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The Importance of Industry-, Country- and Global Factors for the Return on Technology Stocks

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Abstract

We investigate to what degree return on technology stocks are affected by industry-, country- and global factors. Furthermore, the analysis is extended to look deeper into the industry factors by examining what the exposure of technology stocks to industry-specific shocks is caused by. In previous studies, the aim has been to try to determine whether industry-, country- or global effects are the most prominent for international stock returns; however, the technology industry has not yet been thoroughly investigated. There are 27 countries included in the analysis, from both developed and emerging markets. The years investigated are 1990-2015 and include returns from a technology index and an equity index for each country, a global technology index and a global equity index.

The results show that industry-, country- and global effects exist in the technology industry. Moreover, high-technology export is found to have a significantly positive impact on the exposure to industry-specific shocks, whereas the dot-com crisis had a negative impact on the exposure. These results are important for forming an optimally diversified portfolio that includes technology stocks, when diversifying across industries and countries.

Key words: Industry-, country- and global effects, technology industry, exposure, portfolio diversification

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1. Introduction

We investigate to what degree return on technology stocks are affected by industry-, country- and global factors. Furthermore, we extend the analysis by looking deeper into the industry factors and examine what variables causes technology stocks to be exposed to industry-specific shocks. Earlier studies investigate whether industry-, country- and global factors have a varied effect on international stock return, but the technology industry has not yet been thoroughly investigated. This is an industry worth analyzing for several reasons. Due to the globalization seen today, the integration and interaction between different countries, companies and people have become significantly more important. This process is in many ways dependent on technology, and in particular IT, since IT simplifies communication, investments and international trade. IT works as a platform for exchange of knowledge. Moreover, the technology industry is expected to increase in importance, not only as a separate industry but also because of its contribution to other industries, e.g. by the increased use of computing and IT. Furthermore, technology is generally not believed to be limited to the country that develops it since different countries exchange technology products and technology solutions via trade. The technology industry can therefore be considered a global industry with high exposure to the global markets. We investigate the importance of industry effects, which occurs when an industry-specific factor affects the stock return in that industry, for the return on technology stocks. We further analyze if these effects are caused by a wide range of factors such as a country's level of globalization. These issues are important for forming an optimally diversified portfolio that includes technology stocks, when diversifying across industries and countries.

As mentioned, industry-, country- and global effects have been investigated by a number of studies with varied results. Some studies have shown that country effects have a greater impact on international stock returns compared to industry effects (Heston and Rouwenhorts, 1995; Griffin and Karolyi, 1997). Meanwhile, others such as Cavaglia, Brightman and Aked (2000) have found that the importance of industry effects has increased. The technology industry has been mentioned in earlier studies where the main finding has been that the technology industry is mostly affected by industry effects (MSCI Barra Research, 2009). However, even though it has been stated that this could be due to the fact that IT is considered a global industry, any further investigation has never been carried out. The contribution of our study is therefore to use a method that attempts to explain what variables causes technology stocks to be exposed to industry-specific shocks and how this might have an impact on portfolio strategy.

The analysis covers 27 countries spread across the world, including both developed- and developing countries.[1] By including countries from both developed and emerging markets the aim is to provide a broader and more accurate estimate. The years investigated are 1990-2015, which includes important financial downturns such as the dot-com crisis (1995-2000) and the financial crisis (2007-2008). The analysis is divided into two steps. The first step investigates whether industry-, country-, and global effects exist in the technology industry by running a time series regression of the returns on each country's technology index on three factors, i.e. the return on a global technology index, the return on the country's equity index and the return on a global equity index. These effects are separated in an attempt to analyze whether the return on a country's technology index is differently affected by these three factors. In the second step we analyze what variables might affect the exposure estimated in step one. We focus mainly on the global technology index in order to explain what causes technology stocks to be exposed to industry-specific shocks. However, for the sake of comparison, we also investigate the effect of the two other factors. We believe that the technology industry is a global industry with high global exposure. This industry might therefore be more affected by industry factors than country factors. We run three separate regressions, with each of the three estimated exposures from the first step as the dependent variable. We use a selected number of explanatory variables that we believe have an impact on the exposure.

Our findings show that industry-, country- and global effects exist in the technology industry. We further show that the exposure to industry-specific shocks is affected by a country's level of globalization, where a high level of high-technology export increases the exposure. Meanwhile, a global crisis such as the dot-com crisis is found to have a negative impact on the exposure. Considering the fact that the technology industry is a global industry with high exposure to the global market, it might be assumed that it would be preferable to diversify across industries rather than across countries when attempting to construct an optimally diversified portfolio that includes technology stocks. According to

[1] Appendix 1. List of countries included

our findings, however, technology stocks are affected by country factors as well as industry factors. This can be compared to previous studies that state that firms operating on a global scale will be more affected by global industry factors and less affected by country factors. Moreover, we find that the return on technology stocks is negatively affected by global factors, which implies that the returns are negatively related to the global equity market.

The outline of the paper is organized as follows. Section two provides a theoretical background covering previous studies. In section three the method used for the analysis is presented. Section four provides the results of the regressions followed by an analysis. Section five states the main conclusion and provides suggested research topics for future studies.

2. Literature Review

This chapter covers a literature review and provides a theoretical background concerning how different exposures affect international stock returns. Earlier studies have investigated industry- and country effects and have tried to determine which of these is the most prominent.

Heston and Rouwenhorts (1995) investigate country- and industry effects and what impact they have on international stock returns. Their findings show that country effects have a greater impact, in comparison to industry effects, on international stock returns. These results could be used for investors to reduce risk and to obtain optimal portfolio selection by considering industrial and geographical diversification. In conclusion, according to Heston and Rouwenhorst, it is of greater importance to be geographically diversified than industrially diversified when constructing a portfolio.

Griffin and Karolyi (1997) build their research on the same concept as Heston and Rouwenhourst but with data retrieved from a different database. Their findings confirm that country effects have a greater impact on international stock returns than industry effects. Moreover, their study shows that this result is even more prominent than previously believed. According to them, the increased importance of country effects is assumed to be due to the inclusion of emerging countries that demonstrate strong country effects. Their evidence also confirms that industries with a high extent of international trade have greater industry effects. Meanwhile, country effects have a greater impact on stock returns for industries with goods that are not internationally traded.

Another study carried out by Brooks and Del Negro (2005) investigates how industry-, country- and global effects impact international stock returns using a latent factor model. The variation in international stock returns is, according to the study, highly explained by country effects. They further find that multinationals are more exposed to global shocks in comparison to firms that are only operating domestically. Additionally, Brooks and Del Negro explore the link between globally operating firms and the movements in the stock market. This is examined differently in contrast to Heston et al, and Griffin et al, with a model decomposing each stock in the sample into industry-, country- and global effects. Furthermore, the authors explore to what degree firms are operating internationally. This international exposure is measured by “sales betas”. These betas include both exports as well as sales from operations abroad. The results imply a highly significant link between international firms and global shocks, which indicates that globally operating firms are more affected by global factors compared to country factors.

Other studies, such as those by Campa and Fernandes (2003), Carriera, Errunca and Sakissian (2003) and Isakov and Sonney (2002) provide different results than previously mentioned studies, stating that industry effects dominate country effects. Another study that support the theory that industry factors are becoming increasingly more important is carried out by Cavaglia and Brightman (2000). These results are further used for portfolio diversification, where the authors suggest that risk reduction can be obtained by diversifying across industries rather than across countries. This phenomenon of risk reduction across industries will, according to Cavaglia and Brightman, become significantly more important in the future due to increased integration of geographically dispersed markets.

An article carried out by MSCI Barra research (2009) states that there is an increase in the importance and influence of global factors due to globalization. Furthermore, it is shown that industries operating on a global level such as the IT industry has a higher global exposure and will be more affected by global factors. An industry’s stock return and its global exposure are therefore positively correlated. Moreover, according to the article this relationship is dependent on the condition of the market i.e. bull or bear markets. The stock market works in cycles where the different stages in the market will make stocks more or less affected by the global exposure. In a bull market the prices are expected to rise or are rising. In such market conditions the relationship between global exposure and industry returns will be stronger. Meanwhile in a bear market, where there occur pessimism and falling prices, the relationship is not as strong.

