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**EQUITY**

**HOME BIAS**

**IN THE**

**CZECH REPUBLIC**

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I declare that I worked on the thesis on my own with the help of the recorded literature and sources.

In Prague on May 20, 2009

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## **I. Introduction**

Home bias has been recognized as a common phenomenon in world financial markets. Investors reveal a tendency to prefer domestic over foreign equities. This phenomenon has been proved in most of the world and in this paper we will learn about the substantial evidence of the corresponding studies. Home biasness is no longer discussed from the point of view whether it really exists. However, there have not yet been written a study about the evidence of the home bias in the Czech Republic. Can it be possible that a small country in the middle of Europe is different from the rest of the world? The main hypothesis of this paper is: “There is a home bias in the Czech Republic”.

The main research considering the home bias focuses on trying to explain the sources of this puzzle. Two main streams of argumentations are the institutional and behavioral factors. The first stream tries to explain the home biasness as a result of imperfection in financial markets. The markets are far from the state of perfection in the traditional financial sense and the propensity of investors to prefer domestic assets can be viewed as a consequence of the various imperfections. The main market imperfections are the barriers to entry the foreign markets, international transaction costs, insufficient liquidity, asymmetric information and information costs, corporate governance and inflation and exchange rate risks. These factors combined together can be considered as the reasons for the home bias.

On the other hand, the second stream explains the puzzle from the perspective of imperfection of investors. The key assumption of the traditional finance is rationality. Investors are assumed to asses all relevant information and make their decision only upon this information. If the investors are irrational, home bias can easily happen. Investors may be too optimistic about the domestic equities because they think they know them better. They also may frame differently the foreign and domestic investments and evaluate them separately. Decision making process under limited information can be done quite differently from the expected utility framework. The prospect theory may be more precise in explaining actual investment behavior. Behavioral finance is a newly emerging science that tries to learn from cognitive psychologists how the people think and act in reality. Behavioral explanations of the home bias puzzle can be more satisfactory than the institutional.

Czech Republic is a country with relatively young financial markets. The equity market has been created in the process of massive privatization in early 1990s. In the beginning the market lacked the properties of developed markets. The new market was flooded by newly issued stocks. The stock prices did not correspond to the real value and investors were inexperienced. After several years many companies went bankrupt or were delisted from the stock market. Since then the institutional features of the market: liquidity, transaction costs and transparency improved a lot.

To recognize the home biasness of investors in the Czech Republic I will introduce a model of optimal portfolio allocation. In the model I will assume an investor who trades based on historical information. I will consider several levels of risk aversion and the possibility of short selling, due to which the investors can earn profits even if the markets go down. The world market is approximated by stock indices of 9 world equity markets (one market is the European Union). I used the observations for a decade starting in May 1998. The results of the model indicate that the Czech investors should not invest more than 50 % in domestic equities. This result is valid for all levels of risk aversion.

To provide the answer whether there is a home bias in the Czech Republic we need to look on the evidence of the actual portfolio allocation. This evidence will be taken from three sources. Firstly, we will look at the share of domestic equities in the portfolios of investment funds with Czech domicile. Secondly, I will provide a theoretical composition of a portfolio which was formed by students of the Institute of Economic Studies. If we base conclusions on these two sources we would have to reject the home bias in the Czech Republic. The investment funds have around 98 % of stocks in foreign equities and students are more foreign biased than the model implies. However, we should realize that these two sources are more informatory than explanatory. The investment mutual funds are only a segment of the market and students cannot represent all Czech investors. Thirdly, I provide the evidence based on the statistics of OECD. According to the 2006 data the Czech investors hold about 87 % of domestic equities in their portfolios. The paper therefore comes with a plausible conclusion that there is the home bias in the Czech Republic. Investors should invest more than  $\frac{1}{2}$  into foreign equities. Actually they invest less than  $\frac{1}{7}$ . The weakness of these findings is the omission of different investment opportunities as substitutes to equities.

The paper is composed into five main chapters. In the following chapter II. I will introduce the home bias puzzle. I will explain the theoretical benefits from international portfolio diversification. Then, I continue with providing the evidence proving the home bias in several countries. The chapter II. focuses in the institutional explanations of the home bias puzzle. The chapter III. continues with the behavioral explanations of the home biasness. In chapter IV. I will describe the model of optimal portfolio allocation and compare it to the actual portfolio allocation. Finally, in chapter V. concludes with inspirations for future research.

## **II. Home bias in the world**

### **II.1. Introduction**

Investment home bias puzzle describes the phenomenon on the financial markets, where the domestic investors prefer to invest into domestic financial instruments rather than into foreign assets. The home bias occurs when there are clear benefits from the abroad investments that are not exploited by the domestic investors. Home bias has been well documented in past decades. Studies argue that despite the clear benefits of international diversification, investors tend to lock their funds at home.

Rational investors should trade between risk, liquidity and returns. The diversification into foreign financial assets should bring potential benefits because of the risk elimination while attaining the same level of expected returns. In this perspective, home biased investors are either irrational or the expected risk-adjusted returns abroad are reality lower. Investors who invest abroad may face barriers to entry, need to pay additional transaction costs or lack sufficient information, which decreases their expected net profits. The foreign investments are more risky because of the exchange rate risk and higher perceived uncertainty. Abroad investments are harder to evaluate for foreign investors, who make their investment decisions in their domestic countries. And even for investors living in the foreign country, the different environment makes them more uncertain. The investment uncertainty is especially high for investments in countries in different parts of the world with different political, institutional and historical background. The barriers to entry, transaction costs, lack of information, exchange rate risk and high uncertainty decrease the risk-adjusted returns. The question is whether these factors are high enough to justify the current international portfolio allocation. In other words, are the costs and risks so high, that it is rational to prefer domestic investments?

In this chapter, I will start with the standard explanations of the benefits of international diversification. Investors should earn significant risk-adjusted profits from diversifying into low correlated assets. In the following part, I will provide the evidence of the international portfolio allocation and summarize the results of studies of the level of integration of the

world financial markets. Then, I will follow with the explanation of the home bias puzzle and I will try to explain the reasons why the home bias can appear on markets.

## II. 2. International diversification

The main arguments for the international diversification are stemming from the basic financial principles of Markowitz portfolio theory of efficient asset allocation (Zalewska, 2005). Under the assumptions of perfect markets the rational investors gain from diversification of their investments into low correlated assets, because they can lower their risk, while attaining the same level of expected returns. The financial instruments in one economy are much more likely to be correlated than the financial assets across the foreign borders. Financial assets in different countries are subject to country specific risk that is connected with political system, economical performance of the country, legislative framework and other factors. The country specific risk can be diversified through the wise investment into world portfolio of financial assets.

Investors are assumed to maximize their profits for a given level of risk. For illustration of the benefits of diversification, let us look on a simple example of investment decisions. We have three investors: investor A invests to domestic stocks with the Standard& Poor's rating A+, investor B invests in A+ stocks in N different countries and investor C developed an investment strategy to attain higher returns while maintaining the same risk as the investor A. Let us assume that the A+ stocks have the same risk, measured by the standard deviation of the historical movements of the stock prices. Furthermore, assume that stocks in one country are perfectly correlated, while the stocks in different countries are perfectly uncorrelated. The question of this example is what will be the expected returns and risk of the portfolios of these three investors if they all invest in 20 different financial assets.

In this example, I am creating investments portfolios with each stock is represented in the same amount, in other words:  $w_i = w_j, \forall i, j = 1, \dots, N$ , where  $w_i$  is share of stock in a given portfolio. Imagine a world with N countries, where all of the countries have the same amount of country specific risk  $\sigma_i$ , which is correlated with the risks of other countries. The general formula of the portfolio variance is:

$$\sigma_p^2 = \sum_{i=1}^N (\sigma_i^2 w_i^2) + \sum_i \sum_{i \neq j}^N (\sigma_i \sigma_j \rho_{ij} w_i w_j)$$

Firstly, let us compute the standard deviation of the portfolio of investor A. He invests in 20 (N=20) same-risky<sup>1</sup> perfectly correlated stocks in one country ( $\sigma_i = 10$ ). Adding to the formula above, it is clear that he cannot diversify any risk and the standard deviation of his portfolio remains the same as the standard deviation of every single stock<sup>2</sup>:  $\sigma_p^A = \sigma_i = 10$ . Investor A is therefore indifferent between investment into 20 stocks with the same risk and the investment to only 1 single stock. The country specific risk can not be diversified inside one country.

Secondly, let us consider the investor B. His portfolio consists of 20 perfectly uncorrelated stocks in 20 different countries. These stocks have the same rating and therefore same expected returns as the stocks in the portfolio of investor A. The portfolio variance formula can be simplified for this extreme case to a formula:  $\sigma_p^2 = \frac{1}{N} \sigma_i^2$ . The standard deviation of investor B's portfolio reduces to almost one fifth of the single stock's standard deviation:

$$\sigma_p^B = \sqrt{\frac{1}{20}} \sigma_i = \sqrt{5} \cong 2,2.$$

Finally, I will show how the investor C would create his investment portfolio. His aim is to reach the same portfolio risk as the risk of investor A's portfolio:  $\sigma_p^C = \sigma_p^A = \sigma_i = 10$ . Investors C will invest in 20 financial assets in 20 different countries. These assets<sup>3</sup> are no longer the same risky A+ stocks as in the portfolios A and B. Using the simplified formula:  $\sigma_p^2 = \frac{1}{N} \sigma_i^2$  we realize that investor C can invest into financial assets with about 4,5 times higher standard deviation<sup>4</sup>. For increasing N this standard deviation decreases down to 10 as is the standard deviation of the portfolio of the investor A.

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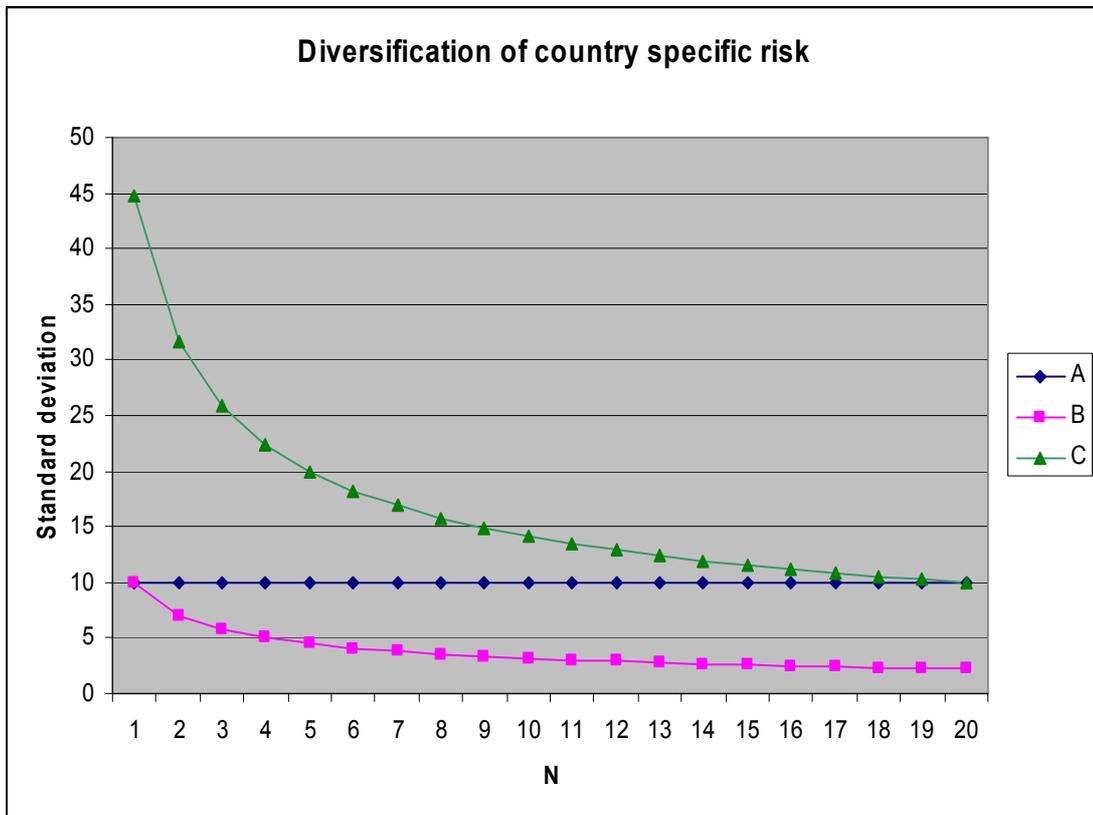
<sup>1</sup> In the example, for the sake of simplicity, we assume that the only risk of the stocks is the country specific risk

<sup>2</sup>  $\sigma_p^2 = \sum_{i=1}^N 10^2 \left(\frac{1}{20}\right)^2 + \sum_i \sum_j^N (10^2 \cdot 1 \cdot \frac{1}{20} \cdot \frac{1}{20}) = 20 \cdot \left(\frac{10^2}{20^2}\right) + 380 \cdot \left(\frac{10^2}{20^2}\right) = 10^2$

<sup>3</sup> Can be stocks with higher risks or derivative instruments that are perfectly uncorrelated

<sup>4</sup>  $\sigma_p^2 = \frac{1}{N} \sigma_i^2 \Rightarrow \sigma_i^C = \sqrt{N} \cdot \sigma_p^C \cong 45$

**Figure 1:** Benefits from portfolio diversification



As the **Figure 1** reveals, the higher the amount of stocks in portfolio the lower the risk, unless the stocks are perfectly correlated. According to the traditional finance theory, there is the trade-off between risk, expected returns and liquidity on the financial market. It is sometimes called “The Magical triangle” (Mejstřík 2008). An investor can increase his returns only by increasing his risk exposures or decreasing the liquidity of the portfolio. Suppose that all three investors are risk averse, they prefer liquid portfolio and gain utility from increasing their wealth. Who is in best investment position?

Investor B obtains the same expected returns from his portfolio as the investor A, but is exposed to lower risks. If the financial world is perfectly integrated, i.e. the liquidity of foreign stocks is the same as of domestic stocks, investor B will be clearly in a better investment position. Investor B is exposed to less risk than investor A, he gets the same

returns while attaining the same liquidity. Due to wise international diversification investor B can almost eliminate the country specific risks.

The investor C is on the same level of risk as investor A. But his portfolio is formed from riskier financial assets. Based on the assumption of trade-off between risk, liquidity and return, he should get much higher returns or much better liquidity than investor A. He would probably invest in derivative instruments which are riskier, but because of his wise diversification he remains exposed to the same level of risk as his brother but with much higher expected gain from his investment. Investors B and C are significantly in a better situation than investor A. It is however unclear whether the portfolio of investor B is better or worse than the portfolio of investor C. This would depend on their individual preferences. Investor C can reach higher profits with higher risk exposure, investor B is more conservative. International diversification creates a wider space of investment opportunities and investors can decide which investment strategy suits them better.

Now move a step closer to the real world. It is unlikely that financial instruments in different countries are not correlated at all. Openness of the markets allows for the interconnection of performance of the same industries in different countries. For example, boom in demand for a specific good in one country increases the supply production not only in the country. Companies can compete with the foreign neighbor companies producing in the same industry sector. All companies in the same sector can benefit from the rise in demand, because of the increase in profits and the value of their equity. Based on financial analysis data we can draw a simple conclusion that generally returns on equity (ROE) of one company in one specific industry sector co-moves with the ROE of a company in a different country, but in the same industry sector. Market prices of these shares should move together, despite the fact that these companies are in different countries; therefore the correlation would no longer be zero. Would the investor B benefit from the investment to N stocks of the A+ companies in the same sector? He can lower the risk exposure if the stocks are not perfectly correlated. The risk of his portfolio will be somewhere between the risk of the portfolio of investor A and 1/N-th of the fully diversified investment of not correlated assets. The higher the correlation, the lower gains of diversification. In **Figure 1**, we can see the space between the lines A and B as an opportunity set of risk decrease. Line A is an extreme case of perfect correlated assets, line B is an extreme for perfectly uncorrelated assets. We move from line B to A as the correlation

increases. The benefits of diversification naturally increase also with the amount of stocks in portfolio.

Investors can benefit from the international diversification as long as there is a non- zero country specific risk across the world. The coefficients of relative correlations between domestic and foreign stocks show us the amount of possible benefits. In case of no barriers to enter the foreign financial markets, no transaction and information costs there is no rational reason, why a risk-averse investor should lock up his funds in one country or even have a major part of his investment in his home country!

