leap forward. However, the strategy was soon found unattainable as China was constrained by the lack of foreign currency. The second attempt was called the market for technology strategy. This strategy essentially saw FDI as a major channel of technology transfer from developed market economies to China, allowing China to quickly acquire industrial production and export capabilities. This strategy has been continued to this day – as it had some real benefits. However, it too had its limitations. While foreign invested firms serve as a conduit of technology imports to China, in most cases the core technologies remained controlled by the foreign firms or partners of the joint ventures – or in some cases by headquarters abroad. These firms would provide only the manufacturing operations in China in order to take advantage of the cheap labor opportunities. The next step is to make the FDI project conditional on

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192 Ibid., p. 248.
193 Ibid., p. 248.
technological transfer – but this had to end with China’s acceptance into the WTO. China’s next policy dimension can be called the talent cultivation phase – the Chinese Government called it “revitalizing the nation through science and technology.” The PRC implemented this policy in 1995 and it has continued to this day. The adoption of this strategy can be seen as a sign that China had come to the realization that it could not rely exclusively on foreign technology and its future competitiveness in the evolving global knowledge economy will be determined by its technological capabilities, not by low labor cost.\textsuperscript{194} The next step on China’s innovation-led approach is the most ambitious. As stated before, in 2006 China adopted the medium-and-long-term plan for the development of science and technology. The objectives the plan sets out to reach by 2020 are as follows: (1) China’s R&D intensity will be increased to 2.5% of GDP (2.0% by 2010), (2) innovation will contribute 60% to economic growth, and (3) China’s reliance on foreign technology will be reduced to below 30%, and overall, China will be among the top five countries worldwide in terms of key innovation output indicators.\textsuperscript{195} This plan is the third of its kind since 1949; however, it is the only plan that emphasizes “home-bred” or indigenous innovation, with a view to create the conditions for achieving a leading position in a number of S&T based industries. The State Council issued a document on the policies for the implementation of the Plan. Policy measures are grouped into the following areas: increased budgetary appropriation at all levels of government, tax incentives for enterprise innovation, public funding for supporting the absorption of imported technologies, government technology procurement, a new strategy for creation and protection of IPR and technology standards, venture capital and funding mechanisms for innovation and technology-based-start-ups, human resources, education and awareness of science, a new evaluation system to improve the

\textsuperscript{194} Ibid., p. 249.
\textsuperscript{195} Ibid., p. 249.
performance of Public Research Organizations (PROs) and the efficiency of public resource use, S&T infrastructure, and enhancing coordination of military and civilian research. Many of these initiatives were discussed earlier in this paper. However, new business practices and other detailed policy initiatives must also be elaborated on. A new policy encourages accelerated depreciation of machinery and equipment for R&D and extends tax breaks holidays to incubators and university science parks. Exemptions from import duties for R&D related material and equipment by business R&D centers and other qualified R&D institutions is also a new initiative aimed at encouraging R&D. The strategies regarding IPR and technology standards aim at harnessing leading Chinese enterprises with their own patented core technologies and international brand names. This is a shift towards speeding up technology development in China’s industry by actively encouraging the creation of intellectual property. This policy can be expected to have a positive impact on the overall protection of IPR in China. This is a must for any ILG approach. The government has also announced a policy to actively take part in the formulation of international technology standards, and of pursuing the transfer of domestic Chinese technology standards to international standards. Thus, Gernot Hutschenreiter and Gang Zhang have laid out a picture of a nation moving toward ILG. They have outlined China’s progression from the 1990s to present, and have also delineated China’s current innovation capabilities. However, they also demonstrate that China has many issues and challenges to their new ILG approach.