Looking further into the technology industry, it is worth mentioning that it has gained an increased interest by researchers over the last few years due to its increased importance and global characteristics. Technology is not limited to the country that develops it, since it spreads via trade to other countries. A country's ability to apply new technology is, however, dependent on its inhabitants' level of education. A highly developed country with a highly educated workforce, are more able to implement new technology products. Moreover, a country's performance is positively related to its level of trade. Extensive trade increases the country's overall performance, and this is believed to be partly due to the exchange of technology. Knowledge and ideas are exchanged when countries trade, leading to increased performance possibilities for the individual country (Jones & Vollrath, 2013).

3. Data and Method

In this section we present the method used to analyze to what degree return on technology stocks are affected by industry-, country- and global factors. The analysis is extended to look deeper into the industry factors and what the exposure to industry-specific shocks is caused by.

In our analysis we use panel data, which means that the included variables will vary both in the time-series- and the cross-sectional dimension. This increases the number of observations compared to using only time-series data or cross-sectional data, which should improve the estimation (Brooks, 2014). The analysis has been divided into two different steps. The purpose of the first step is to run a regression aimed at determining whether industry-, country- and global effects exist in the technology industry. The second step consists of three regressions where the main interest is to investigate what variables causes technology stocks to be exposed to industry-specific shocks.

3.1 Step One

3.1.1 Data

In this step the aim is to investigate if industry-, country- and global effects exist in the technology industry by analyzing to what degree return on a country's technology stocks are affected by industry-, country- and global factors. The returns on four indexes are included in the analysis, i.e. the return on each country's technology index, the return on a global technology index, the return on each country's equity index and the return on a global equity index. The data is retrieved from Thomson Reuter's Datastream and covers 27 countries over the years 1990–2015 (Datastream, 2017). The years included in the regression varies due to the lack of data for some countries. This causes the analysis to be based on unbalanced panel data.

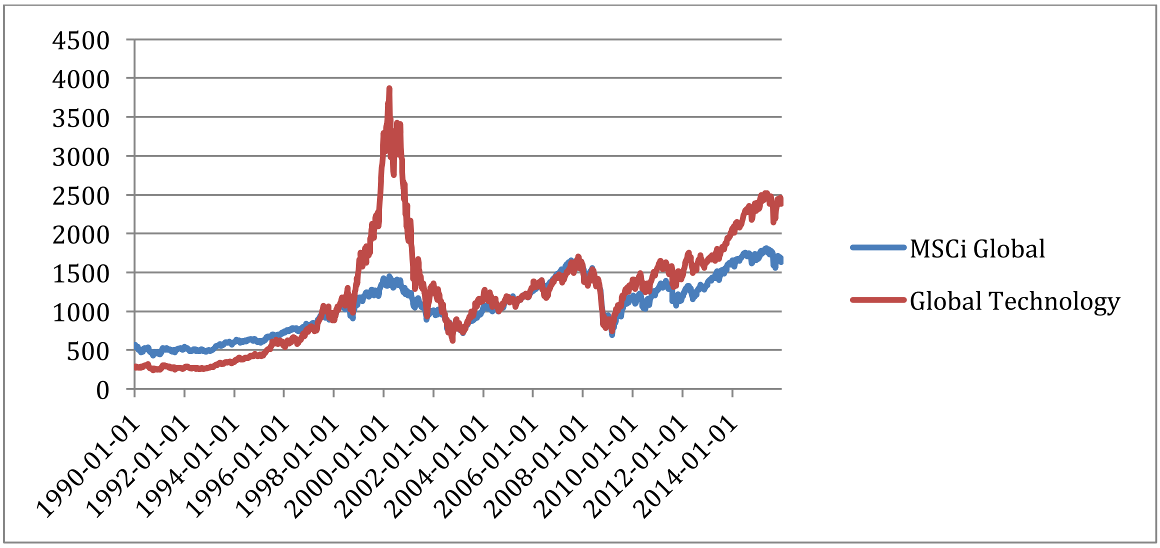
The decision regarding what countries to include is based on whether the countries are defined as developed or developing.[2] The analysis includes 14 developed countries and 13 developing countries (United Nations, 2014). The reason why there is one more developed country is due to the fact that the 14 developed countries can all be regarded as of interest to the analysis, partly because of their positions in different regions. It was, however, not possible to add another developing country due to the lack of data.

- Global Technology Index and MSCi Global Index

To get an overview of how the index of Global Technology has developed relative the index of MSCi Global, the two indexes are plotted in the Figure 1.

[2] Appendix 1. List of countries included

Figure 1. MSCi Global index and Global Technology index for the years 1990-2015



In our data we include two global indexes: Global Technology and MSCi Global. Comparing the development of these two indexes provides an interesting insight since it gives an overview of how they have changed relative each other during the period investigated. According to Figure 1, the two indexes appear to have been following the same positive trend, with an obvious exception during the period of 1999-2001. During this period the index for Global Technology peaked. This is the same period as when the dot-com bubble reached its peak and it can be seen from Figure 1 that the index increased significantly for the period 1999-2000 only to fall back down to its original level in 2000-2001. The technology industry therefore appears to have blossomed impressively right up until the time when the bubble burst. It seems, however, to have settled down at the same level as MSCI Global after the crisis. Moreover, the upward trend for the years 1990-2015 appears to have become more volatile after the crisis, since the differences between the ups- and downs are greater than they were before the crisis occurred.

Another interesting notion is that both indexes fell during the period 2008-2009, which is when the financial crisis took place. There is no clear peak of either Global Technology or MSCi Global before the crisis, but instead a clear downturn in both indexes.

3.1.2 The Regression

In this regression, the aim is to determine whether industry-, country- and global effects exist in the technology industry. The regression can be defined as:

$$R_{i,t} = \alpha_i + \beta_{1,i} R_{GT,t} + \beta_{2,i} R_{Ci,t} + \beta_{3,i} R_{G,t} + \varepsilon_{it} \quad (1)$$

i Represents Country

t Represents time-variation

$R_{i,t}$ Represents the returns for the technology index (Country Technology) for each country i, at time t.

$R_{GT,t}$ Represents the returns for the global technology index (Global Technology) at time t.

$R_{Ci,t}$ Represents the returns for the equity index (MSCi Country) for each country i, at time t.

$R_{G,t}$ Represents the returns for the global equity index (MSCi Global) at time t

The returns are calculated for each index on a weekly basis, using the formula defined as:

$$\frac{P_t - P_{t-1}}{P_{t-1}} \quad (2)$$

To retrieve the different beta coefficients we use the linest-function built inside the index-function in Excel for all the years included. For the purpose of the first step we only require to have one estimate covering all years, for each index-return and for each country. That means we run 27 regressions.

3.1.3 Included Indexes

- Country- and Global Technology Index

Technology can be defined in different ways. To ensure consistency in how we define technology for each country, Thomson Reuter's definition of technology is used, which is the same for all included countries (Datastream, 2017). This measure is also used to represent Global Technology.

For this index, technology is separated into two parts. The first part concerns technology equipment such as computers, phones, household electronics, office equipment, communications and networking, electronic equipment and parts and finally semiconductors and semiconductor equipment. The second part covers online services, software and IT services and consulting. Furthermore, the measure is based on the performance of well-known companies within the technology industry for each country, and across the world (Datastream, 2017).

- Country- and Global Equity Index

In order to get an estimate of the overall equity market, both for each country and on a global scale, we use MSCi to measure the return on an equity index (Datastream, 2017). The global measure (MSCi Global) includes large- and mid-cap equity performances from 23 developed countries. The country measure (MSCi Country) includes large- and mid-cap segments of that particular country's market (MSCI INC, 2017).

These indexes are used to investigate whether market movements, both on a domestic scale and a global scale, affects the return on the technology index differently for different countries. The global technology index is the main independent variable of interest, whereas the others are included for comparative reasons.

