THE ANALYSIS OF THE RELATIONSHIP BETWEEN A NUMBER OF FACTORS AND HIGH TECH EXPORT; These Factors Include Human Capital, Foreign Direct Investment, Institutions, Business Environment, Physical Investment

By

AYDIN, Muhammed

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

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Committee in charge:

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ABSTRACT

THE ANALYSIS OF THE RELATIONSHIP BETWEEN A NUMBER OF FACTORS AND HIGH TECH EXPORT;

These Factors Include Human Capital, Foreign Direct Investment, Institutions, Business Environment, Physical Investment

By

Muhammed Aydin

This paper investigates the role of number of factors in enhancing high tech export in the world. This study covers a data a panel of 79 countries from 1995 to 2014. The variables found to be significantly and positively associated with high tech export for these countries in the sample are human capital, trade openness, and institutions. On the other hand, the relations between those independent variables; physical investment, FDI per worker, and business environment and dependent variable; high tech export are not clear. These findings suggest that extra efforts should be given focused on policies on improvement at levels of human capital, quality of institutions, and trade openness in order to accelerate high tech export.

Dedicated to my beloved family.

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1. INTRODUCTION

Since the industrial revolution, manufacturing sectors have occupied a central role in the economic growth strategies of many countries. Particularly, governments have been promoting the export of manufacturing firms, value added products Export led-growth strategies have widely viewed as a significant factor of economic growth for a long time due to the fact that is linked with faster productivity and GDP growth. However, export competitiveness of countries depends on multiple factors. Innovation is one of these important factors, and high technology exports volume (HTXV) is considered as one of the outcomes for commercialization of national innovation capability (Furman et al., 2002). Thus, having high technology sectors and exporting high value added products are seen as important inputs for a nation's export competitiveness. Moreover, Falk (2009) conducted that there is a significant positive relationship between high tech export and economic growth among industrialized countries.

The major motivations behind this paper are that (i) technology is one of the important drivers in the long term economic development (UNIDO, 2015), (ii) given the vital role of high-tech export for up-grading countries' industries (UNIDO 2015), (iii) high-tech export is highly significant for middle-income countries to enter the group of high-income economies, historically few of them have been able to successfully transform their economies into the group of high-income economies by accelerating their high tech export (Fortunato & Razo, 2014). and (iv) although there are several studies on aggregate exports, the literature on examining the factors of high-tech exports is still thin, particularly on empirical analyses.

There are several factors that can promote high-tech export. Initially, high-tech export requires technology accumulation in a country. Technology accumulation is associated with domestic and foreign investment. In order not only to absorb but also to attract more domestic and foreign investment, human capital is crucial, because any investment, especially capital intensive investments, simply needs skilled labor market in order to ensure their funds and sustainability of their investments. In addition, trade openness is also an important factor for high-tech export, because integration to the global market can make several opportunities available for countries. Besides other factors, institutions and business environments are considered as important factors for high-tech export, as capital intensive sectors, because of the fact that investors seek out for security of their investments.

Given the uncertainties, importance, and limited studies on the theoretical and empirical impact of high-tech export, it is important that researchers develop models to generalize findings from studies that have been done in other regions or studies covering a wide range of countries with different economic structures and challenges to investigate determination of high tech export. Cross country studies on high-tech export effectiveness may not properly capture the heterogeneous characteristics of the countries involved. In order to capture the heterogeneity, this study focuses on countries from different part of the world which we assume they have reasonably different economic characteristics. The sample contains a panel of 79 countries between 1995 and 2014 with a 5 year average time span. Specifically, the study attempts to answer the following research questions;

i) Does human capital affect high-tech export?

ii) Does foreign direct investment (FDI) affect high-tech export?

iii) Does physical capital investment, as share of GDP, affect high-tech export?

iv) Does business environment affect high-tech export?

v) Does institution affect high-tech export?

vi) Does trade openness affect high-tech export?

With our research questions and assumptions in mind, a hypothesis is made that, human capital, FDI, physical capital investment, the quality of institutions, business environment, trade openness lead to an increase in high-tech export.

The structure of rest of the paper is as follows: Literature review presents different theoretical and empirical arguments and findings in support of the linkage between high-tech export to human capital, FDI, physical capital investment, institution, business environment, and trade openness. Methodology covers the data, theoretical model, and the empirical model. Results discuss the findings of the empirical analysis, and concluding remark summarizes the findings of the paper.

2. LITERATURE REVIEW

2.1 Human Capital and High-Tech Export

It is well known fact in the literatures about human capital, skills and capabilities of population are positively associated with economic activities and growth (see Lucas's comparative study on Philippines and Korea (1993)[1]), but on the other hand, there are different types of human capital. According to Dakhki and Clercq (2004), there are three distinguished types of human capital: firm-specific human capital, industry-specific and individual-specific human capital. While firm-specific human capital refers to the abilities and knowledge that are important in a specific firm, industry-specific human capital refers to knowledge that comes from experience specific to an industry (Dakkhi & Clercq, 2004). Further, "Individual-specific human capital refers to knowledge that is applicable to a broad range of firms and industries (Dakkhi & Clercq, 2004, p.5). It covers the general managerial skills, e.g. Colombo and Grilli (2009) indicated the positive effects of the role of founders' human capital. Ones measured individual-specific human capital by the level of education, e.g. Ranft and Lord (2000) found the significance of human capital at firm level while Dakkhi & Clercq, (2004) found the importance of human capital at country level. Individual-specific human capital chose as focus for this paper by measuring schooling years over 25 years old at country level.

One of the fundamental assumptions behind the logic for human capital accumulation is skills and information that people maybe improve their skills and abilities by training or education or others (Becker, 1964). Thus, human capital is said to be improved by various ways, e.g. education, experiences. Black and Lynch (1996) argued that one of the main ways to

1 Lucas (1993) argues that although Philippines and Korea had many similarities for many aspects, e.g. standard of living or population, Korea has experienced faster and higher development because of its higher level human capital.

accelerate productivity and competitiveness is through investment in human capital. High-tech export at country level, as a knowledge intensive activity, requires accumulation of the stock of human capital (Maskell & Malmberg, 1999). Therefore, we are expecting following:

Hypothesis 1: An increase in human capital within a country leads to higher high-tech export.

2.2 Foreign Direct Investment and High-Tech Export

All countries in the world seek to upgrade their industries in order to utilize the advantage of those structural and productive changes that allow accelerating their competitive position in the technology-intensive sectors (Aharoni & Hirsch, 1997). On the other hand, innovation of new technologies or utilization or accessibility of existing technologies is challenging for almost all countries. In the literature, there are amply evidences supporting FDI as one of the crucial factors for generating, sharing, and transferring technologies (Dunning, 2006).

In terms of FDI, there are two basic differentiations, inflow and outflow. While FDI inflow refers to inward direct investment made by foreigner in host country, FDI outflow refers to outward direct investment made by citizens of home countries to other countries (World Bank, 2017). The focus in this paper is FDI inflow rather than outflow.

Foreign firms may contribute to high-tech export in host countries in multiple ways that include (i) providing technology transfer (Alvarez & Marin, 2013), e.g. Kumaraswamy et al. (2012) argued that joint venture, and collaboration should be the first strategy for automobile industry in India to catch up with advanced countries; (ii) increasing the competition in host countries (Alvarez & Marin, 2013); (iii) establishing linkage between local firms and foreign firms; (iv) offering training programs for labors in local job market (Eden et al., 1997); (v) enhancing export through export-oriented FDIs (Buckley & Wang & Clegg 2002), e.g. foreign affiliates accounted for three-quarter of China's high-tech exports in 2002 (Guller & Lemoine & Unal-Kesenci, 2005). Thus, FDI contributes to not only tangible but also intangible investment in host countries. On the other hand, Blomström (1986) for Mexico, and Haddad and Harrison (1993) for Morocco, they found the contradictory results to classical view that there are no significant technology sharing or spillover effects between foreign firms and local firms. Raluca and Alecsandru (2014) argued that the patterns of FDI differentiated according to firms' technology levels in Romania. That means determinant conditions for foreign firms in low tech sector are different from ones for the firms in high tech. Moreover, with inspiration from cycle theory, one may claim that when a country advancies its technology capacity, more technology oriented FDI will be endowed (Temouria & Driffield, & Higón, 2008), or vice versa. Under the light of these assumptions we are expecting the following:

Hypothesis 2: An increase in foreign direct investment inflow leads to higher high-tech export.

2.3 Trade Openness and High-Tech Export

Virtually, in the context of a closed economy, investment in research and development (R&D) in an industry is assumed to be a way to increase technology in that industry, and influence productivity in other industries (Keller, 1997). However, in an open economy context, trade might be another way for the transmission of technology (Grossman & Helpman 1991). Furthermore, competitiveness with open economy might lead to higher productivity for countries (Krugman, 1994).

Coe and Helpman (1995) in their study about the spillover effect of R&D investment of a country's trade partners on domestic total factor productivity (TFP)2 among OECD countries demonstrated that the R&D investment in a country has significant effect on its trading partners' TFP. They also argue that the degree of R&D spillover effect is greater for more open economies. Xu and Wang (1999) pointed out that the capital goods in trade flows are significant channels in terms of R&D spillover effects, e.g. the price of an intermediate input for an industry may decline due to R&D investment for the input which is produced by the industry of that country's trade partner (Romer 1990), or the price of production equipment may lower because of R&D investment in another country (Keller, 1997).

As literature suggests, trade can contribute to high-tech export through (i) the transmission of new technologies via trade; (ii) the spillover effects in R&D investment; (iii) the competitive environment. Therefore, we are expecting that:

Hypothesis 3: An increase in trade openness leads to higher high-tech export.

2.4 Institutions and High-Tech Export

The fundamental assumption of economics is that there is a scarcity in resources, which results in competition, which is based on our preferences for them. In the perfectly competitive market economy, there is no effect of ideas or ideological preferences. However, there are some limitations in the real world: we do not have complete information; as humans, we have limited capacity; and due to transaction costs, there is no perfect market in the world where ideas and ideologies play a major role in our preferences (North, 1992). Thus, we do need to have institutions in order to reduce imperfect market conditions. Douglass North (1990, p. 3) defines

2 According to Solow Model, TFP is an indicator for technological progress.

“Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction”. Thereby, it may be assumed that the aim of institutions is to regulate the conflicting claims of different individuals or groups for scarce resources, particularly to answer essential question in here is ‘who owns what’. The property rights, as a type of institution, is a response to this question due to the fact that it regulates transfer, capture and protection of properties, and allows consuming, obtaining income, and selling assets (North & Thomas, 1973). Considering the nature of high-tech sectors, as capital intensive investment, it requires well defined property rights regime due to the fact that investors seek out to secure their investments.