The first issue they discuss is product market competition. Product market competition is an important framework condition promoting business R&D and innovation. In China, various market imperfections still distort competition, administrative intervention interferes with the

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196 Ibid., p. 250.
197 Ibid., p. 250.
functioning of markets and improper or even illegal conduct and local protectionism hamper or distort competition. Market institutions are still underdeveloped and inadequate. As a consequence innovative activity may not be adequately rewarded. The market environment has discouraged Chinese enterprises from undertaking R&D and innovation. To shift to more innovation-driven growth, modern institutions, including a modern anti-trust law are required. Thus, the Chinese legal structure has a lot of deficiencies and the market has imperfections that distort competition. However, even greater problem in China is its Intellectual Property Rights protection regime. The effectiveness of IPR protection impacts in different ways on innovation activity preformed in China. First, it affects the willingness of foreign partners to transfer technology to China. IPR infringement is a major concern for foreign investors and will be a major concern for domestic firms heavily investing in R&D as well. China’s accession into the WTO obliges it to bring IPR into accordance with the WTO Agreement on Trade Related Intellectual Property Rights (TRIPs). Initially the enforcement of IPR will produce higher costs on Chinese firms as they must pay for the utilization of foreign technology. However, at the same time as Chinese enterprises become more innovative, they, too, become adversely affected by the poor protection of IPR. Concerns over IPR protection have reportedly reduced Chinese inventors’ propensity to commercialize the results of their R&D – thus denying contribution to GDP. 198 Sound IPR protection would facilitate the transfer of research into productivity and increase investment-specific R&D in the private sector. Another problem facing the PRC is enterprise reform – as almost half of their enterprises are still state owned enterprises (SOEs).

Enterprise reform is aimed at transforming Chinese SOEs into modern, market oriented corporate entities. Still, many CEOs in SOEs are politically appointed and are likely to build

198 Ibid., p. 251.
their political career on short-term performance. Thus they have little reason to pursue decisions in R&D which is typically long-term investment and risky in nature. Current reform initiatives will introduce several changes such as delegating responsibilities to the board, including decision making on large investment and financing, performance assessment, remuneration and appointment/removal of senior executives, as well as recruiting more professionals in management functions from outside the SOEs. This reform is in progress and will take time. If successfully implemented, these changes can be expected to improve corporate decision making, and enhance the role innovation has in corporate strategy.\textsuperscript{199} The corporate structure of SOEs is not yet ready to embrace R&D to the fullest extent. One of the biggest challenges to the ILG approach in China is the ability of the nation to build an enterprise-based innovation system.

Enhancing the innovation capability and performance of the Chinese business sector remains a difficult task. So far, the government has relied on a top-down approach, “instructing” SOEs to invest in innovation. This approach has not resulted in genuine improvements. Even though an increasing number of key Chinese enterprises have set up R&D facilities, R&D activities in Chinese enterprises were often found weakly related to market demand. However, a recent study found that R&D performers are more concentrated among SOEs. These enterprises are also the least efficient in knowledge production.\textsuperscript{200} Government policies focused on SOEs have at the same time crowded out support to non-state owned companies which hold large potential. Apart from these governance issues there are serious bottlenecks in Chinese enterprises. Since innovation is an unfamiliar activity for the majority of Chinese firms, there is a severe lack of competent managers who understand and are capable of managing R&D projects. This is a talent acquisition, cultivation, and retention issue – new policy measures in human

\textsuperscript{199} Ibid., p. 251.  
\textsuperscript{200} Ibid., p. 252.
resource and human capital are devoted to this issue. Another issue is R&D funding and defining the role of Public Research Organizations (PROs)

In 1985, China started to reform its S&T system with the primary objective of enhancing the linkages between scientific research, technological development, and economic growth. Reforms in the 1990s concentrated on creating a more market oriented S&T system through restructuring and downsizing of PROs, transforming R&D institutions in applied research into business enterprises, and incorporating large R&D institutions into large enterprises.\textsuperscript{201} These “market reforms” have gradually enhanced the market orientation of the R&D system. But they have also had some unintended consequences, including a weakening of basic research. Despite major achievements the process has yet to be completed. Several challenges remain with regard to how to improve the efficiency of PROs and, more strategically, as to what role the PROs should play in China’s emerging enterprise-centered innovation system.\textsuperscript{202} Also R&D funding programs have been the single most important instrument for promoting R&D and innovation in China. So far the government has lacked alternative funding mechanisms to support R&D. To address the shortcoming, according to the medium-and-long-term plan for S&T development the government intends to introduce several new mechanisms. Non-commercial “policy banks” will be permitted to provide loans and credit support for high tech industries with co-funding, credit guarantees and interest subsidies provided by the government. To promote the provision of venture capital (VC), market insurance companies and stock exchange institutions will be allowed to enter the VC business. Special stock markets for insurance mechanisms for technology companies will be created. New funding will be essential to the ILG approach in

\textsuperscript{201} Ibid., p. 252.
\textsuperscript{202} Ibid., p. 252.
China. The last issue related to ILG in China is the nation’s integration into the global innovation system.

