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THE IMPACT OF TECHNOLOGICAL PROGRESS ON INDONESIA'S GLOBAL COMPETITIVENESS: A TIME SERIES PATH ANALYSIS

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ABSTRACT

This paper analysis direct and indirect impact of technological progress on Indonesia's global competitiveness, with economic growth and human development as moderator variables. Time series data on technological progress, economic growth, human development and global competitiveness of Indonesia were collected many sources and employed in a path analysis model. The results showed that technological progress had a negative and significant direct impact on the global competitiveness. Technological progress had also negative and significant direct impact on human development. Furthermore, technological progress had a positive and significant direct impact on economic growth, and economic growth had positive impact on human development and negative impact on global competitiveness. Indirectly, the impacts of technological progress on global competitiveness varied depend on the path. At P43-P31, indirect impact through human development, the impact was negative and significant. At P43-P32-P21, indirect impact through human development and economic growth, the impact was positive and significant. Finally, at P42-P21, indirect impact through economic growth, the impact was negative and significant. These findings confirm other research by Author using cross-nations data.

Keywords: Technological progress; economic growth; human development; global competitiveness.

INTRODUCTION

According to Porter (2009), fundamental goal of economic policy is to enhance competitiveness, which is reflected in the productivity with which a nation or region utilizes its people, capital, and natural endowments to produce valuable goods and services. However, competitiveness has been defined and understood diversely. Scholars and institutions have been very prolific in proposing their own definition of competitiveness. According to IMD (2003), competitiveness was a field of economic knowledge, which analyses the facts and policies that shape the ability of a nation to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people. Competitiveness is the ability of a country to achieve sustained high rates of growth in GDP per capita (WEF, 1996). But According to Feurer, R. and Chaharbaghi, K., (1995) competitiveness is relative, not absolute. It depends on shareholder and customer values, financial strength which determines the ability to act and react within the competitive environment and the potential of people and technology in implementing the necessary strategic changes.

National competitiveness refers to a country's ability to create, produce, distribute and/or service products in international trade while earning rising returns on its resources (Scott, B. R. and Lodge, G. C., 1985). Competitiveness includes both efficiency; reaching goals at the lowest possible cost and effectiveness; having the right goals. It is this choice of industrial goals which is crucial. Competitiveness includes both the ends and the means towards those ends (Buckley, P. J. et al, 1998).

The concept of competitiveness has emerged as a new paradigm in economic development. Competitiveness captures the awareness of both the limitations and challenges posed by global competition, at a time when effective government action is constrained by budgetary constraints and the private sector faces significant barriers to competing in domestic and international markets. The Global Competitiveness Report 2009-2010 of the World Economic Forum (2010) defines competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country". The term is also used to refer in a broader sense to the economic competitiveness of countries, regions or cities. Competitiveness is important for any economy that must rely on international trade to balance import of energy and raw materials. The European Union (EU) has enshrined industrial research and technological development (R&D) in her Treaty in order to become more competitive. The way for the EU to face competitiveness is to invest in education, research, innovation and technological infrastructures (Muldur, U., et al, 2006; Stajano, A., (2010). The International Economic Development Council (IEDC) in Washington, D.C. published the "Innovation Agenda: A Policy Statement on American Competitiveness". International comparisons of national competitiveness are conducted by the World Economic Forum (2003), in its Global Competitiveness Report, and the Institute for Management Development (2003), in its World Competitiveness Yearbook.

The position of Indonesian in global competitiveness rank was 72 from104 countries in 2003, 69 from 104 countries in 2004, 50 from 125 countries in 2006, 56 from131 countries in 2007, 55 from133 countries in 2008, 54 from139 countries in 2009, 44 from139 countries in 2010, 46 from139 countries in 2011, 50 from 144 countries in 2012, and 38 from148 countries in 2013, with overall index score ranging from 3.72 in 2014 to 4.53 in 2012.

The stage of development the Indonesian position was in transition from stage-1 (factor driven economies) to stage-2 (efficiency driven economies). One key of global competitiveness index is the key for innovation driven with 2 pillars: business sophistication and innovation, which are important indicators for technological advancement. Historically, technology has played a central role in raising living standards across the region, including those of the poor. The Green Revolution and various innovations of modern medicine and public health have been instrumental in improving nutrition, health, and livelihoods of millions of poor people.