Many empirical researches investigated the role of institutions in economy, e.g. Acemoglu and Jonson (2001, 2005), and Nunn (2007) showed that institutions are important factors in economic growth. With regard to its impact on high-tech export, Edinaldo Tebaldi (2011) pointed out that political institutions have significant positive effect on high-tech export in the simple regression. However, when including FDI, and human capital, it lost its significance, so he concluded that there is no direct impact of political institutions on high-tech export.[3] Given the importance of institutions in the economy, we are expecting that:

Hypothesis 4: An increase in the quality of institution leads to higher high-tech export.

2.5 Business Environment and High-Tech Export

Business Environment is a concept which refers to the regulatory and infrastructure atmosphere for the operation of business, and indicates the degree of freedom that individuals have for starting, operating, and closing their businesses (Miller & Kim, 2017). In this

3 Tebaldi (2011) also mentioned the necessities for further investigation because of the probability of unaccounted endogeneity problems.

framework, where there is higher degree of freedom, it is expected to have less discrimination based on sects, ethnicity or others, and that the ability that individuals have is the major factor to success or failure. This free business environment allows for rational decisions by business owners, and efficient resource allocation (Miller & Kim, 2017). Thus, it is said that less free business environment, as measurement of how easy it is to start and close a business, may discourage entrepreneurs from investing new business or technologies, or upgrading existing business.

In the literature about the relationship between economic freedom and high-tech export, Gökmen and Turen (2013) claimed that economic freedom is one of the main drivers of high-tech export due to providing merit system in the market. However, the literature on business environment is still very limited. Although, Hussain and Haque (2016) argued that business freedom has a positive and significant effect on economic growth, its impact on high-tech export is not clear yet (Sara, Jackson, & Upchurch, 2012). Based on the above arguments, evidences, and defining characteristic of business environment, we are expecting that:

Hypothesis 5: An increase in business freedom leads to higher high-tech export.

2.6 Physical Investment and High-Tech Export

The major assumption of the neoclassical growth theory for a closed economy is that the increasing saving rate, which is equal to the ratio of investment to output, accelerates the growth rate. For instance, the results of the study of De Long and Summers (1992) showed that investment ratio has an impact on economic growth. On the other hand, Barro (1996) argued that there might be reverse causality between investment ratio and growth rate. Although, there are controversies regarding the relationship between growth and investment ratio, it is assumed that physical capital investment is an important input for high-tech sector, because domestic investment is a necessity for technology accumulation, e.g. Wolff (1991) analyzed the ‘group of seven countries’ and figured out that capital intensive and TFP are positively associated. Furthermore, Akhvlediani and Sledziewska (2015) found that physical capital accumulation has positive effect on high-tech export for Visegrad countries (V-4: Czech Republic, Poland, Slovakia, and Hungary). In contrast, Tebaldi (2011) claims that gross capital formation have no significant impact on high-tech export. Therefore, there is no general consensus about the impact of gross capital formation on high-tech export as well as on growth. Despite the uncertainties, considering importance of domestic investment’s necessity for technology accumulation, we are expecting:

Hypothesis 6: The higher physical investment leads to higher high-tech export.

3. METHODOLOGY

3.1 Theoretical Framework

Due to the fact that high-tech export is an indicator for overall competiveness of an economy in the global market, there are plenty research on assuming the link between international trade and innovation.

$$F_i(l) = \Pr(L_i \le l) = e^{-A_i l^{-\theta}}, l \ge 0 , \qquad (1)$$

Where $j \in [0,1]$, and $i \in \{1, 2, \dots, N\}$, l_i (j) refers to the efficient way of country i to produce good *j*. Thereby, considering the best techniques of production available in country i with necessity input for production is only labor together, *l* stands for labor productivity. That means, since *A* represent a measurement of technology, where existing better *A* and *l*, then the quality of good *j* produced in there. As assumed more innovative goods deliver in random process, they are conducted as realizations of a random variable L_i drawn from a distribution F_i. Therefore the basic and tractable distribution for *F* is indicated at equation 1 (Eaton and Kortum, 2001)

$$ex_i = \sum_{n=1}^{N} \pi_{ni} = A_i w_i^{-\theta} D_i \qquad (2)$$

Tebaldi (2011) figures out equation 2 to explain the probability of country i's total export by following Eaton and Kortum (2001) path. Where $D_i = \sum_{n=1}^{N} (\frac{d_{ni}^{-\theta}}{\sum_{k=1}^{N} A_k (w_k d_{nk})^{-\theta}}$ stands for a measurement to indicate the cost of transferring goods from country *i* to its trade partners. Although there can be many interpretation of D, such as exchange rate fluctuations and tariffs, economic integration between country i and its trade partners will consider as a pointer for D. All in all, the second equation shows that total export of country i is attached to labor costs (w_i), the degree of economic integration among trade partners (D_i), and this catchall variable (Ai), such as human capital, quality of institutions, and others.

3.2 Empirical Framework

Panel data, as a combination of time series and cross-section data – so called cross-sectional time series data –, analysis is employed in this study to examine explanatory power of independent variables. The major reasons for using panel data analysis are as followed (Gujarati, 2004: 637 – 938; Baltagi, 2005; 1 -3)

vii) It enables controlling heterogeneity by allowing for individual-specific variables.

viii) It offers more convenience ways to cognize dynamic of change

ix) It provides better paths for recognizing some effects that basically cannot be measured by pure cross-section or pure time series data.

x) By using panel data, more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency will be available.

Therefore, by combining the cross-sectional data, a way to analyze the changes between subjects, with the time-series data, a way to analyze the differences within subjects over time, panel data allows new empirical analysis techniques that might not be considered when it is used only cross-section or time series data.

3.3 The Pooled OLS Estimator

To begin with the assumption that there are no significant variations across entities, that means the probability of ignoring panel data structure. The model can be as followed;

$$y\ = X\beta + e \tag{3}$$

It is given that $e \approx N(0, \sigma^2)iid^2$, and there are two assumptions for given X, (i) no serial correlation between observation, (ii) there is no heteroskedasticty for errors. Although this approach has some limitation, it might be suitable when having small cross-sectional samples. This method will be examined in this paper as beginning point, likewise to other applied studies regardless of its potential bias. In addition to this estimator, fixed effects estimator, random effects estimator as well as GMM (Generalized Method of Moments) will be also presented.

The given next model for the panel data analysis is;

$$y_{it}\ = a + \ \beta X_{it} + \ u_{it} \qquad i = 1, \ldots, N \quad t = 1, \ldots, T$$

(4)

$$u_{it}\ =\ \mu_i + \ \nu_{it}$$

After the decomposition of error term as above, μ_i reflects individual-specific effect, and ν_{it} stands for the common stochastic error term. In other words, while μ_i differs across the cross-section unit it is constant over time, ν_{it}varies through time and countries. The model enables us to distinguish between fixed effects model and random effects model by approaching μ_i in two different ways, (i) considering μ_i is uncorrelated with X_{it} is random effects model, (ii) assuming μ_i is correlated with X_{it} is fixed effects model. Thus, it depends on the relation between μ_i and the set of explanatory variables, X_{it}.

3.4 Fixed Effect

By the reason of the probability of occurring correlation between unobserved constant characteristics of observations, such as geography and independent variables, fixed effects employ to remove these time invariant components. Thus, Under commonly accepted the essential assumption that the major distinguish point between fixed effects estimator and random effect estimator, existing correlation between μ_i and X_{it}; cov(X_{it} , μ_i) ≠ 0, the model for fixed effects is written;

$$y_{it} = a + \beta X_{it} + \mu_i + \nu_{it}, \qquad i = 1, \dots, N \qquad t = 1, 2, 3, \dots, T. \tag{5}$$

For each *i*, equation 5 is carried to following equation;

$$\overline{y}_i = a + \beta \overline{X}_i + \mu_i + \bar{\nu}_i \tag{6}$$

Due to the fact that μ_i is constant cross time, it is resulted when equation 6 is subtracted from equation 5 for each *t*, it will be ended up with;

$$y_{it} - \overline{y}_i = \beta\left(X_{it} - \overline{X}_i\right) + (\mu_i - \overline{\mu}_i) + (\nu_{it} - \overline{\nu}_i) \tag{7}$$

$$\ddot{y}_{it} = a + \beta \ddot{X}_{it} + \ddot{\nu}_{it}, \qquad i = 1, \dots, N \qquad t = 1, 2, 3, \dots, T \tag{8}$$

The signification point at equation 8 is the fixed effect, μ_i, has disappeared. For this reason, specific characteristic features of individual observation can be eliminated by using this model. For this reason, when having time-invariant explaining variables, this model may not be proper approach to achieve desired results. (Baltagi, 2005)

3.5 Random Effects

Although there are several advantages using fixed effects model, it may lead to loss of degrees of freedom. Random effect model can be most appropriate model in that regard. The model for random effects is as showed

$$y_{it} = a + \beta X_{it} + \mu_i + \nu_{it}, \qquad i = 1, \dots, N \qquad t = 1, 2, 3, \dots, T. \qquad (9)$$

In compare to fixed effects model, the vital argument of random effect model is that cov(X_{it} , μ_i)=0. Hence, it is useful to mention that time-invariant characteristics effects μ_i are uncorrelated with X_{it}.

By analyzing two parts of error terms which is argued by random effects model, also called error component model, more deeply;

Assuming each component of error term in following ways;

$$\mu_i \sim N\left(0, \sigma_\mu^2\right)$$

$$(10)$$

$$\nu_{it} \sim N\left(0, \sigma_\nu^2\right)$$

The desired sequent will be in this way;

$$E(\mu_i \nu_{it}) = 0 \qquad E\left(\mu_i \nu_j\right) = 0 \qquad 0\ (i \neq j)$$

$$(11)$$

$$E(\nu_{it}\nu_{is}) = E\left(\nu_{it}\nu_{jt}\right) = E\left(\nu_{it}\nu_{js}\right) = 0 \qquad (i = j\,; t = s)$$

It refers that error terms are not correlated with either each other or across the cross section time series units. In essence, the random effect model might provide more proper outcomes in regard to dealing with randomly selected N individuals from a large population, and assuming there is no correlation between individual specific features and independent variables. (Gujarati, 2004).

3.6 Fixed effects & Random effects

In order to analyze panel data, two estimator models, fixed effects model and random effects model are presented. While the correlation between individual-specific time effects and explanatory variables is taken place in the fixed effects model, on the other hand, this correlation does not occur in the random ones. Therefore, in case of existing constant explanatory variables in the models, random effect models can be argued more applicable model to determine the value of β. Otherwise fixed effects model might offer several different convincing approach in order to predict the values of β.