The international perception of China’s new innovation-led approach has been mixed. Some nations feel that China may be entering into a new “Techno-nationalism” political environment. Frictions may be kept at a low level, if inward FDI to China was to find ways to better integrate into the emerging Chinese innovation system. On the other hand, China needs to make efforts to integrate better into the global knowledge system by respecting existing rules and by taking part in improving these rules to suit the needs of a fast evolving global R&D system. A failure to manage the process of integrating China smoothly into the global innovation system would be a missed opportunity.²⁰³

The authors conclude that, “China is actively pursuing a strategy of making a transition to more innovation-driven growth. Nevertheless it can be expected that technology imports, and international knowledge flows in general, will continue to play an important role in China’s development... It seems like China will proceed in developing its own innovative capabilities and emerge as a significant player in global innovation.”²⁰⁴ This paper agrees with this analysis and also agrees with the authors that China has significant hurdles to cross and obstacles to overcome. Few research studies have addressed the PRC and innovation-led growth statistically. However, since China just began their ILG strategy around 4 years ago, it is still too early to make any solid conclusions. Nonetheless, some scholars have attempted to addressed the issue with empirical research.

²⁰³ Ibid., p. 253.
²⁰⁴ Ibid., p. 253.
Baomin Hu, Lili Wang, and Xinkai Yu, have empirically analyzed R&D and economic growth in Hebei Province. The authors acknowledge that, “In China, especially due to the scarcity of supporting R&D data and the lack of a feasible quantitative approach, it is difficult to analyze R&D activities with mathematical models from the macroeconomic point of view.” In research using other countries—such as the ones stated above—it has become clear that regions with a high level of R&D expenditure enjoy a higher gross domestic product (GDP) per capita, and lagging regions with poor R&D activities tend to have a lower GDP per capita. In addition, foreign business R&D (known as international spillovers) has also shown its important contribution to economic growth. Most other studies—which have found these results—have been discussed on the basis of western countries, such as the USA, Europe, and other OECD countries. Studies that do focus on China have found that state-owned sectors have much lower efficiency than non-state owned ones, and foreign firms have higher efficiency than non-state owned sectors. This paper takes the position that, non-state owned sectors are more efficient because they are focusing in investment-specific R&D, and then applying that research to the marketplace. State-owned firms tend to focus more in R&D for the sake of R&D and less on applied research. Hu et al. introduce a data envelopment model to analyze the R&D input-output system from a horizontal point of view. They focus their investigation on Hebei’s R&D expenditure, in order to measure the effect of R&D input on economic growth and evaluate both technical and scale effects in R&D. The authors believe that there are two ways to strengthen R&D in China; one is to increase the total expenditure on science and technology, and the other one is to improve the interior structure of R&D investment between the different components of R&D. R&D can be classified into three parts: basic research, applied research, and experimental

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development. A sound R&D management policy concerns not only how to reach an appropriate R&D expenditure amount, but also on how to get an optimal allocation among R&D components. Using the data envelopment analysis empirical method they have come to several conclusions.