### **II. 3. International portfolio allocation**

The potential gains from diversification of investment portfolios have been recognized for decades. Grubel (1968), Levy and Sarnat (1970) and Solnik (1974) suggested that the risk of investment portfolio can be reduced by investment into foreign equities. Later study of Cooper and Kaplanis (1994) showed the extent of equity portfolios concentration with domestic equities. According to this study, in 1987 the leader of the home biased investors was Sweden. Domestic investors invested practically their entire wealth that was meant for equity investments only into the stocks of their own country. Sweden was even before USA, where about 98 % of US equity portfolio was made up of domestic stocks. Spain and Japan followed with 94,2 % and 86,7 %, respectively. The most diversified portfolio was the French equity portfolio with more than one third of foreign equities. Japan also revealed quite a low proportion of foreign equities in the domestic portfolios. Based on these data we cannot draw conclusion that countries that are geographically isolated from the main other economies had higher domestic equities concentration. Japan and USA have high percentage of domestic equities, but the leaders are Spain and Sweden, who have been very close to other European developed financial markets. **Table 1** reveals more details about the international investment equity positions of 8 major economies.

**Table 1:** The home bias in equity portfolio, December 1987

Country	Ratio of domestic equities in equity portfolios	Market Capitalization in % of total	Domestic holders weighted average
France	64,4%	2,6%	1,67%
Italy	91,0%	1,9%	1,73%
Japan	86,7%	43,7%	37,89%
Spain	94,2%	1,1%	1,04%
Sweden	100,0%	0,8%	0,80%
UK	78,5%	10,3%	8,09%
USA	98,0%	36,4%	35,67%
Germany	75,4%	3,2%	2,41%
Total		100,0%	<b>89,30%</b>

**Source:** Cooper and Kaplanis (1994) Market capitalizations are Morgan Stanley Capital International Indices (1987). The source of portfolio holdings are for the USA Survey of Current Business, for the UK CSO Financial statistics (Feb 1990), for the remaining countries Financial accounts Statistics (OECD (1988-1989)). The domestic proportion for Japan is for bonds and shares combined.

Based on these data and assuming that these 8 countries simulate the whole world, we can simply calculate the average propensity to diversify into foreign stocks. We can use the market capitalizations as weights and sum up the ratios of domestic equities in equity portfolios. The final figure of the world ratio is 89,3 %, which means, that investors were investing about 1/10 of their investment funds in foreign equities in 1987.

Other evidence of low market integration was provided by Tesar and Werner (1995). In their study they presented the international investment positions of USA and Canada in the period 1975-1990. In 1975 the estimated 6,15 % (as a percentage of Canadian equity market capitalization) of Canadian investments were put on US equity market and only 0,87 % of US investment portfolio was formed by Canadian equities.

**Table 2:** Estimated portfolio weights on foreign corporate equities 1975-1990 in %

<b>A: Canadian</b> investment position in foreign equities as share of Canadian equity market capitalization	1975	1980	1985	1990
USA	6,15	5,14	5,53	4,69
UK	0,2	0,07	0,2	0,7
Japan	n.a.	n.a.	0,25	0,23
Total foreign	7,15	5,96	6,51	6,62
<b>B: US</b> investment position in foreign equities as share of US equity market capitalization	1975	1980	1985	1990
Canada	0,87	0,95	0,69	0,83
Western Europe	0,39	0,46	1	2,25
Total foreign	1,4	1,53	2,04	3,31

**Source:** Tesar and Werner (1995). Canadian investment positions are published in Statistics Canada: Canada's International Investment Position. US investment positions are from Survey of Current Business, Department of Commerce. End-of-year stock market capitalization values are from Morgan Stanley Capital International. According to the Department of Commerce, the total foreign weight can be underreported given the problems in estimating value of US holdings in Japanese securities

As we can see in **Table 2** this situation did not improve in Canada during the period. In 1990 they held only 4,69 % of US stocks, which is contradiction with the popular perception, that the financial markets have been opening since the World War II in the western world. On the other hand, the USA seem to improve its international position by diversifying more in the foreign stocks as the time went, ending with 3,31 % of total foreign stock in their equity portfolios. This finding is close to the Cooper and Kaplanis (1995) data of 2 % of foreign stock exposure in 1987.

International diversification studies reached a general conclusion that there has been a low degree of foreign equities in domestic portfolios. How do we know that these "low" figures are not justifiable by financial data? In the previous section I have shown on an example that there is a space for benefits from international diversifications if the assets are not perfectly correlated. In case of perfect correlation in stocks listed on stock exchanges in different countries, there would not be a reason to diversify. As in the example, it would be a case of investor A, who was indifferent between the investment in 20 stocks or 1 single stock. To have reason to diversify, equities in foreign countries should have the correlation below 1. The lower is the correlation coefficient the higher are the benefits from diversification. In other words, we have to examine the degree of market integration.

The empirical studies on financial markets that focused on the degree of integration examined the historical correlations of the stock market indices across the countries. In the logic of this field of research, perfectly integrated markets would also be perfectly correlated. Low correlation creates investment opportunities for investors because they can benefit from the diversification.

There are mixed findings about the degree of integration of developed markets. Firstly, we consider the US and East Asia markets. Cambell and Hamao (1992) argue that US and Japanese markets are highly integrated, while the results of Harvey (1991) and Chan et al. (1992) indicate a lack of integration between the US and major Asian markets. Third point of view provides Sewell et al. (1996) with his evidence of varying degree of integration between Pacific Rim equity markets and the USA. The findings suggest unexpected movements in correlation coefficients between these two major areas.

Secondly, if we examine the long-term linkages between the US and European equity markets, we also realize that there are mixture findings. Kasa (1992) and Arshanapalli and Doukas (1993) found evidence of bivariate cointegration of these regions, but the studies of Byers and Peel (1993) and Kanas (1998) did not find such a linkages.

Thirdly, let us consider the relationship between emerging capital countries and the US. The findings of De Fusco et al. (1996) and Gilmore and McManus (2001) indicate that the equity market in the US is not integrated with the emerging markets in the geographical regions of the Pacific basin, Latin America, the Mediterranean and the Central Europe.

The mixture of findings can be explained by the differences in time periods and in research methods. A common feature of the studies is that they use relatively short-horizon returns. The short-term movements reveal lower correlation than the long-term returns. These findings suggest that the short-term fluctuations are more country specific, but become spread world-wide in long-term horizons. There is one intuitive interpretation to these results. It takes longer time to a domestic investor to realize that there are potential gains in foreign country. It is also more difficult for him to be in touch with all new information about the foreign country development, which would help him to make a rational investment decision. Therefore, he prefers to invest short-term in domestic stocks, but makes a long-term investments in foreign equities.

### II. 3. 1. International portfolio diversification in the Czech Republic

Let us now look at the degree on integration of the Czech stock market. Gilmore and McManus (2001) examined in their paper the short and long-term relationships between US, Polish, Hungarian and Czech equity market. Their results indicate a low short-term correlation between the Central European countries and the US. In the **Table 3** below you can see the correlation coefficients of weekly stock returns between the Czech Republic and the US, as well as Hungary and Poland. Data are provided for two periods. July 1995 - June 1998 and July 1998 – August 2001.

**Table 3:** Correlation coefficients of weekly stock returns

<b>A: July 1, 1995 – August 1, 2001</b>				
<b>Market</b>	Czech Rep.	Hungary	Poland	US
Czech Rep.	1			
Hungary	0,42	1		
Poland	0,4	0,4	1	
US	0,24	0,32	0,33	1
<b>B: July 1, 1995 - June 30, 1998</b>				
<b>Market</b>	Czech Rep.	Hungary	Poland	US
Czech Rep.	1			
Hungary	0,27	1		
Poland	0,23	0,39	1	
US	0,04	0,28	0,15	1
<b>C: July 1, 1998- August 1, 2001</b>				
<b>Market</b>	Czech Rep.	Hungary	Poland	US
Czech Rep.	1			
Hungary	0,56	1		
Poland	0,55	0,4	1	
US	0,35	0,36	0,46	1

**Source:** Gilmore and McManus (2001)

The most important finding is that there is much lower correlation between the Czech Republic and the US, that between the Czech Republic and its neighbors: Hungary and Poland in both periods the data also reveal that there was higher correlation in the second period

between all of the countries. The potential gains of diversification were therefore in the second period. Alarming is the coefficient of 0,04 between the CR and the US in the first period. The Czech and the US equity markets were almost perfectly uncorrelated in that period. It reminds us the case of investor B from our example, who could perfectly diversify between the US and Czech stocks in that period. On the other hand, there is lower space for diversification between the neighborhood markets of Central Europe. But even those markets are not highly correlated. The correlation also increased in the second period, where the 1 % weekly increase in Czech stock index is followed by a 0,55 % increase in the stock indices in Poland and Hungary.

In section IV. 3. 4. I will show a recent evidence of the degree of integration of Czech equity market in the whole world perspective. Based on the evidence of monthly and quarterly correlation coefficients there is a space for international diversification of the investment portfolios of Czech investors.

#### **II. 4. Home bias puzzle in equity markets**

The equity home bias is a situation on a world stock market, where the investors do not exploit the profit opportunity to earn additional risk adjusted profits by international diversification. Studies of the home bias claim that because there are possible measurable benefits of diversifying into low correlated assets abroad, but this opportunity is unexploited, there is a home bias. In other words, investors prefer domestic stocks despite the “easy” profits abroad. Based on such logic, the home bias has been proved in many world economies. The focus of recent research in this field of study is not only to provide additional evidence of the home biasness of the global investors, but more attention is put on the possible explanations of why the home bias exists. The main stream focuses on the explanation of the puzzle by relaxing the assumptions of the model world of international finance.

The main assumptions of the international portfolio diversification are based on the Miller-Modigliani model (Mějstřík 2008) :

1. World has perfect capital markets. No single buyer or seller, even central banks, can influence stock prices. All assets are marketable and perfectly divisible with fixed quantity.

2. All investors have perfect free knowledge. Investors can get and evaluate all relevant information in no time and without any learning costs.
3. There are no transaction costs and no tax differences between domestic and foreign investments, no barriers to entry the markets.
4. All players have the same goal: to maximize the utility of their wealth. Investors make their investment decisions based on the expected returns and the variance of these portfolio returns.
5. Investors are indifferent between unrealized paper profits and cash dividends. This can be defined as “rational behavior”.

In this chapter, I will provide the evidence that the financial markets do not fulfill the first three assumptions. There is no sufficient evidence that the markets are perfect, on the contrary, information is not perfect and not free and there are substantial transaction costs. These deviations from assumptions of the international financial markets have been claimed to be the reason for the home biasness of investors. The last two assumptions about the behavior and decision making of the investors are not questioned in the traditional finance studies. Rationality of investors has been infirmed by the behavioral finance. In the following section I will discuss the traditional explanations and the behavioral explanations of the home bias puzzle will be discussed in the following chapter.

The home bias explanations stemming from the violation of the first three assumptions of international financial diversifications can be divided into six categories. Firstly, there still exist some barriers to enter the foreign financial markets. Those are much lower than in past, but still there are some countries, China for example, where it is not easy to start trading with stocks. Secondly, there are substantially high direct trading costs, as fees and commissions to the brokers. Thirdly, there are significantly high indirect costs arising from the insufficient liquidity. These can be especially important on markets that are not fully developed and where most of the shares have low liquidity. Fourthly, to learn and evaluate information is not free. On the contrary, information processing is highly priced in the financial world. The financial world has been expanding over the decades and there are many companies listed on stock exchanges. Therefore it is almost impossible to know about all of them. Information asymmetries are important driving force behind the investment decisions. Fifthly, there is evidence on how the corporate governance and internal regulation of investment managers can creates compulsory home biased preference. Finally, the home bias can be explained by

the deviations from the Purchasing Power Parity. Domestic investments can be taken as a source of hedge of inflationary and exchange rate risk. On the next pages I will continue with the traditional explanations of this world wide spread phenomenon.

#### **II. 4. 1. Barriers to entry equity markets**

One possible explanation of the home bias puzzle are the barriers for international investments. Barriers mean implicit costs and distract international investors. Basically, we can divide the barriers between the explicit barriers that are directly observable and quantifiable and the indirect implicit barriers. For instance, a restriction on foreign exchange transaction is an explicit barrier. There is a sufficient amount of evidence that proves that the explicit barriers have fallen over time. French and Poterba (1991) and Cooper and Kaplanis (1994) argue that the explicit barriers are no longer large enough to explain the observed portfolio allocations of investors. Implicit barriers remain especially in the emerging markets with low political stability and different institutional background.

In the recent environment, where most of the markets are opened to foreign investors, there are no large big explicit barriers between the financial markets in different countries. However, there still exist few implicit barriers to entry the foreign financial markets. One of the invisible barriers can be a political risk of the specific country. Investors may reject to invest in countries, where they are not sure to get dividends or to sell back their shares. Politically instable country distracts investors because of the uncertainty of their returns. The regions with lower political stability are the South America, Africa, most of the Asia<sup>5</sup> and Eastern Europe<sup>6</sup>.

Other barrier can be the tax disfavor of cross border investments. Foreign investors are typically subject to special taxes on dividends. The after-tax profit may be low enough to prevent foreign investments. There is a possibility to lower the tax liability through the system of foreign tax credit. However, these offsets are not perfect and it is costly and time consuming to obtain such a tax exempt. The tax burden is especially high for institutional investors who have a tax exemption in their country, namely pension funds. For these funds the taxes on returns from foreign investments are inevitable losses. The barriers to investment

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<sup>5</sup> For more informatoin about political stability in Asia see the paper of Younis et al. (2008).

<sup>6</sup> Details about politically instable countries are at World Bank website: Worldwide Governance Indicators.

may be connected with the size of a firm, as Kang and Stulz (1997) suggest in their survey of Japanese firms. They argue that larger firms have much less barriers to international investments and might be easily traded abroad. Feldstein and Horioka (1980) argue that the observed home bias in individual portfolios is a result of the international capital mobility.

Zalewska (2005) provided evidence of the pension funds investment policies around the world. She tried to explain that the home bias behavior does not appear spontaneously, but can be forced by the regulations. According to her study, the restrictions on pension funds' international investments are quite common. For example, German, Italian and Canadian funds can not invest more than 20 % of their assets abroad. In the Netherlands foreign assets can be up to 70 % of their portfolios. The UK and US regulators are more liberal and do not set a rule to the size of international investments. Emerging markets restrictions are generally stronger; the Polish pension fund can have only up to 5 % foreign assets, Peru 8 % and Argentina 10 %. Brazil and Chile are standing on opposite sides, Brazilian pension funds have to lock all their assets at home, while the Chilean allow up to 30 % of the money to allocate in foreign securities.

#### **II. 4. 2. International securities transaction costs**

Trading costs accounts for significant part of transaction costs. Fees and commissions have to be paid to market makers and brokers. Important costs are connected with spreads. The higher the difference between the bid and offer price, the higher the costs. Spreads, which are one of the measures of the liquidity, imply higher costs on stocks with low frequency of trading. Trading costs fall rapidly with trading volumes. Trading in small amounts is very costly; therefore small investor trading is limited.

Transaction costs associated with investments in foreign equities may hinder international diversification and bias the portfolios towards domestic assets. For clarity, we should classify these costs between fixed and variable. Fixed costs are connected to the language barriers, institutional and regulatory differences and information about the foreign market. These fixed costs can be high enough to prevent small investors to enter the foreign financial market. We should however consider that one does not need to speak Chinese to buy stock of a company in Beijing. Internet increases the possibilities to trade in stocks in different countries, therefore the fixed costs are connected only with a contract to a brokerage firm and for a big investor

they are converging to zero. Variable costs are for example the stamp taxes, commissions and higher spreads. If these costs were substantial, we would expect to find that investors should do fewer transactions with foreign equities than with domestic stocks. There is evidence which shows that opposite seem to be true. Tesar and Werner (1995) and Kang and Stulz (1997) that the stocks that are traded by foreign investors are traded frequently, implying that the variable costs should not be prohibitively high. The frequency of trading is connected closely to liquidity issue that is discussed in next section.

There is however a different study that criticized the conclusions of the Tesar and Werner's (1995) evidence of very high turnover rates on foreign equity portfolios. Warnock (2002) claims that this study underestimated the cross-border equity positions. The new study's findings are that the foreign turnover rates calculated using information from comprehensive benchmark surveys on cross-border holdings are much lower than previously reported and comparable to domestic turnover rates. However, this study concludes that the basic intuition from the Tesar–Werner study, that transaction costs do not help explain the observed home bias, was confirmed using data on transaction costs in 41 markets (Warnock 2002).

