The Social Economy

The Social Economy:

Poverty Alleviation and Social Wellbeing

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Edited by

Masudu Alam Choudhury
and Uzir Abdul Malik

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EDITORIAL

This initial issue of the *Journal of Ethics, Economics, Finance, and Society (JEEFS)* comprises selected papers that were presented in three international conferences. These conferences were successfully held by the Center for Interdisciplinary and Integrated Studies (CIIS), Kuala Lumpur, Malaysia, during 2013 and 2014; and by the Postgraduate Program in Islamic Economics and Finance with its headquarters in the Faculty of Economics, Jakarta, Indonesia. *Tawhid* as a field of intellectual studies comprises analytical studies in Monotheistic Unity of Knowledge and the World-System. Here are brief introductions on the academic center and program, respectively; and the nature of the conferences that were held by them between 2013 and 2014.

The first international conference of CIIS held between December 18 and 19, 2013 deliberated on the theme, *Diversity of Interdisciplinary and Integrative Paradigms (Economics, Business, Science, and Society).* The venue was the Bayview Hotel in Langkawi, Malaysia.

Spanning the fields of economics, finance, business, science and society, and related fields, the theme of the conference presented substantive ideas in the field of interdisciplinary unity of theory and practice in diversely interactive and integrative intellectual inquiry. At the end, the conference initiated intellectual inquiry in the field of epistemological inquiry of the unity of the socio-scientific order for understanding critical realism through heterodox paradigms and global case studies. Selected scholarly papers that critically investigated the problems of orthodox intellectual inquiry and its reconstruction or replacement in the light of interdisciplinary and integrative reasoning, thought, practice and case studies are included in this issue of *JEEFS*.

The Second international conference of CIIS was held in collaboration with the Department of Economics and Business, Universitas Sultan Hasanuddin, Makassar, Indonesia between November 26 and 27, 2014. The theme of the conference was *Poverty Alleviation and the Global Social Contract*. The international conference focused on the topic of poverty alleviation with the objective, structure, and policies and programs of the appropriate kind of global social contract.

The primary aim of CIIS (www.ciistudies.com) is to advance scholarly thinking and activities on the epistemology of unity of knowledge and its understanding and applications to all fields of knowledge. CIIS is a non-profit academic organization pursuing scholarly activities and thinking along the conceptual and applied epistemological lines covering diverse interdisciplinary fields.

CIIS pursues academic and practical aspects of the sciences comprising the fields of economics, finance, social sciences and related disciplines, and philosophical, mathematical and scientific themes that have significant bearing on human wellbeing. By doing so CIIS aims at establishing a global outlook of epistemic unity of thought and practice, and unified learning paradigms of global interdisciplinary systems.

Included in it are great issues and questions of economics, finance, social sciences, the socio-scientific methodology, and related disciplines that have significant bearing on human wellbeing. CIIS conducts its activities through discussions and dialogues in seminars and conferences, publications of refereed scholarly papers as in *JEEFS*, and ultimately also training in relevant themes. Academia and practitioners are welcome in intellectual discourse and presentations relating to CIIS activities.

The Eleventh International Conference, *TAWHID2014* was held in its headquarters, the Postgraduate Program in Islamic Economics and Finance, Faculty of Economics, Trisakti University, Jakarta, Indonesia (www.ief-trisakti.ac.id) between November 24 and 25, 2014. The conference deliberated on the theme, *Tawhid and the world-system: "Integration of the Ummah by Tawhidi Methodological Worldview"*. *Tawhid* means Islamic monotheism and also explains the attenuating field of consilience of unity of knowledge by monotheism. Scholarly papers were invited in all areas of relevance to the theme of the conference. Selected papers are included in this issue of *JEEFS*.

Professor Masudul Alam Choudhury
Chief Editor
Masudc60@yahoo.ca

Remedying the Problem of the Middle-Income Trap: The Case of China

Jingjing Yang
School of Economics and Trade, Hunan University (North Campus), Changsha, Hunan, China.
Email: yangjing0216@hnu.edu.cn
and Sana Khalil
University of Massachusetts Amherst, USA.
Email: sanakhalil@umass.edu

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Abstract

Extending the discussion on China's possibility of falling into a middle income trap, we argue that unconventional sources of economic development and growth can serve as remedies to this problem. Using data gathered from 31 regions of China between 2003 and 2011, we examine the role of inventions, higher education and government R&D efforts in determining China's economic development and growth. Our findings suggest that the number of inventions, government R&D expenditure, human capital stock at the higher education (HE) level, and government investment in higher education are closely, positively and significantly correlated with China's economic development and growth. Concerning the governmental policy options of investment in human capital stock and

education, the results imply that human capital stock at the HE level is more closely, positively and significantly related with China's economic development and growth compared to human capital stocks at primary and secondary education levels; human capital stock at initial education levels appears to be negatively related to per capita income and the growth rate of per capita income.

We apply robust regression analysis, the Driscoll & Kraay (1998) method and Arellano-Bond GMM estimation to analyse the sensitivity of our results which show that our variables of interest are robust to heteroscedasticity, autocorrelation of type MA(q), and contemporaneous cross-sectional dependence.

1. Introduction

Though the debate concerning China's possibility of falling into a middle-income trap over the upcoming years is multipronged, we focus our analysis on the remedies to this problem. As recent studies characterise the middle-income trap as a stable, low-growth economic condition of equilibrium where innovation stagnates and talent is misallocated (Agénor, Canuto and Jelenic, 2012), we provide another perspective on this problem by gauging the links between higher education, R&D, invention efforts and per capita income to suggest their significant, positive roles in determining per capita income. Building our intuition on the findings by Eichengreen, Park and Shin (2013) that slowdowns are less likely in countries with a higher ratio of secondary and tertiary education and where high-technology products constitute a large share of exports; it is highly recommended that moving up the technology ladder through higher education, R&D and inventions can help avoid the middle-income trap.