First the authors found that, “The structure of R&D and its gross input are the two sides influencing the final economic output. It is necessary not only to increase the gross input but also to make full use of the R&D resources and to improve its utilizing efficiency.” Thus, the type of R&D is very important, just increasing gross input will not automatically lead to economic growth, the outcome of the input – i.e. its use in the market – will improve GDP per capita. The authors also found that, “in China, a great number of research results only stay quietly in laboratories and have not been embodied in practical uses. Therefore, the relationships between three sectors should be adjusted according to the practical need of China, and great efforts should be made with respect to the third part of the R&D structure, i.e. commercializing the research work is the most urgent task in China.” Thus, much of the state-governed research is not making it to the market and thus not contributing to economic growth. This is why much of China’s 15 year plan is dedicated to investment-specific private R&D – when the research, and innovations from the research, can create profit, it will also create economic growth. The authors go on to state, “A perfect modern R&D system should be built in enterprises to incorporate the main body of doing R&D, which is also a good way to solve the problems caused by an imperfect R&D structure. What is more, a modern system should be open to foreign R&D and innovations. Based on our investigation of 532 large and medium enterprises between 1998 and 2000 in Hebei, we found out that 54.68 percent of business innovations in Hebei were done by

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206 Ibid., p. 231.
207 Ibid., p. 233.
its own enterprises. Therefore, indigenous innovation is currently the main pattern of Hebei’s enterprises. The investigation does not imply that Hebei has an advanced own R&D system, on the contrary, it has been discovered that Hebei is still embedded in a closed R&D environment with a rather low level of technology and knowledge. To realize advanced innovations, Hebei needs to be open and learn from other regions."\textsuperscript{208} Here one can easily see that the ILG strategy should be linked directly to private enterprise – foreign or indigenous. The authors point out that even without a perfect R&D structure, investment-specific or private R&D can compensate for this problem and still produce economic development. This research also confirms the ILG strategy’s approach of directing R&D mostly in private enterprise. The authors conclude that, "The mechanism of research institutes should be reformed. In China, most research institutes absorb a great deal of R&D investment, but they only aim at research results in the laboratories. That is the reason why China needs badly to put more efforts on experimental development, even at a higher percentage than most developed countries. Only in this way, can the input from scientific and technological research to economic activities be improved. The strength of applied research and technological development will be transferred to enterprises only gradually."\textsuperscript{209} R&D innovations must make it to the market to increase economic development. However, because the best talent will come from the universities, nations should develop a strong link between the two. The authors conclude that, "The cooperation between universities and enterprises should be intensified. On the basis of the results of our DEA model, the weight of experimental development should be increased compared to basic and applied research... In other words, professors in most universities usually do projects to enrich their own research achievement list, which is not useful for enterprises. To make up for this loss and to strengthen

\textsuperscript{208} Ibid., p. 233.

\textsuperscript{209} Ibid., p. 233.
the effect that R&D should have on the economy, Hebei needs to do more than others to transform its R&D into productivity.\textsuperscript{210} Hence, is also necessary to bring universities in line with investment specific R&D to translate experimental research into applied research. Overall, this empirical study verifies several aspects of this paper’s proposed innovation-led growth strategy.

However, even though the PRC’s attempts at talent cultivation, attraction, and retention; increased R&D spending, specifically applied research; and economic freedom, will lead to economic development, the PRC faces many challenges to fully implementing its ILG approach. A recent report by the Organization for Economic Co-operation and Development (OECD) in collaboration with China’s Ministry of Science and Technology concludes that “China needs a better return on its fast-rising investments in research and development (R&D) and higher education if it is to meet its goal of becoming an ‘innovation-oriented’ economy by 2020.”\textsuperscript{211} The report also states that “China still has a long way to go to build a modern, high-performance national innovation system.”\textsuperscript{211} Certain attributes of the PRC can slow China’s growth. Its economic success remains unevenly distributed, with wealth still concentrated in its coastal provinces and urban centers. Other issues China faces are an aging population and inadequate intellectual property protection. It also needs to increase the quality of researchers and engineers and, in the future, address an emerging trend of fewer students choosing to pursue science and engineering in college, although it still has the second largest number of researchers after the United States. Many of the economic changes necessary within China to achieve economic growth have been greatly expedited by the inward flow of foreign direct investment, e.g., technology spillover, reform of trade and other laws to enable World Trade Organization (WTO)