3.2 Step Two

3.2.1 Data

The countries included in this step of the analysis are the same as in step one. In this second step of the analysis, however, we require yearly beta coefficients for each index-return and country. This means that we run 539 regressions using the same regression defined above (formula 1) to estimate the beta coefficients, but this time on a yearly basis. These beta coefficients represent the dependent variables in the regressions below. The number of years included depends on how many years of calculated beta coefficients there are for each country. The aim is to have data covering the years of 1990–2015. However, this was not always achievable due to lacking data. Australia, for example, has observations for the years 1990–2015, whereas Indonesia only has data for the years 2010–2015. We are therefore once again dealing with unbalanced panel data.

The data of the independent variables is retrieved from the World Bank (The World Bank Group, 2017)

3.2.2 The Regressions

This step is divided into three different regressions, defined as:

$$\beta_{1,is} = \gamma_0 + \gamma_1 Trade_{i,s} + \gamma_2 High\ tech\ export_{i,s} + \gamma_3 Electricity_{i,s} + \gamma_4 D_{1,i} + \gamma_5 D_{2,s} + \gamma_6 D_{3,s} + \gamma_7 D_{4,i} + \varepsilon_{is} \quad (3)$$

$$\beta_{2,is} = \gamma_0 + \gamma_1 Trade_{i,s} + \gamma_2 High\ tech\ export_{i,s} + \gamma_3 Electricity_{i,s} + \gamma_4 D_{1,i} + \gamma_5 D_{2,s} + \gamma_6 D_{3,s} + \gamma_7 D_{4,i} + \varepsilon_{is} \quad (4)$$

$$\beta_{3,is} = \gamma_0 + \gamma_1 Trade_{i,s} + \gamma_2 High\ tech\ export_{i,s} + \gamma_3 Electricity_{i,s} + \gamma_4 D_{1,i} + \gamma_5 D_{2,s} + \gamma_6 D_{3,s} + \gamma_7 D_{4,i} + \varepsilon_{is} \quad (5)$$

i Represents Country

s Represents time-variation

$\beta_{1,is}$ Represents the estimated beta coefficient for Global Technology, for each country i and for each year s

$\beta_{2,is}$ Represents the estimated beta coefficient for MSCi Country, for each country i and for each year s

$\beta_{3,is}$ Represents the estimated beta coefficient for MSCi Global, for each country i and for each year s

$D_{1,i}$ Represent a dummy variable for “Developed”, for each country i
$D_{2,s}$ Represent a dummy variable for the “Financial crisis”, for each year s
$D_{3,s}$ Represent a dummy variable for Dot-com crisis for each year s
$D_{4,i}$ Represent a dummy variable for Trade agreement, for each country i

The regression for Global Technology is of main interest to investigate since we are interested in what variables causes technology stocks to be exposed to industry-specific shocks. The regressions for the other factors are mainly carried out for comparative reasons.

3.2.3 Included Variables and Their Expected Effect

The variables included in the regressions are based on the belief that they will have an impact on the exposure. They will be presented separately.

- Developed vs. Developing Country

This variable is a dummy variable in the regression. The definition between a developed- and a developing country is based on UN's classification (United Nations, 2014).
This variable is of interest since it might be the case that the exposure of a country's technology stocks to industry-specific shocks differs for developed- and developing countries. It could be that developed countries have a substantial amount of trade with other countries and might therefore be more affected by industry factors than developing countries. At the same time, developing countries tend to be dependent on trade to grow and would therefore be affected by movements in the global market. The expected effect for this variable might therefore depend on which of the aspects mentioned above is the strongest.

- Dot-com Crisis

This is a dummy variable in the regression, set to cover the years of 1995–2000.
During the dot-com bubble the equity markets rose rapidly as a result of substantial investments in Internet-based companies. The bubble eventually burst in 2000 and the dot-com crisis was a fact (Geier, 2015).

It is believed that the dot-com crisis will have an impact on the global exposure and since technology is of main interest in this analysis, it is a relevant variable to include. According to a study carried out by MSCi Barra Research (2009) the exposure to global industry factors depends on whether it is a bull- or a bear market. The exposure is believed to be stronger during a bull market with optimism and rising prices. Meanwhile, when a crisis occurs, and the market can be defined as a bear market with falling prices, the exposure will be less strong. The dot-com crisis is therefore expected to have a negative impact on the exposure of technology stocks to industry-specific shocks.

- Electricity

Electricity is defined as "electric power consumption per capita" (The World Bank Group, 2017).

This variable is included since electricity can be viewed as a measure of infrastructure and is furthermore a necessity for IT (The World Bank Group, 2017). Infrastructure is of interest since infrastructure is believed to improve the ability to trade. It might therefore affect a country's exposure to the global market and it is believed to have a positive impact on the exposure to industry-specific shocks.

- Financial Crisis

The financial crisis is another dummy variable, covering the years of 2007–2008. The crisis had a global impact on the financial markets and several industries all over the world (Helleiner, 2011).

This variable is included in the regression since the financial crisis affected the global market. It is of interest to analyze whether the exposure to industry-specific shocks changed during this period. The exposure of technology stocks to industry-specific shocks is expected to reduce during this crisis for the same reason as mentioned above (see "dot-com crisis").

- High-Technology Export

High-technology exports is calculated as the percentage of manufactured exports and includes products with high R&D intensity, such as computers, pharmaceuticals, aerospace, scientific instruments and electrical machinery (The World Bank Group, 2017).

This variable is included in an attempt to more accurately specify the effect of trade in terms of technology products. It can be assumed that if a country has an extensive amount of export of technology products, it is likely a technology country. A technology country with extensive export might be highly affected by the global market and changes in the technology industry on a global scale. We therefore believe that an increase in technology export will have a positive impact on the exposure to industry-specific shocks.

- Trade

Trade is defined as "exports of goods and services" and is calculated as a percentage of the country's GDP (The World Bank Group, 2017).

The reasoning behind including this variable is that it is believed that trade affects a country's global exposure. If a country is trading with other countries, it is likely to be affected by industry- and global factors. It is therefore assumed that extensive trade will increase the exposure to industry-specific shocks.

- Trade Agreement

Trade agreement is included in the regression as a dummy variable. We define a country as one with a trade agreement if it is part of one of the global trade agreements stated in the appendix (Eker, 2014).[3]

A trade agreement between countries is believed to affect those countries' exposure to the global market. If a country is part of a trade agreement it is likely trading with the other countries included in the agreement. A trade agreement aims at having the positive effect of increasing and improving the ability to trade between the countries. However, this also means that the countries might tend to become more exposed to the global markets. It can therefore be assumed that a trade agreement increases the exposure to industry-specific shocks.

- Excluded Variables

There are several other variables that would have been of interest to include in the regression. However, some of these variables were not possible to include due to the lack of data. One such variable was education. According to Jones and Vollrath (2013), education affects how much technology a country can produce and apply from other countries. It

[3] Appendix 2. Trade Agreements

would therefore be interesting to investigate if education actually has an effect on the exposure to industry-specific shocks. Data covering a country's level of education is, unfortunately, limited and we were therefore forced to exclude this variable.

Another interesting variable to investigate is to what extent companies in a country are operating abroad. According to Brooks and Del Negro, export and sales from operations abroad is considered to have an impact on the exposure. If many companies are operating in other countries, this will most likely increase that country's exposure to the global market. However, due to difficulty in finding such a measure and because estimating it manually would have required extensive work, we decided to exclude this variable as it was not of main interest in our analysis.

Table of Expected Result

Table 1. A summary of the expected result

Independent Variable	***Expected effect on the exposure to Global Technology***
Developed	+
Dot-com crisis	-
Electricity	+
Financial crisis	-
High-tech export	+
Trade	+
Trade agreement	+

3.2.4 Trendline

Lastly, we run one more regression for Global Technology where we add a variable called "trendline". This is carried out in an attempt to investigate how the exposure of technology stocks to industry-specific shocks have developed during the period investigated. This variable is simply a number for each of the years included in the analysis for the different countries and provides an estimate regarding the evolvement of the exposure.