Building on a recent stream of literature that stresses that the governments must induce a greater role of innovations, R&D and education in order to deal with the problem of the middle-income trap, this paper seeks to contribute as follows;

i- It provides both current and historical perspectives on China's economic development and growth while highlighting the possibilities of getting mired in a middle-income trap.

ii- The paper aims at resolving some of the empirical dilemmas in the recent strand of literature. While the literature stresses the role of education, R&D and innovations, there are empirical dilemmas to be resolved; what level of education (i.e. primary, secondary or tertiary) is most closely and significantly linked with economic development and growth? Does investment in education necessarily enhance economic development and growth? If so, which education level deserves more investment? How does one measure the innovation efforts of a society over a given period of time?

iii- Amid numerous forecasts concerning China's future growth slowdown, this paper seeks to propound remedies to such problems. It suggests a greater role of higher education, increasing numbers of inventions and boosting government R&D efforts in economic development and growth, all of which can help remedy the problem of the middle-income trap.

Our analysis stresses the importance of new inventions, measured by number of patents granted; levels of highly educated human capital stock, measured by enrollment ratios at institutions of higher education; government R&D efforts, suggested by the share of government R&D expenditure in gross regional product; and higher education efforts, measured by government investment in HE at institutions of HE themselves, and research per student. The paper also contributes in terms of arguing for a greater role of inventions in determining economic development and growth. The role of inventions, although frequently discussed in literature, still remains empirically obscure, as does the dilemma of measuring inventions in a society. We provide a viewpoint to this problem by using the number of patents granted as a proxy to measure the invention efforts of a society.

Using panel data from 31 regions of China from 2003-2011 (available from the National Bureau of Statistics of China), we find that our variables of interest are highly correlated with economic development and growth. These correlations and links are useful in the context of remedying the problem of the middle-income trap, since higher education, inventions and R&D can not only aid moving up the technology ladder (Eichengreen, Park and Shin, 2013) but also carving the path of future technological efforts.

We argue that China, instead of relying on conventional growth derivers, needs to focus on expediting government R&D activities, invention efforts and increasing the stock of highly educated human capital to remedy the problem of the middle-income trap. Without an empirical understanding of the links, policies toward economic development and growth could be plainly mismatched. Understanding the correlations and empirical linkages can help elaborate a distinctive path for economic policies that needs to be directed toward the rightful economic fundamentals in order to remedy the problem of the middle-income trap.

The paper comprises of six parts: section two seeks to provide a profound discussion on the question of whether the middle-income trap is a myth or reality; section three highlights the means to avoid the middle-income trap by analysing the role of higher education, inventions and R&D efforts in determining per capita income; section four discusses a general neoclassical framework on determinants of per capita income to elicit the some theoretical links; section five draws forth empirical estimations and results; while section six concludes the paper. Our empirical estimations are not based on the neoclassical growth model; instead, we define per capita income as a function of capital stock, stock of highly educated human capital, trade openness, number of new inventions, government R&D efforts, government support of higher education efforts and population growth. However, we do discuss the implications of the neoclassical framework in section four in order to elicit the basic concepts on economic development and growth.

1.1 Background

According to World Bank (2013) estimates, China's GDP growth rate will gradually decline from an average 8.5% between 2011 and 2015, to around 5% in the period 2026 to 2030. Labour growth (growth of the labour force) and labour productivity growth will slow down from an average 0.3% and 8.3% respectively between 2011-2015, to -0.4% and 5.5% respectively between 2026 and 2030.[1] Two factors are set to constrain China's current spree of rapid economic growth: first, the contribution from labour is set to decline due to lower expansion of its working-age population (which is estimated to be eventually negative from 2015 onwards), second, total factor productivity growth, which has been a major source of China's past growth (Brandt and Zhu, 2010; Young, 2003), will decline significantly since much of the productivity gains due to reallocation of resources from agriculture to industry have already been reaped. From this point onwards, continued capital accumulation

[1] The data quoted in the paper, unless otherwise stated, comes from the World Bank and the Development Research Center of the State Council, P. R. China, 2013, *China 2030: Building a Modern, Harmonious, and Creative Society,* Washington, DC: World Bank.

will ineluctably generate less growth due to decreasing returns to capital and labour. Meanwhile, China is set to undergo a major demographic transition whereby the old age dependency ratio will more than double in the upcoming two decades and the size of its labour force will shrink. Total factor productivity has also started declining as the economy has already reaped the benefits from first-generation policy initiatives and gains from second-generation policy measures are more likely to have less impact on growth. Amid this whirlpool of transitions lie the challenges to support sustained economic growth that is inevitable for a leap toward a higher-income level.

Future challenges apart, China's overall experience of sustained economic growth over the past thirty years is unprecedented, and worth exegesis. According to Lin (2011), before the advent of the Industrial Revolution, China was still a leader in innovation as it enjoyed having the largest population in the world, endowing it with a huge stock of craftsmen and farmers. It can therefore be asserted that even prior to the Industrial Revolution, China had a comparative advantage in terms of its unique endowments of human capital stock. The initial drivers of China's comparative advantage were its labour-intensive industries. However, with the advent of the Industrial Revolution which marked the essentiality of capital-intensive industries, the need to shift from an agrarian economy to an industrial one turned dire. China's economic transition can be traced back to 1979 when a dual-system was adopted whereby protection and subsidies were granted to develop the capital-intensive industrial sector, while liberalising the labour-intensive sector by allowing private participation and foreign direct investment. This dual-system of economic shifting bore fruits in terms of dynamic economic progress and sustained growth.