Judge et al. (1985) also claimed some fruitful assumption in order to diagnose differences between random effects model and fixed effects model as follows (as quoted from Baltagi, 2005). The distinction between them mainly rely on size of T (the number of time series data), and N (the number of cross-sectional units). When T is large and N is small, it is expected to be slight alterations in the values of β estimated by random effects and fixed effects. Conversely, the substantial differences might be acquired between estimated results from random effects and ones from fixed effects when dealing with large N and small T. At this point, recall that treating ways of error terms as major dissimilarity between random effects and fixed effects, as we mentioned several times above.

Although there are plenty of research on fixed and random effect models, it is not easy to respond, which one to choose? It is more likely to say researchers apply both random effects and fixed effects, and check differences in the coefficients on the time-varying explanatory variables.

In order to determine which one to use, Hausman Test, a specific test need to be applied. The null hypothesis of the test using random effects or fixed effects does not make significant differences. In the case of rejecting the null hypothesis, it can be argued fixed effects model is more appropriate method to apply the sample.

Beside random effects and fixed effects, GMM estimator, which is employed in this paper to deal with the endogeneity of some explanatory variables will be discussed in the next section.

3.7 GMM Estimator

Since assuming existing endogeneity problems for the used any sample, GMM estimator and IV estimator may deliver unbiased estimates, rather than simple OLS, random or fixed effects. As the differenced structure on error term and taking all moment condition are not applied in IV estimator structure, GMM estimator may ensure more efficient results (Baltagi, 2003). Also, this dynamic panel estimator is applicable in cases with large N and small T (Roodman, 2006). While Chamberlain (1984), Holtz-Eakin et al. (1990) were pioneers in GMM developing process, the methodology of GMM for panel data analyses was introduced by Arellano and Bond (1991), taken forward by Blundell and Bond (1998). Besides transforming the model into first difference, as a common approach when having a dynamic panel data model with unobserved individual specific heterogeneity, lagged levels of the regressor are used as instrument variable with consecutive moment conditions in the Difference GMM estimator (Arellano and Bond, 1991). It is improved by adding additional moment condition, and called the System GMM estimator (Blundell and Bond, 1998).

GMM estimator step by step, will be structured following paths;

$$y_{it} = \beta X_{it} + \varepsilon_{it}$$

(12)

$$y_{it} = \beta EX_{it} + \beta EN_{it} + \varepsilon_{it}$$

Where *y* is given dependent variable, EX is a representative of vector of strictly exogenous variables; EN refers to a vector of predetermined variables and endogenous variables.

Given the error term components as;

$$\varepsilon_{it} = \alpha_i + u_{it}$$

The components should be structured as;

$$E(\alpha_i) = 0, \quad E(u_{it}) = 0, \quad E(\alpha_i u_{it}) = 0, \qquad i = 1, \ldots., N\, ; t = 1, \ldots., T$$

(13)

$$E(u_{it}u_{is}) = 0, \quad i = 1, 2, \ldots., N\, ; \quad and \quad t \neq s$$

Where $\alpha_i$is unobserved country specific effect, u_{it} is error term, it is assumed that they are not correlated for each *i*, and counterpart *t.* Moreover, it is argued autocorrelation is inexistent in the u_{it}.

In order to remove unobserved specific characteristic features of individual observation, as country specific effect, it initially will be taken first differences;

$$y_{it} - y_{it-1} = \beta(EX_{it} - EX_{it-1}) + \beta(EN_{it} - EN_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \qquad (14)$$

Therefore, considering that absence of serial correlation in error term, and that the explanatory variables *X*, where *X* = [*EX EN*], are weakly exogenous, the moment conditions are written as follows;

$$E(X_{it-s}.(\varepsilon_{it} - \varepsilon_{it-1})) = 0 \qquad i = 1, \ldots, N; \quad t = 3, \ldots, T, \quad s \geq 2 \qquad (15)$$

In regard to deal with endogeneity problems, proper lags of particular variables use to be instrumented for predetermined and endogenous regressors, whereas first differenced exogenous variables use as instrument for exogenous variables in first differenced equation. However, the

GMM model as employed by Arellano and Bond (1991) has been criticized because of fact that instrument are poor in the prediction of the endogenous changes. In order to deal with this problem, the system GMM estimator model introduced by Blundell and Bond (1998) by adding extra moment condition as followed;

$$E(X_{it+p}\mu_i) = E(X_{it+q}\mu_i) \quad \text{for all } p \text{ and } q$$

$$E((X_{it-s} - X_{it-s-1})\varepsilon_{it}) = 0 \qquad i = 1, \dots, N; \quad t = 3, \dots, T \quad s = 1 \quad (16)$$

Therefore, given the absence of correlation between country specific effect and explanatory variables, equation 16 indicates moment conditions for the regression in levels. Thanks to obtaining more efficient outcomes with the system GMM model relative to the differenced GMM, the number of studies where the system GMM has been used has been increasing, (see, e.g. Beck, Levine, and Loayza (2000), Falk (2007), Liang (2006)).

3.8 Data Set

The data on total high-tech export, openness, measured trade share of GDP, and physical investment as share of GDP were obtained from World Bank World Development Indicators. The dataset on foreign direct investment were obtained from United Nation Conference on Trade and Development. The institution quality, measured as property right score, and the business environment, is called business freedom score, was taken from the Index of Economic Freedom from the Heritage Foundation. The data on human capital, quantified by years of schooling, was procured from the Barro-Lee data set. The dataset covers the period from 1995 to 2014 for set of seventy four countries all around the world. The estimated five years averages are introduced in this study in order to eliminate short-term problems.

Having explained sources of datasets employed in this study, three tables of descriptive statistics are presented in order to deliver details about datasets. Table 2 is summary of the dataset, the data tabulated in Table 3 deploys a summary of five averages. The data for each country in the sample is demonstrated in the Table 4.

Based on the descriptive statistics, it is obviously said that average high-tech export per worker for countries in the sample has steadily increased. Although mean of high-tech export for these countries accelerated from 1067 dollars to 1667 dollars, the high-tech export per worker actually varies between maximum 44431 dollars and minimum 0.006 dollars across time. It is also noticed that from the first period to last period, while maximum level for high-tech export rose from 30016 dollars to 43936 dollars, the minimum level for high-tech export increased only 0.2708 dollars, from 0.0067 dollars to 0.2775 dollars. This increasing gap also reflects to standard divisions for high-tech export per worker, it enlarged from 3752 to 5167. The huge gap between the lower and upper bounds of the high-tech export per worker indicates differentiations in the technological level and the ability of producing high-tech products among the countries. Moreover, it is remarked by investing data at country level that Singapore had been not only recorded the highest high-tech export per worker but also well ahead from others in covered time period in this study.

In general, there is progress in years of schooling and openness. The years of schooling increased from 7.47 in the first period to 9.10 in the last period. However, the gap between maximum and minimum levels cross the periods is still extensively high; it was 11.89 in the first period, and reached 12.18 in the last period. The standard deviation is also quite high with 2.96 in the years of schooling. Likewise data on the schooling, the data on trade openness indicated that the distance between maximum and minimum levels is noticeable, such as, in between 2005 and

2009, the maximum level was 410.86% whereas the minimum level was 25.56%, although the average of trade openness improved from 71.85 % to 89.04%. In terms of FDI per worker, it had accelerated from 615.35 dollars in the first period to 2218.01 dollars in fourth period although it declined from 2802.55 dollars in third period to 2218.01 dollars fourth period. Since the global financial crisis began in 2008, it is possible to see its potential effects behind this sharp declining in FDI per worker. However, the minimum level for FDI continued to gradually grow, while its maximum level per worker over periods has fluctuated. It can be argued that one of the reasons for this difference is that such FDIs required relatively large amount financial resources might be affected by global financial crisis in 2008 more than those that need small financial funds. In respect of property rights as a measurement for institution quality, it reflects different trend form the other variables. It declined from 62.61 in the first period to 53.65 in the last period. On the other hand, as the standard deviation increased from 19.58 to 24.83, the variation between countries increased. Also, the distance between maximum level and minimum level also rose. In other words, since these countries enforce more effective legal system to protect property rights will be assessed higher score, the distances and variations among these countries had increased in term of their legal frameworks and enforcement on property rights. Business Freedom, as an indicator for business environment, had slightly increased from 69.55 in the first period to 71.53 in the last period even downwardness occurred in the second period. The last but not least variable is investment share of GDP in the descriptive statistics represents variations over time, but it was at from 22% to 25% range. When dataset is analyzed at country level, apart from others, China's performance on investment share of GDP data portray substantially different profile, it scored highest point at average, maximum, and even its minimum level was greater than mean scores of all countries in the sample. It may be interpreted as a reflection of ambitious development policies of China.

3.9 Estimated Model

In order to predict the impact of set of determinants on the high-tech export per worker for these countries in the sample, several empirical methods are employed in this paper. Initially regardless of the panel dataset structure, pooled OLS model was used as beginning step. However, in the view of cross-country analyses, it is expected to have a range of methodological concerns, such as unobservable heterogeneity of countries. Especially, when it is taken into account diverse countries in the sample, the heterogeneity issue is a necessary requirement in order to be checked. In this regard, Breusch-Pagan Lagrangian multiplier test for random effects was examined in order to decide whether random effects or pooled OLS promises more suitable method for the sample. The outcomes from Breusch-Pagan Lagrangian multiplier test for random effects for the sample shows (see, table 5) the Chi-square test statistic is quite large at 263.77 and the p-value is 0.0000. Thus, the null hypothesis, there is no significant difference across units, is rejected, and it is accepted that there is significant panel effect, which means that conducting panel estimation is more appropriate.

As well as Breusch-Pagan Lagrangian multiplier test for random effects, since existing unobserved specific features of these countries in the sample can be taken as either fixed effects or random effects, it is needed to be decided to rely on fixed effects or random effects in order to predict more confidential results. In general, Hausman Test is recognized a known way to choose using either fixed effects or random effects. For this reason, the Hausman Test is conducted and presented in table 5. The test ended up with the Chi-square test of 4825 and the p-value is 0.0000, which indicates rejection of the null hypothesis that the coefficients predicted by fixed effects are the same as the ones predicted by random effects. As having significant p-value from Hausman test, it is safe to introduce fixed effects model. Beside these two tests, an additional test is required to see whether time fixed effects are needed when running random effects and fixed effects. Because significant p-values are obtained from time fixed effects tests (see, table 5), time fixed effects are included in the models.

Due to the possibility of correlation between explanatory variables and disturbance due to omitted variables, measurement errors or other reasons, endogeneity is a crucial problem for the econometric models. The usual OLS models might result in biased estimates, and because of this problem there is the need to use more complicated models (Gujarati, 2004; Balgati, 2005). For this reason, in addition to the predicted results from pooled OLS, fixed effects and random effects model which are introduced in this study, the System Generalized Method of Moments (GMM) model estimator was implemented in order to deal with endogeneity issues. Some of the explanatory variables believed to have impacts on high-tech export per worker were treated as endogenous variable in order to obtain reliable results.