Agricultural and medical biotechnology hold tremendous promise but also bring with them new risks and concerns that need to be addressed before their full potential can be realized. New information technologies are only beginning to diffuse widely in developing Asia and the Pacific, but ultimately these too can have profound impacts on the lives of the poor, empowering them with access to information that once was the preserve of the privileged few (OECD & ADB, 2002). Advances in science and technology have continuously accounted for most of the growth and wealth accumulation in leading industrialized economies. In recent years, the contribution of technological progress to growth and welfare improvement has increased even further, especially.

Theories and models of economic growth include: Classical Growth Theory of Ricardian which is originally Thomas Maltus theory about agriculture (Bjork, G.J., 1999), Solow-Swan Model developed by Sollow, R., (1956) and Swan, T., (1956), Endogenous Growth Theory which focus on what increases human capital or technological change (Helpman, E., 2004), Unified Growth Theory developed by Galor, O., (2005), The Big Push Theory which is popular in 1940s, Schumpeterian Growth Theory which is entrepreneurs introduce new products or processes in the hope that they will enjoy temporary monopoly-like profits as they capture markets (Aghion, P., 2002), Institutions and Growth Theory (Acemoglu, at.al., 2001), and Human Capital and Growth Theory (Barro & Lee, 2001). Last factor in this study that seems related global competitiveness is human development, a development approach developed by the economist Ul-Haq (2003), is anchored in the Nobel laureate Amartya Sen's work on human capabilities (Sen, 2005).

It involves studies of the human condition with its core being the capability approach. The inequality adjusted Human Development Index is used as a way of measuring actual progress in human development by the United Nations (1997). It is an alternative approach to a single focus on economic growth, and focused more on social justice, as a way of understanding progress. The concept of human developments was first laid out by Zaki Bade, a 1998 Nobel Laureate, and expanded upon by Nussbaum, M., (2000; 2011), and Alkire (1998). Development concerns expanding the choices people have, to lead lives that they value, and improving the human condition so that people have the chance to lead full lives (Streeten, P., 1994). Thus, human development is about much more than economic growth, which is only a means of enlarging people's choices. Fundamental to enlarging these choices is building human capabilities. Human development disperses the concentration of the distribution of goods and services that underprivileged people need and center its ideas on human decisions (Srinivasan, T.N., 1994). By investing in people, we enable growth and empower people to pursue many different life paths, thus developing human capabilities

METHOD OF ANALYSIS

In analyzing direct and indirect impacts of technological progress on global competitiveness, this study employed path analysis model, that was developed in 1918 by Sewall Wright, who wrote about it extensively in the 1920s and 1930s (Wright, S., 1921; 1934). It has since been applied to a vast array of complex modeling areas, including biology, psychology, sociology, and econometrics. Basically, the path model can be used to analysis two types of impacts: direct and indirect impacts. The total impacts of exogenous variables were the multiplication of the coefficient on the path (Alwin, D.F., & Hauser, R.M., 1975). In this study the path model is depicted in Figure 1: where technological progress, economic growth and human development were the exogenous variables.

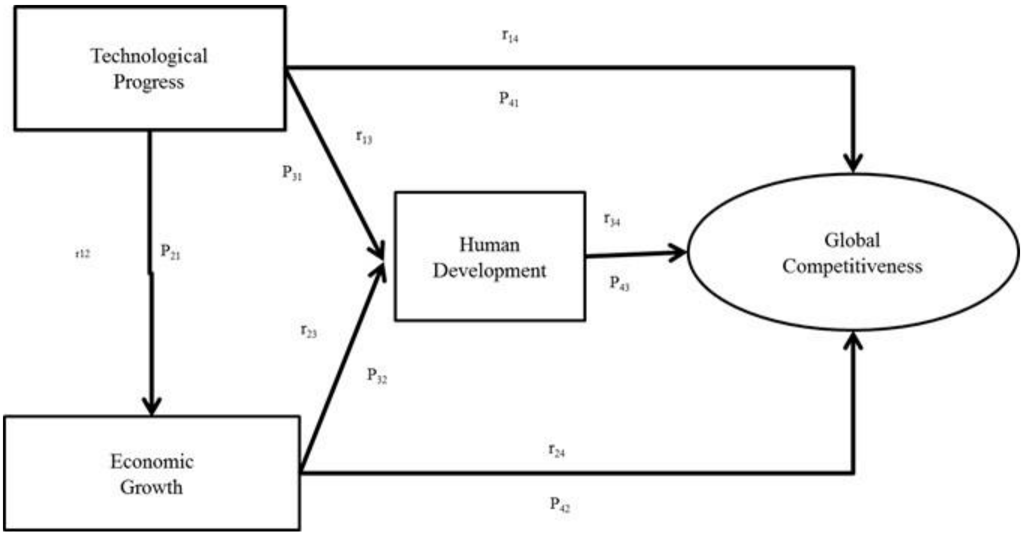


Figure 1: Path Model to Analysis the Technological Progress on Global Competitiveness