### **II. 4. 3. Liquidity**

Liquidity is an important characteristic of markets. The main characteristics of liquidity are the spreads that are the differences between bid price and offer (ask) price, trading volume and frequency of trading. In high-liquidity markets the spreads are converging to zero. Prices change in small steps and therefore the spreads are insignificant. One of the main signals of low market liquidity is the high spread. Big difference between the bid and ask price brings substantial costs for the investors. In markets with high liquidity there is sufficient trading volume and trading frequency should be high enough to bring the highest price of demand close to the lowest price of supply side.

Trading volume is the key measure of liquidity. The amount of tradable shares on stock exchanges is a key factor for the trading volume. If the company lists only a small fraction of its shares on the market, it is probable that the company will be less traded by both, domestic and foreign investors. Dahlquist et al. (2002) suggest that if the investors rights improved, companies would have much less concentrated ownership and bigger share of the company

would be traded on stock exchanges. This would attract more foreign investors and improve their home biasness.

Frequency of trading is another determinant of liquidity. Tesar and Werner (1995) compared the turnover rate of international investments with the turnover rate of national markets. For Canadian investors they found out that the turnover rate of the foreign stocks is over ten times higher than the turnover rate of national stocks. The US have about 2,5 times higher turnover rate of foreign equities to domestic equities.

The importance of market liquidity is indirectly proved in the findings of international portfolio allocation studies. US investors hold a very low share of foreign equities. The US market that is very liquid attracts foreign investors. Foreign investors prefer US stocks because of high trading volumes and low spreads. Investors in Canada and the countries of EU have much higher share of foreign equities than the US. On the other hand, US investors prefer domestic shares to foreign equities listed on low liquidity markets.

Kang and Stulz (1997) provide evidence on Japanese data. They explain that there are significant reasons for foreign investors to trade mainly stocks of big companies. The main reason can be the information costs; it is too costly for foreigner to get information about small firms, on the other hand, not that difficult to obtain valid information about big international companies. They provided evidence that these large companies are very liquid and therefore attractive for foreign investors. They proved that the firms with lowest turnover rate have the lower share of foreign ownership.

Based on these findings we can argue that the home bias can be the consequence of the lack of liquidity on foreign markets. Domestic investors prefer their stocks, because the foreign stocks are not properly traded. Increase in liquidity in one country creates more incentives for diversification in foreign stocks. Better investor's rights and corporate laws may help in creation of friendlier environment for international investors. This is closely linked to the arguments that the bigger companies are more liquid and the ownership of big companies is more diffused in the foreign countries. Bigger companies are more liquid and therefore are better opportunity for foreign investors who can gain in diversifying in their shares and decrease the home bias of their own country's investor's behavior.

The properties of foreign equity market are definitely very important for the decision making process of the investors. Markets with high spreads and low turnover are more risky and costly. Low market liquidity decreases the expected risk-adjusted returns and therefore distracts international investors. The evidence suggests that low liquidity has an effect on the foreign investment. Investors prefer high liquid markets to low liquid markets.

#### **II. 4. 4. Asymmetric information and information costs**

Other possible sources of the home bias puzzle can be found in the asymmetric information and information costs. Firstly, I will discuss the problem of asymmetric information. Asymmetric information is a situation, when one party has insufficient knowledge about the other party involved in the transaction (Mishkin 2003). Not all of the players in the markets dispose of the same information. Managers of the firm have generally better information about the particular firm, than any other participant in the economy. This asymmetry leads to two situations, which have to be dealt with: adverse selection and moral hazard.

Adverse selection and moral hazard are like two sides of the same coin. Adverse selection is an asymmetric information problem that arises *ex ante* and moral hazard arises *ex post*. The danger of adverse selection is that managers who are most likely to cheat are those who generally put the most effort to become managers. Managers have also incentives to hide negative information, because high gains could be at stake. Adverse selection is valid for the companies at whole. The most risky companies would be trying to sell their equities at “favorable” price and do not reveal all relevant data in the information disclosures. Rational investors know about adverse selection, but cannot easily distinguish between good and bad companies. This uncertainty raises the desirable risk premium for the investment or prevent from investing into the company at all. The other side of the coin, moral hazard, occurs *ex post*. Investors are aware of the risk that after investing to the company, the managers could use the funds in high-risky activities. Managers get bonuses if the company earns big profits, but are not generally sanctioned if the company loses. This kind of bonus system is encouraging them to behave very risky. Investors who do not have full information about the companies would be again distracted to invest into them. Asymmetric information problems can cause the home biasness because the foreign investments should be perceived riskier because of the uncertainty.

The home bias studies explain that the asymmetric information problems are higher for investors across borders. Foreign investors are generally in higher risk of not knowing the correct situation of the firms. Coval and Moskowitz (2002) show that US investment managers exhibit a strong preference for locally headquartered firms, particularly small, highly levered firms that produce non-traded goods. These results suggest that asymmetric information between local and non-local investors may drive the preference for geographically proximate investments. The relation between the investment proximity, firm size and leverage may shed light on several well-documented asset pricing anomalies. Investors seem to value local firms differently from the further firms, because they are including the asymmetric information risks into their price evaluation. Foreign firms are therefore riskier.

Asymmetric information has been provided as an explanation of home biasness also in the paper of Matsen (2002). He examined the allocation decision of an investor who owns two projects, a domestic and a foreign one. In his model, a manager governs the expected return from each project, and the investor has less information on the actions of the foreign manager. His profits would be different if he received full information. With asymmetric information, he generally achieved a better risk-return characteristic of his net terminal wealth with an allocation different from full diversification, because a “biased” allocation can be beneficial to the managers’ efforts and risk properties of the optimal contracts (Matsen 2002). The paper however concludes that numerical simulations illustrate that, in general, the portfolio bias is small. According to the study, the asymmetric information does not look like as a prime reason for the observed home-bias in portfolio allocation.

Let us now move to the issue of information costs. The classical assumption of the traditional financial theories is perfect information. All investors should have the same – full information. This assumption is far from reality. It is almost impossible to know everything about every listed firm in the world. And even to acquire full information about only a specific region is quite costly. Foreign investors generally lack the common local knowledge. On the other hand, domestic investors learn a lot about the companies almost without any costs<sup>7</sup>. Foreign investors have less information about the functioning of the financial market and the future perspectives of the firms listed on the equity market. They are therefore in a

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<sup>7</sup> Domestic investors are more likely to have some personal connections in the local companies, hear about the companies from TV or newspapers.

less feasible position than domestic investors. They can learn about the companies, but they have to pay additional “learning” costs. The information costs are especially high in the beginnings of investing in new markets. Therefore they are less important for big investors that continuously operate on foreign market than to small investors who trade on the market only occasionally. The fear of insider trading<sup>8</sup> can also bring substantial costs in terms of increase in uncertainty and decrease the expected risk-adjusted returns.

These information “barriers” are getting smaller if the stock exchanges are well regulated. Stock exchanges play a role of intermediary between firms and investors. Stock exchanges decide which companies they will allow to be listed and sort the stocks into several categories. Category should provide investor with more information about the stock, and thus about the company. Stock exchanges gather the information directly from the companies. It is in their own interest to meet the listing a regulation criteria, because the stock exchange assess those stock higher. Higher category stocks are trusted more and therefore traded in higher volumes. Foreign investors can obtain the relevant investment information with lower costs on a foreign stock exchange

To sum it up, information is the key to international investment. Countries with high asymmetric information are distracting the international investors because the high uncertainty increases the perceived risk. The uncertainty is even higher in countries with low financial data transparency. But the problem of acquiring information is not only in the asymmetry. Foreign investors have to deal with information costs even in countries with transparent equity markets. It takes time to go through all documents and data that are relevant for the investment. The indirect proof of the information problems are the existence of information providing and credit rating companies. If all investors were able to learn about all information costlessly there would be such companies as Bloomberg, Moody’s and Standard and Poor’s. In a perfect world there would be no one who would be interested in their ratings scores for the companies.

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<sup>8</sup> Situation when the insiders – employees or management – provide the internal information to some outsiders, who can benefit based on those information. If the insider information is good for the company, they can buy shares before the good news is incorporated in the price on stock exchange and vice versa.

## II. 4. 5. Corporate governance

There is substantial evidence that the home bias puzzle can be at least partly explained by the corporate governance. Asymmetric information problems are in the business sector known as the problems of agency. The literature on the agency costs of managerial discretion focuses on how the management can make the decisions that should improve the welfare of the managers, but are not in the interests of the owners, the shareholders of the company. Unless the rights of minority shareholders are well protected, managers who control the firm can easily use its resources to pursue their own objectives. It has been often emphasized that the management values the size of a company, instead of pursuing the goal of maximizing the shareholders' wealth. Dahlquist et al. (2002) argue that in many countries those in control of firms are not simply making investment choices that shareholders would disapprove. Instead, they can remove corporate assets from the firm in a variety of ways.

In the Czech Republic, the removal of corporate assets has been labeled as tunneling. Tunneling has been a big problem in the transitional process of Czech privatization<sup>9</sup>. The example of this illegal activity is the "favorable trade". Managers could sell corporate assets at below-market prices to corporations they controlled. Czech Republic has witnessed many examples of these "favorable trades" between different companies with the same owners. The lack of investor protection and lack of control created a space for managers to earn a lot of money. In the beginning of the privatization process the legal protection was weak.

Czech Republic is not the only example of agency problems. If the rights of investors are poorly protected then those who are in control of firms have the ability to expropriate assets, firms may find it too expensive to raise funds unless those in control can commit to limit the expropriation. When those in control of a firm have a large stake in the firm's cash flows, expropriation is expensive for them as it involves them paying a large fraction of these deadweight costs. Consequently, having a controlling shareholder with a large cash flow stake is one solution whereby firms can become public and raise public equity (Dahlquist et al., 2002).

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<sup>9</sup> More details can be found for example in Mlčoch 1996.

There is evidence that the investor protection is vital for sound equity investment environment. According to an entrepreneurship model of Shleifer and Wolfenson (2002) the probability of getting caught is higher in countries with better shareholder protection. In their model, better investor protection leads to greater recourse of external financing by firms. This corresponds to a negative relation between cash flow rights of controlling shareholders and investor protection. Empirical evidence shows that concentrated ownership is prevalent in countries with poor investor protection. The best investor protection is in the US and the UK, where the ownership is less concentrated than in emerging market countries with low investor protection. The question is whether the outcome of diffused ownership is due to the good investor protection or vice versa. There is evidence, that ownership is less concentrated in countries with good corporate law. There is also discussion whether the less concentrated ownership is associated with greater performance.

The important governance characteristic is the potential ability to control the firm. When companies are controlled by large investors, small investors are limited in the fraction of a firm they can hold. Small investors cannot hold the market portfolio, because the controlling packages of shares are in the hands of big investors. The home bias is therefore linked strongly to the corporate governance rules in the country. Dahlquist et al. (2002) concludes that when we take into account the tradable market portfolio of shares the home bias is significantly smaller for the USA and also for most of other countries. The extent to which are the shares held by controlling shareholders has impact on the investors' choices. Investors prefer investments where they have an opportunity to participate in the control of the company to the investments in companies with a small disposable share of the stocks capital on an equity market.

There is evidence contributing to the home bias explanations due to the corporate governance reasons. The largest companies are controlled by the large shareholders and foreign investors are therefore unable to gain a controlling amount of equities. Pinkowitz et al. (2001) constructed an estimate of the world portfolio of shares available to investors who are not controlling shareholders. According to their study, the available world portfolio differs sharply from the world market portfolio. In regressions explaining the portfolio weights of U.S. investors, the world portfolio of available shares revealed a positive effect but the world market portfolio did not have any explanatory power. The test of available portfolio explains that the home bias can be caused by the problems of corporate governance. The foreign

investors are in a disadvantage, because they can hold only a small fraction of a company, while the major part remains in the hands of majority investors. Foreign investors can gain almost no control power of the firm and their valuation of the investment decreases, which can distract them from the investment.

The corporate governance studies provide us with a possible solution how to eliminate the home bias. To decrease the home biasness of the investors it is important to improve the investors' rights across countries, where the firms are mostly controlled by large shareholders. If the investors' rights improved, it would be optimal for firms to have atomistic shareholders. Improvement in investor protection should increase the share of a company on the market. Diffused ownership would be optimal from the agency costs perspective. The dissociated owners can control better the management strategies. Managers would have fewer opportunities to be involved in moral hazard strategies, because they would be independently observed by many owners, than in case of concentrated ownership, where the managers are "friends" to the major owners.

Kho et al. (2006) found that the average home bias of U.S. investors towards the 46 countries with the largest equity markets fell from 1994 to 2004 when countries were weighted by the market capitalization<sup>10</sup>. Since foreign investors can only own shares not held by insiders<sup>11</sup>, there should be a large home bias towards countries in which insiders own large stakes in corporations. Consequently, for the home bias to fall substantially, insider ownership has to fall in countries where it is high. Poor governance leads to concentrated insider ownership, so that the governance improvements would make it possible for corporate ownership to become more dispersed and for the home bias to fall. In their study they found that the home biasness of U.S. investors decreased towards countries in which the ownership by corporate insiders is low and countries in which ownership by corporate insiders decreased. Improvement in the corporate governance can be a tool of overcoming home biasness. They also found that portfolio equity investment by foreign investors in Korean firms is inversely related to insider ownership and that the firms that attract the most foreign portfolio equity investment are large firms with dispersed ownership. According to their findings, firms with diffused ownership are more attractive for foreign investors.

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<sup>10</sup> However, it did not fall when countries are equally weighted.

<sup>11</sup> Employees and managers.

There is also a study examining the relation between corporate governance and ownership structure from the perspective of institutional investments. Institutional investors have become dominant players in the financial markets in many countries. Gillan and Starks (2003) provided evidence on institutional investor involvement in shareholder monitoring. Their study examines the cross-country differences in ownership structures and the implications of these differences for the institutional investor involvement in corporate governance. When there are institutional investors involved, the small foreign investors are in a disadvantage. They also concluded although there was some convergence in corporate governance practices across countries over time, the structural differences of corporate governance in the world still remain.

Evidence of the influence of corporate governance on the home bias puzzle suggests that there is a link between the corporate law, ownership concentration and foreign investor preferences. Low legal protection of investors creates the incentive for high concentration of the ownerships. The companies that have concentrated ownership are less attractive for foreign investors. Low legal protection in foreign countries leads to home bias for domestic investors. The evidence on the international portfolio allocation supports this link. The US is the country with the best investor protection and low concentrated ownership and also with the highest investment home biasness. We can conclude that the investors would prefer to invest into equities of countries that have relatively better investors' protection and less concentrated ownership. Corporate governance can explain partially the home biasness of international investors

#### **II. 4. 6. Hedging of inflation and exchange rate risk**

One of the explanations of the equity home bias is that domestic equities provide a better hedge for some kinds of risks that are specific to the home country. First, it hedges against domestic inflation, second, it hedges against wealth that is non-traded in capital market, such as human capital and third, it hedges with foreign returns implicit in equities of domestic firms that have overseas operations (Lewis, 1999). The first mentioned source of risk arises from the deviations from the purchasing power parity. According to the PPP the differences in the domestic and foreign inflations should be equal to nominal appreciation / depreciation of

the two currencies exchange rate. However, the PPP has been empirically rejected<sup>12</sup> by a vast number of studies (Lewis, 1999). Inflation rates differ across the countries and the foreign investments may be more risky because of the inflation risk. The preference for domestic equities can be explained as a result for inflationary risk hedging strategy of domestic investors. Adler and Dumas (1983) proposed a modification of a CAPM model to test if the PPP deviations can explain the home bias puzzle. This modified model can explain partly the home biasness of the investors. However, according to their findings it can not explain the whole amount of observed home bias.

Cooper and Kaplanis (1994) tested whether the home bias in equity portfolios is caused by investors trying to hedge inflation risk. Their empirical findings are consistent with the inflationary hedging hypothesis only if investors have very high levels of risk tolerance and equity returns are negatively correlated with domestic inflation. They developed a model of international portfolio choice and equity market equilibrium that integrates inflation risk and deadweight costs. For a level of risk aversion consistent with standard estimates of the domestic equity market risk premium these costs are about a few percent per annum greater than observable costs such as withholding taxes. Thus, they also concluded that the home bias cannot be explained by either inflation hedging or direct observable costs of international investment unless investors have very low levels of risk aversion.