The tremendous economic growth over the past 34 years has brought along some negative spill-overs too; external imbalances, distortions in the financial sector and monopolies in telecommunications, power and financial services. At the core of these negative spill-overs are the socio-economic intricacies; an aging workforce, a widening of income inequality and the possibility of falling into the middle-income trap. Simply defined, the middle-income trap is an economic situation in which a country, despite experiencing rapid growth, fails to graduate in upper income levels as growth slows down after hitting the middle income level. Avoidance or disentangling from such a trap usually requires technological advancements, rapid innovations and a rekindling of consumption and demand. Thus, the solution rests in expediting growth on the basis of innovation, productivity improvements instead of relying on conventional resource-based growth (where labour and capital stand as the conventional inputs for growth). This entails investment in higher education and increased efforts for research and innovations which would in turn encourage technological breakthroughs and creativity.

Though the question of whether China has fallen into a middle-income trap or merely runs the risk of falling into one is a matter of debate, the crucial aspect of this debate centers around the remedies to this problem. We, therefore, forward an empirical investigation into the roles played by higher education, R&D expenditure and invention efforts in determining economic development and growth. As mentioned previously, in our paper we use regional level data from China gathered over the period 2003-2011 (the selection of years is based on availability of data and ensuring a sample with the minimum amount of missing values) to discuss economic development and growth from the perspective of higher education, research and development and inventions.

2. Middle Income Trap: Myth or Reality?

Despite achieving growth culminations, only a few economies have been able to graduate from low-income categories to high-income categories. From 1950 to 2010, only 28 economies in the world could narrow their per capita income gap with the United States by ten per cent, while around 150 countries were reported to have been trapped in low-income or the middle-income trap (World Bank and the Development Research Center of the State Council, P. R. China, 2013). The wide gap between the per capita incomes of industrialised high-income economies and developing economies stands as a socio-economic challenge and a focal point of debate.

The term "middle-income trap" is generally acknowledged to have been first[2] used by Gill and Kharas (2007). Middle-income economies are defined in accordance with World Bank classifications of countries based on per capita income levels. The question of why countries fail to graduate to the upper-income levels and are mired at the middle-income level despite a prolonged period of handsome growth, forms an increasing stream of current economic discussion. Though the concept of the middle-income trap is in the current limelight, explanations have generally lagged

[2] As mentioned by Agenor, Canuto, and Jelenic (2012)

behind in catching up with its intricacy. One explanation in this regard comes from the perspective of growth slowdown during the transition phase. That is, for countries striving to graduate to the upper-income levels, their growth engine has to keep working until they can mark their transition from middle-income to higher-income groups. However, in most of the cases, growth has generally been observed to slack down somewhere between lower-middle to upper-middle groups before actually leaping forward to higher-income groups (World Bank and the Development Research Center of the State Council, P. R. China, 2013). While such slowdowns amid the transition path of economies (before a leap-frog to upper-levels of income) are a source of general mystification, their economic explanations are somewhat complicated. A possible explanation (Canuto, 2011), for example, is ingrained in the dual-sector model (or Lewis model) whereby developing countries initially achieve huge productivity gains due to the sectoral shift of workers from agriculture to manufacturing. These initial productivity gains, due to the reallocation of workers, begin to disappear as these countries approach middle-income levels since wages starts rising due to exhaustion of labour supply from the underemployed rural sector, which in turn erodes the competitiveness of labour-intensive exports.

Another explanation for the middle-income trap heavily draws upon the famous concept of “growth convergence” (Sala-i-Martin,1996; Solow, 1956; Mankiw, Romer, Weil, 1992); whereby human capital accumulation, investment share of income, government policies and other factors related to environment and infrastructure are taken as main determinants of economic growth. From this perspective, growth is kindled and kept ignited by these factors at the initial developmental stage of lower per capita income. However, as the economy enters its transition phase and growth heats up, those growth-augmenting factors start wearing out due to diminishing marginal returns unless and until growth is bolstered by technology diffusion or total factor productivity growth.

In a nutshell, the ingredients of rapid growth during an initial phase of economic transition start depleting once the countries reach the middle or upper-middle income levels. For growth to sustain before leapfrogging into the upper-income levels, a different recipe with new ingredients of growth would be required (which underscores higher education, innovation, R&D and high quality human capital as new sources of growth).

According to World Bank and the Development Research Center of the State Council, P. R. China (2013), the concept of middle-income has some empirical backing too, as some Middle East and Latin American economies did reach middle-income levels in the early 1960s and 1970s, but failed to graduate to upper-income levels, remaining trapped in the middle-income levels ever since. Out of 101 middle-income countries in 1960, only a handful (13 economies) moved upwards to high-income levels by 2008.

Turning towards China's case, studies that predict a slowdown for China generally draw a pessimistic picture of its future economic growth. For example, Wilson and Stupnytska (2007) expect a future growth forecast of 5.8 per cent over 2008-2030 for China. Using a growth accounting framework, Lee and Hong (2012) base their growth projections on total factor productivity (TFP) growth estimated through growth derivers such as capital to labour ratio, saving rates, stock of patents, years of schooling, openness and demographic variables. They find that China appears as an outlier with an especially high growth of capital to labour ratio. The authors, further on, project a growth rate of 6.1 to 7 per cent for 2011-2020 and 5 to 6.2 per cent for 2021-2030. The authors suggest a slower growth of growth derivers: labour force growth, growth in educational attainment, growth of capital stock and TFP growth. Slower growth is indicated to result from the convergence of capital to labour ratio and TFP to advanced-economic levels, while slower growth of educational attainment is expected once enrollment ratios reach reasonably high levels due to an ageing population.

Based upon a myriad of forecasts that China might face a growth slowdown, there looms a possibility of it falling into the middle-income trap over the coming years.