\textsuperscript{210} Ibid., p. 233.
accession, better (albeit still inadequate) intellectual property laws, and greater competition among companies. In fact, Chinese leaders are worried about sectors (e.g., real estate, motor vehicles) where supply appears to be growing faster than demand; this could lead to negative financial repercussions (e.g., deflation, overheating economy). Prime Minister Wen Jiabao stated at a State Council meeting in July 2006, “Forceful measures must be taken to help resolve the striking contradictions that exist to prevent rapid economic growth from becoming overheated.”^212^ There are also several environmental issues China will have to face as it continues to develop. However, despite the challenges, the PRC is following the most logical path toward future development. The export-led growth strategy cannot last forever and will not create indigenous growth. Innovation-led growth is indigenous and is the future of economic development – not just for the AINs but for DCs and emerging economies as well. The future is in innovation, patents, and technological development. As Winston Churchill said so many years ago, “the empires of the future will be empires of the mind.” Thus, the ILG approach developed in this paper will eventually be the model of choice for developing and advanced nations all over the world. As each nation around the world enters the take-off stage, the drive to maturity, and the age of mass consumption, they will need to implement an ILG approach to development or it risks falling behind in the global economy. The last section of this paper explores the innovation-led growth strategy empirically. Using data from the 2007 *Chinese Statistical Yearbook* (2005 data) this paper analyzes the effect of talent, R&D, and economic freedom on GDP per capita among all the provinces of the PRC.

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^212^ Ibid., p. 3.
Preliminary Empirical Research on the ILG Approach and Economic Development among the Provinces of the PRC

Rationale and Problem Statement:

China’s State Council in Beijing began to apply the “Medium-and-Long-Term Plan for Science and Technology Development from 2006-2020” by implementing incentives that include: (1) immigration and incentive policies conducive to creating and attracting talent, (2) increases of research and development expenditures, and (3) favorable taxation policies towards innovation-oriented enterprises. The PRC has begun to implement the necessary incentives required to inspire innovation in the private sector, as well as various state research centers. This study will investigate whether the new 15 year plan will have a substantial effect on the PRC economic development. In addition, the Chinese export-led model has often been utilized by other nations looking to duplicate the PRC’s economic success. If the ILG approach is successful in the PRC, it may also gain status as a viable model of growth for other emerging economies and developing nations. Thus, this research has two purposes: (1) To test the ILG approach among the provinces of the PRC and, (2) To test the ILG approach as a viable method for other developing nations in the aggregate.

Data:

Using the official Chinese Statistical Yearbook for 2007\(^2\)\(^3\) this paper uses multiple regression analysis to analyze the effects of the innovation-led growth approach on economic development for the year 2005, among all the regions of the PRC. The data is made up of all 31 regions of the PRC. These include, Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan,

Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang. Each one of these regions coincides with the Provinces in China. The data was collected from the entire population – all the regions of the PRC. For this reason outliers have not been re-coded or removed. To represent the culmination of talent in the PRC the model utilizes investment in education (X1) among the regions of the PRC. Investment in education represents the ability of each region to develop indigenous talent, through the monetary contribution into the educational system. Next, the model uses investment in scientific research, technical services, and geological prospecting (X2) to assess the overall investment in R&D among the regions of the PRC. This variable specifically assesses each region’s overall investment in R&D, not controlling for investment-specific research. The ILG approach maintains that only investment-specific or private enterprise research will contribute to economic development. Therefore, this model uses the number of patent applications examined (X3) to represent applied R&D. It is proposed that only X3 will predict economic development, due to its ability to influence the market (create profit). This model uses the investment from foreign funded firms (X4) to represent economic freedom. Although China as a whole lacks economic freedom, the ability to attract foreign firms is a good measure of trade freedom and others because FDI inflow is linked with a good economic environment. In addition, this model controls for total population at year end (X5), exports (X6), and imports (X7). Thus, the model takes into account a large population, the export-led growth strategy (if a region exports more, their GDP will be higher), and imports (if a region imports more their GDP should be lower). The effect of each one of these variables will be judged against Gross Regional Product (GRP) (Y). Gross Regional Product was chosen over GRP per capita because this model desires to judge the effect of economic development in the aggregate. GRP per capital does not control for
income distribution among classes (because it is GRP/the total population) and thus would not add any additional inferences. The null hypothesis and proposed hypotheses for each variable’s effect on Y are stated below:

H0-1: There is no relationship between investment in education among the regions of the PRC and Gross Regional Product (GRP).