3.3 Potential Problems with Data

As mentioned above, there was a substantial amount of missing data. This was especially the case in the second step of the analysis, where the aim was to find independent variables that might help explain what the exposure estimated in step one was caused by. Lacking data also occurred in the first step since many countries had missing data for the country-specific technology index. We especially found that a substantial number of developing countries had lacking data, which forced us to exclude certain countries that otherwise would have been of interest. One country that we were forced to exclude due to lacking data was Russia. Russia is believed to be a technology country and excluding it from the analysis might therefore cause relevant information to be lost.

In terms of the different indexes and variables included, the data is believed to be fairly unbiased. The data was retrieved from Thomson Reuters Datastream and The World Bank. Both these sources can be viewed as neutral sources that stand more to lose than to gain from providing faulty values. However, if the technology of a country is contributing greatly to the global technology index by having many large and globally operating companies within the technology industry, its technology index might be highly correlated with the global technology index. This could potentially distort the result.

4. Results and Analysis

In this part, the results from the different regressions are presented and analyzed. Initially, the result of the first step of the analysis regarding whether industry-, country- and global effects exists in the technology industry, will be presented. Secondly, the result of the second step of the analysis is presented, which aims to explain what the exposure to industry-specific shocks are caused by. An analysis for country- and global factors will further be carried out for comparative reasons. The tests that have been performed to investigate the reliability of our estimates will be presented separately for each step.

4.1 Step One Results

4.1.1 Testing the Regression

In the first step, only the beta coefficients are estimated in order to investigate whether industry-, country- and global effects exist. To test whether they are significant or not we calculate a confidence interval for each beta coefficient of the three independent factors (Global Technology, MSCi Country and MSCi Global), for each country. We only calculate the confidence interval for one beta coefficient covering all the years for each country and factor. The confidence interval is calculated according to:

$$\bar{X} \pm 1.96 \times \frac{\sigma}{\sqrt{n}} \qquad (6)$$

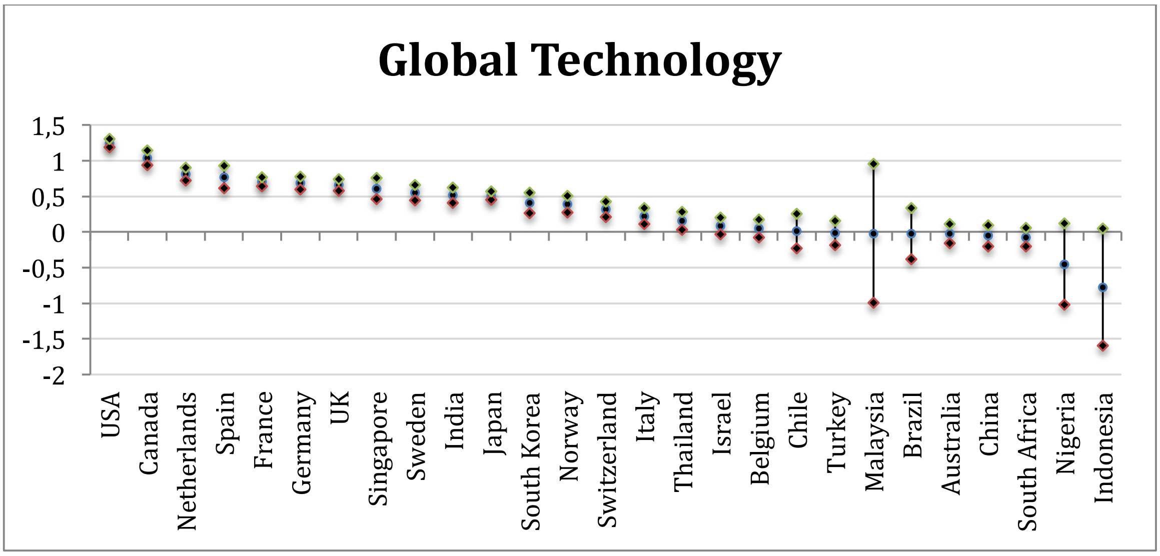
If the confidence interval falls on the same side of zero (Figures 2-4), the beta coefficient is classified as significant. If, however, the interval crosses zero the estimated beta coefficient for that particular country is considered to be insignificant.

4.1.2 Regression Output

The obtained beta coefficients and their calculated confidence intervals are sorted and plotted in three different figures. The results are analyzed separately.

- Global Technology

Figure 2. Estimated beta coefficients for Global Technology



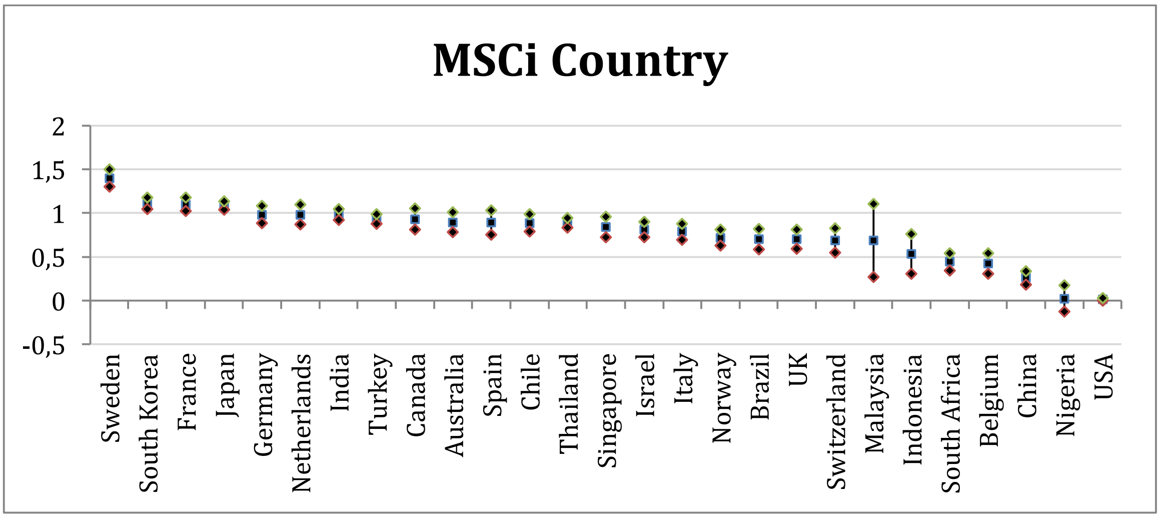
Notes: Figure 2 shows to what degree return on technology stocks are affected by industry factors. It further shows the significance (using a confidence interval) of the calculated beta coefficient for Global Technology. The midpoint represents the beta coefficient estimated for each country.

According to Figure 2, there are significant beta coefficients for 16 countries. Meanwhile, the calculated betas for the countries on the right side of Thailand are not significant. One reason to why we do not observe significant betas for some countries might be partly explained by the lack of data for those countries.

Industry effects are clearly apparent in Figure 2, since the returns on the countries' technology index are affected by industry factors. The exposure is generally positive. That means that if there is a positive upturn in the technology industry overall, the technology industry in the different countries will generally benefit from this. Notable is that countries with a high level of exposure to Global Technology are among those that can be viewed as technology countries and that are generally classified as developed.