3. Remedying the Problem of the Middle Income Trap

China's current level of per capita GDP signals toward its first and foremost challenge of "avoiding the middle-income trap" (The World Bank and the Development Research Center of the State Council, P. R. China, 2013). The focal point of this problem is, how to remedy growth slowdown (growth slackness after a certain period of remaining in the ascent is a general observation in most cases of rapidly growing economies) and enable a smooth transition to higher-income groups without getting stuck in a middle-income trap (as could be the case if growth slacks down during the transition path while the economy gets mired in the middle-income group).

As per the estimates calculated by the World Bank and the Development Research Center of the State Council, P. R. China (2013), the threshold between upper-middle income levels and high-income levels in 2030 would be around $24, 079 per capita (if this threshold continues to grow at a current average of 3.5 per cent per annum). In order to attain that level by 2030, China's per capita GDP (in dollars) needs to grow at an average of 8.9 per cent per annum. Compared to the World Bank's rather optimistic forecasts, Eichengreen, Park and Shin (2011) draw a more serious picture, projecting China's growth to be around 6.1 to 7 per cent 2011-2020 and at 5 to 6.2 per cent per annum over 2021-2030. Similarly, Buitar and Rahbari (2011) forecast China's growth to average at 5 per cent over 2010-2050, while Lee and Hong (2012) project it to be around 6.1 per cent over 2011-2030.

Amid the forecasts concerning the slowdown of the Chinese economy and the risks of falling into the middle income trap, it is essential to explore new economic derivers (so that economic policies can be directed toward them instead of conventional derivers of development and growth) that are closely and significantly linked with economic development and growth in order to avoid growth slowdown in the future. We, henceforth, discuss the role of higher education, R&D and invention efforts in order to explain their empirical linkages with economic development and growth.

3.1 Higher Education

The middle-income trap is an economic situation marked by the stagnation of innovation and misallocation of talent (Agénor, Canuto and Jelenic, 2012) and disentangling from such a trap would entail a better educated work force that has the capability of learning-by-doing and imitating new technological developments. From this perspective, it is essential to decipher the so-called economic returns to educational investment. Though there are compelling reasons to believe that investment in education enhances growth; however, empirical evidence doesn't necessarily support this conclusion. It is also unclear which level of education would contribute most toward growth; would it be primary, secondary or tertiary?

The literature on the positive link between education and growth is generally based upon the argument that more education leads to an improved labour force and therefore higher productivity; as a more educated labour force is easier to train, has better work habits, and can resolve more complex tasks. The 'new' growth theories, for example, suggest that developing nations can catch up with advanced economies if they have a stock of skilled labourers to develop new technologies or imitate foreign technology. Education, in such models, increases output via two channels: more education imparts necessary skills to labourers thereby enhancing the capacity of the labour force to produce more; and it augments the workers' capacity to innovate thereby improving workers' productivity (since with better education workers can learn new methods of using existing technology, create new technology or imitate foreign technology). Thus, the intuition behind 'new' growth theories stresses the human capital aspect of education (that education improves the quality of the labour force and enhances technological advancements) and the externalities created by a skilled labour force (Mankiw et al., 1992). The externalities generated by a better educated labour force are better explained by Agenor, Canuto, and Jelenic (2012) who use the term "knowledge network externalities" to suggest that there is a possibility that a higher proportion of workers with higher levels of education would have a positive effect on the performance of all the workers involved in innovation activities. Such "knowledge network externalities are essential in developing the calibre to understand existing technology and reap the benefits of prevailing knowledge. Thus, it can be suggested that, in the cases of countries at low levels of development, a combination of "knowledge spillover" and the "learning-by-doing' effect would increase the marginal productivity gains. From this perspective, tertiary education may contribute more toward economic development and growth than primary or secondary education levels.

There are practical examples of countries that benefited tremendously from an increased stock of highly educated human capital. The special case of Korea's smooth transition from middle-income levels to high-income levels is linked with its expansion of human capital stock at secondary and tertiary education levels. Korea stands as an example of a country which successfully avoided falling into the middle-income trap by capitalising on returns from higher education (Eichengreen, Park and Shin, 2013). On the other hand, the cases of Malaysia and Thailand, which like many Latin American countries failed to graduate into the upper-income levels after reaching the middle-income stage, have been linked with their failures to upgrade and develop high quality human capital to keep pace with increasing growth (Eichengreen, Park and Shin, 2013; Ohno, 2009; Woo, 2009). The lack of highly educated workers undermines innovation and research activities which constrains productivity gains and exploitation of knowledge externalities. At a micro level, the pool of highly educated workers is considered to enhance the "absorptive capacity"[3] of a firm to gain from knowledge externalities from innovation and other R&D activities (Cohen and Levinthal, 1989). Investment in human capital, therefore, stands as a crucial factor in determining per capita income. Along the same lines, Mankiw et al. (1992) found that investment in human capital along with two other variables, namely population growth and investments in physical capital, account for 80 per cent of the variations in per capita income across countries.

China's transition from middle-income to higher-income groups will, in one way or another, depend on its stock of highly educated human capital that can concoct its future socio-economic landscape by contributing to labour productivity, R&D and innovation efforts.

3.2 Research and Development (R&D)

Investment in research and knowledge efforts has been directly linked with productivity growth and increased innovation efforts (Griliches, 1986). However, most studies apply R&D investments to firm-level decisions rather than to public policy options in order to study the role of R&D efforts on firm productivity and other spill-over effects. In the current debate on the middle-income trap and its avoidance, public policy options concerning R&D investments are increasingly discussed. Agenor, Canuto, and Jelenic (2012) discussing R&D efforts on a macro level, stress the role of government R&D expenditure to enhance learning and innovation efforts throughout the economy. They relate government R&D investment with the creation of incentives for innovation and suggest that at a micro level (at firm-level), "incentives" for innovation could be constrained by an "imitation trap" whereby productivity and wages are relatively low (during initial developmental stage). Market failures, therefore, may lead to underinvestment in R&D activities, which brings in the rationale of government funding of research and development. Since transition to upper-income levels increasingly depends on innovation, productivity growth and learning efforts, government support of R&D efforts turns axiomatic. However, the empirical dilemma still remains as to which R&D measure is significantly and closely linked with economic development and growth, i.e. public or private.