The second source of country-specific risk also could not explain the home bias. If we omit the nontradable wealth, of which is the human capital considered as the largest component, it will even worsen the home biasness. Baxter and Jermann (1997) showed that domestic human capital is highly correlated with domestic stock returns, but not with foreign stock returns. These results imply that if we include the human capital into the model the investors will get stronger incentives to diversify into foreign equities. And more diversification lowers the overall home biasness.

Third explanation based upon country-specific risks argues that the diversification potential for foreign equities is already contained in domestic equities. This would be especially important to multinational companies that have a high exposures in foreign countries and therefore their stock prices already includes the foreign countries-specific risks. This argument was not proved by empirical studies. The stocks of multinational companies usually

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<sup>12</sup> The PPP may hold in very long run, which is a too long for most of the investors.

co-move with the national market indices. This result is not surprising, because the multinational companies are important components of the domestic stock market indices. Investors can not gain by diversifying into these companies and therefore even this source of country-specific risk does not explain the low level of investments into foreign stocks. To sum up, hedging properties of domestic equities can not explain the home bias puzzle.

The other source of risk that could explain the home bias is the exchange rate risk. Investors that consider the investment into foreign assets has to take into account the exchange rate. His returns will be determined by the currency movements. Role of the real exchange rate volatility as a driver of the portfolio home bias, and in particular as an explanation for differences in home bias across financial assets was studied by Fidora et al. (2007). They presented a Markowitz-type portfolio selection model in which real exchange rate volatility induces a bias towards domestic financial assets as well as a stronger home bias for assets with low local currency return volatility. The model was supported by empirical evidence for a broad set of developed and emerging market countries. They concluded that the real exchange rate volatility is an important factor behind bilateral portfolio home bias.

Vassalou (2000) tested for the pricing of exchange rate and foreign inflation risk in equities. According to this study, both the exchange rate and foreign inflation risk factors can explain part of the within-country cross-sectional variation in returns. The results indicate that domestic investors may prefer the domestic assets to hedge the exchange rate risk. However, the results demonstrate that home bias, at least in US equity portfolios, cannot be the result of US investors' efforts to hedge their domestic inflation.

Feldstein and Horioka (1980) examined the degree of capital mobility in a model where consumers prefer to consume domestically produced goods. The results show that international capital immobility is indeed present in the model: extra domestic savings generate extra investment primarily in the home country. People tend to spend their money mainly in domestic assets. When monetary policy focuses on exchange rate stabilization random domestic prices cause individuals to heavily invest in domestic equity as a hedge against price fluctuations.

The risks that are connected with the uncertainty about future inflation and foreign exchange rates can account at least partly for the home bias propensity of the domestic investors. Inflationary hedging is probably less important factor than the exchange rate volatility. The

exchange rate volatility may be one of the most important reasons why the risk averse investors prefer the investment into domestic financial assets.

#### **II. 4. 7. Future of the Home bias puzzle**

Before I try to predict the future, let us first look at the historical development of the home bias phenomenon. Tesar and Werner (1995) examined the development in the international portfolio positions in the period 1975 to 1990 (see Table 2 for more details). According to his study the share of foreign equities in Canadian investment portfolios decreased from 7,15 to 6,62 % and increased in US investment portfolios from 1,4 to 3,31 %. Kho et al. (2006) claims that despite the disappearance of formal barriers to international investment across countries, the average home bias for US investors towards the 46 countries did not fall from 1994 to 2004 when the foreign equities were equally weighted, but fell when they were weighted by the market capitalization.

Amadi (2004) demonstrates that there has been a distinct reduction in equity home bias in recent years. In his paper he examines if any of the theoretical explanations or recent developments such as free trade and globalization, the advent the internet, and the rise of emerging markets and mutual fund investment have affected the increase in the international diversification. The empirical analysis demonstrates that the rise of the internet and mutual fund investment have indeed affected the changes in foreign diversification. The reason for the increase in diversification is the decrease in the asymmetric information and increase in the transparency.

Mylonidis and Sideris (2007) examined the tendency of the home bias effect over time based on the evidence of G-7 countries. They tested a hypothesis that as goods markets become more integrated and consumer preferences become more similar the home biasness declines. They quarterly data for the period 1973:1–2006:1 confirmed the hypothesis that the home bias slowly disappears.

The international studies provide evidence that overall the foreign investments of domestic investors increased. However the increase was lower than one would expected considering the decrease of barriers and transaction and information costs. These findings suggest that there should also be other than institutional factors behind the home bias puzzle. What about the

future of home bias? International openness of the financial markets evidently increased in the past decades. The barriers between countries have fallen significantly. Internet made investing quicker, easier, more transparent and less costly. The trend should continue and based on the traditional financial theories the home bias should slowly disappear.

But what if there are other reasons for the home biasness than those that are mentioned above? Is it possible that even in the world with perfect information, no transaction costs and perfect legal framework without barriers between countries the home bias could persist? Perhaps, but maybe there are different reasons why people prefer domestic stocks. We will discuss the possibility of irrational investment choices in the following chapter.

## **II. 5. Conclusion**

International investors reveal the propensity to prefer the domestic financial assets. According to the vast number of studies the home biasness of the investors holds in general in the whole world. The international portfolio allocation studies reveal there is a very low ratio of international investments by the most developed countries, especially by the US. On the contrary to economic intuition, the markets are not that integrated to justify the low international investments. Measured by the correlation of stock indices, world markets are far from perfectly correlated. The correlation increases, when we increase the time horizons. Daily returns are less correlated than the monthly returns. World has still segmented financial markets and it needs time to spread the shocks across the borders. As the integration (correlation) increases, the home biasness should decrease.

There are several theoretical explanations of the home bias puzzle. The research was made from several perspectives, namely: barriers to entry, transaction costs, liquidity, information asymmetry, corporate governance and hedging the exchange rate and inflationary risk. Nevertheless, none of those can explain the high ratio of domestic assets in the portfolio alone. The theoretical home biasness factors are working together and in each country the role of these perspectives may be different. We can examine the home bias separately from different angles, but it is difficult to evaluate the total effect. Furthermore, asymmetric information and corporate governance are difficult to quantify. Implicit barriers to entry and information costs are much higher for small investors than for big players like banks and investment funds. On the other hand, we can precisely quantify the amount of exchange rate

and inflationary premium. It is difficult to quantify the contributions of each factors and the total effect on the investment behavior.

What would be a conclusion of the survey of home bias studies? Home biasness of the investors has been proved and many different explanations have been proposed. It is difficult to reach an unambiguous conclusion what causes the home bias. Factors of the cause can be found in the deviations from the assumptions of the portfolio allocation models. The factors that have been described in this chapter can not sufficiently explain the home bias puzzle. The findings of the studies are not clear enough to justify the extent of home biasness. To conclude, traditional finance is unable to answer clearly why there is the investment home bias puzzle. However, nothing is lost. In this chapter we have omitted a discussion of an important assumption: rationality of the investors. Home bias can be a result of irrationality of the investors. In the following chapter I will try to explain the home bias puzzle from the perspective of behavioral finance.

## **III. Behavioral finance and the Home bias in equity markets**

### **III. 1. Introduction**

A substantial part of the previous chapter was devoted to the institutional arguments about the sources of the home bias puzzle. Home biasness has been almost accepted as a fact all around the world. From the theoretical perspective we can look for the sources of the home biasness in the “wrong” assumptions of the traditional models, namely perfect markets and perfect investors. Behavioral finance focuses on the weakness of the assumptions about the perfection of the investors. There has been substantial evidence that investors do not behave rationally. Herd irrationality seems to be a global phenomenon.

In this chapter I will try to make a brief introduction to the behavioral perspective of the home biasness. Firstly, I will introduce behavioral finance and explain the purpose and reason that was behind creation of this new field. Secondly, I will provide a list of theoretical behavioral explanations that can be behind the home bias puzzle. Finally, I will present the evidence of the behavioral studies about the home biasness of investors.

### **III. 2. Behavioral finance**

#### **III. 2. 1. Foundations of Behavioral finance**

Behavioral finance is a new field of financial theory that has arisen as a consequence of puzzles and difficulties of traditional finance theories. The conclusions from empirical studies on financial markets do correspond with the predictions of financial theories. Behavioral finance tries to improve the theories by providing an evidence of irrationality of investors. It analyses what happens if we relax the financial view of rationality. The “bible” of behavioral finance was written by Andrei Shleifer. But even before him few studies were written about market efficiency and investors sentiment that we can nowadays take as behavioral studies (Shleifer 2000). In past two decades the behavioral finance have become a fast evolving, but also quite widely dispersed and incoherent field of finance. We can appreciate the work done by Barberis and Thaler (2002) who have written a coherent survey of behavioral finance. I

will use the guidelines in their paper to provide theoretical explanations of the home bias puzzle.

It is common belief that empirical puzzles arise because the models have unrealistic assumptions underlying the financial models. We have already discussed the basic assumptions of capital asset pricing models in section II. 4. In a broader sense, we can divide these assumptions into two categories – perfect markets and perfect investors. On perfect markets there are no transaction costs, no barriers and information are available with no costs. The studies presented in the previous chapter have tried to explain the empirical evidence of home biasness as the consequence of market imperfections. In this Section I will try to explain the home bias puzzle by imperfections of investors.

The assumption of perfect investors is generally labeled as rationality. Rationality is generally understood in two ways. First, investors take into account all relevant unbiased information. Second, they make appropriate judgments of the information based on their utility preferences. The empirical studies have proven the irrationality of investors. However, there were arguments about the consequences of the irrationality. Irrationality does not have to impact the market if it is random or if there are at least some rational agents on the market. If the investors are irrational, but their biases are random, they would offset each other. The irrational investors (noise traders in Shleifer, 2000) should be trading based on a random noise, therefore there would not be an overall impact of this form of irrationality. Furthermore, even the herd irrationality does not have to cause systematic deviations if there are rational investors (arbitrageurs in Shleifer, 2000) who will trade against the irrational investors. Irrational investor trade with losses, because they do not exploit fully the investment opportunities because they do not take into account all information and judge them properly. However, the rational investors also trade on the market and can benefit from the mistakes of the other group. Irrationality should therefore disappear in the long run, because the irrational investors are systematic loser. These arguments make a perfect sense on perfect markets, but have clear weakness if the markets are imperfect. Moreover, the assumption that there are even at least few truly rational investors who can offset the mistakes of the irrational group seems to be too strong. Behavioral studies try to explain that irrationality is a common feature of all people. Herd irrationality can not be offset by rational investors if there are no truly rational investors on the market!

Instead of arguing about how many investors are rational and how many are irrational, we can have a look on the investment decision from different perspective. Let us forget about the assumptions behind rationality and ask how the investors are behaving in the real world. This is one of the key questions of behavioral finance. Behavioral finance tries to explain the actual behavior of investors with the advice of experimental psychology. In the following section I introduce the biases that are, in my opinion, relevant as the home bias puzzle explanations.

### **III. 2. 2. Psychological biases**

Cognitive psychologists have documented few biases of the beliefs formations and people's preferences. Barberis and Thaler (2002) have taken into account the psychological biases to explain the biases on the markets. In this paper I will introduce the Optimism, Overconfidence, Decision making under limited information, Memory biases, Narrow framing and Loss aversion.

**Optimism.** People tend to display unrealistically optimistic views of their abilities and prospects. The psychologist surveys show that over 90 % of people think that they are above average in some ability (Barberis and Thaler, 2002). The optimism can also be one source of the home biasness. Investors tend to be too optimistic about their skills to assess the domestic equities. They are likely to think that because they read news every day they "know" which stock is going to rise or fall. The optimistic domestic investor would buy much more domestic equities than it should be rational.

**Overconfidence.** People tend to be overconfident in their own judgments. This can appear in two ways. Firstly, people cannot calibrate well the estimated probabilities. Events that are evaluated as certain in fact occur only in 80 % of cases. On the other hand, impossible events occur in 20 % of the time. Secondly, the confidence intervals people assign to quantity estimates are too narrow. They can, for example, believe that an event occurs in 98 % of cases, but it happens only in 60 % of cases (Barberis and Thaler, 2002). The overconfidence bias can actually distract them from the investments into foreign assets. Overconfident investor can perceive that the increase in the price of equities as impossible even if this event occurs in fact with a 20 % probability. Overconfidence is more likely to occur on assets the investors do not know properly. People tend to use heuristics that help them evaluate the uncertain cases. They are usually not thinking in the percentages of probabilities but

constructing a subjective scale instead. For example, the scale can comprise of 5 levels each interval of 20 %: impossible, unlikely, indifferent, likely, certain. Therefore, they will omit some stocks that have some probability of gains, but certainly include some stocks that have a nonzero probability of loss. Even though, this bias is valid for both domestic and foreign assets, it is stronger for foreign investments. Investors are more uncertain about foreign equities which make them more overconfident.

**Decision making under limited information.** It is important to realize how the judgments are formed in the case of limited information. People are not able to evaluate all information, because of the natural capacity of their brain. To form a decision they have developed heuristics that help in the judgment creation process. People tend to use simplifying methods, i.e. they round the figures and ignore small differences. On stock markets this would imply, that the investors would take, for instance, the yields of 0,4 % and 0,5 % as equivalent. Markets that have similar historical characteristics as Czech equity markets are considered as the “same” and investors would not find a reason to diversify into these markets that are perceived as similar. If we combine this with the overconfidence bias we realize that the “same” markets can be actually quite different.

**Memory biases.** When estimating the probability of an event people search their memories for relevant information. This may lead to bias because not all memories are “available” (Kahneman et al. 1982). More recent and more extreme events are weighted as much more important. The memory bias has a clear implication for international investments. Investors have generally less information about the world markets, but this information is usually more salient. Investors have more information about their domestic equities which can bias their judgments. For example, there was a bankruptcy of a big firm in Japan half a year ago and a bankruptcy of a firm in Czech Republic at the same time. Which of these two events would be taken as more risky? Say, that investor learned one piece of information about Japanese markets a week, but few pieces of information a day about Czech market. After half a year, the extreme event of a bankruptcy in Czech Republic would be seen as much farther than the same event in Japan, because of the different amounts of information he had heard in the mean time. Because of the memory bias the Japanese market would be perceived as a more risky market than the Czech.

**Narrow framing.** Kahneman and Tversky (1982) demonstrated that people do not evaluate their utility from the total outcome, but instead they are usually evaluating different risk separately. Narrow framing means that the investor would derive the utility of the specific investment separately. The possible losses and gains of the investment are evaluated independently to the impact on total wealth of the investor. The investor therefore does not evaluate the particular equity investment as part of the contribution to his portfolio, but separately as a specific investment. This kind of thinking goes in the opposite direction than the incentive to diversify the risks. Instead of assessing the total portfolio risks, investors tend to evaluate each risk individually. Narrow framing bias can lower the incentives to foreign investments because of the tendency to omit the risk diversification benefits that arise if we see the portfolio as a whole.

**Loss aversion.** In the expected utility framework the negative and positive gambles are taken as equally important. If I lose 100 CZK one day and win 100 CZK the other day, my total utility change should be zero. However, it has been shown that people tend to violate this framework (Kahneman, Slovic and Tversky, 1979). The prospect theory claims that people define their utilities separately over their gains and losses rather than over their final wealth. It means that the total utility of 100 CZK loss followed by the 100 CZK gain is no longer zero. People tend to be more risk averse over their losses, therefore their utility would be below zero. In standard prospect theory the people preferences exhibit the risk aversion for gains, risk loving for losses and loss aversion<sup>13</sup>. The loss aversion can distract investments into risky assets with higher volatility. Volatile stocks can bring higher losses, which are more painful than the possible gains. Investors are therefore not only simply risk averse, but they evaluate the risks of temporary decrease in their wealth with higher importance. Investment into foreign assets is generally more risky because of two components: asset and exchange rate risk<sup>14</sup>. Exchange rate risks increases the possibility of loss which can distract the loss averse investors from the foreign investments.

The overall theoretical impact of these psychological biases is difficult to evaluate. It is clear that these biases are very natural for human beings. The limited rationality is quite rational if we realize the limitations of human brain. The failures of the traditional models are the

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<sup>13</sup> These preferences create a special convex-concave (convex for losses, concave for gains) shape of utility function that can be found in Kahneman and Tversky (1979).