- MSCi Country

Figure 3. Estimated beta coefficients for MSCi Country

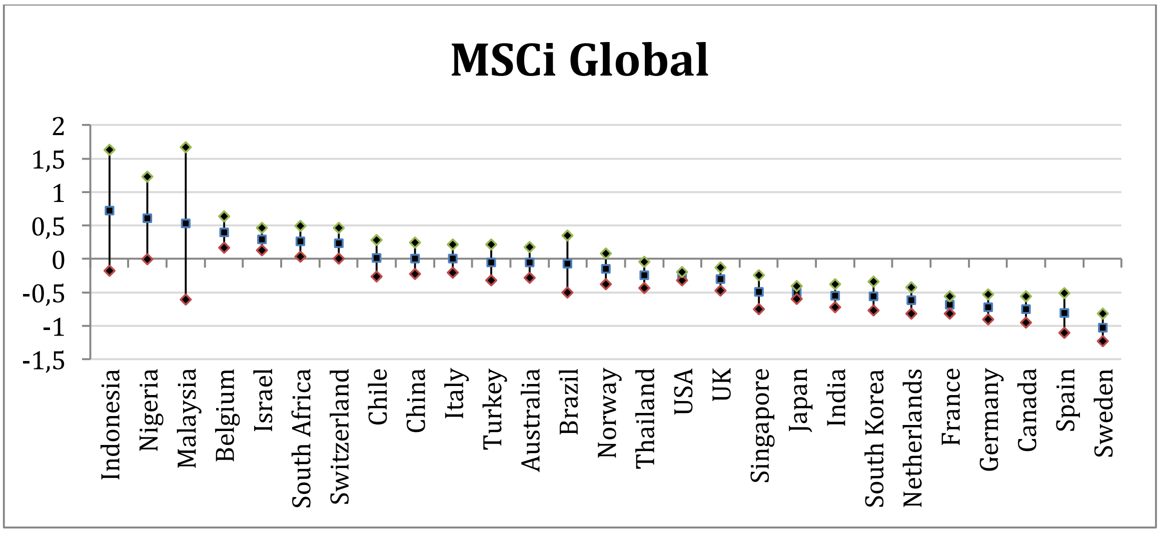


Notes: Figure 3 shows to what degree return on technology stocks are affected by country factors. It further shows the significance (using a confidence interval) of the calculated beta coefficient for MSCi Country. The midpoint represents the beta coefficients estimated for each country.

In Figure 3, all the countries show significant beta coefficients except Nigeria and USA. As seen in Figure 3, country effects exist since the different countries appear to be affected by factors in their "home-markets". It is believed that a country's level of technology is affected by that country's overall performance. If a country is going through a recession (or a temporary downturn) with lower consumption and production, the technology industry in that country is likely to be negatively affected by this (and vice versa).

- MSCi Global

Figure 4. Estimated beta coefficients for MSCi Global

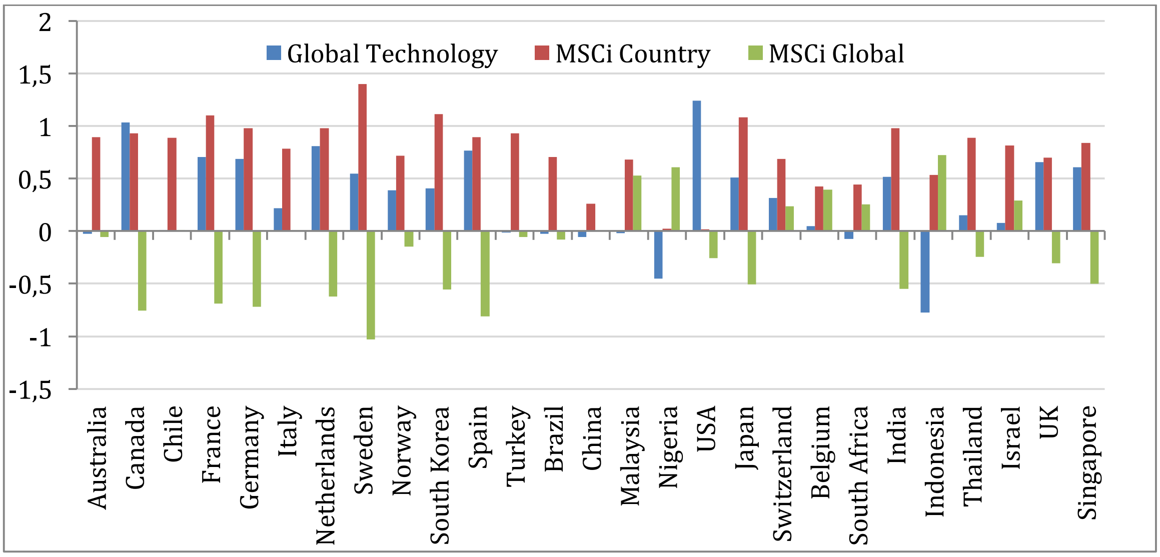


Notes: Figure 4 shows to what degree return on technology stocks are affected by global factors. It further shows the significance (using a confidence interval) of the calculated beta coefficient for MSCi Global. The midpoint represents the beta coefficient estimated for each country.

Global effects are apparent in Figure 4 of MSCi Global, since some of the countries' technology stocks appear to be affected by global factors. Moreover, it can be observed that 17 countries have significant beta coefficients. It is mainly the developed- and technological countries that have significant betas and these tend to be negative. This implies that if there is a general upturn (downturn) in the global equity market, the technology industry in the different countries tend to be negatively (positively) affected by this. It is not possible to reach any certain conclusions regarding the less developed countries (among others) since those estimated beta coefficients are insignificant. We find insignificance for some of the beta coefficients calculated for countries with lacking data, e.g. Indonesia and Nigeria.

As a summary and to attain an overview of the above results, the beta coefficients for Global Technology, MSCi Country and MSCi Global are plotted in Figure 5 below.

Figure 5. Overview of the results for the estimated beta coefficients



Notes: Figure 5 provides an overview of the results for the different factors presented above. The highest (or lowest) value of each pillar represents the estimated beta coefficient for that particular country

An analysis regarding what might be causing the different effects observable in Figure 2-5 will be carried out in the presentation of the second step of the method. The importance of these findings is that we observe industry-, country- and global effects.

4.3 Step Two Results

It is apparent from step one that industry-, country- and global effects exist in the technology industry. In this section we aim at explaining what variables have a significant impact on the exposure. Before we present the different results, however, the regressions are tested to ensure that the results are reliable.

4.3.1 Testing the Regression

The following tests are carried out in Eviews and only concern the second step of the method. Three regressions are performed regarding what variables causes technology stocks to be exposed to industry-specific-, country-specific- and global-specific shocks. The first one concerns industry effects (Global Technology) and is of main interest for the analysis. The last two regressions are mainly carried out for comparative reasons.

- Durbin-Wu-Hausman Test

The simplest way to estimate panel data is to use a pooled regression, which essentially means, "pretending" that the data is a cross-sectional regression. Several issues arise with this method. Firstly, it assumes that there is no heterogeneity (no dependence between the observations within cross-sectional units on a specific variable). Secondly, by simply treating the data as a larger cross-sectional regression it causes information about the true cross-sectional relationship to be lost. An alternative to the pooled regression is the error component models: the fixed effects model and the random effects model. The fixed effects model can be viewed as simply adding an additional intercept term to each entity and that this is fixed. Meanwhile, the random effects model is most easily seen as adding an additional, entity-specific random error (Brooks, 2014). We believe that there is a difference between the entities in our estimation and we therefore estimate our regressions using the random effects model. However, we test the regression using the fixed model, to see whether this model gives a better estimate.

To analyze whether the fixed effects model or the random effects model provide the most efficient estimate, we perform a Durbin-Wu-Hausman test. This test is based on the null hypothesis that the entity-specific effect (α_i) is not correlated with the error term (Brooks, 2014):

$$H_0 \colon \alpha_i \text{ } is \text{ } not \text{ } correlated \text{ } with \text{ } the \text{ } error \text{ } term \tag{7}$$

The results for the three regressions are presented in Table 2.

Table 2. The results of the Durbin-Wu-Hausman test

Regression	**p-value (5% significance)**	**Fixed or Random**
Global Technology	0.0025	Fixed
MSCi Country	0.0046	Fixed
MSCi Global	0.1868	Random

For both Global Technology and MSCi Country, the null hypothesis is rejected using a significance level of five percent. These two regressions should therefore be estimated using the fixed effects model. Comparing the results from the random effects model with that of the fixed effects model, it is clear that the fit of the model improves with the fixed effects model since it has an R^2 of 0.3622 as opposed to 0.0952 for “Global Technology” and 0.3529 compared to 0.0418 for “MSCi Country”.[4] Since R^2 is a measure of how well our model fits the data, it is clear that the fixed effects model would have provided a better estimate. However, since we believe that entity specific effects exist in our data, we still run the regression using the random effects model for Global Technology and MSCi Country, and test if the entity specific variables are significant. These variables are “developed” and “trade-agreement”, and are dummy variables that take on the value one if the country is developed/has a trade agreement. Both these variables are found to be insignificant and we therefore estimate the regressions for “Global Technology” and “MSCi Country” using the fixed effects model and exclude the insignificant variables.[5]

The regression for MSCi Global is most efficiently estimated using the random effects model since the null hypothesis is not rejected.