Government funding of R&D could be given through the following channels; i), the funding of R&D activities at government research

[3] The term "absorptive capacity" was first identified by Cohen and Levinthal (1989).

institutions and universities, ii) subsidising the R&D efforts of private firms (David et al., 2000; Svensson 2008). Promoting R&D via private organisations (through government subsidies for R&D activities) entails disadvantages as the conflict of interests (firm-interests versus social-interests) may lead to biased R&D decisions, and companies may choose projects that guarantee a higher private return (rather than social return) with higher returns in the short-term(David et al., 2000). Thus, leaving the incentive for R&D activities to companies could prove quite tricky in its outcomes.

At firm-level (when R&D activities are financed by the firm itself), however, returns on publicly funded and privately funded R&D activities could be congruent. A handful of studies have directly compared the returns on publicly-funded R&D and privately-funded R&D and found that there is no major difference between the returns on both types of R&D at the firm-level (Griliches, 1992)

At an aggregate level, the link between government funded R&D activities (at universities and other institutions) and economic growth has been connected through the channels named as “knowledge transfer” and “knowledge externalities” (Salter and Martin, 1999; Agenor, Canuto, and Jelenic, 2012). That is, the public R&D efforts expedite knowledge transfer and result in positive spill-overs to other economic fundamentals; i.e. productivity and foreign direct investment (FDI). Guellec and Van (2004), for example, link government funded R&D activities at universities and research institutes with productivity growth, implying that public support of R&D activities through public institutions serve as a better tool to enhance economic performance (since public institutions lay more emphasis on social return than on private return). From this perspective, the role of government R&D expenditure in determining per capita income can of be great significance in the discussion concerning the middle-income trap.

In our empirical estimations we would test the roles of government R&D efforts, measured by share of government R&D expenditure in gross regional product; and private R&D activities, measured by the number of R&D projects carried out by small and medium private enterprises (we use this proxy since the data relating to the R&D expenditure of private firms is unavailable).

3.3 Inventions

Whilst there is no general consensus on what actually should be considered as an "invention" or how to measure it, we provide a perspective on this issue by using the number of patents granted (accepted) as the measure of new inventions made in a society. Though it may not reflect the true effects of firm-level innovations or other technological innovations, it does provide a standard measure of inventions being made in a society over a certain time period.

The role of innovation and other design activities is essential for their spill-over effects of higher productivity and economic growth. Intellectual property rights (patents), in this regard, serve as a means to generate incentives for firms and individuals to innovate which in turn translates into development of a high quality work force (Agenor, Canuto, and Jelenic, 2012). The role of patents is generally linked with "innovation sales" (Hall and Mairesse, 2006) and incentives to engage firms and individuals with increased innovation efforts (Agenor, Canuto, and Jelenic (2012).

Technology catch-up based on imitation generally requires a lower level of skills, and countries in their initial phase can grow rapidly by copying the technology from advanced economies. However, once the development process heats-up, sustained growth would require innovation rather than imitation to preclude the possibilities of productivity slow-down. Also, once the economy heats-up, the old drivers of growth start wearing out; this turns the role of innovation to a requisite rather than a luxury.

4. The Neoclassical Framework for the Determinants of per Capita Income

The basic framework for the estimation of per capita income can be derived from the augmented version (Mankiw, Romer and Weil, 1992) of the basic neoclassical growth model (Solow, 1956). Assuming a Cobb-Douglas production function, income, Y, at time, t, can be written as follows;

$$Y(t)= K(t)^{\alpha} H(t)^{\beta} (A(t) L(t))^{1-\alpha-\beta}$$

Where K and H represent physical and human capital, L represents Labour and A stands for the level of technology. Over time, technology and labour grow exogenously at rates *g* and *n*. Given the physical and human capital per unit of labour, the dynamics of growth can be summarised as follows;

$$\dot{k}(t) = s_k(t) A(t)^{1-\alpha-\beta} k(t)^{\alpha} h(t)^{\beta} - (n(t) + \delta) k(t)$$

$$\dot{h}(t) = s_h(t) A(t)^{1-\alpha-\beta} k(t)^{\alpha} h(t)^{\beta} - (n(t) + \delta) h(t)$$

Where $\dot{k}$ ($k = K/L$ and $h = H/L$) and $\dot{h}$ represent the growth rate of physical and human capital per unit of labour, while s_k, s_h and δ are rates of investment in physical and human capital and depreciation rate. Assuming $\alpha+\beta<1$ (decreasing returns to physical and human capital), the steady-state dynamics can be summarised as follows;

$$\ln k^*(t) = \ln A + \frac{1-\beta}{1-\alpha-\beta} \ln s_k(t) + \frac{\beta}{1-\alpha-\beta} + \ln s_h(t) - \frac{1}{1-\alpha-\beta} \ln(n(t)+g+\delta)$$

$$\ln h^*(t) = \ln A + \frac{\alpha}{1-\alpha-\beta} \ln s_k(t) + \frac{1-\alpha}{1-\alpha-\beta} + \ln s_h(t) - \frac{1}{1-\alpha-\beta} \ln(n(t)+g+\delta)$$

$$\ln y^*(t) = \ln A + \frac{\alpha}{1-\alpha} (\ln s_k(t) - \ln(n(t)+g+\delta) + \frac{\beta}{1-\alpha} \ln h^*(t)$$

Where per capita income, $y = Y/L$, and ln stands for log-linearisation.

Since the steady-state level of human capital in the last equation is unobservable, a log linearised form can be stated as follows;

$$\ln h^*(t) = \ln h(t) + \rho.\Delta \ln h(t)$$

Where ρ is a function of technological parameters (α, β).