<sup>14</sup> In an extreme case of perfect correlation of exchange rates and stock movements the exchange rate risk would not be longer relevant for the investors.

consequences of the irrational assumption of rationality. Home bias puzzle, as many other puzzles (Barberis and Thaler 2002, Shleifer 2000), will remain a puzzle only as long as we stick to the assumption of the rationality. The overconfident, optimistic, narrowly framing, loss averse investor with imperfect information will clearly make decisions quite differently from the rational investor. In the perspective of the behavioral finance the home biasness is not a puzzle, but a feature of real world investors. In the following section we will look at the behavioral evidence of the home bias.

### **III. 3. Empirical evidence on behavioral sources of equity home bias**

Magi (2007) provided an explanation of aggregate portfolio behavior in the framework that took into account the narrow framing bias described in the previous section. In the paper, the utility of wealth of the representative investors was not derived only from the total consumption level, but also from the wealth fluctuations caused by the financial assets. The investor behaved loss averse and framed the stock market risks narrowly. This study concludes that if we take into account the loss aversion and narrow framing than the model of international portfolio choice provide a plausible explanation of the equity home bias puzzle. They also conclude that only the investors who are able to process correctly the information about equities can exploit the international diversification opportunity.

There are empirical studies about the role of optimism in the investor's choice. The results of optimism towards the performance of domestic firms were documented by Fellner and Maciejovski (2003). Their results show that there is a general optimistic perception of the domestic industry. Companies at home are expected to be performing much better by domestic than by foreign investors. The other study looks at the role of optimism from a different perspective. Graham et al. (2006) investigate the optimism and its effect on the trading frequencies. They provide theoretical link between the optimistic feelings of investors and the trading strategies. Optimistic investors believe that they have about average skills and knowledge about the stock market. This belief makes them feel more competent to trade in stocks. In the paper they found evidence that investors who feel to be more competent trade more often and have more internationally diversified portfolios. They also found that the male investors perceive themselves to be more competent than female investors, investors with bigger portfolios feel more competent than investors with smaller portfolios and highly educated feel more competent than investors with lower education. Optimistic investors tend

to act more often on their belief which leads them to higher frequency of trading. The findings of the paper implicate that the home bias would be lower if there were more optimistic investors who would not be afraid to invest into foreign equities. The home biasness can be therefore understood actually as overall low degree of optimism between investors.

Fellner and Maciejovski (2003) further investigate home biasness from the perspective of the social identity of investors. In their study they conducted an experiment in which they contrasted institutional with behavioral explanations of the home bias. They compared the asymmetric information with the social identity. The results of the experiment show that social forces lead to a domestically biased portfolio. Social identity of being a citizen of a country drives investors to invest into the domestic equities. They argue that social identity explains the observed home bias equally well as the asymmetric information.

### **III. 4. Conclusion**

The irrationality of investors is a plausible explanation of the home bias puzzle. Behavioral finance with the help of cognitive psychology provides a theoretical framework, as well as substantial evidence, that explains the home biasness of investors. Optimism and narrow framing are the potential behavioral features that can explain the home bias puzzle best. There is however a vast space for further research in this area. The studies that try to explain the home biasness can answer more questions about the actual belief formation and preferences of the real world investors. Home bias puzzle is no longer a puzzle if we accept the fact that people are not rational.

## **IV. Home bias in the Czech Republic**

### **IV. 1. Introduction**

Czech Republic has a relatively new equity market which was born after the fall of the Communist era and division of Czechoslovakia into Czech Republic and Slovakia. Czech stock exchange is a fifteen years old equity market. For foreign investors there are no explicit trade barriers. However, there may still exist implicit barriers associated with perceived lower political stability and different institutional background. The transaction costs are higher than in developed countries (Báťa 2004), because of higher spreads and lower trading volumes. Only the main trading companies can be traded almost continuously throughout the year, the rest of listed companies have a very low liquidity. For foreign investors the investments into Czech equities are also accompanied with learning costs and asymmetric information, despite the improvement in the control and information disclosures of the listed companies. Overall, Czech stock market reveals signs of imperfections that distract investors and decreases their expected risk-adjusted returns. Therefore, there should be less foreign investors on the Czech stock market than on traditionally perfect and perfectly integrated equity market.

In this chapter, however, the main aim is not to evaluate the degree of imperfection of Czech equity market. On the other hand, we are trying to evaluate the degree of imperfection in the investment decisions of Czech investors. After a brief introduction of the Czech equity market I will continue with a model of optimal investment portfolio of a typical Czech investor. I will use a model derived from the classical CAPM theory. I will try to find an answer to a question what the optimal proportion of the allocation of the funds of Czech investor between Czech and foreign stock indices is. Data sets have been collected from 9 foreign countries in the period 1998-2008. After providing the theoretical investment portfolio for investors with different levels of risk aversion, I will continue with the actual evidence of the portfolio allocation of Czech investors. I will introduce three sources of evidence of investors choice. Firstly, I will examine the composition of the mutual funds with Czech domicil. Secondly, I will introduce the results of the investment questionnaire filled by students of IES. Thirdly, I will provide the most relevant evidence from the OECD statistics. I will conclude with an answer to the main hypothesis: “Is there equity home bias in the Czech Republic?”.

## IV. 2. Czech equity market

In the initial years of transformation, the Czech Republic suffered from the absence of a financial market. The financial market was created during the process of public property privatization. Most of the companies were transferred, virtually for no charge<sup>15</sup>, into the hands of private owners during the process of coupon privatization. The creation of the financial market was very fast and therefore accompanied with several problems.

Firstly, the financial market served only as a trading place of issued stock, where the price is adjusted via the supply and demand. It did not fulfill the primary function of the financial markets: to allocate the resources to the firms. The capital of the owner stockholders did not flow into the company. The stocks were used mainly as a tool of the company governance or as a speculation instrument.

Secondly, the market did not play the role of informational price former. The citizens, who obtained the stocks, did not have sufficient amount of experience and knowledge with trading in stocks. Furthermore, the Czech Republic lacked the functioning informational network, the information was distributed asymmetrically and most of the important information was known only to a small group of investors and former managers of enterprises. The common citizens did not have enough information and knowledge to be taken as a group of rational investors<sup>16</sup>. The irrational investors can not properly trade on the market and help to evaluate the real price of the equity<sup>17</sup>. Thus, the prices of the stock could not, at least in the beginning phase of transformation, reveal the fundamental value.

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<sup>15</sup> In the process of coupon privatization the citizens paid only for the “book of coupons”, which was the fee to cover the administrative and operational costs of the privatization. Mlčoch (1996) names the coupon privatization as the gratuitous transfer of actives from the state to citizens.

<sup>16</sup> The rationality of investors, who are trading on the market is important assumption of the efficiency and was discussed in detail in chapter III.

<sup>17</sup> One of the heritages of the planned economy was the absence of the real price. One of the purposes of the market is to asses the appropriate price of the stock. In the beginning of the coupon privatization the prices of the stock were set rather arbitrarily and the result of price adjusting was anticipated. The process of searching for market equilibrium should bring the prices to the equilibrium real price. In the case of Czech privatization we faced the obstacles of imperfect markets and asymmetric informatik. These obstacles made a rational calculation difficult.

Finally, the institutional background<sup>18</sup> of the economy was not prepared for the fast transition to the market economy. Laws and regulations were weak and allowed the privileged groups of investors and managers to abuse their power and gain from their informational advantage<sup>19</sup>. The weak enforcement of the law, namely the slow work of the courts and publicly accepted and commonly exercised corruption was another pitfall of the transformation. The background of the financial market allowed gaining the dominant power on the equity market to small group of investors, which was in strong contrast with the starting position of few million of investors<sup>20</sup>.

The financial market which was formed in the Czech Republic did not bear the properties of the developed markets. Insufficient legislative framework, lack of information and absence of the allocation function were only the major weaknesses of the system. The situation started to change in the years 1997-1998 when the new listing requirements and the better bankruptcy law enabled to clean the market of the bad companies.

The Prague Stock Exchange (PSE) was founded on 24<sup>th</sup> November 1992 as a publicly traded company. During the period 1993-1995 trading volumes and market capitalization increased rapidly, due to listing of 1700 companies from the privatization. Since then only very few IPOs<sup>21</sup> took place. The stock exchange was not used as a tool for financing the companies. The main importance of the stock exchange was the price formation and the space for speculative gains. During the boom in 1993-1996 due to the weak listing requirements, even insolvent and low performing firms could be listed. In 1997 the new listing requirements were introduced and the bankruptcy law was adjusted. As a consequence of this change in legislation, many firms went bankrupt or had to be delisted from other reasons in the following years. The number of the traded companies decreased significantly.

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<sup>18</sup> The need of institutional change is described in detail in Mlčoch (1996). Economy which is used to the different type of laws, enforcement of the law, norms of behavior, all the different formal and informal institutions under the central planned economy, has to deal with several problems during the transition to market economy in the period of few years.

<sup>19</sup> The firms and banks did not have the legislative obligation to reveal all the information to the public. What is even more surprising is the fact, that the managers of the banks and mutual funds used their informational advantage as an argument in the advertising campaign in the Coupon Privatization to gather the stocks from small uninformed and inexperienced investors. Informational asymmetry, which is punished in the developed countries, was present in the Czech Republic as an allowed action commonly used for profit earning.

<sup>20</sup> More than 6 million people took part in the first wave of the Coupon Privatization in the Czechoslovakia.

<sup>21</sup> Initial Public Offerings

At the present time the market is segmented into main, secondary, free and new<sup>22</sup> market. Firms have to meet different criteria to be listed on the different markets. Only 6 companies are listed on the main market, 67 on the side market and about 100 on the free market. In total there are not even 200 companies traded on the stock markets in the Czech Republic, only 44 stocks on PSE. These figures are in contrast with 1700 listed companies in 1996. The main visible reduction in the number of companies occurred in the years 1998 and 1999, after the new listing requirements were implemented. Companies that suffered from low liquidity and “bad quality” had to be delisted. Since 1999 quality of stocks that are traded on PSE has improved, but the trading activity has not risen significantly. At the present time<sup>23</sup> the index PX is no longer called PX-50 and consists of 13 companies (PSE).

### **IV. 3. Optimal investment portfolio of Czech investor**

We are finally approaching the main aim of this thesis. To answer the question whether the Czech investors are biased towards the domestic equities we have to know how should an optimal investment portfolio of an average Czech investor look like. We will develop a model of investment portfolio which is very similar the model used in Lewis (1999). She tested a bias implied by a standard CAPM model for two assets, domestic and foreign equities. We will use a more general version of the model for domestic and 9 foreign stock indices. The result of the model should be the optimal weights of the 10 stock indices which would an average Czech investor buy in order to maximize his utility in the following period.

I will start with describing the assumptions of the optimal portfolio model. I will continue with the description of the data. Then I will follow with the discussion about the assumptions of the model. In next section I will provide an optimal portfolio solution for a special case of a risk neutral investor. Before revealing the details of the optimal portfolio model we first discuss simple implications of the data: the correlation coefficients between Czech and foreign stock indices. The results will indicate us the degree of international integration of Czech equity market. This will provide us with an answer if there is a reason for international diversification. Then I will go into detail of the model. And finally, I will discuss the findings of the model.

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<sup>22</sup> New market was created in 1999. See Musílek (2002) for listing requirements of new market

<sup>23</sup> As of 2/4/2009

### IV. 3. 1. Data description

To test the home bias puzzle in Czech Republic we need to simulate a world equity portfolio. I decided to use the 10 years of data starting in May 1998 and finishing in May 2008. Selection of this period was not arbitrary. As I have discussed above, the Czech stock market did not have properties of a developed stock market. In 1993-1994 the stock market was overflown by many companies that were forced by Czech government to be listed on the market. Small companies were traded with very low liquidity. Furthermore, vast pool of the investors who bought the shares during the coupon privatization was uninformed and did not have any experience with trading in stocks. Since 1998 fewer companies with higher liquidity were traded and investors were much more informed and rationally behaving. This was the main reason, why we started in May 1998. The reason, I did not use the data till the year 2009, was the major financial crisis. Markets at the times of the peak of the crisis (August-November 2008) were much more volatile and unpredictable. Therefore, I selected data till the end of May 2008. The beginning of the data period can be seen as an extreme event for the Czech equity market and the end of the data period as an extreme event for the whole world. However, I did not want to omit these extreme events completely from the analysis. In May 1998 there were still many “bad companies” listed on the market and in May 2008 the crisis had already influenced the stock prices. Therefore, I used the data sets for 10 years (1998-2008)<sup>24</sup> of monthly returns for 9 foreign and one domestic indices<sup>25</sup>. Foreign equity indices were converted into CZK<sup>26</sup>.

At this point I was to determine how to compute the monthly returns. There are basically two options how to calculate them: continuous compounding and discrete compounding. We prefer the continuous compounding monthly rate of return. The reason for selecting the continuous compounding instead of discrete one is rather practical. As we can see on an

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<sup>24</sup> The monthly data were taken as the closing prices at the end of month, starting at the end of May 1998 and finishing at the end of May 2008. For the indices of New Zealand and South Africa the monthly data were taken as the opening prices at the beginnings of following months. We assume that the one day difference should have only a neglectable impact on the investment decision.

<sup>25</sup> Domestic index: PX. Foreign equities: United States: SP 500 (US), European Union: Dow Jones EUROSTOX 50 (EU) – consists of 12 EU countries excluding Czech Republic, Japan: Nikkei (JA), Russia: RTS \$ (RS), China: Schanghai composite (CH), India: Bombay Sensex (IN), Brazil: Brazil Bovespa \$ (BZ), New Zealand: DJTM NEW ZEALAND \$ (NZ), South Africa: DJTM SOUTH AFRICA \$ (SA). Sources: PSE, Data Stream

<sup>26</sup> Monthly closing prices of CZK/USD, CZK/EUR and CZK/JPY exchange rates were taken from ČNB ARAD. We had to calculate the cross exchange rate for CZK/YUYN, CZK/BRL and CZK/INR. We used the monthly opening prices of YUAN/USD, INR/USD and BRL/USD taken from Data Stream. Again we assume that the one day difference should have only a neglectable impact on the investment decision.

example below, the discrete compounding is a victim of a bias. To calculate total returns for 2 months, we cannot simply sum two separate discrete compounded returns. If the price fell by 10% per month, it has to rise by more than 10% to reach the previous level. The reference point in the nominal returns is the  $P_{t-1}$ , which is different for both days. Discrete compounded returns would cause mistakes in calculation of quarterly and yearly returns. On the other hand, continuous compounding owns this advantage. For this reason we prefer the monthly continuous compounding returns<sup>27</sup> that can be calculated by the formula:  $r_t = \ln\left(\frac{P_t}{P_{t-1}}\right)$ . The yearly rate of return can be now calculated simply as the sum of monthly continuously compounded returns.

#### **IV. 3. 2. Assumptions of the model**

The CAPM model assumes a perfect market. There are no transaction costs, no barriers to enter and for every asset there exists a perfect substitute. Perfect substitute does not mean a twin asset with identical characteristics. It has to be perfect in the financial sense. Perfect substitutes should have the same present value of the share; it means the sum of expected future cash flows discounted by the same risk factor. On a perfect market, where the rational agents are present and react to the information, the prices will always be correct.

I will assume the weak form market efficiency. Weak form of efficient market hypothesis claims that prices fully reflect all past information that is already reflected in the past prices. The investors on the market have perfect data about past prices. If the market is weak form efficient it is impossible to predict future prices only examining the past prices and it is impossible to earn abnormal risk adjusted profits. Past prices already reflect past information and future changes in price can be caused only by new information which cannot be forecasted. Information in future can only be expected and because the differences from the expectations are random, also changes in prices are unpredictable.

I assume that the returns are normally distributed with the mean and variance which are constant in time, i.e. same as historical mean and variance during 1998-2008. Therefore, in the model we get 10 weak form efficient markets with country specific drifts.

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<sup>27</sup> We obtained 120 monthly returns for 10 stock indices. We took the end of May 1998 (beginning of June 1998) closing price as a  $P_0$ .

