China's Economic Growth - 21st Century Puzzle

Abdul Ghafoor Awan

Dean of Faculties, Institute of Southern Punjab, Multan, Pakistan

ABSTRACT

China's fast economic growth since 1960s was the result of gradual shift in its economic system, open door policy and its accession to the world trade organization. The institutional reforms and access to foreign markets has been followed by investment strategies expanded 45% of Chinese GDP during last 40 years. The consistent vertical economic growth has no precedent in the economic history of the world. China has increased its share in world trade from 0.5% in 1960 to 10% in 2010 and accumulated foreign exchange reserves of US$3.19 trillion by March 2013. It is not less than a miracle.

The objective of this study is to investigate into the Chinese labour productivity and output in the short and long-run perspective to detect the real source of Chinese economic growth.

Our study is spread over a period starting from 1962 to 2010 because of political and economic stability with minor crisis. The data was taken from China Bureau of National Statistics, IMF, World Bank and relevant research Journals and books. The variables included in this study are: labour productivity, investment, exports, R&D expenses, capital stock, open door policy, real exchange rate and US GDP. The VAR model proposed by Johansen (1988), Johansen and Juselius (1990,1994) and Hendry and Mizon (1993) was used to measure the nature of relations among the above variables. Different tests including unit root test were applied to test the stability of the model.

The Econometric results show that international trade and investment in capital stock and R&D expenses by Chinese Government are the major determinants, which are responsible for enhancing labour productivity and output in the long-run, Similarly, real exchange rate appears as an important determinant to explain change in output in the long-run. US GDP has played no role in explaining Chinese output growth.

Key words: China, labour productivity, investment, R&D, Open door policy, exports, Output.

JEL Classification Code: F43; O47

INTRODUCTION

China's economic growth during last 40 years has been miraculous. The GDP growth of China has showed an average growth rate of about 8% for the period 1963-1978, in spite of the negative effects of the" Great Leap Forward" and the " The Cultural Revolution"

Policies. Moreover, this growth has geared up since the start of 1980s and is continued till 2013 when the average annual growth rate was fluctuated between 10 and more than 7 percent.. This development has no comparison with other big economies of the world. The vertical growth in the Chines GDP has substantially contributed into the world GDP because its share in international trade has jumped from less than 0.5% in 1960 to 10 % in 2013. This in turn economic performance has led to more than proportional increase of the market share in major economic regions (Japan, the United States, and European Union).

There are many factors that have played pivotal role in the China's economic growth. But important among them are: savings and investment, which has increased to around 45% and 35% respectively against 20 percent in 1950s and 1960s. However, capital accumulation has not shown substantial impact on the improvement of total factor productivity (TFP) (Chow, 1993), De Long and summer of 1991, and 1992). However, with the beginning of a series of economic and institutional reforms in 1978, China's impressive export performance has initiated debate about the role of exports in Economic growth. Public interventions and institutional reforms were the dynamic process that transform the whole the economic, financial and social systems during 1962-2010 but the reforms process was gradual to consolidate growth momentum particularly in case of the liberalization of the economy and opening it for foreign direct investment. Transition from planned economy to the market economy has brought tremendous impact on the Chinese economy and society. This process reached its peak gradually in 2001 when China joined the World Trade Organization (WTO). It was the major event that shift world trade paradigm. Although the reforms that took place in the Maoist era were not free from some shortcomings, but they have provides basis for transition period. In Maoist period, priority sectors for investment were transport ,infrastructure, and technical Improvements in agriculture. Without that Moist's policies, rapid economic growthwas not possible during transition period. Moreover, the industrial growth strategy promoted heavy industry representing 13% of industrial output in 1952. This effect was intensified and reached 33% in 1965, and 42% at the beginning of the reforms. On the other hand, light industry, which represents 52 % in 1952, shrinked to 30% to 20% in 1978. This indicates a high degree of the transformation of China's industrial sector in the pre-reform period (Bramall, 2000). The investment process was a prominent feature of Chinese policies before and after reforms periods. Contrary to the pre-reform period both domestic and foreign investment was important, and allowed a steady increase of China's productivity, which stimulated international trade particularly exports. But before reform period, no foreign direct investment was allowed and the economy was closed for foreign investment. One of the factors that contributed into the success of Chinese economic reforms was high level of education vis-à-vis least developed countries (Nolan, 1995). China's years of schooling in 2010 was 8.16 years as compared to world average years of schooling of 8.12 years. In 1950 about 70 percent population of China was illiterate. To eradicate illiteracy, China initiated a program of mass secondary education in 1955 and it contributed in the industrialization of rural areas (Pepper, 1996). When reforms started in 1978 there was macroeconomic stability, no political and economic crisis and low public debt. (Bramall,2000; Rodrick, 1996; Lardy, 1995).

OBJECTIVE OF THE STUDY

The objective of this study is to study the main factors that are responsible for China's labor productivity and output in the short and long-run during 1962-2010. For this purpose, we

have intended to concentrate on two factors: capital accumulation and opening up of the Chinese economy, which are the two main drivers of China's productivity growth puzzle. Besides focusing capital accumulation and exports, we will analyze the role of Research and Development (R&D) expenditures which has boosted Chinese economic growth. We will also try to illustrate different aspects of technological Progress in this process. Since the interaction between a large economy, Such as China and the rest of the world is known , we have included two other variables such as the real exchange rate and the level of activity in the United States in this study.

METHODOLOGY OF RESEARCH

Data and Source:

The secondary data was used in this study. The data was collected mainly from China's Bureau of National Statistics, IMF and World Bank database, relevant books and research journals, Robert and Lee database. Study Period: The study period was selected from 1962 to 2010 because it was mostly free of economic and political turmoil.

Variables:

The selected variables for our study are as under:-

1. Savings.
2. Investment.
3. Capital Stock accumulation
4. Openness.
5. Research and Development.
6. Technological Progress.
7. Real Exchange Rate.
8. US level of economic activity.

Estimation Techniques:

The VAR Model was proposed by Johansen (1988), Johansen and Juselius (19990:94) and Hendry and Mizon (1993) was used to measure the strength of relationship among selected variables. Time series *data analysis techniques were* applied to measure change of in the Chinese GDP during the study period.

Hypothesis:

We frame the following three hypotheses for our study.

(i) The existence of a positive and stable relationship in the long run between these variables is more consistent with the existence of a positive effect on technical progress,

(ii) The labor productivity is increasing faster than the capital-labor ratio in the majority of the period considered.

(iii) Unlike others studies export exogenously drive output and productivity in the long run.

LITERATURE REVIEW (THEORETICAL BACKGROUND)

Classical economists, such as Adam Smith (1776), David Ricardo (1817), Thomas Malthus (1798), Frank Ramsey (1928), Joseph Schumpeter (1934) and Frank Knight (1944) laid foundation of theoretical framework of modern theories of economic growth. Their ideas include the basic approach of competitive behavior and equilibrium dynamics, the role of diminishing returns and its relations to physical and human capital, the interplay between per capita income and the growth rate of population, the effects of technological progress

in the form of increased specialization of labour and discoveries of new products and methods of production, and the role of monopoly power as an incentive for technological progress. The starting of modern growth theory is the classical article of Ramsey (1928), a work several decades ahead of its time. Ramsey's inter-temporally separate utility function is as widely used today as the Coo-Douglas production function. The economists did not accept his approach until the 1960s. Between Ramsey and the late 1950s, Harrod (1939) and Domar (1946) tried to integrate Keynesian analysis with elements of economic growth. They used production functions with little substitutability among the inputs to argue the capitalist system is inherently unstable. The most important contribution was those of Solow (1956) and Swan (1956). The key aspect of the Solow-Swan model is the neoclassical form of the production function, a specification that assumes constant returns to scale, diminishing returns to each input, and some positive and smooth elasticity of substitution between the inputs. This production function is combined with a constant-saving rate to generate an extremely simple general equilibrium model of economy. One prediction from these models is conditional convergence. The lower the starting levels of per capita GDP, relative to the long-run or steady-state position, the faster the growth rate. The economies that have less capital per worker relative their long run capital per worker tend to have higher rates of return and higher growth rates.The convergence is conditional because the steady-state levels of capital and output per worker depend on the saving rate, the growth rate of population and position of the production function-characteristics that might be vary across the countries. Another prediction of Solo-Swan Model is that, in the absence of continuing improvements in technology, per capita growth must eventually cease. This assumption, which resembles those of Malthus and Ricardo, also comes from the assumption of diminishing returns to capital. It has been observed that positive rates of per capita growth can persist over a century or more and that these growth rates have no clear tendency to decline.