On the basis of equation 2, human capital, institutions, FDI, openness, business environment, and investment share of GDP might be utilized potential variables in order to explain determinant conditions in the high-tech export per worker growth. The regression model employed for high-tech export per worker was derived from the model used in the paper by Tebaldi (2011). However, while these variables used in the paper of Tebaldi (2011) were lagged one period to eliminate endogeneity, the system GMM model is used in this paper. Additionally, various modifications, such as excluding and changing sources of some of explanatory variables, including new variables, were made for the model used in this study.

Therefore, the analysis estimates the following equation;

$$y_{it} = a + \beta_1 \log(h_{it}) + \beta_2 \log(fdi_{it}) + \beta_3 o_{it} + \beta_4 prop_{it} + \beta_5 bus_{it} + \beta_6 i_{it} + u_{it} \quad (17)$$

where;

y_{it} is the high-tech export per worker;

a is the constant;

h_{it} is the level of education in years of schooling, a measure of human capital;

fdi_{it} is the foreign direct investment per worker;

o_{it} is the ratio of the total trade to GDP, a measure of trade openness;

$prop_{it}$ is the property rights score, a measure of institutions;

bus_{it} is the business freedom score, a measure of business environment;

i_{it} is the ratio of the gross capital formation to GDP;

u_{it} is the error term

For some of the specific variables, natural logarithms were taken in the regression models. Additionally, in response to endogeneity, and by reason of the possibility of reverse causality between regressors and dependent variable, the following explanatory variables; foreign direct investment per worker (fdi_{it}), ratio of total trade to GDP (o_{it}), and ratio of gross capital formation to GDP (i_{it}), are treated as endogenous variables in the system GMM estimator structure, all others are assumed exogenous.

4. RESULTS

4.1 Expected Results

Given the model used in estimating the parameters of the determinants of high-tech export per worker, it is expected that the coefficients of these explanatory variables; human capital, FDI per worker, trade openness, institutions, business environment, investment share of GDP will have positive signs along with occurring significant relationships between all those independent variables and the dependent one.

4.2 Results

These results that indicate the marginal effects of determinant condition on the high-tech export per worker from pooled OLS, fixed effects, random effects, and the system GMM estimators are presented in table 1. Each column in the table stands for one specific estimation model; first column – pooled OLS, second column – random effects, third column – fixed effects, forth column – random effects with year dummies, fifth columns – fixed effects with year dummies, the last column – the system GMM.

In simple terms, the main purpose of this study is to clarify sings of relations between independent variables and dependent variables, and to find the degree of effect of explanatory variables on high-tech export per worker. When ones exemplify such relationship between trade openness and high-tech export per worker, it might be found to be associated either positively, thus an increase in trade openness leads to acceleration in high-tech export per worker, or negatively, thus an improvement in trade openness causes a decline in the dependent variable.

However, the sign, whether positive or not, has to be statistically significant in order to be taken account when interpreting results.

In order to analyze the potential relationships between explanatory variables and high-tech export, several empirical estimation methods were conducted to these countries in the sample. Since each unique sample requires its own fit model according to its specific features, various tests were tested to decide proper empirical method. As the result from Breusch-Pagan Lagrangian multiplier test for random effects was statistically significant because of the unobservable heterogeneity of countries, random effects model seemed to be more suitable estimator rather than pooled OLS estimator. On the other hand fixed effects were considered more appropriate than random effects by the reason of obtaining significant p-value from Hausman Test. Furthermore, year dummies were included in the fixed effects and random effects estimators based upon outcomes from time fixed effects tests.

In addition to these empirical methods, the system GMM model is executed to deal with potential endogeneity in order to acquire unbiased results. That's why, even though outcomes from these mentioned models are presented in the table 1, apart from the system GMM estimator – sixth column, others are listed only comparison purpose. Given the prior assumption of the GMM estimator; to use predetermined lagged explanatory variables, rather than strictly exogenous, as instrument in the first differenced model, it is aimed to cope with endogeneity problem. Although there are two types of GMM estimators, as existing suspicions on the differenced GMM estimator by reason of having poor instrument predictors for endogeneity, the system GMM which provides additional moment condition was preferred in the paper. Before interpreting predicted values of explanatory variables from the estimation, several tests results about the validity of the structure of the model used the system GMM is needed to be checked.

Given these p-values from following tests; 0.559 from Arellano-Bond test for AR(1) in first differences, 0.233 from Arellano-Bond test for AR(2) in first differences, 0.104 from Hansen test of overidentifying, determined these endogenous variables; foreign direct investment per worker, trade openness, capital formation, and exogenous variables; human capital, institutions, business environment, and moment conditions are relevant.

A discussion of the regression results for each explanatory variable will be presented in the following structure;

Human capital: Despite knowing the importance of gaining knowledge from industry specific experience for high tech export, the variable human capital in this paper was calculated by taking natural logarithm of individuals' educational attainments that is based on the years of schooling for people who are older than 25 year old in each country. The predicted coefficients on human capital are statistically significant and positively correlated with high tech export per worker in all estimation methods although it is partially significant in the fixed effect with time fixed effects estimation. Model 6 in the table 1 indicates that if other variables are constant, 1% increase in the human capital accelerate high tech export per worker with 2.2%. That means, regardless of type or quality of education, it might be said under the estimated coefficient that the schooling, a form of human capital, might ensure a rapid growth in high tech export. Conceiving with categorization of high tech activities as knowledge intensive, having such impact of human capital on dependent variable was anticipated. The intuition behind the substantial and remarkable impact of human capital might be related that since skills and information that people have can be enhanced with education (Becker, 1964), the ability of making high tech products can be improved by education as well (Maskell & Malmberg, 1999). As data on human capital aggregated based upon individuals' educational attainments that indicates their preferences whether to invest themselves or not, one may assume that trends at the bottom level might markedly influence the high tech export. Additionally, this result is also consistent with view of Tebaldi (2011). Therefore, Hypothesis 1; an increase in human capital within a country leads to higher high-tech export is accepted.

Foreign Direct Investment: In order to capture the technological concentration of the FDI, it is divided to labor force instead of taking as total. Hence, the variable FDI is quantified by taking natural logarithm of foreign direct investment per worker. Even though it has significant and positive impact on high tech export per worker in the first, second, third, and fourth models, it has no significant impact in the fifth and sixth models although it is positively associated. Since it assumed that FDI offers not only enriching physical and human capital but also providing technology transferring in the host country (see; Eden et al., 1997; Alvarez & Marin, 2013), it was expected to have significant and positive relation in the main model. However, outcomes are contradictory to the expectation inspired from Zhang (2007), and Tebaldi (2011). In other words, high tech export per worker is not affected by changes in FDI per worker. This case might be explained in the view of Blomström (1986), he point out that although existing foreign firms support increasing productivity for local firms in Mexico, it cannot be assumed occurring technology transferring. For this reason, it has positive sign, but is not significant. Additionally, one of the explanations for this result may be that since FDI was treated as endogenous regressor in the system GMM estimation, (i) endogeneity may cause biased results for other used models in the paper, because in regard to cycle theory, as FDI can be reason for growth in high tech export per worker, the opposite case is also possible, which means having more high tech export per worker may attract more FDI, (ii) owning to limited time section per country in the system GMM estimator may also lead lack of enough variation in the data. Therefore, Hypothesis 2; an increase in foreign direct investment inflow leads to higher high-tech export, is failed to be accepted

Trade Openness: Considering spillover effect through international trade, it is an essential channel to the transmission of technology (see, Grossman & Helpman 1991; Coe and Helpman 1995, Xu and Wang 1999). In this regard, it is reasonable that the variable trade openness, measured the ratio total trade of GDP, is significantly and positively associated with high-tech export per worker. As the sixth model in the table 1 shows numerically that controlling other variables, one unit increase in the trade openness leads 1% increase in the high-tech export per worker. Comparing with first five models and the last model in the table 1, it is important to mention that the impact of trade openness might be underestimated when the system GMM estimator is not used. Also, this result supports the view of Tebaldi (2011). Given the significant positive the impact of trade openness, high restrictions on trade cause lowering in the spillover effect, which results slowing down the speed of new technology adaptations and transmissions, and what is worse that such protectionist policies can generate interest groups enjoy with their outmoded technologies, and by virtue of willingness to secure own position, they might become a fundamental obstacle when require obtaining new technologies. That means losing competitiveness in the global market. Moreover, such restrictions can weaken not only high tech export but also all economic system by being source of rent-seeking behaviors and corruption. Therefore, Hypothesis 3; an increase in trade openness leads to higher high-tech export is accepted.

Table 1: Results for a Number of Factors and High-Tech Export

	(1) Pooled OLS	(2) Random Effect (RE)	(3) Fixed Effect (FE)	(4) RE with time dummies	(5) FE with time dummies	(6) System GMM
Dependent Variable	High-Tech Export	High-Tech Export	High-Tech Export	High-Tech Export	High-Tech Export	High-Tech Export
Human Capital	1.801***	2.602***	2.664***	2.342***	1.061*	2.228***
	(0.244)	(0.327)	(0.517)	(0.343)	(0.639)	(0.568)
FDI per worker	0.522***	0.331***	0.242***	0.252***	0.124	0.357
	(0.089)	(0.067)	(0.072)	(0.074)	(0.078)	(0.275)
Trade Openness	0.009***	0.012***	0.013***	0.011***	0.008**	0.014**
	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.006)
Institutions	1.678***	0.638***	0.367*	0.906***	0.655***	1.319***
	(0.287)	(0.190)	(0.211)	(0.215)	(0.218)	(0.410)
Bus. Envr.	0.349	0.024	-0.209	-0.170	-0.598	1.127
	(0.735)	(0.441)	(0.442)	(0.444)	(0.444)	(0.796)
Physical Invs.	0.014	0.013	0.020	0.019	0.033**	-0.042
	(0.016)	(0.012)	(0.013)	(0.012)	(0.013)	(0.062)
R-squared within model		0.4326	0.4432	0.4595	0.4823	
R-squared between model		0.6728	0.6339	0.6871	0.6697	
R-squared overall model	0.7001	0.6548	0.6191	0.6671	0.6127	
Arellano-Bond test for AR(1)						0.559
Arellano-Bond test for AR(2)						0.233
Constant	-11.222***	-6.522***	-4.341**	-6.026***	-0.200	-12.106***
	(2.411)	(1.683)	(1.938)	(1.693)	(2.168)	(4.116)
Observations	312	312	312	312	312	312

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Institutions: Since institutions are substantial in using limited resources in effective way (North, 1992), so it might be believed having good institutions is one of the main components to be located in elevated position in the global competitive market. For this reason, it is not surprise to have positive and highly significant the estimated coefficient value on institutions for all models, as shown table 1. Taken into consideration sixth model as main estimator, when controlling other factors, one percent increase in quality of institution is associated with an increase which is more than 3% in high tech export per worker. Likewise trade openness; by only looking the result of institutions from second, third, fourth, and fifth columns, the causality from institutions to high tech export per worker might be undervalued. For instance, the predicted coefficient on institution is 0.655 in the fifth column which stands for fixed effects with year dummies whereas the coefficient that is predicted by the system GMM, a dynamic panel estimator, is 1.319. However, this outcome is inconsistent with Tebaldi (2011).[4] The contradictory results might be construed that since property rights, as measurement for economic institutions, is regarded in this paper to quantify institutions while the data on institution in the paper of Tebaldi (2011) contained not only economic institutions but also political ones. In this context, the result in this paper may suggest that as requiring enormous tangible and intangible investment to fabricate high tech products, instead of political institutions in general, the acceleration in high tech export per worker rely on – properly defined and executed property rights regimes – economic ones. Therefore, Hypothesis 4; an increase in the quality of institution leads to higher high-tech export is accepted.