Now I will discuss the assumptions of the behavior of the investors. Investors are assumed to be rational and can not influence the price. They have free access to all relevant information and evaluate only the relevant information. New events are expected to be random with a zero mean on price change, therefore they form their expectation only based on historical prices and historical variances. Therefore the expectations simplify to:  $E(r_{t+1}^i) = Average(r^i)$  and variance:  $E(Var_{t+1}^i) = Average(Var^i)$ . All investors are maximizing their utilities. All investors have the same utility function. In the model described in section IV. 3. 5. we assume a risk averse investor with a concave utility function that is increasing in expected profits and decreasing in expected risk. For the sake of simplicity we assume that there is not a risk free investment opportunity other than no investment. This assumption implies that investors will invest into stock all their wealth unless they get less money than their initial wealth at the end of the investment period.

I will also assume that investor decision is independent of the size of his wealth, only the proportions are important. This assumption means that two investors with the same utility functions will allocate the assets into their portfolio in the same proportion no matter how much many they have decided to invest. The investment of 1 mil CZK would be divided by the same weights as the investment of 1 CZK. This assumption allows us to create a model of an average investor, who does not care about the absolute, but relative returns and risks. In the following section we will begin with an extreme case of risk neutral investor. I also assume that the investors do not take into account the inflation<sup>28</sup>.

### IV. 3. 3. Special case: risk neutral investor

Risk neutral investor evaluates his investments only based on expected profits. His utility functions can be described by a formula:  $U = U(E_t r_{t+1}), \frac{\partial U}{\partial E_t r_{t+1}} \geq 0$ . Optimal solution of utility maximization is therefore the maximum rate of expected returns. Based on the assumption discussed above, the investor expects that the future return will be same as the average of historical returns. The following table shows the historical averages of annual returns of 10 stock indices.

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<sup>28</sup> I will discuss the PPP and inflation risk at the end of section IV.3.5.

**Table 4:** Optimal portfolio comparison of risk neutral investor

Average yearly rate of return (May 1998 - May 2008)										
Stock index:	CR	US	EU	JA	RS	CH	IN	BZ	SA	NZ
Rate of return (%):	13,1	-4,7	-2,7	-5,5	18,3	1,5	1,0	9,2	3,5	-2,5

As we can see from the **Table 4**, the highest average returns<sup>29</sup> were on the Russian stock index. The variances of the indices are in this special case irrelevant. The optimal strategy of a risk neutral investor behaving under our assumptions would be to invest 100 % of his wealth into the Russian stock index.

#### IV. 3. 4. International portfolio diversification in the Czech Republic

Based on our data we will try to examine the degree of the integration of Czech equity market. As discussed in the section II. 3. the degree of integration has been judged by the correlations between financial markets. The higher is the correlation, the higher is the integration. We use the monthly data of 10 stock indices described above and calculate the historical correlation coefficients between the indices. Correlation coefficients between Czech and foreign index are computed by a formula:  $\rho_{CR,Foreign} = \frac{Cov(r_{CR}, r_{Foreign})}{\sigma_{CR} \cdot \sigma_{Foreign}}$ , where  $\sigma_X$  a historical standard deviation of return series and  $Cov(X, Y)$  is the covariance between two data sets of stock returns<sup>30</sup>.

<sup>29</sup> All returns are nominal returns in USD terms.

<sup>30</sup> See Table in Appendix for full variance-covariance matrices  $\Omega$

**Table 5:** Monthly correlation coefficients

$\rho$	CR	US	EU	JA	RS	CH	IN	BZ	SA	NZ
CR	1,00									
US	0,26	1,00								
EU	0,37	0,73	1,00							
JA	0,25	0,62	0,51	1,00						
RS	0,44	0,45	0,49	0,45	1,00					
CH	0,32	0,26	0,32	0,30	0,63	1,00				
IN	0,26	0,06	0,18	0,10	0,25	0,81	1,00			
BZ	0,42	0,51	0,62	0,37	0,58	0,44	0,21	1,00		
SA	0,31	0,41	0,46	0,42	0,45	0,38	0,24	0,46	1,00	
NZ	0,20	0,52	0,52	0,48	0,39	0,32	0,17	0,35	0,52	1,00

As we can see from the **Table 5** above, the lowest monthly correlation was between Czech stock market and the markets in New Zealand and Japan. The price increase on Czech market was accompanied only by up to 25% surge in a price movement in these two countries. On the other hand, the highest monthly correlation was between Czech and Russian stock market. But even between these two countries did not reached a 50 % level. Interesting observation is that all coefficients are positive. Positive correlation signifies the partial comovement of the stock prices between Czech and other world markets. Highest monthly correlation reveal the markets of China and India (0,81) and of the US and EU (0,73). On the contrary, the lowest correlated pairs are the markets of India and New Zealand (0,17) and of the Czech Republic and New Zealand (0,2). These low correlation coefficients signal good opportunities for diversification.

**Table 6:** Quarterly correlation coefficients

$\rho$	CR	US	EU	JA	RS	CH	IN	BZ	SA	NZ
CR	1,00									
US	0,28	1,00								
EU	0,45	0,80	1,00							
JA	0,37	0,71	0,68	1,00						
RS	0,59	0,43	0,50	0,46	1,00					
CH	0,18	0,29	0,14	0,29	0,48	1,00				
IN	-0,04	0,16	0,01	0,30	0,36	0,81	1,00			
BZ	0,64	0,44	0,56	0,41	0,58	0,40	0,13	1,00		
SA	0,46	0,51	0,64	0,60	0,70	0,41	0,33	0,46	1,00	
NZ	0,33	0,54	0,56	0,43	0,37	0,15	0,19	0,21	0,65	1,00

Quarterly correlation data reveal few interesting results. Firstly, let us look on the relationship of the Czech and foreign markets if we extend the investment period. Correlations between Czech and most of the foreign indices increase in quarterly data relatively to monthly data. The economic explanation of this observation can be that as the investors have more time to evaluate the information, the markets become more integrated in longer run. The exemption of this rule is the correlation with Indian and Chinese markets. These markets seem to be less integrated with the Czech market in longer run. Indian market is even negatively correlated with the Czech market. Secondly, the market pairs (US, EU) and (China, India) commove together both in monthly and quarterly data. The reason for this fact can be that the one type of investors invests into emerging Asian markets and the other type invests into the developed western markets. In this sense the Brazilian market is closer to the developed markets than the Indian.

Based on these data we can conclude that Czech equity market is better integrated with the developed than with the emerging markets. With the markets of the US, Japan, EU and South Africa, there are higher profit possibilities from diversification if we invest on a monthly basis. On the other hand, in a three month investment horizon, the market of India seems to be a plausible opportunity for diversification, because it is negatively correlated to the Czech

market. The important conclusion is that Czech stock market is not perfectly world integrated. Therefore, there should be very good incentives for Czech investors to invest abroad.

#### IV. 3. 5. Model of optimal investment equity portfolio

In this section I will introduce a model derived from CAPM model (Lewis, 1999) to determine how much foreign equities should have an average Czech investor in his equity portfolio. We will evaluate the more realistic case of risk averse investor who tries to maximize his risk adjusted wealth. He is trading off between risk and returns. In our model are his preferences described by a Markowitz utility function:

$$U = E_t W_{t+1} - \lambda \cdot \text{var}(W_{t+1}) \quad (1)$$

where  $\lambda$  is in this model a proxy of risk aversion<sup>31</sup>. His utility is linearly increasing in the expected wealth:  $\frac{\partial U}{\partial E_t W_{t+1}} = 1$  and decreasing in variance of his future wealth:  $\frac{\partial U}{\partial \text{var}(W_{t+1})} = -\lambda$ .

The higher is his risk aversion measured by  $\lambda$ , the lower will be his utility from a given level of variance.

How big should be the coefficient of risk aversion? Suppose that investor invested all of his funds to one single stock index. The following table shows us his utility if the stock prices followed the expected growth patterns for different levels of  $\lambda$  for monthly data.

**Table 7:** 100% investment into single stock index (monthly horizon)

	R CR	R US	R EU	R JA	R RS	R CH	R IN	R BZ	R SA	R NZ
AVERAGE	0,0109	-0,0039	-0,0022	-0,0046	0,0153	0,0012	0,0008	0,0077	0,0029	-0,0021
VAR	0,0048	0,0030	0,0034	0,0043	0,0223	0,0352	0,0928	0,0158	0,0069	0,0035
Wealth (t=0)	1	1	1	1	1	1	1	1	1	1
Wealth (t=1)	1,0109	0,9961	0,9978	0,9954	1,0153	1,0012	1,0008	1,0077	1,0029	0,9979
Utility (1/3)	<b>1,0093</b>	0,9950	0,9966	0,9940	<b>1,0078</b>	0,9895	0,9699	<b>1,0024</b>	<b>1,0006</b>	0,9968
Utility (1/2)	<b>1,0086</b>	0,9945	0,9961	0,9933	<b>1,0041</b>	0,9836	0,9544	0,9998	0,9995	0,9962
Utility (1)	<b>1,0062</b>	0,9930	0,9943	0,9911	0,9930	0,9660	0,9080	0,9919	0,9961	0,9944
Utility (2)	<b>1,0014</b>	0,9900	0,9909	0,9868	0,9707	0,9308	0,8152	0,9762	0,9892	0,9909

<sup>31</sup> In this model I am not using the traditional coefficient absolute (or relative) of risk aversion.

**Table 7** shows us a case of investments in completely isolated markets, where the investors can invest only into their domestic stock index. We can see that for a single 100 % even the risk aversion  $\lambda = 1$  is quite high. For  $\lambda \geq 1$  the only profitable investment opportunity would be the Czech stock index. In this case the only investment that would make sense (on the assumption of non-negative risk-free rate) would be the investment to Czech stock index. All other possibilities mean the decrease of utility at the end of next period. It is interesting to realize that investment which was the most beneficial for risk-neutral investor (100% into Russian index) would mean decrease of utility of risk averse investor with Markowitz utility function with  $\lambda = 1$ . The limiting risk aversion for which would an investor invest into any (in this case Czech) stock index (on the assumption of only 100% investments) is  $\lambda = 2,7$ . Investors who are more risk averse would not invest at all.

**Table 8:** 100% investment into single stock index (quarterly)

	<i>R CR</i>	<i>R US</i>	<i>R EU</i>	R JA	R RS	R CH	R IN	R BZ	R SA	R NZ
AVERAGE	3,28%	-1,18%	-0,67%	-1,37%	4,58%	0,36%	0,25%	2,31%	0,88%	-0,0062
VARIANCE	0,0172	0,0092	0,0088	0,0144	0,0607	0,0716	0,0601	0,0447	0,0233	0,0085
Wealth (t=0)	1	1	1	1	1	1	1	1	1	1
Wealth (t=1)	1,0328	0,9882	0,9933	0,9863	1,0458	1,0036	1,0025	1,0231	1,0088	0,9938
Utility (1/3)	<b>1,0270</b>	0,9851	0,9904	0,9815	<b>1,0255</b>	0,9797	0,9824	<b>1,0082</b>	<b>1,0010</b>	0,9910
Utility (1/2)	<b>1,0242</b>	0,9836	0,9889	0,9791	<b>1,0154</b>	0,9678	0,9724	<b>1,0008</b>	0,9971	0,9896
Utility (1)	<b>1,0156</b>	0,9789	0,9845	0,9719	0,9851	0,9320	0,9424	0,9784	0,9855	0,9853
Utility (2)	0,9984	0,9697	0,9757	0,9575	0,9244	0,8604	0,8822	0,9338	0,9621	0,9768

The situation for quarterly data looks very similar with monthly data. But the limiting risk aversion in this case is only  $\lambda = 1,9$ . In our model we will test the optimal portfolio weights for  $\lambda = 3$ ,  $\lambda = 2$ ,  $\lambda = 1$ ,  $\lambda = 1/2$  and  $\lambda = 1/3$ . As it was explained on an example in Chapter II. the investor can be more risk averse and still invest if we allow him to diversify the risks. For  $\lambda = 3$  no one would invest 100% of his wealth into any stock market, but could diversify into different indices and thus decrease the risk exposure. Furthermore, if we allow short selling, investor's investment opportunities increase.

Let us now finally describe the model. In our case, the investor can choose from  $n$  stock indices<sup>32</sup>. We assume that investor invests all his wealth into stocks so he gets the maximum utility of the expected wealth at the end of the next period. Let us denote the vector of expected returns<sup>33</sup> as a  $(n \times 1)$  vector  $r$ , the transposed vector of returns looks like:  $r' = (r_1, r_2, \dots, r_n)$ <sup>34</sup>. Our investor can sell stock indices even without owning them and buy them with profit at the end of next period. Therefore he can gain even from the downfall of the stock prices.

Let us denote  $\Omega$  for the  $(n \times n)$  variance-covariance matrix,  $\omega$  for a  $(n \times 1)$  vector of desirable weights of the stock indices in portfolio:  $\omega' = (\omega_1, \omega_2, \dots, \omega_n)$  and  $I$  for a  $(n \times 1)$  vector:  $I' = (1, 1, \dots, 1)$ . Investor is constrained with an equation:  $\omega_1 + \omega_2 + \dots + \omega_n = 1$ . If we rewrite this condition in matrix algebra we get an optimization constraint:  $\omega' \cdot I = 1$ . In this model we will allow for costless short selling so the weights can be also negative.

In this notation the investor utility function of the portfolio at the end of next period:

$$U = W_t(1 + \omega' \cdot r) - \lambda \cdot W_t^2 \cdot \omega' \cdot \Omega \cdot \omega \quad (2)$$

we can simplify the equation by the assumption:  $W_t = 1$ <sup>35</sup>. To solve the maximization problem we need a Lagrangean function:

$$L = (1 + \omega' \cdot r) - \lambda \cdot \omega' \cdot \Omega \cdot \omega - \varphi \cdot (\omega' \cdot I - 1) \quad (3)$$

where  $\varphi \in R$  is the Lagrange multiplier. The first order condition with respect to  $\omega$  is<sup>36</sup>:

$$\frac{\partial L}{\partial \omega} = r - 2 \cdot \lambda \cdot \Omega \cdot \omega - \varphi \cdot I = 0 \quad (4)$$

solving for  $\omega$ ,  $\lambda \neq 0$  :

$$\omega = \frac{\Omega^{-1}(r - \varphi \cdot I)}{2 \cdot \lambda} \quad (5)$$

where  $\Omega^{-1}$  is inverse to  $\Omega$ . We can rewrite the equation (5):

---

<sup>32</sup>In our case  $n=10$ .

<sup>33</sup>In a model I assume only 1 period investment, therefore I will use henceforth the notation of  $r$  instead of  $E_t r_{t+1}$ .

<sup>34</sup> In our case:  $r_1 = r_{CR}$ ,  $r_2 = r_{US}$ ,  $r_3 = r_{EU}$ ,  $r_4 = r_{JA}$ ,  $r_5 = r_{RS}$ ,  $r_6 = r_{CH}$ ,  $r_7 = r_{IN}$ ,  $r_8 = r_{BZ}$ ,  $r_9 = r_{SA}$ ,  $r_{10} = r_{NZ}$ .

<sup>35</sup> The assumption of irrelevance of absolute wealth was discussed in the section IV. 3 . 2.

<sup>36</sup> This statement is expressed in matrix form, there are in fact  $n$  F. O. C.'s.

$$\omega = \frac{1}{2 \cdot \lambda} \cdot \Omega^{-1} \cdot r - \frac{\varphi}{2 \cdot \lambda} \cdot \Omega^{-1} \cdot I \quad (6)$$

which transposed gives:

$$\omega' = \frac{1}{2 \cdot \lambda} \cdot r' \cdot \Omega^{-1'} - \frac{\varphi}{2 \cdot \lambda} \cdot I' \cdot \Omega^{-1'} \quad (7)$$

and multiplied by I:

$$\omega' I = \frac{1}{2 \cdot \lambda} \cdot r' \cdot \Omega^{-1'} \cdot I - \frac{\varphi}{2 \cdot \lambda} \cdot I' \cdot \Omega^{-1'} \cdot I = 1 \quad (8)$$

which is the investor's constraint condition. Realizing that  $I' \cdot \Omega^{-1'} \cdot I$  is only a number and therefore  $I' \cdot \Omega^{-1'} \cdot I = (I' \cdot \Omega^{-1'} \cdot I)' = I' \cdot \Omega^{-1} \cdot I \neq 0$ . Also we should note that the variance-covariance matrix  $\Omega$  and therefore also  $\Omega^{-1}$  is symmetric which means the transposed matrix is identical to original matrix:  $\Omega = \Omega'$  and  $\Omega^{-1'} = \Omega^{-1}$ . We can now rewrite for  $\varphi$ :

$$\varphi = \frac{r' \cdot \Omega^{-1} I - 2 \cdot \lambda}{I' \cdot \Omega^{-1} \cdot I} \quad (9)$$

plugging this equation for  $\varphi$  into (6) we finally get:

$$\omega = \frac{\Omega^{-1} \cdot r}{2 \cdot \lambda} - \frac{\frac{1}{2 \cdot \lambda} r' \cdot \Omega^{-1} \cdot I - 1}{I' \cdot \Omega^{-1} \cdot I} \cdot \Omega^{-1} \cdot I \quad (10)$$

This is our final equation. We will solve the optimal portfolio weights for the monthly and quarterly for 5 levels of risk aversion:  $\lambda = 3, 2, 1, 1/2$  and  $1/3$ . The results of the tested model are presented in the following section.