After the mid-1980s, research on economic growth experienced a boom, beginning with the work of Romer (1986) , Lucas (1988) and Rebelo (1991) built on the work of Arrow (1962), Scheshinski (1967) and Uzawa (1965). In these models, growth may go on indefinitely because the returns to investment in a broad class of capital goods, which include human capital. Spillover the knowledge across producers and external benefits from human capital are parts of this process, but only because they help avoid the tendency for diminishing returns to accumulation of capital.

The clear distinction between the growth theory of the 1960s and 1980s is that the recent research pays close attention to empirical implications to the relation between theory and data. However, much of this applied research involved application of empirical hypothesis from the older theory, notably neoclassical growth model of conditional convergence. The cross-country regressions motivated by the neoclassical model surely because a fixture of research in the 1990s. An interesting recent development in this area involves assessment of the robustness of the kinds of estimates. Other empirical analysis apply more directly to the recent theories of endogenous growth, including the role of increasing returns, R&D activity, human capital, and the diffusion of technology.A question arises here is that whether it is possible for an economy to enjoy positive growth rates forever by simply saving and investing in its capital stock.A look at the cross-country data from 1969 to 2000 show that the average annual growth rate of real per capital GDP for 112 countries was 1.8 percent and average ratio of gross investment to GDP was 16 percent. However, for 38 sub-Saharan African countries, the average growth rate was only

0.6 percent and the average investment ratio was only 10 percent. At the other end, for nine East Asian "miracle" economies, the average growth rate was 4.9 percent and the average investment ratio was 25 percent. These observations suggest that growth and investment rates are positively related (Sala-i-Martin et al,(2004)

There is no doubt that investing in equipment and infrastructure, R &D or human capital, and other institutional factors along with more (Such as openness, regulations, property rights, and a mechanism for distribution, etc.), are responsible for the dynamics of the activity and productivity levels observed in most economies. However, very little consensus exists about the preponderance of different factors in these processes. This question will be not greater importance if it were not for the foreseeable differences in relation to the long-term sustainability of growth and its impact on economic development policy. Have policies that encourage savings at the expense of domestic consumption contributed since the long-term growth view? Is the adoption or maintenance of export programs really an appropriate strategy in China? Is there any evidence Integration between the different sources of growth considered to-date , ore there are yet, or is there Certain periods of certain alternation?

Therefore, explaining whether the economic growth that the Chinese economy has experience has been caused only by high domestic savings and high investment rates, and the consequent accumulation of capital, or if on the contrary, there is another case of export-led growth due to the open-door policy. The basic issue is re-evaluation of the controversy that emerged in the mid-nineties for sources of economic growth in the Asian economies with high performance (package and Page,(1994) and Young, (1992) and (1994). There is abundant evidence to show that those countries that invest more tend to grow more. However, this effect appears to be transitory and could disappear in the absence of other factors that stimulate growth. In other words, the differences in investment rates do not explain the persistent differences in economic growth. The result will be that the country will have the largest per capita income, and that economic growth has stabilized the price of a "normal" after a certain period of time. From this perspective, investment cannot be considered a source of sustainable economic growth. This target can only be reached by other factors (i.e, openness and human capital accumulation, and investment in research and development, etc.), and to the extent that these factors Increase the total factor productivity, it is likely because it involves a larger effort in the field of investment. On the other hand, defenders of another point of view focus their attention on to the greater importance of capital accumulation as is the main factor of economic growth, and on increase trade as being more consequence than a cause of economic growth process. so than the cause of the process of economic growth.

Regardless of what we think in terms of neoclassic growth models, like that by Solow (1956), or in terms of endogenous growth models, the accumulation of the productive factors plays an important role in economic growth in both the initial "AK" models or R&D based models. In the absence of technological progress however, which is widely understood as improved technical skills and management that allow sustained increases of the productivity of these production factors, it is not possible to obtain a maintained positive effect in the dynamics of the output level in the long run. Thus according to the most widespread view, investment only affects the output level in the short run. This is true in the neoclassical growth models, but also in the literature on endogenous growth. However, De Long and Summers (1991 and 1992) argue that equipment investment is apparently associated with higher growth, due to the embodied technological progress,

and the positive role of government infrastructure investment in improving economic activity and productivity is well-known. Finally, as the Schumpeterian version of endogenous growth models implies, long-run growth and productivity levels are endogenous and depend on innovation and capital accumulation among other factors. In this kind of models, "capital and knowledge are two state variables determining the level of output at any point of time" and "capital accumulation and innovation should be complementary processes, both playing a critical role". In this sense, both investments in equipment and R&D expenditure can interact to reinforce this relationship. It is relevant that this complementary relationship is mainly supported by the existence of the embodied technological progress in equipment investment. However, capital accumulation is not free of certain ambiguity with regard its relationship with the level of GDP or labor productivity. From the perspective of conventional growth models, saving and investment precede and are among the most important determinants of output and economic growth. Nevertheless, the opposite view may be found in the empirical literature. More specifically, if capital investment is driven fundamentally by supply side factors (such as the embodied technological progress), it is expected that investment determines output. In contrast, if demand factors dominate among the determinants of investment, it is not unexpected to find causality relations from output to investment. There is little empirical evidence in the literature on the investment-led growth effect in China. However, any evidence to this effect seems to recognize that capital accumulation has played an important role in the process of economic growth.

There is fewer consensuses on the role of capital accumulation as a source of technological progress. For example, Chow (1993) emphasized the role of capital accumulation as the main source of Chinese economic growth since the fifties until the end of the eighties. However, there was no evidence of technological progress during this period. Nonetheless, Yusuf (1994) argued that not only was capital accumulation an important determinant of economic growth, but that technological progress also played a significant role from 1978 to 1993. In addition, Wu (2000) found evidence that investment has been an important stimulus for TFP in Fujian, Guangdong, Taiwan and Hong Kong. Unlike previous studies, Qin et al. (2005) found some recent evidence that output drives investment in the Chinese economy.

The evidence found in the literature suggests that capital accumulation has been an important factor of China's successful growth. However, there is debate about whether capital accumulation is the only factor to explain the high growth rates in China similar to other planned economies, or if other additional factors intervene together with capital accumulation, which could help explain the dynamics of the Chinese performance. For example, factors such as foreign trade which especially in China has shown spectacular development given its high growth rates. Openness, especially exports expansion, has been considered to be one of the key factors to promote economic growth in developed and developing countries. Among the channels identified in the literature as potential generators of positive effects on output and productivity, the most immediate the most immediate is the possibility that the exposure to trade will induce a self-selection of the firms (Melitz, 2003) being the most productive that finally become in exporters and affecting therefore positively to the aggregated productivity. In addition, access to foreign markets positively affects productivity in the presence of economies of scale. However, the literature on this question emphasizes the existence of positive spillovers associated with the exporting activity. Several channels exist in which these spillovers can affect

productivity. The interaction with firms from others countries and increased competence tend to improve the competitiveness of the firms operating in the exporting sector. Moreover, there is a learning-by-exporting effect that tends to generate productivity and enhances the effects among exporting firms which, in turn, can generate positive externalities on the rest of the economy since more efficient management and organizational styles, labor training and improved production techniques are adopted.