Business Environment: The impact of business freedom, a measurement for business envıronment, on high tech export is not clear for all estimators in the table 1. Beside it has any

[4] Although the impact of political institutions on high tech export per worker is positive and significant in the simple regression, it lost its significance when adding other control variables in the paper of Tebaldi (2011)

significant effect on dependent variable, the sign of the effect changes according to the each used estimator. It was thought positively and significant association between business environment and high tech export per worker because of fact that in the view of Miller and Kim (2017), effectively resource allocation are based on rational choices made by business owner in free business environment. Moreover, keeping in mind the positive role of human capital of the new technology-based firms' founder (Colombo & Grilli, 2009), expecting also positive and significant role for the business environment where high tech firms operating was perceived realistic. However, the result is in the same line with Sara, Jackson, and Upchurch (2012) shows that regulations on starting, obtaining, and closing a business, and infrastructure environment does not have any impact on high tech export per worker, put it differently, the result does not support the idea that obtaining more effective regulatory and infrastructure system encourage high tech export. On the other than, the reason behind such relation might be that the business environment for high tech firms can be different than general one, that's why the impact may be captured by this indicator or likewise FDI indicator, having limited time section per country may be another one. Nevertheless, it is failed to accept the Hypothesis 5; an increase in business freedom leads to higher high-tech export.

Physical Investment: The physical investment variable is the ratio of gross capital formation to GDP. Even if the expected value was significant and positive by the reason of importance of physical investment for technology accumulation, apart from fifth model, the obtained value on the impact physical investment on high tech export was contrast with the anticipation. There are several supportive literatures on the relationship between physical investment and high tech export for both pro- and anti-camps , e.g. Tebaldi (2011) argued high tech export does not respond change in the ratio of grass capital formation to GDP whereas Wolff

(1991) claimed capital intensity and TFP is positively associated. Besides, the result from fifth model indicates positive and significant relations corroborates, as supportive argument to Wolff' view (1992). After treating physical investment endogenous variable in the sixth model, it, however, lost its significance, even sign has changed, and it is located in same path with Tebaldi (2011). Thereby it might be said that the significance of physical investment in fifth model rooted in endogeneity, and overestimated and biased result for physical investment is prevented by using the system GMM estimator. Therefore, Hypothesis 5; the higher physical investment leads to higher high-tech export, is failed to be accepted.

4.3 Discussion of the Findings & Policy Implications

4.3.1 Discussion of the Findings

The results from estimations models figure out several findings. Firstly by analyzing all results from each model, it is realized that impacts of human capital, trade openness, and institutions on high tech export are positive and significant whereas the cases of other explanatory variables are not clear. For instance, the sing of physical investment turn into negative when it is entered as endogenous variable in the last model while it was significantly and positively indicated in fifth column.

Secondly, paying attention to outcomes for FDI and trade openness in the last model together, transmission of new technologies through international trade channel by spillover effect is seen to be more common paths instead of expecting technology transferring or sharing via FDI. Furthermore, by adding human capital and institutions in this picture, it can be pointed out that beyond the impact of international trade, high tech activities mainly derive from internal dynamics, such as by improving human capital and institutions. The impacts of foreign firms are not significant.

Thirdly, since changes in business environment might occur in short period relatively to ones in institution , when analyzing having insignificant results for business environment – measured by business freedom – and significant one for institutions –measured by property rights – together, the nature of high tech export products might be a respond this case. For instance, an invest in aerospace, as a high tech export product, requires not only physical investment but also upper level human capital and large amount investment in Research and Development (R&D), so it can be taken into in the long term investment category, and it may not respond changes in the short term . For this reason, even if issues about the business environment might have effects in initial stage, human capital or more importantly property rights regime is counted more significant than business environment for long term concerns.

Fourthly, given the result for human capital and physical capital, the significant impact of human capital, rather than physical capital, on high tech export per worker was observed. Thereby, When evaluating results from human capital and physical investment together, it might be ended up with the view of Barlevy (2004) that is assuming high tech is associated with human capital intensive activities rather than capital intensive ones(as quoted, Tebaldi, 2011). That means to manufacture pharmaceuticals products, high tech export, for instance, and to survive in the global competition in the high tech market, requires enormous amounts of well-educated human resources in the either manufacturing stage or R&D stage, instead of physical investment. Additionally, taken into consideration that decision on physical investment is top-down processing while individuals decide whether invest their education or not, this case might be interpreted that instead of top-down activities, bottom-up ones are more determinant in the high tech export.

The last but the most important point is about estimation models itself. Even though it can be taken reliable outcomes either random effects or fixed effect, their results might be evaluated bias when having endogenous variables, which mean the probability of autocorrelation or reverse causality in the regression. In this aspect, the system GMM estimator was employed in this paper in order to obtain unbiased results. Comparing with results from the system GMM estimator in the sixth column and fixed effects estimator in the fifth column[5], to use dynamic panel estimator, the system GMM, prevents overestimations, underestimations, misinterpretations, e.g. the impact of trade openness increased by using the system GMM, and physical investment lost its significance when entering the system GMM estimation model.

4.3.2 Policy Implications

As a priority point to begin to recommend policies, it has been believed that recommended any types of policies, e.g. infrastructure investment, increase trade openness, might have impacts on high tech export on the basis of two core assumptions of economic “scarcity of resources and human being are rational”. In other words, it is more likely to be said that selective logical policies should be implemented in order to create right environments to allocate limited resource in efficient ways. Knowing the extensive role of the high tech export for counties form the view of UNIDO (2015), after having discussed on results and finding from several estimators, it must be deal with another discussion on what bring these results and findings as policy implications for countries that want to accelerate their high tech export per worker. In short, it

[5] The fixed effects estimators in the fifth model used by taking advice from Hausman Test (1978) and Time Fixed Effect Test (see table 4)

might be ended up in partially parallel thoughts from Tebaldi's paper (2011), whole policies, however, need to be rethought since having some contradictory results with him

To begin with one the significant determinants of high tech export, trade openness, it brings two important actions in order to improve high-tech export per worker. Firstly, policies which promise a more integrated domestic market into the global market generate conditions that make possible a growth in high tech export. Secondly, policies aim to impose restriction on international trade due to several reasons, such as to protect internal market, tend to be concluded demolishing in the necessary atmosphere to provide an increase in high tech export. Thereby, given the relationship between high tech export and trade openness is strong enough, efforts on increasing economic integration into the global market and lowering restriction on international trade will be more likely to positively affect countries' high tech export in the world.

It might be perceived physical investment, e.g. investing to facilities, equipments, is the prior condition for high tech activities. Moreover, there can be also perceptions on FDI as an essential way to acquire new technologies. However the results do not stand on the same with expected line, and advice another policy implementation in order to enrich high tech export, which is to introduce strategies targeted at improving human capital. Thereby, investing in intangible assets rather than tangible ones ensures preferable ways to enhance high tech export by taking into account necessity of using limited resources efficiently. More importantly, in order to augment high tech export, instead of following policies rely upon only foreign firms, countries should also consider making investment in education. Therefore, existing the significant link between human capital and high tech export, such policies that encourage human capital accumulation, will be appreciated regarding growth in high tech export.

The last but not the least policy implementation that can be thought in order to boost high tech export is to execute strategies seek to take forward the quality of institutions. Since high tech products is defined R&D intensive, protecting property rights in general, intellectual property rights in specific, might be counted as first condition to generate those products. For this reason, these actions, such as promote the improving quality of institutions in a way that strengthening system to protect physical property, intellectual property right, and investor and to prevent expropriations should be implemented for the high tech export growth.

Therefore, from the a policy view, these findings and results suggest that countries where embody right system that promotes human capital accumulation, more integrated economy into world, and good institutions will enjoy with its appropriate atmosphere for high tech export growth.

5. SUMMARY AND CONCLUSIONS

It is aimed to investigate determinant factors in high tech export per worker. Human capital, physical investment, trade openness, FDI per worker, institutions, and business environment are decided explanatory variable to examine their potential effects on high tech export. In order to obtain generalized conclusions, any attempt was not made to narrow the sample. Although it was employed different types estimation methods, the main interpreted results were taken by the system GMM estimator in order to deal with endogeneity problems.

The variables found to be significantly and positively associated with high tech export for these countries the sample are human capital, trade openness, and institutions. On the other hand, the relations between those independent variables; physical investment, FDI per worker, and business environment and dependent variable; high tech export are clear. Thus, these result implies that high tech export per worker responds the changes in human capital, trade openness, and institutions meanwhile others does not cause any change. Necessities of well-educated human resources, well defined intellectual property rights due to the nature of high tech activities might be the reason behind the relationship between human capital, institutions and high tech export per worker. Taken international trade as a vital channel for technology transmission, the strong link between trade openness and high tech export per worker is understandable. On the other hand, observed insignificant impact of FDI on high tech export per worker might be occurred by the fact that the degree of technology sharing was at lower levels, and the probability of reverse causality with dependent variable. As well as FDI, the variations in high tech export were not properly detected by business environment and physical investment. For this reason, no matter how much business environment is free or invest in physical capital to growth high tech export. Another, more technical, approach to explain for these unexpected results might be related to not have enough variations in the sample. All in all, extra efforts should be given focused on policies on an improvement at levels of human capital, quality of institutions, and trade openness by countries where willingness to achieve an uptrend in high tech export.

6. LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDIES

The estimated results should to be carefully interpreted due to some limitations of the study. Initially, the used models in this study in order to analyze differentiations among countries on high tech export per worker may not be appropriate. The links between explanatory variables and explained one may not properly capture by reason of used datasets in the sample. Since human capital, institutions, and business environment are determined as exogenous variables in the model, probability of potential endogenetiy issues might always be taken into consideration. When looking listed countries in the sample which is basically based on data availability together with the assumption that where more advance country, more data will be, the sample used in this study might be problematic in order to gain generalized outcomes. Also, to employ four periods per each country may cause lack of variations for variables in the sample. For the reason of having limited time periods, lagged high tech export per worker did not introduce as a regressor in the model. Under these limitations, the obtained results can be biased, and the recommendations on the basis of these results can be too. Therefore, it is recommended that after finding evidences from other studies which use more appropriate model, it can be bring more proper recommendation for high tech export growth.