H1: As investment in education among the regions of the PRC increases, GRP will increase.

$$H1: \beta_1 > 0 \quad H0: \beta_1 = 0$$

H0-2: There is no relationship between investment in scientific research, technical services, and geological prospecting among the regions of the PRC and GRP.

H2: As investment in scientific research, technical services, and geological prospecting increased among the regions of the PRC, GRP will remain the same.

$$H1: \beta_2 > 0 \quad H0: \beta_2 = 0$$

H0-3: There is no relationship between the number of patent applications examined among the regions of the PRC and GRP.

H3: As the number of patent applications examined increases among the regions of the PRC, GRP will increase.

$$H1: \beta_3 > 0 \quad H0: \beta_3 = 0$$

H0-4: There is no relationship between investment from foreign funded firms among the regions of the PRC and GRP.

H4: As investment from foreign funded firms increases among the regions of the PRC, GRP will increase.

$$H1: \beta_4 > 0 \quad H0: \beta_4 = 0$$

H0-5: There is no relationship between the total population at year end among the regions of the PRC, and GRP.

H5: As the total population at year end among the regions of the PRC increase, GRP will increase.

$$H1: \beta_5 > 0 \quad H0: \beta_5 = 0$$
H0-6: There is no relationship between exports among the regions of the PRC, and GRP.

H6: As exports among the regions of the PRC increase, GRP will increase.

\[ H1: \beta_6 > 0 \quad H0: \beta_6 = 0 \]

H0-7: There is no relationship between imports among the regions of the PRC, and GRP.

H7: As imports among the regions of the PRC increase, GRP will decrease.

\[ H1: \beta_7 < 0 \quad H0: \beta_7 = 0 \]

This research uses the OLS multiple regression model of prediction. The prediction model equation is: \( Y_i = \alpha + (b_1) (X_{1i}) + (b_2) (X_{2i}) + (b_3) (X_{3i}) \ldots \); this model estimates the amount of change or variation in the dependent variable for one unit change in one independent variable, controlling for the other independent variables in the multiple regression. The alpha level (\( \alpha \)) for this research is .05 or 95 percent for confidence intervals, t-tests, and F-tests. Each hypothesis is tested using t-scores. Next, Standardized Regression Coefficients (\( \beta_j^* \)) represent how much of an impact, in absolute value, an independent variable has on the dependent variable. Also, the coefficient of determination (\( \rho^2 \)) is estimated using \( R^2 \) and tested using an F-score. The coefficient of determination will determine the amount of variation in the dependent variable of all the independent variables combined.

**Results:**

The model summary has R (Pearson’s Correlation) at .987 and R squared at .967, which means that all the predictors (X variables) in the model explain approximately 96.70% of the variability among Gross Regional Product. Part of this strong association is due to the high Pearson’s Correlation between the predictors and GRP – discussed later. The F-Statistic for the regression was 126.456. Degrees of freedom for \( F_{v_1, v_2} \) are calculated as \( V_1 \) equaling the number of variables plus the constant, and \( V_2 \) is calculated as \( N - \) minus the number of independent
variables plus the constant. Thus, V1 is calculated to be 8 (7 independents plus the constant) and V2 is calculated to be 24 (31 -7). The F critical value is 2.36\textsuperscript{214} and R\textsuperscript{2} is statistically significant because the F-statistic is equal to 126.456 and it was greater than the Fc.v. of 2.36. The standard error of the estimate is 990.80932. This statistic measures the average deviation of actual Y scores around the regression line. Four (4) independent variables were statistically significant in this model. They were investment in education, the number of patent application examined, investment from foreign funded firms, and total population at year end.

There were 31 valid cases in this model. Since this regression uses seven variables, plus the constant, Degrees of Freedom for the T-Critical Value is equal to N - 8 or 31 - 8 = 23. The critical value (t.c.v.), using a two-tailed test at an alpha level of \( \alpha = .05 \) was equal to 2.069.\textsuperscript{215} The t-scores for investment in education, number of patent applications examined, investment from foreign funded firms, and total population at year end were 3.799, 2.449, 2.361, and 2.423, respectively. Export and imports were not statistically significant; this has a great impact on the export-led growth strategy, as exports should have increased GRP. In addition, investment in scientific research, technical services, and geological prospecting was not statistically significant; this demonstrates that only applied research genuinely affects GRP (economic Growth). The number of patent applications was statistically significant; verifying that applied research or investment-specific R&D has the greater affect on economic development. Hence, the three elements of the innovation-led growth strategy are statistically significant.