Finally, the steady-state income can be given as follows;

$$\ln y^*(t) = \frac{\alpha}{1-\alpha} \ln s_k(t) - \frac{\alpha}{1-\alpha} \ln(n(t)+g+\delta) + \frac{\beta}{1-\alpha} \ln h(t) + \frac{\beta}{1-\alpha} \rho.\Delta \ln h(t) + \ln A(0) + gt \qquad \textbf{(1)}$$

The equation reflects that the long-run steady-state level of per capita income can be determined by investment rates of physical and human capital (s_k and s_h), growth rate of population, n, and the level of technology. This long-run steady-state equilibrium relationship can be estimated directly either in its level form or through a growth-based form. The model has generally been more often used in its growth-based form to examine convergence and to compare growth specifications in different countries. On the other hand, estimation of the long-run steady-state relation in a static form has been employed by a handful of studies (Hall and Jones, 1999; Bernake and Gurkaynak, 2001). However, the static or dynamic specifications are considered to yield congruent results (Hervé Boulhol, Alain de Serres and Margit Molnar, 2008) for homogenous countries (which are not far from their steady states and share similar characteristics).

An important aspect of the Eq. (1) is that in neoclassical growth models forwarded by Solow (1957) and others, technological change is unaltered by openness to world trade. However, 'new' growth theories suggest that a country's openness to world trade affects long-term growth via its impact on technological change (Grossman and Helpman, 1992). These models are based on the intuition that openness to world trade leads to increased exposure to technology embedded in imported input.

5. Data and Empirical Estimation Results

In our empirical specifications, we would embed the role of non-conventional derivers of economic development and growth i.e. inventions, government R&D efforts, the stock of highly educated human capital and government support of higher education efforts. The basic intuition is that, for China, where conventional derivers of economic development and growth (like capital and labour) are predicted to go through major setbacks in forthcoming years (as mentioned earlier in the introduction), new derivers of economic development and growth need to be explored. The number of new inventions created in a society over a certain time period, government R&D efforts, the stock of highly educated human capital and government support of higher education efforts can serve as cornerstones in explaining per capita income due to their spill-over effects on income, growth and productivity. We define per capita income as a function of capital stock, stock of highly educated human capital, trade openness, number of new inventions, government R&D efforts, government support of higher education efforts and population growth. Per capita income for region *i* at time *t* can be specified as follows;

$$Y_{it} = \beta\ (CAPSTOCK_{it}\ ,\ PRIMSTOCK_{it}\ ,\ SECSTOCK_{it}\ ,\ HESTOCK_{it}\ ,\ INVENTIONS_{it}\ ,\ R\&DEXP_{it}\ ,\ EDUEXP_{it}\ ,\ OPENNESS_{it}\ ,\ POPGROWTH_{it}) \qquad \textbf{(2)}$$

From (2), the regression equation for empirical analysis can be written as follows;

$$\ln Y_{it} = \alpha + \beta_1 \mathbf{CAPSTOCK}_{it} + \beta_2 \mathbf{OPENNESS}_{it} + \beta_3 \mathbf{PRIMSTOCK}_{it} + \beta_4 \mathbf{SECSTOCK}_{it} + \beta_5 \mathbf{HESTOCK}_{it} + \beta_6 \mathbf{R\&DEXP}_{it} + \beta_7 \mathbf{INVENTIONS}_{it} + \beta_8 \mathbf{EDUEXP}_{it} + \beta_9 \mathbf{POPGROWTH}_{it} + \varepsilon_{it}$$

$$i = 1,\ldots\ldots 31; \qquad t = 2003,\ldots.2011 \qquad (3)$$

Where Y_{it} is per capita income (calculated as gross regional output divided by total population for region i at time t), $CAPSTOCK_{it}$ is the ratio of gross capital formation to gross regional output (used as a proxy for investment to GDP ratio to measure capital stock), $OPENNESS_{it}$ is a proxy for trade liberalisation and is measured by the sum of total exports and imports divided by gross regional output, $PRIMSTOCK_{it}$, $SECSTOCK_{it}$ and $HESTOCK_{it}$ are the higher educational levels which are in turn measured by primary, secondary and higher education enrollment ratios respectively. $R\&DEXP_{it}$ is per capita government expenditure on R&D activities at institutions of higher education (R&D expenditure divided by total population), $INVENTIONS_{it}$ is the number of inventions made (proxied by number of patents granted), $EDUEXP_{it}$ is government investment in higher education per student, which is measured by government appropriation of funds per student at higher education institutions, $POPGROWTH_{it}$ is the population growth rate, while ε_{it} is a disturbance term which reflects unobserved shocks that might affect output. These shocks could include sudden changes in factors of production, weather conditions or other such effects.

Measures such as R&D efforts, patents and highly educated personnel are associated with “national technological efforts” (Lall, 1992). Measuring the technological efforts of a country empirically is a difficult exercise, therefore studies resort to proxies to remedy that. A few studies forward suggestions for measuring a country’s innovative capacity or technological efforts through number of patents. Furman and Hayes (2004), for example, use number of patents to measure the innovative capacity of countries and find large variations in invention figures across countries at similar income levels, suggesting that the link between patents and income could be different across different countries.

We would use the static specification (which is useful to study the correlative links assuming an equilibrium condition) of Eq. (3) to study the determinants of per capita income and analyse the dispersion in economic performances across the regions from the viewpoint of higher education, R&D and innovation, which alternatively can play a significant role in helping to avoid the middle-income trap. In our empirical estimations, we would use the static specification in OLS, robust egression and the Driscoll & Kraay method for sensitivity analysis. In addition, we would use stepwise regression to allow for selection of explanatory variables that are closely and significantly related with per capita income and the growth rate of per capita income. Also, in order to look at the causal relationship we would employ the dynamic form which can elaborate how the variables evolve over time. We would use the Arellano-Bond GMM estimation method for dynamic panel data analysis.