### IV. 3. 6. Results of the model

In this section I will discuss the model of the optimal portfolio model for different levels of risk aversion and different time horizons. Let us first look on the result of the optimal portfolio model for an investor who invests with an investment horizon of one month and is allowed to short sell.

**Table 9** : Optimal monthly portfolio weights (with short selling)

<b>Investor's risk aversion:</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1/2</b>	<b>1/3</b>
<i>Czech Republic</i>	0,72	0,92	1,52	2,72	3,92
<i>United States</i>	0,12	0,04	-0,23	-0,75	-1,27
<i>European Union</i>	-0,11	-0,26	-0,69	-1,56	-2,44
<i>Japan</i>	-0,11	-0,22	-0,54	-1,18	-1,83
<i>Russia</i>	0,13	0,26	0,63	1,39	2,14
<i>China</i>	-0,18	-0,29	-0,61	-1,26	-1,92
<i>India</i>	0,04	0,07	0,17	0,36	0,55
<i>Brazil</i>	-0,01	0,03	0,15	0,39	0,63
<i>South Africa</i>	0,11	0,15	0,26	0,47	0,69
<i>New Zealand</i>	0,28	0,29	0,34	0,43	0,52
<b>Utility gain</b>	<b>-0,001</b>	<b>0,004</b>	<b>0,014</b>	<b>0,031</b>	<b>0,047</b>

As we can see from the **Table 9** the leader is the Czech stock index. Optimal decision is to “borrow” money and invest into it more than initial wealth for all cases of tested risk aversion except the case  $\lambda = 3$ . For investors with such risk aversion the optimal outcome would be no investment. Under our assumptions, no investment yields zero return. Utility of zero risk-free return is zero which is higher than the returns from the portfolio. As we can see from the **Table 9** the investors should invest mainly into Czech stock index. The investment strategy should focus also on the acquiring the shares of New Zealand, South Africa, India, Brazil, Russia and US. On the other hand, the investor should short sell EU, Japanese and Chinese indices. We can see that with decreasing risk aversion the amount of investments increases in both directions. The less risk averse the more the investor buys “good” stocks and the more he sells “bad” stocks. Also we can see that higher risk aversion implies lower gains in utility. In this sense, the risk aversion is a negative trait of investors that damages their utility.

In the real world the short selling is very costly and in most of the cases it is virtually impossible to short sell an ordinary stock index. On the contrary, it is usually possible to take a short position in the derivative instruments like futures and options that consist of these stock indices. However, the trading on derivative markets has a barrier for ordinary investors. It is costly and the trades occur in high figures. Furthermore, the derivative instruments increase the risks and multiply the expected returns which is suitable for big financial

institutions, but not for individual investors. Therefore, in the following table I will show what the optimal portfolio of an investor without the short selling possibility would be.

**Table 10:** Optimal monthly portfolio weights (no short selling)

<b>Investor's risk aversion:</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1/2</b>	<b>1/3</b>
<i>Czech Republic</i>	0,51	0,53	0,50	0,47	0,46
<i>United States</i>	0,09	0,02			
<i>Russia</i>	0,09	0,15	0,21	0,24	0,25
<i>India</i>	0,03	0,04	0,05	0,06	0,06
<i>Brazil</i>		0,02	0,05	0,07	0,07
<i>South Africa</i>	0,08	0,08	0,08	0,08	0,08
<i>New Zealand</i>	0,20	0,17	0,11	0,07	0,06
<b>Utility gain</b>	<b>-0,003</b>	<b>0,000</b>	<b>0,004</b>	<b>0,007</b>	<b>0,008</b>

In this case, also only investors with  $\lambda \leq 2$  would invest at all. For the coefficient of risk aversion  $\lambda = 1/2$ , the Czech investor would choose about 44 % of Czech equities, 20 % Russian equities and 11%, 9 %, 6 % and 6 % he would allocate into the indices of New Zealand, South Africa, Brazil and the United States, respectively. As we can see the optimal weights do not differ significantly for different levels of risk aversion if we do not allow for short selling. These results indicate that Czech investors would be unreasonably home biased if they invested more than 50 % into domestic equities. As we can conclude from the **Tables 9 and 10** the happiest investor would be the investor with the lowest risk aversion that is able to sell the stock indices short. Investor with  $\lambda = 1/3$  would gain 4,7 % increase in his utility if he is allowed to short sell free of costs, but gains only 0,8 % if he is not.

Now let us move to the example of an investor who invests with an investment horizon of three months. From the data description we know that we used continuously compounded return. Average quarterly returns are therefore calculated:  $\overline{r^q} = 3 \cdot \overline{r^m}$ . The relative returns of the stock indices are therefore the same, because  $\frac{\overline{r_i^q}}{\overline{r_j^q}} = \frac{\overline{r_i^m}}{\overline{r_j^m}}$ ;  $i, j \in (1, \dots, n)$ . The difference

between the monthly and quarterly data is in the relative volatilities and covariations. The change in portfolio allocation should be only caused by the change in variance-covariance matrix. In the following table we can see whether the optimal weights changed at all. This

would be an indirect proof of changes in the correlations coefficients if we use different investment horizons.

**Table 11** : Optimal portfolio quarterly weights (with short selling)

<b>Risk aversion:</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1/2</b>	<b>1/3</b>
<i>Czech Republic</i>	0,86	1,11	1,87	3,38	4,90
<i>United States</i>	0,42	0,52	0,81	1,40	1,99
<i>European Union</i>	0,27	0,18	-0,08	-0,61	-1,15
<i>Japan</i>	-0,52	-0,74	-1,38	-2,68	-3,97
<i>Russia</i>	-0,06	-0,03	0,06	0,25	0,44
<i>China</i>	-0,21	-0,30	-0,58	-1,14	-1,70
<i>India</i>	0,37	0,47	0,78	1,39	2,01
<i>Brazil</i>	-0,09	-0,10	-0,11	-0,14	-0,16
<i>South Africa</i>	0,06	0,15	0,44	1,01	1,58
<i>New Zealand</i>	-0,09	-0,27	-0,80	-1,87	-2,94
<b>Utility gain</b>	<b>-0,002</b>	<b>0,009</b>	<b>0,034</b>	<b>0,078</b>	<b>0,120</b>

The situation remains the same for  $\lambda = 3$ . In this case would be no investing the best investment. The optimal weight of Czech stock index do not change dramatically. The main difference is that the investor would no longer evaluate the investments into New Zealand and Brazil as desirable. In the case of an investment period of three months he would decide to short sell the indices of the mentioned countries. He would also almost neglect the Russian index, which was the second best option in the monthly horizon. On the other hand, he would no longer short sell the Indian index.

As was mentioned above, the reasons for these differences can be found in the covariance-variance matrices<sup>37</sup>. For example, the monthly variation of the Russian index was around 0,02. The quarterly variation of the same index was three times higher. On the other hand the Indian index had the monthly variation higher than the quarterly variation. For the longer period the variation decreased from 0,09 to 0,06. Therefore the investment into Indian index has become more desirable in the longer run. The important are not only changes in the relative variations, but also the relative covariation changes. The changes in variation and covariation are brought together in the coefficients of correlation The **Tables 5 and 6** in section IV. 3. 4. reveal the changes in the correlation coefficients if we increase the time

<sup>37</sup> See **Tables 14 and 15** in Appendix.

horizon. Russian index becomes more correlated with Czech index, but Indian index gets even negatively correlated with the Czech index in the quarterly period. Therefore the Indian index can offset part of the downward movements of the Czech index, which is great for risk diversification.

**Table 12** : Optimal portfolio quarterly weights (no short selling)

<b>Risk aversion:</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1/2</b>	<b>1/3</b>
<i>Czech Republic</i>	0,53	0,46	0,47	0,46	0,45
<i>United States</i>	0,26	0,21	0,20	0,19	0,18
<i>European Union</i>	0,17	0,08	0,00	0,00	0,00
<i>Russia</i>	0,00	0,00	0,02	0,03	0,04
<i>India</i>	0,00	0,19	0,20	0,19	0,18
<i>South Africa</i>	0,04	0,06	0,11	0,14	0,14
<b>Utility gain</b>	<b>-0,013</b>	<b>-0,003</b>	<b>0,011</b>	<b>0,020</b>	<b>0,023</b>

Let us now look at optimal portfolio weights without short selling. In this case even the investor with  $\lambda = 2$  would not invest to stock indices at all. In case of prohibited short selling we will omit the indices of the UK, Japan, China, Brazil and New Zealand in the investment portfolio. It is interesting to realize that the weight of the Czech index in the optimal portfolio do not change dramatically for the monthly and quarterly invest horizons . For the coefficient of risk aversion  $\lambda = 1/2$  , the optimal weight is only 1 % lower. The Czech investor would hold again less than 50 % in Czech equities. As was explained above, he would no longer invest into same indices as the “one month” investor. In this case, the US index would be the second best and the Indian index third best investment options.

Let us draw an overall conclusion from the results of the model. A risk averse Czech investor with the Markowitz utility function with reasonable levels of risk aversion would invest around 45 % of his fund into Czech equities. His decision is almost the same for different levels of risk aversion and investment horizons. We should also realize that for the sake of simplicity of the model I did not take into account other investment opportunities. In our model the only alternative to investment into stock indices is no investment at all. This is a weak point of our model, but can be also interpreted behaviorally. This model would imply that the investors choose a part of their wealth that is meant only for investments into equities. This fact is not so unrealistic if we realize that the most of the financial institutions have some limits on equity investments. Also financial advisers usually recommend that only certain

percentage of the investor's wealth should be invested into stocks. The managers of pension funds have also limits of the funds they are allowed to invest into equities (Zalewska, 2005). Therefore we can interpret the results that Czech investors should not invest more than 50% of their funds that are earmarked for the stocks.

We should not forget about the exchange rate risk and risk of inflation. Exchange rate risk in our model became a part of the index risk, because the foreign indices were recalculated in USD terms. The returns of Czech stock index were without the exchange rate risk component. Therefore I implicitly assumed that the Czech investors hold their wealth in Czech crowns, i.e. without any exchange rate risk for Czech index. Foreign investors holding foreign currency would have to exchange money and therefore the Czech equities would be more riskier for them than for domestic investors.

Now, let us move to the discussion about the risk of inflation, more precisely the risk of unexpected changes in the difference between domestic and foreign inflations. The returns in the model were in nominal terms that means that in the model I omitted the risk of inflation. The theory of PPP<sup>38</sup> suggests that investors should take into account real and not nominal returns. The difference between domestic and foreign inflation should be immediately offset by the change in nominal exchange rate. Investors who assume that PPP holds should take into account also the expectations about future inflation and therefore take into account the real returns. However, in the real world the nominal returns can be justified by the argument that PPP holds in the long run, but fails in short run. Therefore, even rational investors would not have to take into account the inflation, because they realize that the mechanism of the exchange rate adjustment works slowly and do not influence the exchange rate immediately.

Based on this logic I have tried to find the evidence on actual portfolio allocation. I have asked the question how much there is domestic and foreign equities in the equity portfolio of Czech investors, rather than the question how much of their wealth is allocated into domestic and foreign equities. In the following section I will provide an evidence of relative weight of domestic and foreign equities in the hands of Czech investors.

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<sup>38</sup> The Purchasing Power Parity.

#### **IV.4. Evidence on actual Czech portfolio allocation**

As mentioned in the section IV.2. the first experience of Czech investors began in 1993 in the process of coupon privatization. Equities were distributed between public in a special way that is different from the usual investment mechanism. Each adult Czech citizen got the opportunity to invest 1000 CZK into newly issued equities. Most of the people were completely uninformed and inexperienced. But there were few who knew more than others. The situation on the market in the first years of privatization can be taken as an example of asymmetric information. Investors with insider information about the companies could earn a high profits.

In the first phase state as the owner had a motivation to sell the companies at any costs, which distorted the prices. After several years when many companies went bankrupt and were delisted from the stock exchange the Czech equity market began to resemble the developed markets. I am writing these historical facts to remind the reader about the background of the Czech equity market. Many investors got shares for less than the correct market price.

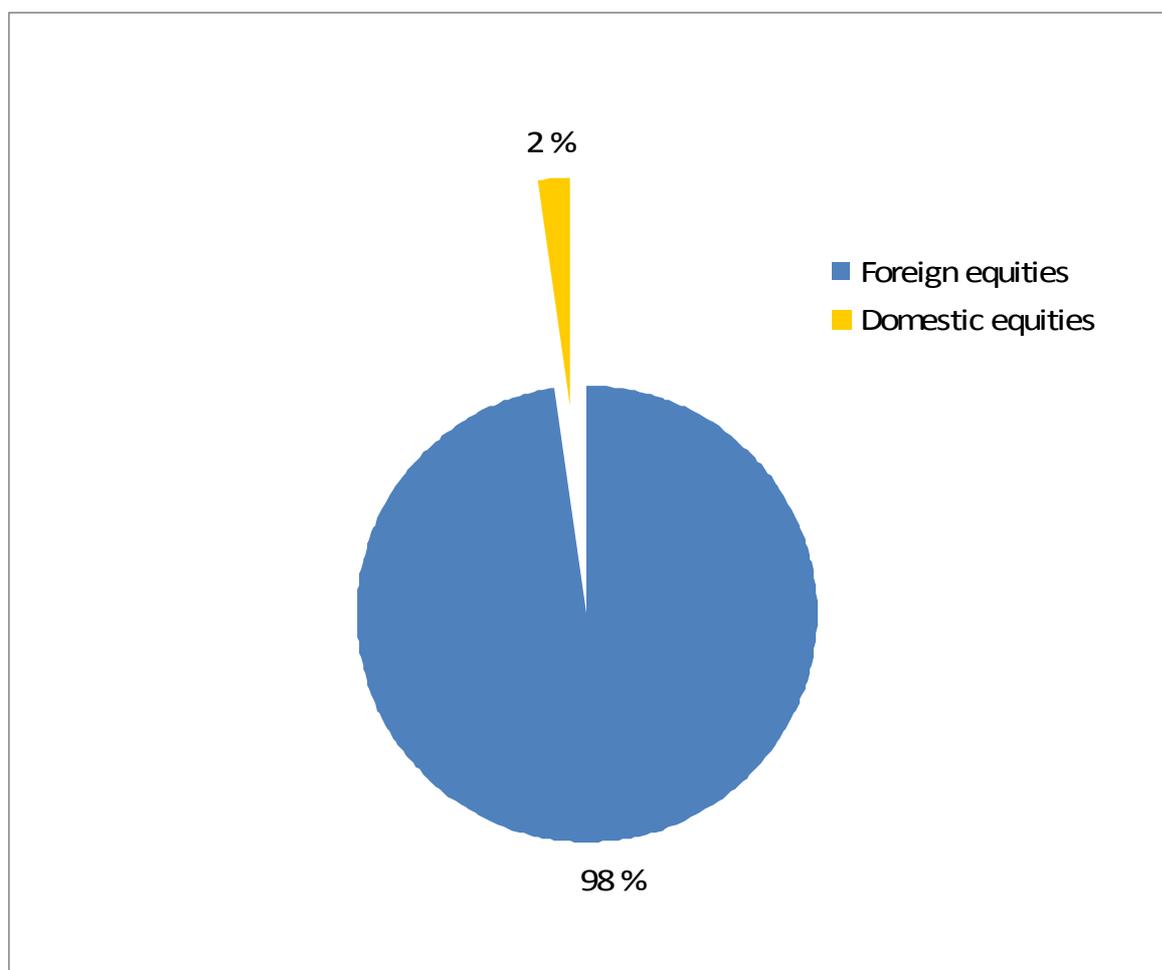
In the present time the stock prices are driven by the law of demand and supply. Investors who wish to buy or sell their stocks can trade on a stock exchange. During the privatization most of the people learned about stock market and gained useful information about the trading in stocks. Even small investors are familiar with the possibilities of trading in domestic stocks. But it can be a bigger problem for them to trade in foreign equities. This information asymmetry and higher transaction costs could be the reason for the home biasness of the Czech investors.