- Multicollinearity

Multicollinearity arises when the independent variables are highly correlated with each other. This might cause miss-specified p-values and make it difficult to make correct inference regarding the separate variables’ effects (Brooks, 2014).

To determine whether multicollinearity is a problem in the data, a correlation matrix is set up. The correlation between the independent variables should not exceed (+/-) 0.80 (Brooks, 2014). The highest correlation values will be the same for all three regressions since the included variables are the same in all regressions. The highest correlation has a value of 0.6808 (between trade and high-technology export) indicating that we do not have a multicollinearity issue in our data.[6]

[4] Appendix Tables. Tables A.1-A.4 Regression outputs
[5] Appendix Tables. Tables A.1-A.4 Regression outputs
[6] Appendix Tables. Tables A.5-A.6 Correlation matrix

- Autocorrelation and Heteroscedasticity

Autocorrelation implies that the covariance between the error terms over time do not equal zero, meaning that the error-terms are dependent on each other. This problem might arise when using time-series data and occurs when a "shock" in the economy in one period affects the following period (Brooks, 2014).

To find out whether autocorrelation exists in our data, the Durbin-Watson test is used. This tests for first-order autocorrelation and is given in the regression output. It is compared to the null hypothesis:

$$H_0: \acute{p} = 0 \; (the\ error\ terms\ are\ not\ dependent\ on\ each\ other) \qquad (8)$$
$$Durbin - Watson\ stat\ \approx 2\times(1 - \acute{p})$$

$\acute{p}$ represents the autocorrelation in the regression. The null hypothesis of no autocorrelation is not rejected if the DW statistic does not differ considerably from 2. It is worth mentioning, however, that we acknowledge that the Durbin-Watson test in Eviews, the program used throughout the analysis, is not the most efficient test to use since it does not make any adaption to the fact that we are dealing with panel data. However, it provides an indication as to whether autocorrelation exists in the data (Brooks, 2014).

Heteroscedasticity is a problem that arises when the error terms are dependent on each other. This means that the error terms have a tendency to increase when the independent variable increases in value, which is undesirable. Meanwhile, homoscedasticity implies that the error terms show no dependence between each other (Brooks, 2014). To test for this, a Breusch-Pagan-Godfrey test is performed and is compared to the null hypothesis of:

$$H_0: Homoskedasticity\ in\ the\ data \qquad (9)$$

The results for the two tests of the different regressions are given in Table 3.

Table 3. The results of the Durbin-Watson test and the heteroscedasticity test

Regression	**Durbin-Watson**	**p-value (5% sign)**	**Heteroscedasticity**
Global Technology	1.58	0.1898	No
MSCi Country	1.46	0.0370	Yes
MSCi Global	1.79	0.3249	No

The general case when dealing with panel data is that there are many cross-observations but only a few period-observations. In those cases autocorrelation is generally considered to be negligible (Brooks, 2014). In our case we have mostly cross-observations, but almost as many period-observations for some countries. Observing the results in Table 3, however, autocorrelation does not appear to be a major issue. Since the program Eviews does not provide a simple way of dealing with autocorrelation when using panel data, we base our analysis on the results given.

Furthermore, "MSCi Country" shows sign of heteroscedasticity in the data. This is corrected for by estimating the regression using White's Robust Standard Errors directly in Eviews.

- Endogeneity

Endogeneity is a problem that arises when the explanatory variables (the independent variables) are correlated with the error term. This problem can be caused by omitted variables, measurement error and simultaneity. Omitted variables are variables that should have been included in the regression but for some reason are not and instead falls into the error term. Measurement error occurs when variables cannot be observed directly but must instead be proxied (Brooks, 2014). Simultaneity would occur if there is inverse causality, which in our case would mean that the exposure would have an impact on one of the variables included in the regression; e.g. the level of trade. By using the fixed effects model for Global Technology and MSCi Country, we automatically remove the risk of endogeneity problems caused by omitted variable. Moreover, we do not believe that inverse causality (or measurement error) is a likely (major) problem in this analysis.

4.3.2 Regression Output

In this section the results of the regressions will be presented and analyzed. The three different regressions will be presented separately, where the emphasis will be placed on the regression for Global Technology. As mentioned previously, the regression for "MSCi Country" and "MSCi Global" are included for comparative reasons. The total number of observations in all regressions is 440.

<u>Global Technology</u>

Table 4. Regression output for Global Technology

Variable	Estimated coefficient	Standard error	P-value
Intercept	-1.1914	0.3489	0.0007*
Dot-com crisis	-0.1854	0.0580	0.0015*
Electricity	0.0002	0.0000	0.0044*
Financial crisis	-0.0540	0.0759	0.4774
High-tech export	0.0291	0.0075	0.0001*
Trade	-0.0014	0.0038	0.7163
R^2 = 36.22 %			

Notes: * Represents significance, using a significance level of 5%. Uses the fixed effects model.

This can be compared to the expected results, discussed in the method-section.

Table 5. A summary of the expected- and actual results for Global Technology

Independent Variable	***Expected effect on the exposure to Global Technology***	***Actual Result***
Developed	+	Excluded
Dot-com crisis	-	-
Electricity	+	+
Financial crisis	-	Not significant
High-tech export	+	+
Trade	+	Not significant
Trade agreement	+	Excluded

As mentioned above, the dummy variables for “developed” and “trade agreement” are excluded from the analysis since they were not significant. By excluding them it was possible to estimate the regression using the fixed-effects model, which increased the explanatory power of the model. The model gives an R^2 of 36.22%.

We expect other variables that were not included in the regression to have an impact on the exposure as well, but for reasons mentioned in previous sections, we limited the analysis to the selected variables. The included variables will be analyzed separately.

It is of importance to point out that if a variable turns out to have a significantly positive/negative impact on the exposure it only means that the exposure increases/decreases. It does not necessarily mean that that the exposure is positive or negative.

- Dot-com Crisis

As predicted above, the dot-com crisis reduces the exposure of technology stocks to industry-specific shocks. During this dot-com crisis, there was initially a rapid rise in the stock prices and increased investments in the IT sector. It was a speculative market that created a bubble fed up by easy capital and overconfidence about the market, a bull market that eventually burst. In the research carried out by MSCi Barra Research (2009) it was stated that industries operating on a global level such as the IT industry will be more affected by global industry factors and therefore have a higher global exposure. It further claims that is affected by the market condition i.e. bull- or bear markets. The exposure to industry-specific shocks is expected to increase during a bull market with optimism and increasing prices. However, when a crisis occurs and prices drops, the exposure will be reduced. This is what we see in the data since the exposure was reduced during the dot-com crisis. It is important to keep in mind that this result only means that the exposure during the crisis is lower. It may, however, still be positive.

- Electricity

Electricity is a measure of infrastructure and it is furthermore a necessity for IT. Infrastructure is believed to improve the ability to trade. A country with an infrastructure that allows for extensive use of technology can not only use this to its advantage to exchange tradable goods with other countries and between companies inside its own borders, but will also benefit from the exchange of information that occurs automatically and which can further aid that country's pursuit of future growth. It was initially assumed that electricity (infrastructure) would affect trade and that it would therefore have a positive impact on the exposure. This is confirmed by the regression output where energy is shown to have a significantly positive impact on the exposure to industry-specific shocks. It is once again pointed out, that it does not necessarily have to be the case that the exposure is positive, it only means that the exposure to industry-specific shocks increases when the level of electricity increases.