Finally, the exporting activity allows foreign exchange constraints to be relaxed, thus permitting increased imports of capital and intermediate goods. Nevertheless, and in spite of all these arguments, there is certain skepticism as to openness explaining the success in foreign markets, or to exporting firms being more productive than non-exporting ones. Alternatively, we could find the presence of a growth-driven exports hypothesis, according to which, countries with higher incomes engage in more trade, i.e. Helpman (1988). In fact, the endogeneity problem of trade has been a recurrent aspect in the empirical literature on openness and growth, and there are no conclusive results, especially in the time series analysis.

The evidence found in the Chinese economy is in agreement with the rest of the empirical literature. Shan and Sun (1998) show a wide selection of empirical studies on the export-led growth hypothesis, and all papers seem to support the hypothesis. However, their results indicate that bidirectional causality exists between exports and output in China. This result coincides with that found by Liu et al. (1997) and (2002), but with different specifications. Finally, in a recent paper, and contrary to the general perception, Hsiao and Hsiao (2006) found that exports do not cause China's GDP and consequently its growth. Thus, the current empirical literature on the role that exports play in the Chinese economic development seems inconclusive.

Regardless of the controversial aspect of the direction that causality runs between investment and output, an investment-led growth in China should be reconciled with the spectacular growth of Chinese exports. This possibility was underlined by Rodrik (1995) when explaining Korea and Taiwan economic growths in the sixties. According to Rodrik, the outward orientation of these economies was more the result of the investment boom than the consequence of an export-led growth effect. The increase in exports was the result of export-oriented policies that enabled the increase in demand of imported capital goods, a consequence of the investment boom, to be met. However, the opposite point of view is also feasible, as Baldwin and Seghezza (1996) argue; a trade-induced investment-led growth could have taken place, and in line with our results, there is evidence that both exports and investment are determinants that boost output growth (Yu, 1998, and Kwan et al., 1999).

The question is not whether it is necessary or not that permanent productivity shocks exist to guarantee a sustained growth in the long run, rather what factors can be the cause of these shocks. Nobody questions that the accumulation of productive factors, especially capital accumulation, has positive effects on output and productivity in the short run. The question is whether that effect is permanent or it affects both variables in the long run. Our objective is not to test alternative specifications of the relationship between the accumulation of productive factors and other sources of economic growth, as found in the empirical literature of economic growth. Indeed, our objective is something more basic, to detect the regularities and interactions between the different sources of growth, and to identify the direction of the causality in the both long and short run in the singular process of the Chinese economic growth. Our analysis consists in a previous step to consistently explain this process, and it is an additional piece in the puzzle that

politicians and economists attempt to solve.

DISTINCTION OF THE STUDY

As compared to previous empirical studies, our study differentiates and contributes to the empirical literature in three ways:-

i) In our view, capital accumulation and innovation play a complementary role and foreign trade is assumed to be the main *channel that stimulates* economic activity;
ii) Unlike Yu (1998), we have extended sample in the post-reform period until 2010 because investment has played a key role in both pre-reform and post-reform periods. Although *the share* of export was low in the pre-reform period, presently it is one of the most important channels to accelerate economic growth.
iii) The co-integrated VAR model used in this study has facilitated us to carry out a joint modeling in a context in which variables are closely related to each other. This methodology does not impose any restriction upon our analysis and allows the data to reveal *real relationships* between different variables in the long and short-run.

EMPIRICAL FRAMEWORK

Now we initiate empirical analysis with a general and the least possible conditional assumptions, thus allowing the data to reveal the nature of the interactions among them. From these relationships, it is possible to advance with the hypothesis about the nature and causes of the forces that have stimulated the rapid economic growth in China in recent decades.Our empirical analysis basically uses Chinese annual data for the period 1962-2004 derived from the NBS of China which has currently published the latest compilation of the Chinese economy in 2004. Our data set consists of GDP (lgdp), labor productivity - output per worker- (lprod), investment (linv), exports in FOB terms (lexp), R&D expenditure (lrd) of the Chinese economy, the US GDP(lgdpusa) and the real exchange rate (lrer). All variables are in logs and real terms, and have been deflated by the GDP deflator.

The real exchange rate has been calculated using the nominal exchange rate between the Chinese currency and the US $ (Renminbi/$) and the consumer price indices (CPIs).Although data are available from China since 1952, we preferred to move to the beginning of the effective sample until 1964 given the difficulty to perform a sufficiently homogenous treatment during such a turbulent period as that between 1958 and 1962, with the Great Leap Forward and the consequent economic collapse that produced abnormally low values of macroeconomic aggregates for the period 1961-1963. However, it is well-known that the period under study is not void of shocks, and this led us to use different level-shift dummies in the empirical analysis. An analysis of the stationary properties of our variables can be seen in the Appendix. It is possible to see from the unit root test (PhillipsPerron and ADF), that all our variables considered are I(1) in the levels, and which also show the rejection of the order of integration equal to two. We focused on the time series evidence in our empirical analysis and we have used the methodology of the cointegrated vector autoregressive (VAR model) proposed by Johansen (1988), Johansen and Juselius (1990), Johansen and Juselius (1994) and Johansen (1996). This methodology is based on the principle of "general to specific" discussed in Juselius(1992) and in Hendry and Mizon(1993). We start the analysis with a broad general specification in which certain restrictions will be imposed both of statistical and economic origins, until the most irreducible form possible is reached. We consider that this methodology is appropriate given the potential interdependence between the different variables

considered. Furthermore, joint modeling is suggested and the convenience of distinguishing between the short-run and long-run relationships between them, which in our case is the key element of the analysis proposed. The analysis can be seen for the fixed properties26 of our variables in the Appendix. It is It is possible to see the unit root test (Phillips Peron and ADF), that we have all the variables Consider the first (1) levels, which also appear on the system's rejection of integration Equals two. Two types of variables available investment in China: Gross fixed capital formation, as is common in the majority of national accounts and fixed assets. According to the manual OECD (2001) on capital Measures, and a more precise definition in China is a constant in assets. However, this variable is limited, so we have The use of total fixed capital formation in our analysis. In future research, we will try to use fixed assets. To More details on the management of physical capital, see the Halls (2006).