Our dataset comprises panel data from 31 regions of China from 2003 to 2011 available from National Bureau of Statistics of China.[4]

In table 1 we regress per capita income to the set of explanatory variables conventionally associated with per capita income i.e. physical capital stock, human capital (measured by primary and secondary enrollment ratios), trade and population growth. Results in table 1 indicate that the higher education enrollment ratio and trade openness stand as the strongest variables among others in their individual positive influences over per capita income, accounting for 63% and 43% of the variance in per capita income respectively. The coefficients on the gross capital formation ratio, CAPSTOCK, and trade openness, OPENNESS, both enter the specification positively and significantly with a 1% significance level. This result is congruent with the conventional concepts about physical capital investment, trade openness and output. The gross capital formation ratio, CAPSTOCK, which is calculated as the ratio of gross fixed capital formation to GDP (or share of fixed investment in GDP), which serves as a measure for investment in physical capital, is found to be positively associated with economic growth (Barro, 1991; De Long and Summers, 1992). However, in our study we link investment in physical capital with both per capita income (in Tables 1-5) and with economic growth (in Table 6) and find that a higher physical capital investment ratio contributes significantly toward economic development and growth. Also, the positive link between trade openness, OPENNESS, and per capita income is in line with the results found by Frankel and Romer (1999) who used cross country regression estimates to suggest that trade has a

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[4] The link to the data can be accessed from http://www.stats.gov.cn/english/statisticaldata/yearlydata/

quantitatively large, robust yet moderately statistically significant positive effect on per capita income. In their direct specification to estimate per capita income with population, area and trade share as the only dependent variables, they found that with an increase in the ratio of trade to GDP by one percentage point, per capita income is raised by around 0.5 per cent to as much as two per cent. They also found that by increasing both population and area by one per cent, per capita income is raised by 0.1 per cent.

The most surprising results concern the coefficients of enrollment ratios at primary, PRIMSTOCK, and secondary, SECSTOCK, education levels, which always enter the specification with negative signs, except for the specification under the growth rate of per capita income whereby SECSTOCK enters positively in the specification. Results in Tables 2 and 3 further corroborate this finding; PRIMSTOCK and SECSTOCK always enter with a negative sign under per capita income while SECSTOCK enters positively but insignificantly under growth rate of per capita income. One explanation for this result could be that the stock of students at primary and secondary educational levels represents “idle human capital” which is not involved in the production function directly. On the other hand higher education is usually the last stage of education more closely associated with production function in its spill-over effects. Therefore, stock of students at the higher education level would represent “highly educated human capital” closely linked with the economic output. The negative link between primary and secondary enrollment ratios with per capita income can imply that regions with higher enrollment ratios at primary and secondary levels are those which have a lower per capita income. That is, poor regions have higher enrollment ratios for primary and secondary education. Also, the positive link between higher education and per capita income could suggest that regions with a higher enrollment ratio for higher education are those which have higher per capita income or that the rich regions are experiencing higher enrollment ratios for higher education. Results in Tables 2 and 3 suggest that coefficients of initial education levels (primary and secondary enrollment ratios) carry negative signs toward per capita income; however, in the case of the growth rate of per capita income, the coefficient on secondary education carries a positive sign. Thus, results in both tables support the findings that the higher education level, compared to initial education levels, is more closely, positively and significantly related to per capita income and the growth rate of per capita income.

We experiment with alternative specifications in order to test the robustness of our results; Tables 4, 5 and 6 show the results from these exercises. Tables 2 and 3 examine the individual contributions of the four variables toward per capita income and the growth rate of per capita income respectively. Table 4 examines the explanatory powers of selected independent variables when other independent variables are held constant. Results indicate that human capital stock at the higher education level (HESTOCK), government investment in higher education per student (EDUEXP), government R&D expenditure (R&DEXP), and the number of inventions (INVENTIONS) are significantly and positively related to per capita income. The adjusted R^2 is 0.89 indicating that around 89 per cent of the variation in per capita income can be explained by the four variables. Table 4 shows that a one per cent increase in the higher education enrollment ratio, HESTOCK, increases per capita income by 0.78 per cent. A one per cent increase in government investment in higher education per student (EDUEXP) raises the income per person by 0.57 per cent. From the perspective of remedying the problem of the middle-income trap, these findings carry significant implications; a higher level of human capital stock at the higher education level and increased investment in higher education can contribute significantly toward economic development by ensuring that a highly educated labour force is set in place to build the capacity for technological advancements and productivity improvements, since a highly educated labour force can imitate technology faster (Nelson and Phelps, 1996) and contribute more to labour productivity. Also, higher education can be more closely linked with the production function since it is usually the last educational stage after which students join the labour force as highly skilled workers. From this perspective, higher education can be considered more important than primary and secondary education.

The coefficient on government expenditure on R&D activities at institutions of higher education, R&DEXP, enters positively and significantly with a one per cent significance level; a one per cent increase in government R&D expenditure per person leads to 0.08 per cent increase in per capita income. The result signals toward the fact that higher “technological efforts” contribute positively toward per capita income (Lall, 1992).

The results in table 4 also indicate a statistically significant and positive relationship between inventions and per capita income; a one per cent increase in number of inventions, boosts per capita income by 0.1 per cent. This finding carries significant implications toward the role of innovative capacity in economic development. The earlier work by Fagerberg and Srholec (2008) also suggested a close correlation between economic development (as measured by GDP per capita) and the "innovation system variable". Using factor analysis on data from 115 countries between 1992 and 2004, Fagerberg and Srholec (2008) found that four principal factors jointly explained about 75% of the variance of the total set of indicators. These four principal factors (which, along with electricity consumption and education, are jointly termed as the "innovation system variable") were associated with "technological capability" and were measured through patenting, ICT infrastructure, scientific publications, and ISO 9000 certifications.