Several important determinant factors in high tech export per worker were detected by the framework used in this paper though there can be numerous different additional independent variables which might have impact on it, such as the income distribution. Since the human capital is measured the years of schooling which approach to education regarding quantity, rather than quality, this method of measuring might be poor when conceiving differences in the quality of the education among countries. In this regard, the impacts of the quality of education are needed to be controlled with a comparable international test, such as PISA. Although acquired insignificant results for FDI per worker, after accepting its importance for technology transmission, the future studies require. Moreover, instead of taken only aggregate FDI regardless which country comes from, to analyze it along with its origin country can provide more clarifications in outcomes.

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APPENDIX

Table 2: Descriptive Statistic by Country

Countryname		Hgh-Tch Exp. per worker	Years of Schooling	FDI per worker	Openness	Property Rights	Business Freedom	Investment (% of GDP)
Albania	Mean	3.0681	9.170	380.273	65.064	33.750	66.170	31.014
	Std. Dev.	1.6757	0.927	351.534	14.746	5.679	7.281	7.589
	Max	4.7358	9.850	812.583	77.075	42.000	74.480	37.134
	Min	1.2438	7.820	43.228	45.531	30.000	59.200	21.331
Algeria	Mean	0.6814	5.038	119.817	62.907	36.000	70.150	33.260
	Std. Dev.	0.3228	0.752	73.413	8.757	9.522	2.146	6.853
	Max	1.0598	5.980	194.384	72.391	50.000	72.920	41.518
	Min	0.2775	4.170	34.441	51.433	30.000	67.680	26.486
Argentina	Mean	58.1509	8.908	454.447	31.588	40.500	71.355	17.442
	Std. Dev.	26.6804	0.548	198.254	7.242	22.825	11.339	1.725
	Max	87.9796	9.480	678.558	39.281	70.000	85.000	18.668
	Min	29.3152	8.340	241.888	21.869	18.000	59.900	15.004
Australia	Mean	291.5505	11.470	2171.507	40.494	90.000	82.660	26.638
	Std. Dev.	77.3649	0.234	1469.853	1.383	0.000	10.204	1.415
	Max	379.2954	11.770	4185.649	41.636	90.000	92.480	27.992
	Min	191.8627	11.260	703.263	38.529	90.000	70.000	25.415
Austria	Mean	2787.1000	9.320	1524.085	89.820	90.000	72.990	24.579
	Std. Dev.	1069.0570	0.459	854.489	12.453	0.000	4.079	1.278
	Max	3832.1750	9.890	2775.891	102.470	90.000	78.640	26.365
	Min	1382.9450	8.870	849.318	73.641	90.000	70.000	23.544
Barbados	Mean	123.9464	8.975	1679.287	90.051	79.000	81.130	16.060
	Std. Dev.	22.2626	0.328	1275.603	3.286	13.317	8.006	2.395
	Max	146.6168	9.320	2738.676	94.594	90.000	89.000	18.498
	Min	100.9906	8.680	156.442	86.748	60.000	70.000	13.067
Bolivia	Mean	16.1483	7.503	153.648	63.765	32.250	56.175	16.941
	Std. Dev.	12.3213	0.297	74.649	16.662	18.518	1.728	2.189
	Max	34.2646	7.770	220.726	81.887	54.000	58.660	18.909
	Min	7.8392	7.110	61.460	49.303	10.000	55.000	14.592

Brazil	Mean	68.4799	6.258	389.932	23.515	50.000	61.270	19.108
	Std. Dev.	28.1904	1.217	258.290	4.324	0.000	7.187	1.648
	Max	92.8552	7.660	775.530	27.003	50.000	70.000	21.457
	Min	29.7772	4.840	237.887	17.253	50.000	53.860	17.953
Bulgaria	Mean	133.8132	10.075	832.642	101.370	39.000	63.055	21.852
	Std. Dev.	125.2967	1.097	896.936	17.891	10.520	9.747	7.858
	Max	296.7923	11.450	2148.385	121.286	50.000	74.680	31.763
	Min	25.5269	9.050	133.865	81.141	30.000	55.000	12.538
Canada	Mean	1391.7950	11.598	2025.854	69.463	90.000	89.620	22.130
	Std. Dev.	34.5689	0.937	970.637	6.482	0.000	5.336	2.073
	Max	1425.2320	12.560	3147.435	75.404	90.000	94.380	24.456
	Min	1345.3590	10.630	1007.549	62.189	90.000	85.000	20.319
Chile	Mean	45.7720	9.068	1425.516	65.208	89.500	75.040	23.650
	Std. Dev.	30.5150	0.599	805.867	7.879	1.000	8.402	2.139
	Max	73.8124	9.710	2514.691	73.650	90.000	85.000	26.179
	Min	14.0723	8.400	735.141	54.870	88.000	68.080	21.527
China	Mean	288.1326	7.023	98.837	46.847	26.000	52.025	41.346
	Std. Dev.	273.3217	0.578	44.564	10.066	4.899	3.446	4.707
	Max	634.7941	7.530	156.201	58.528	30.000	55.000	47.386
	Min	29.2595	6.220	59.390	33.952	20.000	48.720	37.008
Colombia	Mean	19.4446	6.933	323.860	35.964	43.000	75.665	20.990
	Std. Dev.	2.3147	1.042	199.746	1.178	8.246	7.613	2.930
	Max	22.9130	8.450	559.893	37.137	50.000	86.900	24.088
	Min	18.1512	6.090	132.364	34.386	34.000	70.000	17.260
Croatia	Mean	278.9447	10.298	911.039	79.007	33.750	57.330	23.596
	Std. Dev.	120.9505	0.911	639.953	7.385	4.787	3.773	4.043
	Max	392.9536	11.420	1816.298	83.258	40.000	62.900	28.784
	Min	125.7266	9.310	345.803	67.954	30.000	55.000	19.781
Czech Republic	Mean	1977.5410	12.805	1001.030	112.958	69.500	75.355	29.612
	Std. Dev.	1679.8670	0.501	337.751	26.470	1.000	13.450	2.532
	Max	4054.9270	13.160	1420.255	144.399	70.000	94.000	32.228
	Min	317.6471	12.070	594.705	84.282	68.000	63.640	26.163
	Mean	2876.4830	10.840	1875.126	87.603	90.250	93.120	21.290
	Std. Dev.	724.8683	0.701	1082.700	13.734	0.500	6.408	1.521

Denmark	Max Min	3658.4710 1922.0160	11.530 9.910	3051.892 477.061	100.780 70.430	91.000 90.000	98.640 85.000	22.971 19.290
Ecuador	Mean Std. Dev. Max Min	8.0247 3.5694 11.4685 4.0577	6.983 0.334 7.440 6.710	94.970 24.312 125.484 69.692	54.383 7.202 60.772 45.548	33.250 12.580 50.000 20.000	54.975 1.625 56.940 52.960	23.450 3.428 28.151 20.459
Egypt, Arab Rep.	Mean Std. Dev. Max Min	1.5386 1.5872 3.7471 0.2739	5.240 1.082 6.550 4.050	142.564 137.710 337.217 44.527	48.701 9.963 63.557 42.239	43.500 6.807 50.000 34.000	56.495 5.094 63.860 52.120	18.411 1.780 19.828 16.097
El Salvador	Mean Std. Dev. Max Min	38.5263 27.5575 69.5006 13.7307	6.160 1.315 7.660 4.580	160.539 91.889 287.106 71.642	67.843 5.033 70.919 60.388	50.000 5.657 54.000 42.000	71.120 9.633 85.000 63.500	15.788 1.269 16.865 14.082
Estonia	Mean Std. Dev. Max Min	953.0187 635.6241 1803.1300 263.0982	11.698 0.860 12.480 10.490	1470.261 1085.097 2933.614 431.966	141.944 15.858 161.937 126.289	76.250 7.228 83.000 70.000	82.675 2.872 85.000 79.100	30.411 3.128 32.651 25.896
Finland	Mean Std. Dev. Max Min	3204.4910 1245.9410 4560.1320 1736.3740	9.490 0.679 10.210 8.630	1987.576 311.252 2394.846 1680.526	73.674 6.303 79.806 66.265	90.250 0.500 91.000 90.000	83.278 13.370 94.660 66.250	22.633 1.119 24.099 21.557
France	Mean Std. Dev. Max Min	2567.1930 802.6781 3611.6960 1817.4280	9.690 0.891 10.640 8.540	886.601 370.942 1298.156 501.466	52.828 4.738 58.046 46.606	72.500 5.000 80.000 70.000	80.755 7.186 85.000 70.000	21.878 1.228 23.011 20.220
Germany	Mean Std. Dev. Max Min	3061.5820 1201.4550 4391.3720 1672.3370	11.208 1.374 12.690 9.660	983.743 387.552 1485.147 557.499	67.617 15.470 83.850 48.619	90.000 0.000 90.000 90.000	78.995 10.562 90.340 70.000	20.917 1.644 23.215 19.653
Greece	Mean Std. Dev. Max Min	173.7156 62.4277 224.3311 88.7931	9.195 0.981 10.260 8.180	337.362 187.213 593.892 159.464	51.901 8.270 60.632 40.705	56.500 9.983 70.000 48.000	72.240 3.094 76.560 70.000	21.662 5.413 25.790 13.694