We focused on time-series evidence in our analysis and we used the experimental self vector regression methodology (model VAR) co-integrated proposed by Johansen. The methodology is based on the principle of "public to private" discussed in Juselius (1992) and Hendry and Maison (1993). We start with the analysis of the broad general specifications. Some restrictions will be imposed on both statistical and economic assets and even the most form is reached irreducible possible. We consider that this methodology appropriate given the potential correlation between the different variables into account. It is suggested modeling and comfort to distinguish between short-term and long-run Relations between them, which in our case is a key element of the proposed analysis. In particular, we start with the unrestricted VAR model; a linear trend is restricted in Common space of integration and unrestricted constant of dimension RX 1:

In this analysis, we have assumed a restricted linear trend in co-integration space, because variables in the model have linear trend during the period of analysis, which appears to be difficult to prove from economic view point. From empirical view, however, the deterministic linear trend may be an alternative to the stochastic trend (Nielson and Christensen,2005).The VAR model considers that residuals are not auto correlated and are distributed normally. To meet this criterion of VAR model, we have chosen an unrestricted permanent dummy variable,Ds89 and two level-shift dummies restricted to co-integration spaces Ds 78 and Ds94.The dummy D89p attempts to capture the political and economic restrictions in 1989 (a fiscal and monetary policy was enforced by Chinese Government at the end of 1988 to stop sharply rising inflation. This policy effect was noted visible impact on gross fixed capital formation, caused a fall of around 14% on investment and trade. China suffered a significant loss of trade and investment in the late 1980s (Bramall,2000).Conversely, justification of the level shift dummies is immediate. The dummy in 1978 is related the beginning of political and economic reforms process, initiated after Cultural Revolution, whereas dummy in 1994 mainly corresponds to the exchange rate. Unification of exchange dual exchange rate that caused 43 percent depreciation of exchange rate (Adams et al,2006) is still in existence. Apart from this, lifting price restriction in 1994 accelerated efficiency of allocation framework in the Chinese economy. Aunced in1994 precipated the effectiveness of the whole public finance due to decentralization of decision-making process as well as reducing enforcement cost.

PRODUCTIVITY MODEL

Primarily, the endogenous variables in this model are: (1) (labour productivity, (2) investment, (3) exports, (4) real exchange rate and (5) Research & Development outlay.

Productivity was corrected by applying methodology suggested by Nielson (2004). In order to measure external influence on the Chinese economy, the level of US economic activity was inducted in the model as a weakly exogenous variable. In sequential analysis of the model, however, exports and R&D outlay were finally assumed to be weakly exogenous variables. Initiating from a four equation system (labour productivity, investment as exogenous variable, showing r=1 P-value 0.90. In this new specific scenario of four endogenous variables (productivity, investment, real exchange rate and R&D outlay), we have intended to used exogenous test to highlight that R&D outlay can also be assume Hannan and Quinn indicated that two lags are sufficient to capture the dynamics effects of model and to remove the possibility of auto correlation. Thus, we have considered a VAR (2) model with three exogenous variables (exports, R&D outlay and US economic activity), with their corresponding deterministic components.Avariety of misspecification tests for residual of the model shown in Table 1, where neither autocorrelation nor normality exists. In this univariate analysis, no ARCH effects are noted while in multivariate analysis, a small ARCH effect is detected. Rahbek et al (2002) and Juselius (2006) suggested that statistical inference, the determination of rank test, in the co-integrated VAR model is robust to a moderate ARCH effect, and that, overall, the model is well behaved.

LONG-RUN RELATIONSHIP

Based on a statistical model, we can get a number of long-term relationships (r), and number of common trends (p - r) by the LT test. Given in Table 2 that shows Trace Test where everything indicates that two long-term relationship (R = 2) exist in this Model as well as a common trend (p - r = 1). Moreover, the root of the inverse characteristic Polynomial of this rank is 0.80, less than the unit, which shows that the model is Fixed. The co-integration vectors in the model are as under:

The equation (2) describes how both exports and investment account for the level of productivity in the long term. It means that relationship between investment and exports are long-term nature. The equation (3) shows that R & D outlays boosted investment. The coefficients attached with both variables are statistically significant and show expected signs. The restrictions levied in both relationships were accepted with p-value of 0.175. The coefficients of adjustment toward equilibrium are statistically significant and negative, and take a value of -0.36 (-5.55) for first co-integrated vector and -0.66 (-5.86) for the second. The reduced form model is stable in the forward and backward analysis.

The findings are consistent with an export-led productivity growth effect and reflects a positive relationship between productivity and exports, where the causality runs unidirectional from exports to productivity in the long-run. Opposite to other empirical analysis, we have not found a bidirectional causality relation as exports become exogenous in our model. However, this relationship is only possible when investment is assumed jointly with exports. The two have positive effect on productivity. We conclude that both exports and capital accumulation contribute to enhance productivity in the long-run.

Our results are consistent with existence of an investment-led productivity growth effect. The second co-integrated vector shows that investment and R&D expenses are co-integrated. An interesting result drawn from this analysis is that R&D expenses directly and positively affects investment with moderate co-efficient and it had an indirect effect on productivity through investment.A positive sign in dummy variable Ds78 in the ecm2 means that real investment growth rate was scaled down since 1978. When we compare

with other countries, however, the growth rate of China was appeared to be spectacular. This was due to four reasons:

- The environment in Maoist regime;
- Decrease in the growth rate in two sectors such as construction and transportation;
- The re-allocation of investment from traditional to more dynamic sectors such as electronic appliances, plastics, pharmaceuticals and chemicals due to fiscal incentives given by Chines Government;(23) =31.669 (0.1072).

We can observe in the Appendix that both the null hypotheses of the absence of co-integration and the existence of one co-integration vector are clearly rejected. In our model, therefore, we accepted the null hypothesis of the existence of two long-run relationships (r = 2), and a common trend (p –r = 1), where both p-values accept the null hypothesis, and the inverse roots of characteristic polynomial for r = 2 is 0.78 less than the unit. This shows that our relationships are stationary and adjust toward equilibrium. In the model we selected, the following co-integration vectors can be found to be expressed as error correction mechanisms (statistics in brackets):

The coefficients associated with the variables in both relations are statistically significant and show the expected signs. The restriction imposed in both co-integration vectors are accepted with a p-value0.425. The adjustment coefficients toward equilibrium are also statistically significant and negative, and show a value -0.42 (-7.21) and -0.82(-6.47) for the first and second relationship, respectively (ecm1 and ecm2). Finally, the reduced form model is stable in the forward and backward analysis. Similarly to the previous model however, the complete parameter constancy is difficult to guarantee. In this sense, our estimates should be considered to be average effects. The first relationship corresponding to (4) shows a positive relationship among China's output, investment, real exchange rate and exports. Our findings are consistent with the export-led growth hypothesis which predicts that a positive relationship exists between the level of domestic activity and exports, where the direction of the causality unidirectional runs from exports to the GDP in the long run. However, the literature has also emphasized a positive effect of investment on output in the long run. A close relationship remains between investment and technology transfer since capital formation remains obsolete in the absence of technological progress and it would have no effect on economic growth in the long run (Howitt, (2000); Arayama and Miyoshi, (2004). New technological advances require an investment that enables its incorporation into the productive process and which favors the output growth in the long run. We observe that investment played a significant role in the first co-integration relationship, and is similar to exports in the output growth of the Chinese economy. Our findings are consistent with Yusuf (1994), who found that capital accumulation is one of the most important factors in the economic growth process in China. Unlike other studies on China, we included the real exchange rate as a proxy variable to measure terms of trade in the analysis given that a close relationship is maintained between the real exchange rate and exports. Unlike the previous productivity model however, the real exchange rate affects output in the long run. The effects of R&D expenditure on investment can be observed in the second relationship (5). This result is interesting in the sense that investment is affected by the innovating effort of the Chinese economy in both the models analyzed as it allows investment to increase and stimulates the accumulation of physical capital, which also favors economic growth. The interpretation of the deterministic components is similar to the productivity model. In the first co-integrated vector however, it is possible to observe that dummy Ds78 has a

positive effect on the real GDP, showing that the output level had increased after that year, as already pointed out.