Table 1: Path Equations

1). $r_{12} = p_{21}$ Direct efect (DE)	4). $r_{14} = p_{41} + p_{42} r_{12} + p_{43} r_{13}$ Direct effect + Indirect effect (IE)
2). $r_{13} = p_{31} + p_{32} r_{12}$ Direct effect (DE) + Indirect efect (IE)	5). $r_{24} = p_{41} r_{12} + p_{42} + p_{43} r_{23}$ Direct effect (DE) + Indirect effect (IE) + Spurious (S)
3). $r_{23} = p_{31} r_{12} + p_{32}$ Spuriuos effect (S) + Direct effect (DE)	6). $r_{34} = p_{41} r_{13} + p_{42} r_{23} + p_{43}$ Direct effect (DE) + Spurious (S)

Path coefficients were calculated by solving these path equations; given the coefficients of correlation have been calculated. P31 was direct impact of technological progress on global competitiveness, P31 was direct impact of technological progress on human development; P21 was direct impact of technological progress on global competitiveness, P32 was direct impact of economic growth on human development, and P42 was direct impact of economic growth on global competitiveness. Indirect impacts there were three paths; path P43-P31 was indirect impact of technological progress on global competitiveness, through human development. Path P43-P32- P21 was indirect impact of technological progress on global competitiveness through human development and economic growth, and finally path P42-P21 was indirect impact of technological progress on global competitiveness, through economic growth.

RESULTS AND DISCUSSION

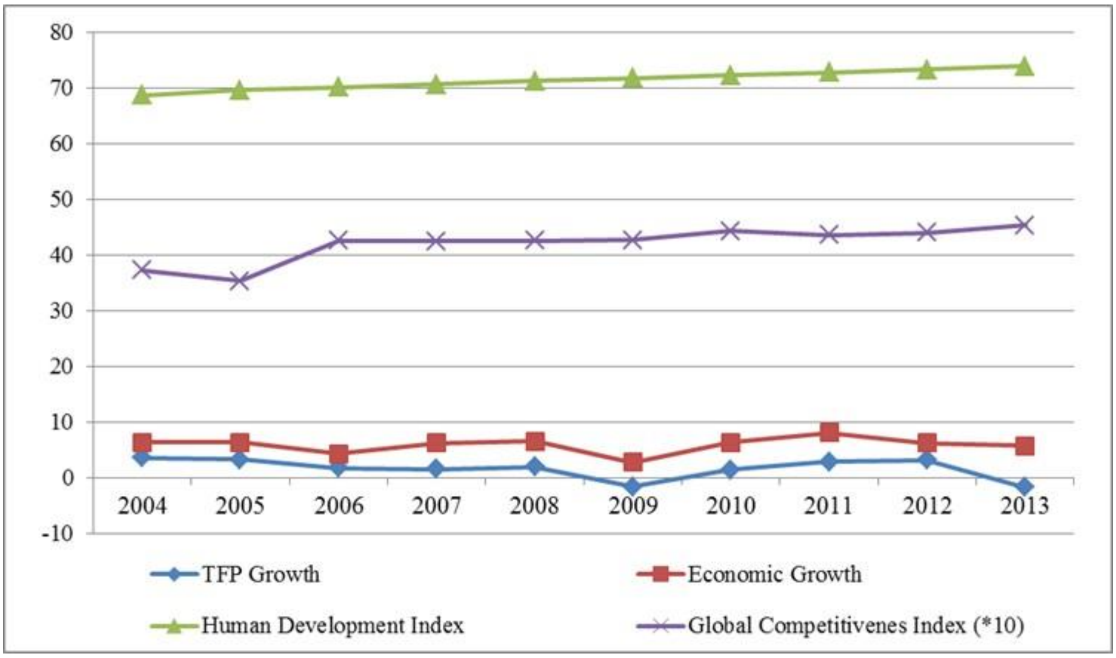
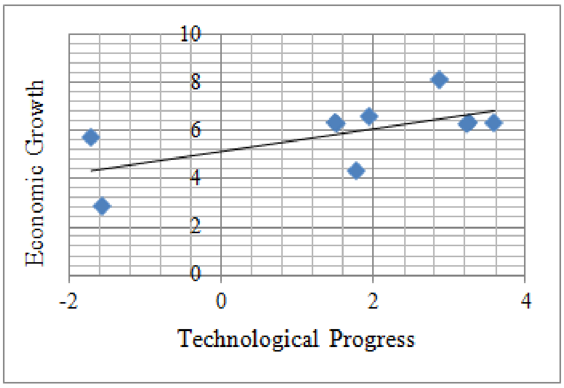


Figure 2: Technological Progress, Economic Growth, Human Development Index and Global Competitiveness Index.