The standardized regression coefficient (\( \beta^* \)) represents the average standard deviation change in Y-hat given a 1 standard deviation change in X; giving each X \( \beta^* \) the ability to be compared to each other. The standardized coefficients illustrate that investment from foreign


funded firms has the most impact on GRP with a \( \beta^* \) of .446. Investment in education had the second most impact on GRP with a \( \beta^* \) of .389. Next, the number of patent application examined had the third most impact on GRP with a \( \beta^* \) of .270. Lastly, total population at year end had the fourth greatest impact with a \( \beta^* \) of .182. All of the relationships are positive, meaning that increases in \( X \) leads to an increase in \( Y \). Next, this paper will discuss the un-standardized regression coefficients.

The prediction model equates to \( \hat{Y} = a + bX \), where \( a = Y \) intercept (constant) and \( b = \) the slope of the regression line. Hence, for every 1 unit change in investment in education (100 million yuan), Gross Regional Product will increase by \( 41.368 \) million yuan, on average, among the regions in the PRC, while controlling for the other \( X \) variables in the model. For every 1 unit change in number of patents examined, GRP will increase by \( .092 \) (100 million yuan). For every 1 unit change in investment from foreign funded firms (100 million yuan), GRP will increase by \( 3.281 \) (100 million yuan). Lastly, for every 1 unit change in each of the PRC’s provinces total population at year end (10,000 persons), GRP will increase by \( .372 \) (100 million yuan). Thus, each element of the ILG approach, on average, will predict an increase in economic development, represented by Gross Regional Product, controlling for the other variables in the model.

The closer the correlation between each \( X \) and \( Y \), the more the \( X \) variable is representative of \( Y \) (or another measure of \( Y \)); this inhibits the ability of \( X \) to explain \( Y \). Thus, although 4 of the independent variables can predict \( Y \), they cannot explain it. In addition, the \( X \) variables are highly correlated with each other, meaning that they are measures of the same thing. According to the correlation table, in the appendix, investment in education is closely correlated with GRP at .899. It is the most correlated with GRP. Investment in scientific
research, technical services, and geological prospecting is correlated with GRP with a Pearson’s Correlation of .603. The number of patent applications examined correlates with GRP with a Pearson’s Correlation of .878. Investment from foreign funded firms and GRP had a Pearson’s Correlation of .810. The Pearson’s Correlation between total population at year end, exports, and imports with GRP was .769, .780, and .755, respectively. Thus, each of these independent variables correlates highly with GRP. This plagues the regression because none of these variables can be said to explain the size of GRP. In addition, investment in education is highly correlated with investment in scientific research, technical services, and geological prospecting, at .716, and it is also correlated with total population, with a Pearson Correlation of .868. The number of patent applications examined is highly correlated with investment from foreign funded firms, with a Pearson Correlation of .897. Therefore, this model is highly restricted by collinearity, and correlation between the independent and dependent variables.

Nonetheless, several of the variables within the regression can still statistically predict GRP. In addition, since the measures of investment in education, number of patent applications examined, and investment from foreign funded firms are so highly correlated with GRP, it can be said that any increase in these measures will increase GRP because they are technically supplementary measurements of Gross Regional Product. In fact, the innovation-led growth strategy surmises that, in order to increase investment in private enterprise-specific R&D, a nation must have an adequate supply of researchers, scientists, engineers, and other technical professionals. Thus, it is not unusual that investment in education would be highly correlated with the number of patent applications examined or investment in S&T and R&D. Therefore, a nation (and their private firms) could not increase R&D without increasing investment in education, or acquiring more talent. In addition, foreign firms investing in China are more
investment-specific than their domestic counterparts. Therefore, it is not uncommon for investment from foreign funded firms to be highly correlated with the number of patent application examined. According to this data, if the leaders among the regions of the PRC desire to increase GRP, they should be advised to invest in education, increase investment in enterprise-specific R&D, and increase their economic openness to attract foreign firms.