SHORT-RUN RELATIONSHIP

Table 3 shows the dynamics of short-run structure. Like long-run identification, the starting point consists of a general model in which the restrictions that are imposed on coefficients show a sequential form. Then variables with non-significant coefficient are eliminated until irreducible model is reached. The over-identification restriction LR test is accepted and distributed as χ (23) = 31.669 (0.1072).Table 3 represents the in Annex dynamics of structure in the short term. To determine the long-term, the starting point consists of a model year in which restrictions Levied on transactions show a sequential form. Then, with the variables is large transactions are excluded until access to the form most irreducible. And over identifying LR restrictions are accepted and distributed test as? (23) = 31,669 (0.1072). Productivity adjusts toward equilibrium with the export-led and investment Productive relationship (ECM 1) Investment carriers (ECM 2). Alpha coefficients show speed and direction towards equilibrium.

Labor productivity in the equation, it is possible that adjustment relatively slowly, almost every two years, productivity adjusts towards equilibrium, and possibly associated with continuous transformations in the Chinese economy between the various sectors. In addition, we can note in the dynamics of the model that R & D spending has a positive effect on the productivity equation in the short term. This shows that it is not limited to the transfer and absorbforeign technology through the generation of the indirect effects of exports in favor of efficiency and productivity efforts, but this is in the field of innovation play a effective role to improve productivity in the Chinese economy. Moreover, foreign demand, and the measured activity of the United States level, and shows the performance of procyclic, which favors the growth of productivity. Investment also adjusts towards equilibrium with vectors found in the long term. Alpha coefficients in the investment equation that show Similar to the previous equation, the adjustment with the first vector is relatively slow. But with the second adjustment Vector co-integrated (Vector investment) indicates to adapt fairly quickly toward equilibrium almost every year. Moreover, the investment in its own equation shows a minor overreaction given the negative coefficient in the ecm 1. It is difficult to explain the reasons for this effect in a model where the parameters are conditioned in conjunction with each other, and where there is Tankers more than one. However, a positive sign is compensated in an overreaction with higher value and negative in the ECM2. An interesting result in the short term is that the investment. It also accelerates the increase in productivity since the positive productivity shock attracts perhaps through investment expectations for returns in the future. In addition, we note thatboth foreign demand and R & D expenses increase investment. However, one unexpected cause we have found is that exports will have a transient and negative impact on investment Equation.

Third equation reveals that the real exchange rate is increased when Investment is less than the steady-state (ECM2). Here real exchange rate has been included into the model as a control variable. This result explains the fact that When the investment is above its value in the long term, it leads to inflationary impact due to the an increase in aggregate demand, and the consequent appreciation of the real exchange rate. In the dynamics of this model we can observe that exports will have a positive impact on the real Exchange rate. In other words,

increasing exports decreased the value of the real exchange rate. However, the activity level of the United States has a negative impact on the real exchange rate.

Table 6 in the Appendix shows the dynamic structure of the output model. Similarly to the previous model, we started with a general specification in which restrictions are imposed on the coefficients of the variables analyzed sequentially, and the non-significant variables are eliminated until the most irreducible model is reached. The over-identifying restrictions LR test is accepted and is distributed as χ (25)=32.606 (0.1412).

The Chinese activity level adjusts toward equilibrium with the two co-integrated vectors found. Conversely to the previous model, the alpha coefficients in this model show a reasonable fast adjustment approximately every year and a half, when the first co-integrated vector adjusts toward equilibrium, as does the second vector to a lesser extent. This result is interesting since both the trade-oriented policy and the accumulation of physical capital increase output in the long run. In addition, the technology embodied in investment and exports allows the generation of spillovers that increase the activity level. Moreover, the specific policy regarding the exchange rate that the Chinese government applied has accelerated the activity level through gains in competitiveness. On the other hand, and unlike other studies, a positive effect in investment is noted when the R&D variable is included in the model. In the dynamic model, the US activity level displays a procyclic performance which is similar to the productivity model. Furthermore, R&D expenditure, investment and exports positively affect output in the short run. However, the real exchange rate shows a transitory and negative effect. Similarly to the productivity model, investment adjusts toward equilibrium with the two vectors found. In this equation, it is possible to observe that both vectors show a relatively fast speed of adjustment. The investment vector adjusts approximately every year, and the output vector adjusts every year and a half. Similarly to the productivity model, investment overreacts in its own equation, but is also compensated with the negative coefficient in ecm2. The R&D expenditure, which allows the absorption of knowledge or innovations, has directly favored increased investment in China, and has also allowed the overall growth rate to accelerate in the last two decades. The dynamics of this model shows that investment, R&D expenditure and the real exchange rate has a transitory and negative effect in the short run. The real exchange rate adjusts toward equilibrium with the second co-integrated vector found (ecm2). Unlike the previous model and in relation to the output model in this equation, the alpha coefficient shows a reasonable speed of adjustment toward equilibrium, at approximately a year and a half. When investment is below its steady-state, the real exchange rate is appreciated in the long run. This result is probably similar to the previous model and may be justified by an increase in the aggregate demand owing to investment growth that not only favored pressures on domestic prices, but also the consequent appreciation of the real exchange rate. In the dynamics of this model, we observe that the Chinese activity level has a positive effect on the real exchange rate equation. However, investment shows a negative effect in the short run.

OUTPUT MODEL

Like the previous model, our starting point is a simple form that contains the following variables: the level of Chinese activity (GDP), exports and investment and the real exchange rate and the level of activity in the United States. Once relationships were common integration of this new model. If any, will be included variable R &D, and specifications are maintaining the same model. Once more, either the erogeneity or

endogeneity of the variables considered in the simple model is analyzed under the assumption that the US activity level is weakly exogenous. Similarly to the productivity model, the exogeneity test shows us that exports are exogenous with a p-value of 0.27. Therefore by following the same sequence as the previous model specification, we also found that R&D expenditure is exogenous with a p-value of 0.09. Thus at the end of this process, our model contains three endogenous variables (China's GDP, investment, and real exchange rate) and three exogenous variables (exports, R&D expenditure and the US activity level). Finally, the determination of the number of lags in accordance with the criterion of Hannan and Quinn shows that two lags are enough to capture the dynamics effects and to avoid autocorrelation problems.

Table 4 in the Appendix shows a battery of misspecification tests for the residuals of our model, where this model does not display autocorrelation and normality problems. Similarly to the productivity model, a slight ARCH effect is observed in the multivariate analysis. Nevertheless, the model is well behaved (Rahbek et al.(2002); Juselius (2006).

FINDINGS & RESULTS

In this study, we have examined whether the rapid economic growth process in China since the sixties, especially in labor productivity and output, can be mainly explained by an investment-led growth effect, or export-led growth effect. Unlike others studies, we included investment and exports in our models, together with other relevant factors such as R&D expenditure. The reason for this was that investment has played an important role since the fifties when massive investment in infrastructure was made, which laid foundation for economic growth since 1978. As China is a large economy and it has interactions with other world big economies, we also included the real exchange rate and foreign output in our study. Our empirical evidence shows that an export-led growth effect in the first co-integrated vector can be found in the productivity model. This vector describes a positive relationship among labor productivity, exports and investment in the long run. The second vector shows that R&D encourages investment with a moderate coefficient in the long run. An interesting result in the equilibrium is that exports show a greater effect on productivity than investment, and are likely associated with the economies of scale and the positive effects of spillovers from technology transfer, more efficient reallocation of resources, and competitiveness in the international market. In the dynamics, we found common positive effects of the lag of productivity and the R&D effect on the productivity and investment equations in the short run. Similarly to the productivity model, we found an export-led growth effect in the output model. The first vector describes the relationship among output, exports, investment and the real exchange rate. The second vector shows that an increase in R&D encourages investment. In contrast to the previous model, we found that the real exchange rate played an important role in determining the output level. Our findings are interesting in the sense that trade, exports, and investment all promotes productivity and output. However, exports seem to stimulate more productivity than output, reinforcing their role as a source of technological progress. Additionally, we found that R&D favored an increase in investment in all the models. In the dynamics of the output model, we found that the US GDP, exports and R&D positively and regularly affect to output equation, but only US GDP and R&D have a positive effect on the investment equation in the short run. In contrast, the real exchange rate has a negative and transitory effect in both the aforementioned equations. Although our empirical analysis cannot disentangling whether the positive effect of investment on output and productivity is caused

by an increase in capital accumulation or by improvements in total factor productivity or both, we can hypothesize that both channels are relevant because:

- The existence of a positive and stable relationship in the long run between these variables is more consistent with the existence of a positive effect on technical progress,
- The labor productivity is increasing faster than the capital-labor ratio in the majority of the period considered.
- Unlike others studies export exogenously drive output and productivity in the long run. This is a precondition to accept the export-led growth hypothesis and we have provided evidence that in both models exports exogenously drive growth. In line with Bramall (2000), however, the existence of some additional preconditions, for example, a rising share of exports in GDP, are needed to completely accept the hypothesis together with the casual linkage between exports and economic growth, and we have shown clear causality between exports and output or productivity. Looking investment and export growth rates and their shares to GDP, there are two clear sub-periods along the period considered. Investment is growing faster than exports from 1962 to the end of seventies, and the reverse is true since then until now.

Thus, the ratio of exports to GDP is increasing clearly in the second period considered, from the end of seventies until now, while the ratio of investment to GDP is increasing along the two periods. This suggests that investment has been a permanent source of growth along the four decades analyzed, while exports as a source of growth appear to be especially relevant only during the post-reform period, initiated at the end of the seventies in China. In short, our results support the idea that the investment efforts and trade openness have played a significant role in China since the sixties until the present-day, and have encouraged output and productivity. Our findings suggest that investment and openness, especially exports, are jointly the most important determinants of productivity and output in the long run. In addition, R&D expenditure has a positive effect on investment in all the models analyzed. These results are consistent with the theory that both export-led growth effect and an investment-led growth effect are significant in Chinese economic performance, and in accordance with the Schumpeterian version of the endogenous growth model, which suggests that trade and investment- oriented policies play an important role in economic growth process. the investment policy duringTo sum up, the pre-reform period has probably created favorable conditions to gradually and successfully implement the economic reforms made by Chinese government since 1978 while the open-door policy, the progressive deregulations of the market, R&D investment, and greater efficiency in resource allocation, etc, have helped maintain the high growth rates in China for almost four decades.

REFERENCES

[1] Adams F.G, Gangnes B. And Shachmurove Y. (2006), "Why China is so competitive? Measuring and Explaining China's competitiveness", World Economy. Vol. 29, pp 95-122

[2] Arayama Y. Miyoshi K. (2004) "Regional diversity and sources of economic growth in China", World Economy Volume 27, pp 1583-1608.

[3] Aschauer, D.A. (1988), "Government spending and "Falling rate of "profit", Journal of Economic Perspectives Volume Issue 12, pp 11-17

[4] Aschauer, D.A. (1989) "is Public spending productivity", Journal of Monetary Economics vol 23, pp 177 - 200

[5] Aw, B.Y, S.Chung and M,J.Rober (2000) "Productivity and Turnover in the Export Market: Micro-level Evidnece from the Republic of Korea and Taiwan (China)", World Bank Economic Review,Volume 14, pp. 65-90.

[6] BaharumshahA.Zand Rashid S. (1999) "Exports and imports and economic growth in Malaysia: Empirical Evidence based on multivariate time series. Asian Economic Journal Volume 13, pp389-406.
[7] Baldwin R. And Seghezza E. (1996) "Trade-induced investment-led growth ," NBER 5582
[8] Barrow R. (1991) " Economic Growth in Cross-section of countries" Quarterly Journal of Economics vol:. 106 pp. 407-447
[9] Blomstrom M. Lipsey R.E and Zejan M. (1996) "is a fixed investment thekey to economic growth? " The Quarterly Journal of the economy Volume 111, p 269-276.
[10] Bramall C.(2000), " Sources of Chinese Economic Growth 1978 to 1996" Studies in Contemporary China. Oxford University Press.
[11] Cameron G. Broadman J. Redding S. (2005) "Technological convergence, R & D, trade and Productivity growth" European Economic Review.vol. 49 pp. 775-807
[12] Chow G.(1993) "Capital formation and Economic Growth in China" The Quarterly Journal of Economics, Vol.108 pp 809-842
[13] Chuang Y. (1998) "Learning by doing, the technology gap, and growth" International Economic Review Vol. 39, pp 697-721
[14] COE D.T, Helpman E.And Hoffmaister A.W. (1997) " North-South Spillovers" The Economic Journal Vol, 107 pp. 134-149.
[15] Connolly, M. (2003), "The dual nature of trade: measuring its impact on imitation and growth," Journal Development Economics, Vol 72, pp 31-55.
[16] De Long J.B and Summer LH (1991) "Equipment investment and economic growth," Quarterly Economics Journal Vol 106 pp. 445-502
[17] De Long c. B, Summers LH and Abel A.B. (1992), " Equipment Investment and Economic
[18] Growth: how Strong is the nexus" Brookings Papers on economic activity vol, 1992 pp. 157-211.
[19] Easterly W. And Levine R. (2001), "It's Not Factor accumulation : Stylized Facts and Growth Models" World Bank Economic Review Volume 15, pp. 117-219.
[20] Ezaki M. And the sun L. (1999) "Growth Accounting in China for national, regional and provincial Economies: 1981-1995 "Asian Economic Journal Volume 13, pp 39-71
[21] Frankel J.A and Romer D. (1999) "Does Trad causes growth", American Economic Review Vol. 89 Ppp. 379-394
[22] Gordon,Rober J (2012) "Macroeconomics", New Delhi: PHI Learning Private Ltd.
[23] Griffith R., Redding S, and. Renin J.V (2004) "Mapping the two faces of R & D: productivity growth in Panel of OECD industries " Review of Economics and Statistics, Vol. 86 pp. 883-895
[24] Grossman G.M. And Helpman E. (1991) "Innovation and Growth in the Global economy,"Cambridge, Massachusetts, the MIT Press.
[25] Helpman, E. And P.R Krugman (1985): "Market Structure and Foreign Trade." Massachusetts Institute of Technology Press.
[26] Helpman E. (1988), " Growth Technicalogical Progress and Trade", Empirical Austrian Economic Papers, Volume 5 Pp. 5-25
[27] Holz, C.A. (2005) " OECD.-China Governance Project : institutional arrangements for the production of Statistics" OECD Statistics working paper, 2005/1, OECD Publishing.
[28] Holz, C.A. (2006) " New capital estimates for China", China Economic Review, vol 17, pp. 142-185
[29] Henrique I. And Sadorsky P. (1996) " Export-led growth or Growth-Driven Export? The Canadian case " Canadian Journal of Economics Vol. 29, pp. 540-555.
[30] Hendry D.F, and Maison GE (1993) " Evaluating econometric models by encompassing the VAR." In PC.B Philips (ed). Models,methods and application of econometrics: Essays in Honor
[31] ofA.R.Bergstron MIT Press: Cambridge Mass.
[32] Hewitt P. (2000) "Endogenous Growth and cross-country Income Differences",AmericanEconomic Browse. Pp. 829-846