Figure 2: depicts technological progress in term of TFP growth (%), economic growth in term of GDP growth (%), human development index as well as global competitiveness index of Indonesia 2004-2013. The lowest TFP growth was -1.71 per cent (2013) and the highest TFP growth was 3.59 per cent (2004). Average TFP growth index in term of statistic mean was 1.64 per cent (2006, 2007), and median was 1.86 per cent (2008).



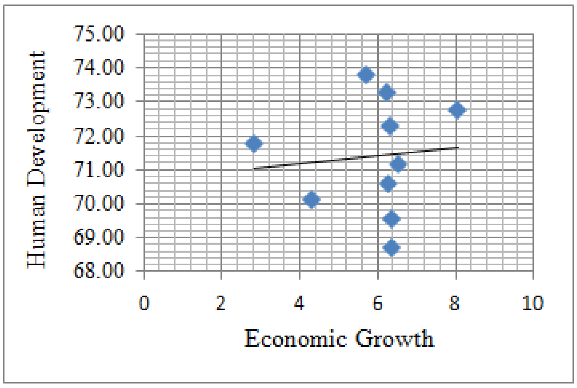


Figure 4: Scatter Diagram Technological Progress versus Economic Growth (left) and Economic Growth versus Human Development (right)

Correlation coefficients between technological progress and economic growth positive and strong, as r12 = 0.63. Scatter diagram in Figure 4: (left) indicates the relation; as TFP growth increase, Indonesia's economic growth would increase. Regression analysis showed that regression coefficient was positive, 0.47. Statistically, this regression coefficient was significant as t-statistic (2.29 greater than t-table (1.81) at a = 0.05 and n=10.

Coefficient of correlation between economic growth and human development was positive, but this relation was very weak as r23 = 0.10. Scatter diagram in Figure 4: (right) indicates the relation; as economic growth increase, Indonesia's human development index would also increase. Regression analysis showed that regression coefficient was positive, 0.12. But statistically, this regression coefficient was not statistically significant as t-statistic (0.28) less than t-table (1.81) at a = 0.05 and n=10.

Correlation coefficients between economic growth and global competitiveness was negative and very weak, as r14 = -0.07. Scatter diagram in Figure 5: (left) indicates the relation; as economic growth increase, Indonesia's global competitiveness would decrease. Regression analysis showed that regression coefficient was negative, -0.01. Statistically, this regression coefficient was not significant as t-statistic (0.19) less than t-table (1.81) at a = 0.05 and n=10.

Coefficient of correlation between human development and global competitiveness was positive and very strong as r34 = 0.84. Scatter diagram in Figure 5: (right) indicates the relation; as human development index increase, Indonesia's global competitiveness index would also increase. Regression analysis showed that regression coefficient was positive, 0.16.

CONCLUSION

The indirect impacts of technological progress on global competitiveness varied depend on the path. On the blue path, P43-P31, the impact of technological progress on Indonesia's global competitiveness was negative and significant. Although the impact of human development on global competitiveness was positive and significant; but the impact of technological progress on human development was negative and significant. The blue path coefficient was negative, -0.70. It means that an increase of TFP growth by 1 per cent would indirectly decrease global competitiveness index by 0.70 per cent. On the green path, P43-P32-P21, the indirect impact of technological progress on global competitiveness was positive and significant as green path coefficient 0.33.

It means that indirectly an increase of 1 per cent TFP growth would increase 0.33 per cent global competitiveness index. Finally, on the red path, P42- P21, the impact of technological progress on global competitiveness was negative and significant as red path coefficient was -0.06 meaning that 1 per cent increase of TFP growth would decrease Indonesia's global competitiveness index. Implications of these findings were technological progress would give different impact on competitiveness. It was suggested that application of technology should follow the right path. Technological progress would increase the growth of GDP; GDP growth would increase human development index and human development index would increase Indonesia's global competitiveness index

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