Guatemala	Mean	21.8230	3.758	110.281	58.076	37.250	53.875	16.903
	Std. Dev.	7.8598	0.386	62.585	9.886	9.215	1.320	2.545
	Max	33.0999	4.300	193.985	64.399	50.000	55.000	19.839
	Min	16.2585	3.410	56.640	43.484	30.000	52.460	14.367
Hungary	Mean	2595.3230	11.365	1129.220	133.096	68.750	73.465	24.401
	Std. Dev.	1557.0040	0.758	346.863	29.972	2.500	3.484	2.512
	Max	3937.7470	12.140	1554.303	165.027	70.000	78.300	26.450
	Min	608.6265	10.370	770.860	95.428	65.000	70.000	20.988
Iceland	Mean	813.8001	9.753	5414.475	81.145	90.000	83.425	21.764
	Std. Dev.	884.8646	0.719	7143.144	15.143	0.000	10.943	4.732
	Max	2112.3530	10.590	15990.210	102.682	90.000	92.620	27.176
	Min	247.2613	8.930	566.385	69.742	90.000	70.000	15.659
India	Mean	13.3024	4.533	34.804	38.453	50.000	49.720	33.738
	Std. Dev.	11.3035	0.791	29.688	13.799	0.000	8.758	5.852
	Max	28.8932	5.390	62.693	52.792	50.000	55.000	39.944
	Min	4.0723	3.510	6.843	23.438	50.000	36.740	27.944
Indonesia	Mean	43.4317	5.525	58.482	55.108	36.000	53.160	25.964
	Std. Dev.	12.7057	1.350	70.771	5.501	9.522	2.782	5.462
	Max	53.8226	7.260	154.479	60.362	50.000	55.000	33.874
	Min	25.4702	4.210	-11.880	48.636	30.000	49.120	21.760
Ireland	Mean	13296.4600	11.293	7535.284	165.082	90.000	87.560	23.422
	Std. Dev.	2689.0240	0.820	7810.382	20.857	0.000	3.125	3.541
	Max	16699.0600	12.200	18021.850	195.039	90.000	91.360	27.256
	Min	10120.1800	10.400	-296.925	147.018	90.000	85.000	19.175
Israel	Mean	1826.2600	12.003	1757.536	69.565	70.250	73.595	21.466
	Std. Dev.	472.6061	0.572	864.087	6.224	0.500	7.972	2.186
	Max	2519.5560	12.760	2638.850	77.365	71.000	85.000	24.668
	Min	1468.9950	11.400	892.949	62.405	70.000	67.240	20.049
Italy	Mean	969.1805	8.763	657.155	49.985	61.250	74.055	20.098
	Std. Dev.	190.9611	0.680	318.857	4.427	10.178	3.210	1.271
	Max	1170.2350	9.540	971.050	55.068	70.000	77.000	21.271
	Min	739.6835	7.930	212.492	44.685	51.000	70.000	18.570
	Mean	1673.8030	10.900	92.605	25.441	79.500	81.935	25.329
	Std. Dev.	101.2285	0.579	58.198	6.606	8.226	4.128	2.868

Japan	Max Min	1754.4650 1536.8240	11.520 10.180	164.876 35.215	32.270 18.565	90.000 70.000	85.000 76.000	29.267 22.626
Jordan	Mean Std. Dev. Max Min	34.7600 11.3308 48.8653 25.5554	8.033 1.071 9.210 6.710	772.277 656.393 1648.876 140.335	124.779 12.733 139.469 116.890	59.250 7.632 70.000 52.000	66.910 4.152 70.000 61.220	26.220 3.730 29.790 22.348
Kazakhstan	Mean Std. Dev. Max Min	133.6143 152.0988 334.8236 12.9034	10.728 1.109 11.740 9.270	731.315 569.964 1296.285 154.458	82.860 12.300 96.091 70.272	30.750 2.217 34.000 29.000	60.050 8.928 73.380 55.000	24.990 5.156 31.464 18.841
Korea, Rep.	Mean Std. Dev. Max Min	3111.2640 1490.7180 4805.8160 1469.4150	10.918 0.840 11.890 9.940	353.239 84.198 420.035 230.354	77.522 19.442 102.722 59.269	78.000 9.798 90.000 70.000	78.895 11.026 92.700 70.000	32.382 1.778 34.957 30.872
Kuwait	Mean Std. Dev. Max Min	17.4182 19.7911 45.9181 1.2707	5.998 0.238 6.260 5.690	348.652 485.374 1058.116 -25.797	91.957 5.296 98.960 86.108	66.250 19.328 90.000 50.000	72.255 9.772 85.000 61.480	15.838 1.276 17.730 14.937
Latvia	Mean Std. Dev. Max Min	269.7283 311.2369 711.2457 39.1806	9.748 0.710 10.480 8.890	640.176 407.868 1079.342 278.648	96.590 16.692 120.596 84.516	50.750 0.957 52.000 50.000	73.333 2.468 75.960 70.000	27.001 6.035 34.597 20.955
Lithuania	Mean Std. Dev. Max Min	456.6565 484.7894 1076.3270 41.3875	10.158 0.902 11.050 9.030	471.364 297.484 894.799 230.494	113.774 29.824 154.839 88.513	52.250 4.500 59.000 50.000	75.615 6.484 81.240 70.000	21.882 2.290 24.629 19.509
Malawi	Mean Std. Dev. Max Min	0.2670 0.2139 0.5345 0.0766	3.360 0.679 4.290 2.710	19.079 15.903 41.309 4.957	60.519 5.954 66.058 54.453	47.500 3.000 50.000 44.000	50.995 6.250 55.000 41.840	15.840 3.841 21.574 13.488
Malaysia	Mean Std. Dev. Max Min	4399.1790 609.8929 4924.4000 3517.9150	8.603 0.951 9.750 7.560	542.818 213.816 800.891 290.922	184.709 25.320 205.539 148.352	56.750 8.995 70.000 50.000	75.975 6.729 85.000 69.260	26.502 6.113 35.430 21.561

Malta	Mean	7032.1110	9.560	51861.270	256.692	77.000	71.425	21.482
	Std. Dev.	923.1442	0.713	52610.490	39.049	14.376	3.990	2.688
	Max	7849.7870	10.330	117634.200	309.100	90.000	76.000	25.363
	Min	6052.9890	8.710	2180.105	221.241	58.000	66.700	19.552
Mexico	Mean	666.6836	7.453	489.335	55.406	51.000	69.345	21.707
	Std. Dev.	171.7735	0.821	122.444	6.551	2.000	13.377	1.454
	Max	820.7889	8.330	559.310	64.245	54.000	82.100	23.303
	Min	420.9706	6.480	306.263	49.840	50.000	55.000	19.809
Moldova	Mean	9.6354	9.503	146.629	127.534	47.000	65.970	26.194
	Std. Dev.	4.5807	0.855	110.741	5.639	4.761	5.633	4.463
	Max	15.6606	10.660	283.267	133.870	50.000	70.000	32.810
	Min	4.7890	8.670	40.535	121.727	40.000	58.000	23.029
Morocco	Mean	56.5849	3.488	163.385	66.543	43.000	72.315	30.543
	Std. Dev.	23.0828	0.682	68.743	13.676	13.115	3.008	4.275
	Max	75.3278	4.240	231.528	81.118	62.000	76.320	34.417
	Min	23.7675	2.660	79.790	50.949	32.000	70.000	25.685
Mozambique	Mean	1.7922	1.015	119.362	73.509	30.000	53.150	27.282
	Std. Dev.	2.4260	0.197	174.289	20.743	0.000	7.411	9.746
	Max	5.3845	1.240	380.466	101.879	30.000	63.540	40.235
	Min	0.2156	0.800	20.636	52.151	30.000	46.000	16.817
Netherlands	Mean	6078.0730	11.048	3829.646	126.908	90.000	78.850	21.407
	Std. Dev.	1414.7380	0.404	761.245	15.915	0.000	6.638	1.497
	Max	7393.0620	11.600	4528.062	148.720	90.000	84.080	22.955
	Min	4387.9050	10.630	3070.805	112.174	90.000	70.000	19.360
New Zealand	Mean	240.0660	11.535	872.865	59.139	91.500	91.515	22.662
	Std. Dev.	30.0136	0.159	489.671	2.737	2.380	7.577	1.006
	Max	276.1626	11.650	1221.368	63.024	95.000	99.140	23.429
	Min	215.2430	11.300	148.327	57.127	90.000	85.000	21.215
Nicaragua	Mean	1.8679	5.275	169.576	77.882	26.500	54.890	26.742
	Std. Dev.	0.8351	0.608	91.044	25.152	5.745	1.459	2.557
	Max	2.5100	6.000	297.165	109.010	30.000	56.560	29.324
	Min	0.6899	4.560	100.456	54.016	18.000	53.000	23.951
Niger	Mean	1.2543	1.183	43.819	50.436	33.750	46.285	22.047
	Std. Dev.	1.6505	0.247	58.093	10.544	7.500	10.136	12.798
	Max	3.6207	1.450	125.305	64.642	45.000	55.000	37.621

	Min	0.0726	0.880	1.564	42.315	30.000	36.080	9.862
Norway	Mean	1211.6550	11.470	2894.494	70.294	90.000	78.935	24.339
	Std. Dev.	436.3502	0.573	1621.488	1.393	0.000	10.437	2.522
	Max	1717.7360	12.070	4726.660	71.643	90.000	89.800	26.747
	Min	742.1083	10.800	1324.393	68.392	90.000	70.000	20.787
Pakistan	Mean	2.7041	3.750	31.747	33.214	37.000	64.490	17.071
	Std. Dev.	2.1930	0.868	28.562	2.214	14.000	7.892	1.644
	Max	5.0341	4.510	73.994	35.529	58.000	71.420	18.791
	Min	0.2238	2.770	14.276	30.437	30.000	55.000	14.919
Panama	Mean	261.8159	8.670	1041.872	138.687	38.500	71.740	36.253
	Std. Dev.	520.8579	0.494	662.237	10.233	8.386	2.089	6.579
	Max	1043.1020	9.150	1941.975	149.242	50.000	74.180	43.603
	Min	0.8666	8.040	440.349	124.857	30.000	70.000	28.789
Paraguay	Mean	7.3374	6.520	76.392	97.804	33.250	59.200	17.218
	Std. Dev.	6.1816	0.639	58.745	6.033	5.852	5.700	2.386
	Max	15.1993	7.240	154.900	103.068	42.000	67.000	20.796
	Min	1.7000	5.870	18.659	89.282	30.000	54.900	16.004
Peru	Mean	6.7076	8.348	288.964	43.292	42.000	63.210	21.651
	Std. Dev.	4.4632	0.823	164.842	10.037	8.165	5.338	2.817
	Max	13.1847	9.190	497.243	52.275	54.000	70.520	24.557
	Min	3.7043	7.250	110.797	32.442	36.000	58.000	18.024
Philippines	Mean	619.6816	7.673	53.932	86.489	44.000	55.175	20.786
	Std. Dev.	153.5393	0.452	15.563	15.996	17.436	4.108	1.886
	Max	763.8662	8.180	67.898	102.113	66.000	61.000	22.717
	Min	470.4706	7.120	32.793	65.147	30.000	51.760	18.555
Poland	Mean	233.1641	10.643	526.224	69.920	60.250	65.440	21.728
	Std. Dev.	252.5707	0.678	202.344	16.595	7.588	5.787	1.253
	Max	584.2033	11.420	741.459	88.589	66.000	70.000	23.146
	Min	30.5442	9.830	309.761	50.062	50.000	57.940	20.540
Portugal	Mean	341.1778	6.615	736.354	66.739	70.000	74.740	23.138
	Std. Dev.	133.6807	0.527	268.156	5.736	0.000	5.925	4.364
	Max	505.2810	7.200	908.381	74.817	70.000	82.260	26.478
	Min	178.9709	5.920	340.801	61.901	70.000	70.000	17.066
	Mean	160.5511	10.200	397.040	70.765	32.750	62.950	24.472