The findings in Table 4 are further tested at full specification by including other explanatory variables. Table 5 shows the regression results under full specification. The estimated coefficients on the selected variables remain significantly and positively related to per capita income: the coefficient estimates on HESTOCK 0.71(.062), R&DEXP 0.062 (.036), INVENTIONS 0.106 (0.015) and EDUEXP 0.443 (0.041) are almost comparable with those estimated in Table 1.

In Table 6 we try out alternative specifications for per capita income and the growth rate of per capita income. The coefficient on birth rate enters positively and significantly under the specification for per capita income; but, negatively and insignificantly under the specification for the growth rate of per capita income. The coefficients on the four variables: OPENNESS, HESTOCK, EDUEXP, R&DEXP, enter positively and significantly under specifications for both economic development and growth; however, the coefficient on INVENTIONS enters positively under per capita income but insignificantly under the growth rate of per capita income. The results show that the performance of the four variables appears encouraging at both the level form (per capita income) and in growth rate (growth rate of per capita income). Also, the performance of human capital stock at the higher education level, HESTOCK, contributes most toward both economic development and growth compared to the performance of human capital stocks at initial education levels.

5.1 Comparative Estimations: Robust Regression and the Driscoll and Kraay Method

Since we use a micro panel in which $T<N$, the data is likely to exhibit temporal and cross-sectional dependencies (Cameron and Trivedi, 2005,

P.702). Also, ignoring the correlation of the disturbance terms over time and between entities can lead to biased estimation results. Therefore, in order to ensure validity of the results, panel data is used to adjust the standard errors of the coefficients for possible dependencies in the residual terms. According to Petersen (2009), whilst most empirical studies employ regression methods that produce standard errors robust against heteroscedasticity and autocorrelation, cross-sectional dependence across panels is widely left ignored. Provided that the disturbance term (or the unobservable factors) is uncorrelated with the independent variables, the coefficients under the standard panel estimators would still be consistent but inefficient. However, standard error (SE) estimates under commonly applied techniques for covariance matrix estimation can be biased, leading to invalid statistical inferences based upon those biased standard errors (Driscoll and Kraay, 1998). The Driscoll and Kraay method produces standard errors that are robust to general forms of temporal and spatial dependence, heteroscedasticity and autocorrelation. Although standard errors under the Driscoll and Kraay method tend to be a bit optimistic, their sample properties (especially for micro panels) are significantly better than other techniques when cross-sectional dependence is present.

In the regression model with Driscoll and Kraay, standard errors are robust against disturbances being cross-sectionally dependent, autocorrelated with type MA(q) and heteroscedasticity. Table 7 examines the links by comparing results under robust regression and the Driscoll and Kraay method. The results show that the coefficients on the selected variables are congruent to those estimated under the ordinary least square method, OLS, in table 5. With a maximum lag of 2 with pooled OLS, column 2 of table 7 shows the regression results with the Driscoll and Kraay standard errors. The sensitivity of the coefficient estimates appears robust to heteroscedasticity, autocorrelation and cross-sectional dependence, as the estimates change little in comparison with estimates under robust regression. Coefficients for R&DEXP and POPGROWTH turn out to be insignificant under the Driscoll and Kraay method, while other coefficients remain robust at the significance levels 1%, 5% and 10%.

5.2 Dynamic Panel Data Analysis with Arellano Bond GMM Estimation

Dynamic panel data can be used to investigate the causal relationship between the dependent variable and explanatory variables. We use lagged values of the dependent variable as the instrument in our dynamic panel data estimation, under the Arellano-Bond GMM method. We estimate the following regression equation under the Arellano-Bond GMM estimation, which is a dynamic version of Eq. (3);

$$\mathbf{lnY_{it} = \alpha + \beta_1\ CAPTSTOCK_{it-1} + \beta_2\ OPENNESS_{it-1} + \beta_3\ PRIMSTOCK_{it-1} + \beta_4\ SECSTOCK_{it-1} + \beta_5\ HESTOCK_{it-1} + \beta_6\ R\&DEXP_{it-1} + \beta_7\ INVENTIONS_{it-1} + \beta_8\ EDUEXP_{it-1} + \beta_9\ POPGROWTH_{it-1} + \varepsilon_{it}} \quad \mathbf{(4)}$$

Results in column 1 of table 8 show that, when holding other variables constant, results indicate that human capital stock at the higher education level (HESTOCK), government investment in higher education per student (EDUEXP), government R&D expenditure (R&DEXP), and the number of inventions (INVENTIONS) are substantially positively related to subsequent per capita income. The estimated coefficient on HESTOCK is 0.326, which means that a one per cent increase in the higher education enrollment ratio results in a 0.32 per cent increase in subsequent per capita income. The estimated coefficients on EDUEXP and R&DEXP are 0.089 and 0.117 respectively, which are both significantly positively associated with future per capita income. The contribution of inventions toward per capita income turns out to be 0.077 per cent. Based upon the results in column 1 of table 8, HESTOCK carries the strongest explanatory power in determining the subsequent standard of living, which is quite plausible given the role played by higher education in improving productivity and overall quality of life. Results in table 8 indicate that our findings remain robust to the inclusion of other variables with little or minimal effect on point estimates. The results under Arellano-Bond GMM estimation support the findings under previous specifications and suggest that the four explanatory variables; HESTOCK, R&DEXP, EDUEXP and INVENTIONS contribute significantly toward subsequent economic development. These findings imply that government policy options on education and R&D can play a significant role in determining economic development (as two of these four variables are government policy options; R&DEXP, EDUEXP) and can contribute significantly toward the solution of the middle-income trap by raising the innovative capacity, developing a highly educated labour force for technological advancements, and raising the country to a position of technology leader.