[33] Hewitt P. And Aghion P. (1998). "Capital Accumulation and innovation as complementary Factors in Long-term growth", Journal of Economic Growth. Volume 3, pp 111-130
[34] Johansen, S. (1988) "Statistical analysis of co- integration Vector" Journal of Economic Dynamics and Control, Vol .12,pp 231-254.
[35] Johansen, S. And Juselius K. (1990) "Maximum Likelihood Estimation and inference on cointegration-with Application to the Demand for money" Oxford Bulletin of Economics and Statistics Volume 52,pp.231-254.
[36] Johansen S.andJuselius K. (1994) "Identification of the long-term and short-term structure: An Application to the ISLM Model." Journal of Econometrics Volume 63 pp. 7-36
[37] Jones CH. I. (1995) "Time-series tests of Endogenous growth models," The Quarterly Journal of Economics Vol 110 pp. 495-525
[38] Juselius K. (2007),The co-integrated VAR Model: Econometric methodology and applications", Oxford University Press.
[39] Kwan CCA, Wu Zhang, Y. And J. (1999) "Fixed investment and Economic Growth in China's economy", Economics of Planning Vol. 32, pp 67-79.
[40] Lardy NR (1995) "The role of trade and investment in China's economic transformation" China Quarterly vol. 144 pp. 1065-1082
[41] Liu, X., songs, H., and ROMILLY, P. (1997): " An empirical investigation of the causal relationship between openness and economic growth in China".Applied Economics, Vol. 29, pp. 1679-1686
[42] Liu, X. Burridge P. And Sinclair PJN (2002) "Relationship between economic growth and foreign direct Investment and Trade: Evidence from China, " Applied Economics Vol. 34, pp 1433-1440.
[43] Lopez, R.A. (2005): "Trade and growth: Reconciling the Macroeconomics and Microeconomic Evidence", Journal of Economic Surveys Vol.19 pp. 623-648.
[44] Lucas R. (1988) "On the mechanisms of economic growth," Journal of Monetary Economics Volume 22, pp 3.42.
[45] Madsen, J.B (2002) "The causality between investment and economic growth", economic Letters, Vol. 74, pp157-163.
[46] Martin Sala-i- et al (2009) "Economic Growth". New Delhi: PHI Learning, India.
[47] Melitz, M.J (2003) "The impact of trade on intra- industry Reallocations and Aggregate Industry Productivity, Econometrica, Vol. 71, pp. 1695-1725
[48] Nielsen H. Christensen A. (2005) "U.S. monetary policy 1988-2004: An empirical analysis" Finance Research Unit, Institute of Economics, University of Copenhagen, WP No. 2005/01.
[49] Nolan, P. (1995) "China's rise,, Russia Fall" London, Macmillan.
[50] Noguer M. And Siscart M. (2005) Trade raises income: a precise and robust", Journal of International Economics Vol. 65 pp. 447-460
[51] Pack H.and Page J. (1994) "Accumulation, exports and growth in the high performing Asian economies," Carnegie Rochester conference series on public policy. vol. 40 pp. 199-235.
[52] Park S. and Kwon J. (1995) " Rapid Economic growth with increasing returns to scale and little or no Productivity growth," The Review of Economic and Statistics Vol. 77 pp. 332-351
[53] Perkins, D. (1994) "Completing China's move to the market?" Journal of Economic Perspective Vol. 8, pp 23 - 46
[54] Prasad, E.S. And Rajan, R.G. (2006): "Modernizing China's growth Paradigm",, American Economic" Review, Vol. 96 pp. 331-336.
[55] Qin D., Cagas A., Quising P. The X (2005) "How much does Investment Drive Economic Growth in China?" Queen Mary University of London, Department of Economics, Working Paper No. 545.
[56] Rahbek, A., Hansen, E. And Dennnis J.G. (2002): "ARCH innovations and their impact on co-integration rank Testing", Department of Statistics and Operations, University of Copenhagen. WP No. 22, Centre for analytical Finance.

[57] Rebelo S. (1991), " Long-run policy Analysis and Long-run Growth," Journal of Political Economy Vol. 99 Pp. 500-521.
[58] Riezman, R.G, Summers, P.M and Whiteman, C.H (1996): "The engine of Growth and its handmaiden? A time series assessment of export-led growth", Empirical Economics, Vol. 21, pp. 77-113.
[59] Roderick D. (1995), "Getting the interventions right: how South Korea and Taiwan grew rich", Economic policy Volume 10 pp. 53-107.
[60] Roderick D. (1996), "Understanding Economic Policy Reforms," Journal of Economic Literature, Vol. 34 p 9-41.
[61] Romer P. (1986) "Increasing Returns and Long-Run growth", Journal of Economics Perspectives Vol. 8 Pp. 3-22
[62] Shan J. And the sun F. (1998) " On the Export-led Growth hypothesis: the Economic evidence from China", Applied Economics Vol. 30 PP 1055-1065
[63] Wang and Yao (2003) "Sources of China's economic growth 1952 - 1999: Integrating human capital accumulation", China Economic Review, vol 14, pp. 32-52.
[64] Wolf E.N. (1991) "Capital Formation and Productivity Convergence over the Long Term" , American Economic Review. Vol. 81. Pp. 565-579
[65] Wu, Y. (2000), "productivity, growth and economic integration in the South China region." Asian Economic Journal Vol. 14, p 39-53.
[66] Young A. (1991) "Learning by doing and the dynamics of the effects of international trade" The quarterly Journal of Economics, Vol.106 pp. 369-405
[67] Young A. (2003) " Gold into base metals: productivity growth in the People's Republic of China during Reform period," Journal of political and economic vol . 111 pp. 1220-1261
[68] Yu Q (1998) "Cspital investment, international trade and economic growth in China: Evidence in 1980 - 90S", China Economic Review, Volume 9, pp 73-84.

Appendix
Unit Root Test

Model 1 (trend & const.)		
PP		
Vbles.	Levels	Diff.
lgdp	-1.75	-5.04*
lprod	-0.23	-6.47*
lexp	-2.31	-5.64*
lrer	-1.63	-5.43*
lgdpusa	-4.13**	-4.89*
lrd	-2.39	-6.40*
linv	-3.14	-5.90*

Model 2 (constant)		
PP		
Vbles.	Levels	Diff.
lgdp	0.73	-4.77*
lprod	5.47	-4.01*
lexp	1.34	-5.41*
lrer	-1.01	-5.47*
lgdpusa	-1.76	-4.81*
lrd	-0.19	-5.59*
linv	-0.52	-5.82*

Model 3 (none.)		
PP		
vbles.	Levels	Diff.
lgdp	22.38	-2.61**
lprod	-3.11*	-3.52*
lexp	6.83	-2.91*
lrer	1.95	-4.94*
lgdpusa	10.50	-1.91***
lrd	5.25	-4.12*
linv	10.30	-3.46*

Note:
* Rejection of the null hypothesis at all levels of significance
**Rejection of the null hypothesis at 5% and 10%
*** Rejection of the null hypothesis at 10%

Model 1 (trend & const.)		
ADF		
Vbles.	Levels	Diff.
lgdp	-1.73	-4.44*
lprod	-0.56	-4.62*
lexp	-2.35	-5.67*
lrer	-1.46	-5.50*
lgdpusa	-4.93*	-4.90*
lrd	-2.38	-4.60*
linv	-4.88*	-4.81*

Model 2 (constant)		
ADF		
Vbles.	Levels.	Diff
lgdp	0.25	-4.48*
lprod	2.30	-5.35*
lexp	1.36	-5.40*
lrer	-1.01	-5.53*
lgdpusa	-1.39	-4.37*
lrd	-0.43	-4.63
linv	-0.45	-4.88*

Model 3 (none.)		
ADF		
vbles.	Levels	Diff.
lgdp	11.01	-2.22**
lprod	-2.69*	-3.48*
lexp	7.15	-3.04*
lrer	2.09	-4.93*
lgdpusa	10.26	-2.17**
lrd	3.05	-4.14*
linv	5.87	-3.26*

Misspecification Test and Rank Test

Table 1: Residual Analysis in the Productivity Model.