- Financial Crisis

The financial crisis was believed to have a negative impact on the exposure for similar reasons as those mentioned for the dot-com crisis, regarding bull- and bear markets. We find, however, that the financial crisis does not have a significant impact on the exposure. This result differs from that of the dot-com crisis, which proved to have a significantly negative impact on the exposure. As a global industry, it was initially believed that technology stocks would be affected by global industry factors and shocks that hit the global markets, such as the financial crisis. However, this is not what we find in our data since the variable for the financial crisis is insignificant.

Looking back at that which we found when comparing the global technology index (Global Technology) with the global equity index (MSCi Global) in Figure 1, they appeared to have been similarly affected by the financial crisis. We also found that the indexes both fell during the crisis. This implies that the global technology industry was affected by the crisis, but that does not necessarily mean that the exposure changed significantly during this period.

- High-Technology Export and Trade

High-technology export and Trade are analyzed together since a similar analysis can be carried out for both of them.

According to previous studies, trade affects a country's level of globalization, where an increase in international trade would lead to higher exposure (Griffin and Karolyi, 1997). It was therefore assumed that both these variables would have a positive impact on the exposure. Research carried out by MSCi Barra Research (2009) claims that global industries such as IT, has a high global exposure and will therefore be more affected by industry factors. Furthermore, Jones & Vollrath (2013) states that technology is not bound to the country that develops it but rather spreads across country borders as countries trade with each other. Trade would therefore have an impact on the exposure of technology stocks to industry-specific shocks. Interestingly, the result of the regressions shows that high-technology export is significant and positive whereas trade is not significant. The fact that high-technology export is significantly positive implies that if a country has a high level of high-technology export it is likely to be highly exposed to shocks that hit the industry on a global scale. If a country increases this type of export, it will increase its exposure since it becomes more dependent on the global industry and shocks that hits it. This result coincides with our expectations and previous studies that have investigated this relationship. The fact that trade does not appear to have a significant effect on the exposure is slightly unexpected. In an attempt to investigate whether it would be more efficient to exclude this variable completely from the regression, the same regression is run again but this time without the trade variable. The result does not change significantly, except for a slight reduction in R^2 (from 36.22% to 36.20%).[7]

[7] Appendix Tables. Table A.7 Regression output for Global Technology, excluding trade

Below follows the results from the regression of MSCi Country and MSCi Global. These will be analyzed shortly, since they are mainly included for comparative reasons.

MSCi Country

Table 6. Regression output for MSCi Country

Variable	Estimated coefficient	Standard error	P-value
Intercept	0.5115	0.2589	0.0489*
Dot-com crisis	-0.010	0.0557	0.8514
Electricity	0.0000	0.0000	0.1902
Financial crisis	-0.1122	0.0330	0.0007*
High-tech export	0.0174	0.0052	0.0009*
Trade	-0.0074	0.0025	0.0037*
R^2 = 35.29 %			

Notes: * Represents significance, using a significance level of 5%. Uses the fixed effects model.

According to Table 6, the significant variables are the financial crisis, high-technology export and trade. These results differ from the result in the regression for Global Technology. In that case we did not find that the financial crisis nor trade were significant. The result for MSCi Country shows that during the financial crisis, technology stocks became less exposed to country-specific shocks. This can be compared to the research carried out by MSCi Barra Research (2009), which states that the exposure to industry-specific shocks will be reduced during bear markets, e.g. the financial crisis. According to our results, the exposure to country-specific shocks is also reduced during bear markets.

Considering the variables for trade and high-technology export, it is notable that these appear to have different impact on the exposure. The fact that trade has a negative impact on the exposure could be because an increase in trade will make that country less affected by changes and shocks that occur in their "home market" and more exposed to the global market. High-technology export, meanwhile, has a positive impact on the exposure. If this exposure increases, it could be an indication that the country has increased its level of technology production. One possible explanation to why an increase in high-technology export increases the exposure to country-specific shocks could be because a country that increases its technology export is dependent on continued development in their technology industry to remain competitive on a global scale. They might therefore be affected by a shock that hits their "home-market".

MSCi Global

Table 7. Regression output for MSCi Global

Variable	Estimated coefficient	Standard error	P-value
Intercept	0.1590	0.1400	0.2566
Developed	-0.1276	0.1727	0.4602
Dot-com crisis	0.1164	0.0817	0.1550
Electricity	-0.0000	0.0000	0.2260
Financial crisis	0.1326	0.1100	0.2287
High-tech export	-0.0163	0.0062	0.0084*
Trade	0.0035	0.0022	0.1114
Trade agreement	-0.0356	0.1376	0.7961
R^2 = 3.74 %			

Notes: * Represents significance, using a significance level of 5%. Uses the random effects model.

In this regression we get an R^2 of only 3.74%, indicating that this model has a very low explanatory power. This can also be observed when looking at the significance levels in Table 7, where only the variable of high-technology export is significant. It is notable that the variable for high-technology export is significant in all three regressions, though in this case it has a negative impact on the exposure. The fact that high-technology export has a negative impact on the exposure to the global equity index implies that if a country increases its high-technology export, its technology industry will be less affected by the global market's overall performance.

It appears to be the case that the technology industry is highly sensitive to shocks that hit the global technology industry (see results for Global Technology), but not the global market overall. If technology can be considered a necessity good, it will not be significantly affected by shocks that hits the global market overall, such as the financial crisis. However, it will be affected by shocks that hit the industry directly, such as the dot-com crisis.

4.3.3 Trendline

To investigate how the exposure of technology stocks to industry-specific shocks changed over the period investigated, we run one more regression for Global Technology and include a variable called “trendline”. The results are plotted in Table 8.

Table 8. Regression output for Global Technology including “trendline”

Variable	Estimated coefficient	Standard error	P-value
Intercept	-23.0706	10.5832	0.0298*
Dot-com crisis	-0.1299	0.0637	0.0419*
Electricity	0.0001	0.0000	0.0233*
Financial crisis	-0.0494	0.0756	0.5142
High-tech export	0.0301	0.0075	0.0001*
Trade	-0.0046	0.0041	0.2633
Trendline	0.0112	0.0054	0.0392*
R^2 = 36.88 %			

Notes: * Represents significance, using a significance level of 5%. Uses the fixed effects model

According to Table 8, the trendline indicates that the exposure has increased during the period. This implies that technology stocks have become increasingly more exposed to industry-specific shocks, which might be a result of recent years’ globalization and the intensified use of technology across borders.

4.4 Summary and Portfolio Analysis

The results presented in this section states that industry-, country- and global effects exist in the technology industry. When analyzing industry effects separately, it can be observed that the exposure to industry-specific shocks are positively affected by high-technology export and electricity, and negatively affected by the dot-com crisis. Technology is generally believed to be a highly global industry with high exposure to industry-specific- and global-specific shocks. Interestingly, however, according to our results the technology industry appears to be positively affected by industry- and country factors, whereas it is negatively affected by global factors. These findings might be explained by the fact that technology can be seen as a necessity good due to the increasing use of IT in our society and that it for this reason is less affected by shocks that hits the global market overall, compared to other industries.

As a global industry, it was believed that the technology industry would be more affected by industry factors than country factors. Our analysis does not, however, prove which of industry- and country effects is the strongest. Instead it shows that they both exist in the technology industry. Previous studies have given different results in terms of whether country- or industry effects are the most prominent. Those results do not, however, give any guidance as to how an investor should approach portfolio construction in terms of what industries to include, but rather states whether an investor should diversify by including stocks from different countries or different industries. Our beliefs regarding how to construct a portfolio are based on the assumption that as a global industry, technology stocks will be highly affected by industry factors, and more so compared to country factors.