Romania	Std. Dev.	174.4696	0.504	380.281	8.821	4.856	9.185	3.660
	Max	397.9037	10.810	946.242	78.600	40.000	71.280	28.588
	Min	9.9210	9.620	82.893	58.495	30.000	55.000	20.559
Russian Federation	Mean	60.6502	11.013	289.175	54.219	35.500	59.330	21.507
	Std. Dev.	26.0309	0.857	261.647	5.410	11.091	4.124	1.481
	Max	94.2315	11.730	553.864	60.925	50.000	64.000	23.395
	Min	30.8809	9.780	43.349	47.852	25.000	55.000	20.176
Rwanda	Mean	0.3554	2.633	16.547	37.107	23.500	52.135	18.093
	Std. Dev.	0.2600	0.663	22.445	6.416	9.983	14.477	5.254
	Max	0.6280	3.480	48.951	44.951	32.000	72.040	24.804
	Min	0.0067	1.970	0.953	31.254	10.000	40.000	13.902
Saudi Arabia	Mean	12.0769	6.933	1126.100	75.736	56.250	73.828	23.381
	Std. Dev.	8.7797	0.753	1399.470	12.697	19.466	7.444	4.025
	Max	21.5063	7.790	3024.038	89.545	85.000	81.250	27.932
	Min	4.3410	6.050	31.423	62.164	42.000	65.320	19.598
Senegal	Mean	6.4554	1.968	49.512	68.343	50.250	56.250	21.702
	Std. Dev.	4.6862	0.366	27.031	4.706	7.762	1.446	5.475
	Max	12.9848	2.400	72.519	73.179	60.000	57.600	26.362
	Min	1.8554	1.520	20.254	62.776	41.000	55.000	14.711
Singapore	Mean	38386.2900	8.843	11416.060	371.376	90.000	98.860	28.493
	Std. Dev.	6971.3190	1.369	6112.870	32.330	0.000	1.329	4.192
	Max	44321.6500	10.630	20096.730	410.864	90.000	100.000	34.268
	Min	30016.8800	7.320	6698.341	331.700	90.000	97.500	25.045
Slovak Republic	Mean	883.2934	12.140	898.842	141.113	51.250	71.145	27.764
	Std. Dev.	963.4854	0.818	519.907	29.093	1.893	1.303	4.106
	Max	2213.8400	13.070	1356.047	173.602	54.000	73.000	32.547
	Min	110.1977	11.390	376.530	109.856	50.000	70.000	22.577
Slovenia	Mean	848.3787	11.663	458.660	116.306	56.250	78.300	25.801
	Std. Dev.	466.2843	0.373	177.931	20.219	3.500	5.875	3.884
	Max	1356.0190	12.130	616.481	139.157	60.000	82.880	29.502
	Min	337.5037	11.230	206.164	94.564	52.000	70.000	20.347
	Mean	81.3602	8.278	210.601	55.603	50.000	75.925	18.927
	Std. Dev.	28.1415	0.900	108.016	6.949	0.000	6.131	1.848

South Africa	Max	114.2664	9.430	330.126	61.079	50.000	85.000	20.668
	Min	57.2699	7.230	107.487	46.576	50.000	71.640	16.792
Spain	Mean	455.9305	9.260	1381.505	54.743	70.000	73.665	25.161
	Std. Dev.	105.0340	1.224	506.371	3.755	0.000	4.318	3.905
	Max	594.9692	10.300	1849.959	58.907	70.000	78.380	29.362
	Min	344.3002	7.690	690.509	50.011	70.000	70.000	20.723
Sweden	Mean	3114.3650	11.588	3490.424	81.523	84.250	81.060	22.244
	Std. Dev.	276.2773	0.509	1648.966	7.122	9.743	12.852	1.033
	Max	3371.4290	12.090	4927.260	87.881	91.000	93.880	23.037
	Min	2747.1480	10.950	1484.996	72.405	70.000	70.000	20.848
Thailand	Mean	607.4082	5.720	171.665	120.151	60.750	70.890	27.046
	Std. Dev.	222.7864	1.387	51.282	18.509	16.761	1.046	3.547
	Max	857.4544	7.300	228.534	134.167	82.000	72.020	31.983
	Min	368.9720	4.330	126.371	94.006	45.000	70.000	23.530
Tunisia	Mean	101.2419	5.340	306.679	92.986	48.500	77.885	24.417
	Std. Dev.	63.1785	1.059	187.505	10.074	3.000	5.516	0.300
	Max	164.2827	6.580	562.026	103.916	50.000	82.000	24.742
	Min	28.3543	4.130	138.678	83.564	44.000	70.000	24.032
Turkey	Mean	48.9355	5.743	327.077	47.406	57.000	67.640	25.691
	Std. Dev.	23.7030	0.748	317.612	2.243	9.452	6.297	3.139
	Max	75.2702	6.560	703.121	50.514	70.000	76.000	29.070
	Min	20.6521	4.810	38.508	45.252	50.000	61.000	22.172
Uganda	Mean	1.8435	4.273	43.625	41.313	44.000	61.675	21.819
	Std. Dev.	2.3461	0.877	28.051	8.054	17.436	11.135	4.195
	Max	5.1561	5.420	72.845	49.842	66.000	76.000	27.189
	Min	0.1147	3.380	17.035	33.647	30.000	49.980	17.352
Ukraine	Mean	50.8277	10.805	169.605	100.391	31.000	50.800	21.484
	Std. Dev.	32.9133	0.581	162.248	8.518	2.000	4.961	1.844
	Max	94.0566	11.340	356.502	112.558	34.000	55.000	23.800
	Min	16.8541	10.040	22.212	92.666	30.000	45.320	19.382
United Kingdom	Mean	2213.7030	10.625	2327.323	53.748	89.500	89.180	17.274
	Std. Dev.	152.6470	1.342	1387.760	4.949	1.000	3.782	1.015
	Max	2373.6580	12.320	4407.075	60.578	90.000	94.060	18.436
	Min	2073.8400	9.290	1550.578	49.712	88.000	85.000	16.093

United States	Mean	1122.3500	7.813	1139.174	25.812	88.500	87.860	21.310
	Std. Dev.	136.2621	0.342	164.934	3.377	3.000	3.303	1.430
	Max	1264.6660	8.110	1299.255	30.046	90.000	90.820	22.277
	Min	941.4240	7.320	992.425	22.858	84.000	85.000	19.247
Uruguay	Mean	38.5228	13.043	657.994	48.406	68.250	68.495	18.042
	Std. Dev.	37.2541	0.309	632.815	9.704	4.193	2.675	3.092
	Max	92.6138	13.420	1449.437	59.732	71.000	70.000	21.379
	Min	13.5486	12.690	106.521	36.872	62.000	64.500	14.907
Venezuela, RB	Mean	7.4217	6.773	237.421	50.104	27.250	57.305	24.300
	Std. Dev.	2.5571	1.144	103.199	2.021	19.517	11.418	1.911
	Max	10.0438	8.160	365.225	53.068	50.000	73.000	26.578
	Min	3.9091	5.500	112.515	48.736	4.000	46.880	21.974
Zimbabwe	Mean	4.0958	6.358	25.486	80.080	18.250	46.350	12.003
	Std. Dev.	4.3340	0.783	23.014	6.859	16.049	10.706	5.856
	Max	10.5796	7.250	53.133	86.328	42.000	55.000	18.297
	Min	1.5638	5.540	2.323	71.053	8.000	32.980	5.925
Total	Mean	1455.9970	8.293	1652.983	81.139	57.051	69.705	23.302
	Std. Dev.	4700.2410	2.958	7956.146	52.047	22.952	13.455	6.034
	Max	44321.6500	13.420	117634.200	410.864	95.000	100.000	47.386
	Min	0.0067	0.800	-296.925	17.253	4.000	32.980	5.925

Table 3: Data Summarized by Five Years Periods

Period		Hgh-Tch Exp. per worker	Years of Schooling	FDI per worker	Openness	Property Rights	Business Freedom	Investment (% of GDP)
1995 - 1999	Mean	1080.9530	7.47	615.35	71.85	62.61	69.55	22.77
	Std. Dev.	3752.6440	2.87	1118.41	47.80	19.58	12.12	5.65
	Max	30016.8800	12.69	6698.34	331.70	90.00	100.00	39.48
	Min	0.0067	0.80	0.95	17.25	10.00	40.00	9.86
2000 -2004	Mean	1380.8480	8.02	976.02	77.66	57.65	67.87	22.32
	Std. Dev.	4477.5110	2.91	2351.19	49.65	22.25	11.11	5.23
	Max	35269.7200	12.93	17549.21	372.49	90.00	100.00	38.29
	Min	0.1134	0.91	-25.80	21.16	14.00	43.00	8.27
2005 - 2009	Mean	1676.0570	8.59	2802.55	86.10	54.30	69.86	24.58
	Std. Dev.	5304.3950	2.96	13290.16	53.96	24.13	14.49	6.01
	Max	44321.6500	13.13	117634.20	410.86	91.00	97.94	42.70
	Min	0.3434	1.11	-296.92	25.56	9.00	39.06	5.92
2010 - 2014	Mean	1686.1300	9.10	2218.01	89.04	53.65	71.53	23.55
	Std. Dev.	5167.2870	2.88	8307.35	55.65	24.82	15.62	6.99
	Max	43936.9100	13.42	70081.59	370.45	95.00	99.14	47.39
	Min	0.2775	1.24	24.38	24.25	4.00	32.98	13.07
Total	Mean	1455.9970	8.29	1652.98	81.14	57.05	69.70	23.30
	Std. Dev.	4700.2410	2.96	7956.15	52.05	22.95	13.46	6.03
	Max	44321.6500	13.42	117634.20	410.86	95.00	100.00	47.39
	Min	0.0067	0.80	-296.92	17.25	4.00	32.98	5.92

Table 4: Summary of Data

Variable	Mean	Std. Dev.	Min	Max
High-Tech Export per worker	1455.997	4700.241	0.007	44321.650
Years of Schooling	8.293	2.958	0.800	13.420
FDI per worker	1652.983	7956.146	-296.925	117634.200
Trade Openness	81.139	52.047	17.253	410.864
Property Rights	57.051	22.952	4.000	95.000
Business Freedom	69.705	13.455	32.980	100.000
Investment (% of GDP)	23.302	6.034	5.925	47.386

Table 5: Selective Test Results

Test	**Chi 2**	**Prob > Chi 2**	**Result**
Breusch and Pagan Lagrangian multiplier test for Random Effects & Simple OLS	263.77	0.0000	Rejects H_0
Hausman Test for Fixed Effects & Random Effects	48.25	0.0000	Rejects H_0
Testing for using year dummies for Fixed Effects	5.63	0.0010	Rejects H_0
Testing for using year dummies for Random Effects	8.18	0.0423	Rejects H_0
Hansen Test for GMM Model	10.53	0.104	Does not Rejects H_0