Discussion and Conclusions

The conclusions from this preliminary model are vast. The correlation among the independent variables and GRP are very high, which means that the model’s explanatory power is low. However, this also means that the Xs can be considered supplementary measures of Y, meaning that any change in these independent variables will lead to a change in Y. This model also demonstrates that the pillars of the ILG approach are statistically significant predictors of economic growth — GRP among the regions of the PRC. Thus, China’s shift toward an innovation-oriented country puts the nation in a prime position for even greater economic development. Also, exports were not a statistically significant predictor of GRP — this undermines the export-led growth strategy among the regions of the PRC. The evidence is strongly in favor of the ILG approach, and not the export-led growth strategy. Another clear inference that can be drawn from this data is that R&D for the sake of R&D will not lead to economic development. Only applied research — in the form of the number of patent applications examined — was a significant predictor of economic development. Investment in scientific research was not a significant predictor. Thus, the ILG approach proposed in this paper recommends that nations — especially the PRC — try and encourage private enterprise R&D, and just increase investment in R&D in the aggregate. The type of R&D matters more than the amount of R&D — at least among the regions of the PRC. More research needs to be conducted
and time-series models need to be used in the future to fully determine the full impact of the ILG strategy. The PRC will have a long journey ahead of them between now and their 2020 deadline for an innovation-oriented country.

**Conclusion**

This paper covers many topics and attempts to develop a contemporary approach to economic development. The first half of this paper examines a greater part of the literature on the export-led growth hypothesis – the approach that many scholars believe helped China to become the economic powerhouse it is today. However, the analysis of the research shows that there is still a question of whether the ELG is a successful approach to economic development. The second half of this paper develops a new paradigm for economic development – the innovation-led growth hypothesis. ILG postulates that the culmination, attraction, and retention of talent; the increase in investment-specific R&D dollars; and increased economic freedom as provided by the *Heritage Foundation* will allow a nation-state greater economic development. This paper hypothesizes that all nations, both developing and developed, will need to pursue the ILG strategy as the global economy becomes more integrated. This paper then applies the ILG strategy to the PRC’s shift to an innovation-oriented nation. It is clear that China is attempting to make this shift, and it appears to be following the approach proposed in this paper. While the PRC still has many challenges to overcome – including the need for stronger intellectual property rights – it is pursuing a long-lasting path to economic development in the global economy. The preliminary empirical data in the last part of this paper illustrates that the ILG approach – as measured by investment in education, the number of patent applications examined, and investment from foreign funded firms and their effect on Gross Regional Product – is a statistically significant predictor of economic growth / development. Innovation-led growth will
eventually become the dominant strategy for nations in the take-off, drive to maturity, and age of mass consumption stages of economic growth. Winston Churchill may have been right when he predicted that “the empires of the future will be empires of the mind.”
Appendix

Descriptive Statistics for All Variables

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<th>Gross Regional Product</th>
<th>Investment in Education (2005) (100 Million Yuan)</th>
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<td>Mean 73.23344516</td>
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<td>Standard Error 9.197428018</td>
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<td>Median 64.76</td>
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<td>Mode #N/A</td>
</tr>
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<td>Standard Deviation 51.20911195</td>
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<td>Kurtosis 2.215807639</td>
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<td>Count 31</td>
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<td>Confidence Level (95.0%) 18.78365385</td>
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### Investment in Scientific Research, Technical Services, and Geological Prospecting (2005) (100 Million Yuan)

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<table>
<thead>
<tr>
<th>Total Population (year-end) (10,000 persons (2005))</th>
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<tbody>
<tr>
<td>Mean</td>
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<tr>
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### Exports (2005)

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### Imports (2005)

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## Correlations between All Variables

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### Model Summary

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### ANOVA

**ANOVA**

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b. Dependent Variable: Gross Regional Product
## Coefficients

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* Dependent Variable: Gross Regional Product
Bibliography