Admittedly, according to our results it appears to be efficient to diversify across countries as well as across industries. Since the technology industry is negatively affected by global factors, however, it might be efficient to invest in industries that are positively affected by global factors if the aim is to construct an optimally diversified portfolio that includes technology stocks. An aspect worth considering when constructing portfolios is which country the technology company is based in. If a country has a high level of high-technology export, its stocks will be positively affected by industry- and country factors, whereas they will be negatively affected by global factors. It is therefore relevant to consider the country's characteristics, in terms of its level of globalization. This can be compared to that which was found by Brooks and Del Negro (2005), who showed that firms operating on a global scale were more affected by industry- and global factors and less affected by country factors. We show, however, that even though the technology industry can be considered a global industry, technology stocks are affected by country factors as well as industry factors. These aspects as worth considering and they ought to have an impact on portfolio strategy.

5. Conclusion

In this study we investigated whether industry-, country- and global effects exists in the technology industry by analyzing to what degree return on technology stocks are affected by these three factors. The analysis is extended to investigate what variables causes technology stocks to be exposed to industry-specific shocks.

The analysis was carried out in two steps. Both steps uses 27 countries and covers the years of 1990-2015. The first step investigates whether industry-, country-, and global effects exists in the technology industry by running a time series regression of the returns on each country's technology industry on three factors, i.e. the return on a global technology index, the return on the country's equity index and the return on a global equity index. In the last step the aim was to determine what variables caused technology stocks to be exposed to industry-specific-, country-specific- and global-specific shocks, which was performed by running a regression for each of the factors separately. The main index of interest was the global technology index since we hoped to provide an answer as to what variables causes technology stocks to be exposed to industry-specific shocks.

The result shows that industry-, country- and global effects exist in the technology industry. Furthermore, high-technology export and electricity have a positive impact on the exposure to industry-specific shocks, whereas the dot-com crisis had a negative impact on the exposure. Interestingly, it was also found that the return on technology stocks appeared to be negatively related to the global equity market. This indicates that the technology industry is sensitive to shocks that hit the global technology industry and the individual country, but not necessarily shocks that hits the global market overall. It might therefore be efficient to invest in industries that are positively affected by global factors, when constructing optimally diversified portfolios that include technology stocks.

For future studies it would be interesting to include variables such as human capital and to what extent firms are operating abroad, when analyzing what is causing the exposure of technology stocks to industry-specific shocks. Furthermore, we would like to see constructions of portfolios that consider the findings in this analysis. A similar analysis as ours could be carried out but for another industry to investigate if they differ in terms of global exposure. A portfolio could then be constructed to include stocks from industries that are differently affected by global factors.

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Appendix

1. List of Countries Included

Developed Countries	**Developing Countries**
Australia	Brazil
Belgium	Chile
Canada	China
France	India
Germany	Indonesia
Italy	Israel
Japan	Malaysia
Netherlands	Nigeria
Norway	Singapore
Spain	South Africa
Sweden	South Korea
Switzerland	Thailand
United Kingdom	Turkey
USA	

2. Trade Agreements

North American Trade Agreement (NAFTA)	**European Union (EU)**	The Association of Southeast Asian Nations (ASEAN)	Southern Common Market (MERCOSUR)	Southern African Development Community (SADC)
Canada	Austria	Brunei Darussalam	Argentina	Angola
Mexico	**Belgium**	Cambodia	**Brazil**	Botswana
USA	Bulgaria	**Indonesia**	Paraguay	Lesotho
	Cyprus	Lao People´s Democratic Republic	Uruguay	Malawi
	Czech Republic	**Malaysia**		Mauritius
	Denmark	Myanmar		Mozambique
	Estonia	Philippines		Namibia
	Finland	**Singapore**		**South Africa**
	France	**Thailand**		Swaziland
	Germany	Vietnam		Tanzania
	Greece			Zambia
	Hungary			Zimbabwe
	Ireland			
	Italy			
	Latvia			
	Lithuania			
	Luxembourg			
	Malta			
	Netherlands			
	Poland			
	Portugal			
	Romania			
	Slovak Republic			
	Slovenia			
	Spain			
	Sweden			
	United Kingdom			

Appendix Tables

A. 1 Regression output for Global Technology

Variable	Estimated coefficient	Standard error	P-value
Intercept	-1.1914	0.3489	0.0007*
Dot-com crisis	-0.1854	0.0580	0.0015*
Electricity	0.0002	0.0000	0.0044*
Financial crisis	-0.0540	0.0759	0.4774
High-tech export	0.0291	0.0075	0.0001*
Trade	-0.0014	0.0038	0.7163

R^2 = 36.22 %

Notes: * Represents significance, using a significance level of 5%. Uses fixed effects model

A. 2 Regression output for Global Technology

Variable	Estimated coefficient	Standard error	P-value
Intercept	-0.2251	0.1289	0.0815
Developed	0.1846	0.2120	0.3844
Dotcom bubble	-0.2024	0.0755	0.0076*
Electricity	0.0000	0.0000	0.0508
Financial crisis	-0.0229	0.0556	0.6807
High-technology export	0.0190	0.0036	0.0000*
Trade	-0.0030	0.0017	0.0748
Trade agreement	0.0335	0.1301	0.7970

R^2 = 9.52 %

Notes: * Represents significance, using a significance level of 5%. Uses the random effects model. According table A.2, the variables for "Developed" and "Trade agreement" are insignificant at the 5% significance level

A. 3 Regression output for MSCi Country

Variable	Estimated coefficient	Standard error	P-value
Intercept	0.5115	0.2589	0.0489*
Dot-com crisis	-0.010	0.0557	0.8514
Electricity	0.0000	0.0000	0.1902
Financial crisis	-0.1122	0.0330	0.0007*
High-tech export	0.0174	0.0052	0.0009*
Trade	-0.0074	0.0025	0.0037*

R^2 = 35.29 %

Notes: * Represents significance, using a significance level of 5%. Uses fixed effects model

A. 4 Regression output for MSCi Country

Variable	Estimated coefficient	Standard error	P-value
Intercept	0.6335	0.1083	0.0000*
Developed	0.1185	0.1423	0.4057
Dotcom bubble	0.0252	0.0528	0.6393
Electricity	0.0000	0.0000	0.7720
Financial crisis	-0.1284	0.0036	0.0004*
High-technology export	0.0114	0.0038	0.0027*
Trade	-0.0024	0.0015	0.0582
Trade agreement	-0.0246	0.1341	0.8545

R^2 = 4.18 %

Notes: * Represents significance, using a significance level of 5%. Uses the random effects model. According table A.4, the variables for "Developed" and "Trade agreement" are insignificant at the 5% significance level

A. 5 Correlation matrix

	Developed	Dotcom	Electric	Financial crisis	High-tech export	Trade	Trade agreement
Developed	1.0000	-0.0139	0.6478	-0.0019	-0.0260	-0.2009	0.2372
Dotcom		1.0000	-0.0256	-0.1774	0.0553	-0.0370	-0.0105
Electric			1.0000	0.0233	0.1167	0.0435	0.0363
Financial crisis				1.0000	-0.0418	0.0533	-0.0014
High-tech export					1.0000	0.6808	0.2531
Trade						1.0000	0.2449
Trade agreement							1.0000

Notes: All variables included. The highest correlation observed in the correlation matrix above is the one between high-technology export and trade, with a correlation of 0.6808

A. 6 Correlation matrix

	Dotcom	Electric	Financial crisis	High-tech export	Trade
Dotcom	1.0000	-0.0256	-0.1774	0.0553	-0.0370
Electric		1.0000	0.0233	0.1167	0.0435
Financial crisis			1.0000	-0.0418	0.0533
High-tech export				1.0000	0.6808
Trade					1.0000

Notes: Trade-agreement and developed excluded. The highest correlation observed in the correlation matrix above is the one between high-technology export and trade, with a correlation of 0.6808

A. 7 Regression output for Global Technology, excluding trade

Variable	**Estimated coefficient**	**Standard error**	**P-value**
Intercept	-1.1946	0.3484	0.0007*
Dot-com crisis	-0.1800	0.0560	0.0014*
Electricity	0.0001	0.0000	0.0031*
Financial crisis	-0.0579	0.0751	0.4411
High-tech export	0.0290	0.0075	0.0001*

R^2 = 36.20 %

*Notes: * Represents significant, using a significance level of 5%*