Univariate Analysis		Normality	ARCH	R^2
$\Delta lprod$		2.412(0.29)	4.412(0.11)	0.891
$\Delta linv$		0.779(0.67)	0.699(0.70)	0.900
$\Delta lrer$		2.536(0.28)	1.777(0.41)	0.719
Multivariate Analysis				
AR(1)	AR (2)	Normality	ARCH (1) ; ARCH (2)	
15.41(0.08)	5.24(0.81)	7.47(0.27)	51.86(0.04); 84.38(0.15)	

Note: Residuals analysis corresponds to an unrestricted VAR(2). AR(1) and AR (2) are the LM test of autocorrelation for the first and second order in the residuals, and are distributed as $\chi(9)$.The normality test, is distributed as $\chi(6)$.ARCH(1) and ARCH (2) corresponds to the LM test of ARCH effects for first and second order, and are distributed as $\chi(36)$ and $\chi(72)$ respectively. (p-values in brackets).

Table 2: Determination of the Rank Test in the Productivity model

p-r	r	E.Value	Trace	Trace*	95%	p-value	p-value*
3	0	0.77	117.85	100.96	77.10	0.000	0.000
2	1	0.59	56.11	49.36	49.6	0.011	0.052
1	2	0.37	19.09	16.55	25.86	**0.254**	**0.415**

Note: (*) corresponds to the trace test with Bartlett's correction. The asymptotic distributions have been simulated for the current deterministic specifications

Table 4: Residual Analysis in the Output Model.

Univariate Analysis	Normality	ARCH	R^2
$\Delta lgdp$	2.46(0.29)	4.78(0.09)	0.892
$\Delta linv$	1.39(0.49)	0.40(0.81)	0.900
$\Delta lrer$	1.45(0.48)	3.92(0.14)	0.756
Multivariate Analysis			
AR(1)	AR (2)	Normality	ARCH (1) ; ARCH (2)
14.51(0.10)	2.42(0.98)	5.10(0.53)	53.05(0.03);85.35(0.13)

Note: Residuals analysis corresponds to an unrestricted VAR(2). AR(1) and AR (2) are the LM test of autocorrelation for the first and second order in the residuals, distributed as $\chi(9)$.The normality test, is distributed as $\chi(6)$.ARCH(1) and ARCH (2) corresponds to LM test of ARCH effects for the first and second order, distributed as $\chi(36)$ and $\chi(72)$ respectively. (p-values in brackets).

Table 5: Determination of the Rank Test in the Output model

p-r	r	E.Value	Trace	Trace*	95%	p-value	p-value*
3	0	0.76	116.82	99.43	76.16	0.000	0.000
2	1	0.59	58.39	50.49	49.62	0.006	0.041
1	2	0.40	20.95	17.02	25.60	**0.166**	**0.375**

Note: (*) corresponds to the trace test with Bartlett's correction. The asymptotic distributions have been simulated for the current deterministic specifications

Table 3: Short-Run Structure: Productivity Model

	$\Delta lprod$	$\Delta linv$	$\Delta lrer$
$\Delta lprod_{t-1}$	0.39	1.14	-
	(4.79)	*(7.26)*	-
$\Delta lgdpusa$	0.36	-	-0.65
	(2.74)	-	*(-3.01)*
$\Delta lgdpusa_{t-1}$	0.50	1.05	-
	(3.66)	*(2.99)*	-
$\Delta lexp_t$	-	-0.18	0.13
	-	*(-3.32)*	*(4.55)*
$\Delta lexp_{t-1}$	-	-	-0.09
	-	-	*(-2.80)*
Δlrd	0.12	0.40	-
	(5.64)	*(7.95)*	-
Δlrd_{t-1}	0.07	-	-
	(2.95)	-	-
Constant	-0.95	0.84	0.43
	(-3.58)	*(1.32)*	*(2.35)*
$\Delta Ds94$	0.12	0.20	-
	(-6.18)	*(3.95)*	-
$\Delta Ds78$	-0.03	-0.14	-
	(-2.31)	*(-3.23)*	-
$\Delta Ds78_{t-1}$	-0.03	-0.13	-
	(-2.33)	*(-3.05)*	-
dum89p	-0.04	-0.27	-
	(-2.46)	*(-6.29)*	-
ecm_1	**-0.35**	**-0.31**	-
	(-7.11)	*(-2.54)*	-
ecm_2	**-0.27**	**-0.81**	**-0.13**
	(-5.18)	*(-6.52)*	*(-2.17)*

Table 6: Short-run Structure: Output model

	$\Delta lgdp$	$\Delta linv$	$\Delta lrer$
$\Delta linv_{t-1}$	0.21	0.41	-0.23
	(7.35)	*(5.33)*	*(–3.18)*
$\Delta lgdp_{t-1}$	-	-	0.64
	-	-	*(3.83)*
$\Delta lrer_{t-1}$	-0.25	-0.48	-
	(-2.80)	*(-2.14)*	-
$\Delta lexp$	0.07	-	-
	(4.08)	-	-
$\Delta lgdpusa$	-	-0.83	-
	-	*(-2.78)*	-
$\Delta lgdpusa_{t-1}$	0.54	0.94	-
	(4.00)	*(2.76)*	-
Δlrd	0.15	0.35	-
	(7.29)	*(6.92)*	-
Δlrd_{t-1}	-	-	-
	-	-	-
Constant	2.29	3.67	1.03
	(7.87)	*(5.00)*	*(4.79)*
dum89p	-0.04	-0.27	-
	(-2.30)	*(-6.27)*	-
ΔD_{s94}	-	-	0.16
	-	-	*(5.84)*
ΔD_{s78}	-	-	-0.08
	-	-	*(-3.39)*
ΔD_{s78t-1}	-0.05	-0.11	-
	(-3.07)	*(2.64)*	-
ecm_1	**-0.61**	**-0.65**	-
	(-7.65)	*(-3.27)*	-
ecm_2	**-0.39**	**-1.02**	**-0.52**
	(-5.19)	*(-5.09)*	*(-4.77)*

$$ecm_1 = lprod - 0.16linv - 0.29l\exp - 0.17D_{s94}$$

$$ecm_2 = linv - 0.31lrd + 0.20D_{s78} - 0.08t$$

$$ecm_1 = \lg dp - 0.39linv - 0.88lrer - 0.10l\exp - 0.15D_{s78} - 0.25D_{s94}$$

$$ecm_2 = linv - 0.28lrd + 0.23D_{s78} - 0.09t$$

Table (7): China's Economic Growth Rates during 1960-2004

	Δlgdp*	Δlinv*	Δlexp*	Δlprod*	Δl(K/L)*	exp/gdp	inv/gdp
%							
1960-64	-0,97	-2,56	-7,15	-2,35	2,62	0,04	0,21
1965-69	6,98	9,85	2,49	3,15	1,57	0,03	0,20
1970-74	8,08	13,94	19,63	5,52	6,74	0,04	0,25
1975-79	6,79	8,30	8,21	4,82	6,18	0,05	0,29
1980-84	9,75	10,89	19,96	6,28	4,20	0,07	0,28
1985-89	9,75	7,26	18,51	6,75	7,50	0,11	0,30
1990-94	10,63	19,05	28,23	6,68	6,31	0,18	0,32
1995-99	8,46	8,75	6,44	7,24	8,97	0,20	0,35
2000-04	8,92	13,90	22,76	7,80	7,77**	0,28	0,41

*Δlx is the average annual growth rate of x; **Information available only for the year 2000.
Fuente: Nacional Bureau of Statistics of China