I will introduce three sources of evidence of investors choice. Firstly, I will examine the composition of the mutual funds with Czech domicile. Secondly, I will introduce the results of the investment questionnaire filled by students of IES. Thirdly, I will provide the most relevant evidence from the OECD statistics.

#### IV. 4. 1. Czech mutual funds

Before we look on the total amount of domestic and foreign equities held by Czech investors, let us look on the portfolio composition of the mutual funds. AKAT<sup>39</sup> collects the information about the portfolio holdings of the mutual funds registered in the Czech Republic. I have calculated the total amount of the shares of equities and other mutual funds that have these registered mutual funds in portfolio<sup>40</sup>. Following **Figure 2** shows the proportion of the domestic and foreign equities out of the total.

**Figure 2:** Foreign and domestic equities shares in portfolio of Czech mutual funds (2008)



Sources: AKAT, AXA, PROSPERITA.

<sup>39</sup> Association for the Czech capital market.

<sup>40</sup> See **Table 16** in Appendix for detailed information.

As it is clear from the Figure above the Czech mutual funds are significantly foreign biased. Only 2 % of total shares are of domestic origin. It is almost alarming that the managers of the mutual funds invest only so little into domestic equities. Drawing the conclusion based on these data, I would have to strongly reject the hypothesis of the home bias in Czech equity market.

Why there are so little domestic equities in the portfolio of Czech mutual funds? The possible explanation can be that this type of investment strategy is driven by Czech investors themselves. It is easy and familiar for them to go and buy Czech equities. On the other hand, it can be quite difficult for them to buy foreign equities directly. They also lack the information about foreign companies. These uninformed investors could prefer to invest into foreign equities indirectly. Investments into mutual funds could therefore be taken as substitutes for the foreign equity investments.

Let us now look how important the equities in mutual funds are in terms of market capitalization. The total reduced market capitalization of PX<sup>41</sup> accounts for 691,7 billion CZK. And as we can see in **Table 16** the total capitalization of equities locked in mutual funds exceeded 413 billion CZK. However, the amount of domestic equities was only 8 billion CZK! Only something more than 1 % of Czech equities is part of mutual funds. Over 400 billion CZK of foreign equities is held by the owners of the mutual funds shares<sup>42</sup>. Based on these data we can see that mutual funds are quite important part of equity portfolios of domestic investors.

#### **IV. 4. 2. Student's portfolio**

In the chapter III. I have discussed the behavioral explanations of the home bias puzzle. I have argued that the key reason of the home biasness should be the irrationality of investors in the sense of traditional science. Investors do not take into account all relevant information and do not make appropriate judgments based on the information. Therefore they are behaving irrationally on a market. To show the irrationality of investors I created an investment

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<sup>41</sup> As for 07/05/2009. Source: BCCP.

<sup>42</sup> I assume that the only owners of mutual funds with Czech domicile are the Czech citizens.

questionnaire which was distributed between the students of Institute of Economic Studies, IES henceforth<sup>43</sup>.

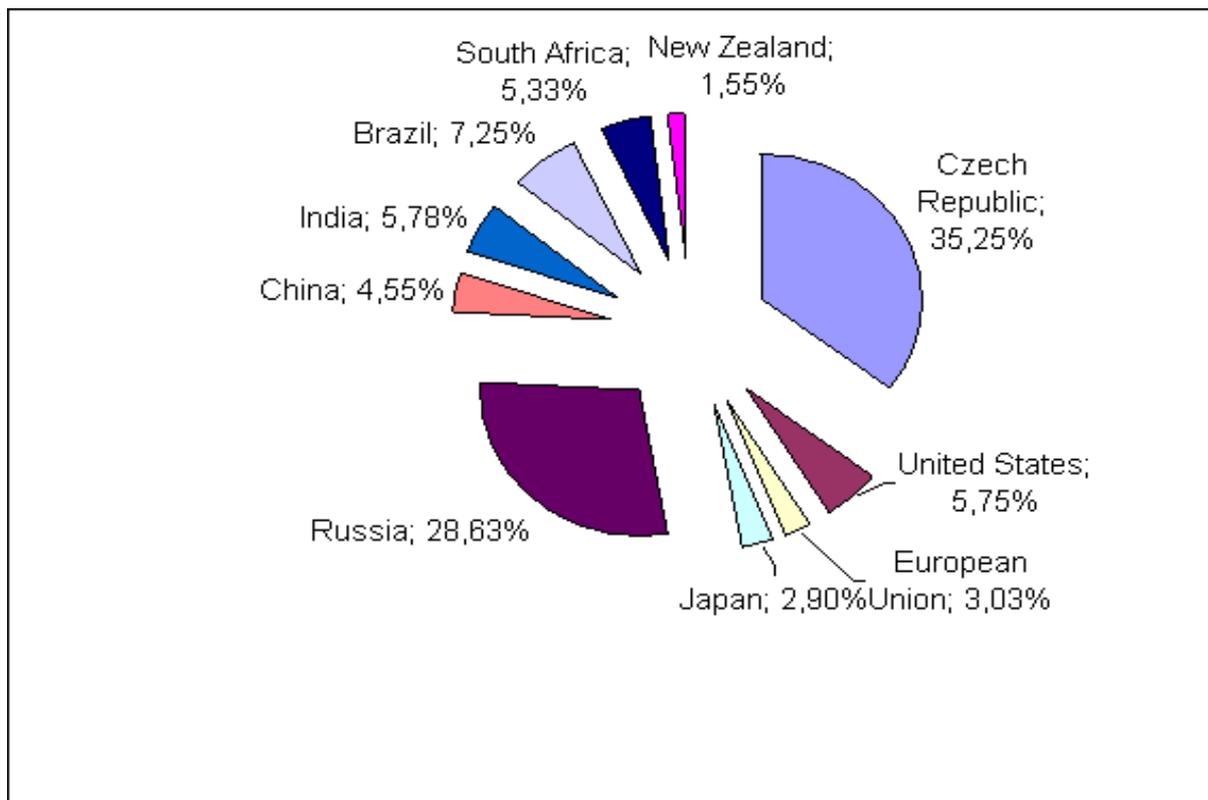
The task of the investment questionnaire was simple. Each investor was “given” one million CZK. He than advised to invest all his wealth into different stock indices. I provided them with the monthly historical data of average returns, standard deviations and correlation coefficients (**Table 17** in Appendix). However, the questionnaire did not include the exact dates of the historical period.

During the process of filling in the questionnaire several students came to me with questions and comments. Firstly, part of the students refused to fill in the questionnaire because it seemed to be too difficult. They were confused with all the data, especially of the correlation coefficients. The idea that they should compute the variance of the total portfolio distracted them from any investment at all. These students took into account all relevant information, but refused to make an appropriate judgment based on this information, because the process of evaluation was perceived too costly for them. However, they also argued that if this was a real world situation and they were given 1 million CZK they would take their time and think it through properly. Secondly, part of students reacted almost independently on the given data. Personal preferences for the specific countries ruled their investment decision. Few students told me that they did not bother about the historical data, but they made their choices because they like or have visited the country. One students told me that she prefer investment into Czech equities because it is a possibility to support the domestic companies. She was a typical home biased investor. The investment questionnaire revealed the irrationality even of students of the IES: they did not take into account all relevant information and refused to make appropriate judgments based on the given information. If the students of IES do not behave rationally, who should? In the **Figure 3** you can see the average student’s portfolio.

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<sup>43</sup> The questionnaire was distributed in the week 23 – 27. March 2009.

**Figure 3** : Investment portfolio of IES students



**Source:** Research on IES (March 2009). 41 students responded.

As we can see the students overall were not the typical home biased investors. Quite the opposite! If we compare these results with the results of the model of optimal portfolio in **Table 10**, we will realize that the students are in fact foreign biased. The model predicts about 46 % of investment into Czech equities. However, the students would invest only 35 % of their wealth into Czech stock index. Students would also invest into stock indices with negative historical returns, which is in contrast with the results of the model. They would buy 5,75 %, 3,03%, 2,9 % and 1,55 % of the stock indices of the US, EU, Japan and New Zealand, respectively. In total more than 13 % of their wealth would be invested into equities with negative historical returns. These findings can be understood as a trend reverting belief. The investors believe that because the returns were negative in past there is a space of the change in trend. This violates the assumptions of the model that the return should be normally distributed and the historical data should predict the future. Students did not seem to behave to know about this assumed feature of the equity markets.

The questionnaire revealed that students do not behave rationally in the traditional sense. They are foreign biased because they would invest only 35 % of their wealth in Czech stock index. Furthermore, they believe in the trend change, because they invested into stock indices with negative returns. However, we should note that these results can not have a strong explanatory power, because only 41 students responded to the questionnaire. The students of Economics are not only irrational, but also very lazy!

#### IV. 4. 3. Czech equity portfolio: OECD statistics

The most valuable evidence of the portfolio allocation of Czech investors can be obtained from the OECD data. **Table 13** provides the evidence of the stock of assets and liabilities for different sectors at the end of 2006. The domestic equities held by Czech investors are on the asset side of the balance sheet, foreign equities can be found on the side of liabilities of rest of world. If Czech investor buys foreign equities it becomes a liability of rest of world.

**Table 13:** Financial balance sheets of Czech Republic

##### A: Assets

mil CZK	Financial	Non financial	Government	Households <sup>44</sup>	Total economy	Rest of World
Shares and other equity	144 488	488 704	771 833	306 810	1 711 835	1 595 246
Mutual funds	27 854	18 088		225 350	271 292	
<b>Shares and mutual funds</b>	<b>172 342</b>	<b>506 792</b>	<b>771 833</b>	<b>532 160</b>	<b>1 983 127</b>	<b>1 595 246</b>

##### B: Liabilities

mil CZK	Financial	Non financial	Government	Households	Total economy	Rest of World
Shares and other equity	223 471	2 907 440			3 130 911	176 170
Mutual funds	156 392				156 392	114 900
<b>Shares and mutual funds</b>	<b>379 863</b>	<b>2 907 440</b>	<b>0</b>	<b>0</b>	<b>3 287 303</b>	<b>291 070</b>

Source: OECD 2006

At the end of 2006 Czech investors owned 1 711 billion CZK in shares and other equities, of which 45 % owned the government, 29 % non financial, 18 % households and 8 % financial institutions. Almost the same amount of Czech equities was owned by the rest of world. Foreign investors owned more equities (1 595 billion CZK) in Czech Republic than Czech investors owned foreign equities (291 billion CZK).

<sup>44</sup> Including non profit institutions serving households

To answer the question whether there is home bias we have to compute the ratio of domestic equities in the equity portfolio of Czech investors. If we include the mutual funds<sup>45</sup> into equity, the ratio of domestic/total equities in Czech portfolio was 87,2 %<sup>46</sup>. This high figure can be little bit biased, because it includes the government, which is not a typical investor. However, if the government is excluded, the ratio is still quite high: 83, 3 %. The model of optimal portfolio investment revealed that Czech investors should own up to 50 % domestic shares. The evidence shows that there is more than 30 % difference between the theoretical and actual portfolio allocation of Czech investors. Based on the evidence we can conclude that there is home bias in equities in the Czech Republic.

#### **IV.5. Conclusion**

The Czech equity market has been created rapidly in the process of privatization in early 1990s. Czech citizens acquired many shares during the first years. In the early years Czech equity market was full of companies. Many companies went bankrupt or were delisted in the period 1998-1999. The market have become more transparent and investors gain experience with trading in shares.

The aim of this chapter was to answer the question of home biasness of Czech investors. I have introduced a model of optimal portfolio allocation. The historical data of 9 foreign indices were taken as an approximation of ten years of history of world stock markets. In the model Czech investor could choose between domestic stock index and foreign indices. Assuming that the markets are weak efficient without any barriers and all investors are rational with perfect information, I have shown that a risk neutral investor would invest all his investment wealth into Russian stock index. I have used the Markowitz utility function for the risk averse investors. The results of the model indicated that the optimal share of domestic equities in the portfolio of a risk averse Czech investor would be around 45 %.

The evidence of the actual portfolio allocation reveals that there are around 87 % of domestic equities in the investment portfolios held by Czech investors. Almost half of it was owned by Czech government who is still the major owner of Czech companies. These empirical findings

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<sup>45</sup> Assuming that mutual funds are perfect substitutes to foreign shares.

<sup>46</sup> Ratio=Total economy assets/(Total economy assets + Rest of World Liabilities)

suggest that the Czech investors are home biased, because they hold more domestic equities than it should be optimal.

## **V. Home Bias puzzle conclusions**

People prefer to buy stocks of their own country despite the loss they suffer. This is evident based on the findings of the research in international portfolio studies. In this paper I have tried not only to prove this observation, but also to provide theoretical explanations of the sources of the home biasness. The market imperfections as the barriers to entry, transaction and information costs are one of the institutional reasons for the creation of home biased portfolio. However, the institutional features can explain only partly the home biasness, there is not a model that evaluates the impact of these factors together. It is difficult to quantify the impact of factors such as asymmetric information and corporate governance have on the investment decisions. First conclusion of this paper is that we can explain the home bias partly, but not fully, by the imperfection of traditional finance models that assume no barriers to entry to equity markets, zero transaction and information costs and dispersed ownership of companies that works without any agency problems.

Behavioral finance can help us to understand how the investors are making their investment decision. Evidence from cognitive psychology suggests that the assumption of rationality in traditional financial sense is too strong and unrealistic. It is actually quite irrational to assume rationality. People reveal many psychological biases. Some of these biases can provide us with explanations of the propensity of investors to prefer domestic equities. Investors tend to be too optimistic about the future perspectives of a domestic firm. Narrow framing can also lead to home biasness. However insightful the behavioral theories are, the exact impact of the irrationality is difficult to assess. Second conclusion is therefore quite similar to the first one. Behavioral finance that assumes specific form of irrationality can partly explain the home bias puzzle.

Czech investors are also home biased. This conclusion is a result of the comparison of the evidence of international portfolio allocation and the model of optimal portfolio allocation. Czech investors hold 87 % domestic equities out of total equity holdings. This figure includes the ownership of Czech government. The model suggests that there should be not more than 50 % of domestic equities in equity portfolios of Czech investors. The evidence is coherent with the main hypothesis of the existence of the home bias in the equity market of the Czech Republic.

The weakness of this conclusion can be found in the assumptions of the model. The model of optimal portfolio allocation assumes perfect markets and rational investors. The student's questionnaire indicates that even trained students of economics do not make their decisions in the same way as the model would predict. The model also assumes that there are no transaction costs, including the costs with currency costs. The model does not take into account other investment opportunities. If we took into account these imperfections the home bias puzzle would no longer have to be a puzzle in the Czech Republic.

There is a big potential in future research in the field of behavioral finance. Models able to simulate truthfully the decisions of irrational investors could explain the home bias. In my opinion, the home bias is result of both factors: the imperfection of markets and investors. It would be interesting, but very demanding, to combine the institutional with behavioral factors. The factors behind the home biasness can help us in understanding of the financial world in reality. Financial models have made predictions based on unrealistic assumptions and therefore many puzzles have arisen. I believe if the research focused more on the way investors make their decisions and took into account the degree of market imperfections it would increase the ability of economists to predict the actions of the agents in the economy.

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## List of abbreviations and symbols:

<b>AKAT</b>	Association for Czech capital market
<b>BRL</b>	Brazilian real
<b>BZ</b>	Brazil Bovespa index
<b>CH</b>	Shanghai composite index
<b>CR</b>	PX stock index
<b>CZK</b>	Czech crown
<b>EU</b>	DJ Eurostoxx 50
<b>IN</b>	Bombay Sensex
<b>INR</b>	Indian rupee
<b>IPO</b>	Initial Public Offering
<b>JA</b>	Nikkei
<b>JPY</b>	Japanese yen
<b>NZ</b>	DJTM New Zealand - Price index in \$
<b>PPP</b>	Purchasing power parity
<b>RS</b>	RTS – Russian price index in \$
<b>SA</b>	DJTM South Africa - Price index in \$
<b>US</b>	Standard and Poor's 500
<b>YUAN</b>	Chinese Yuan
$r$	Average returns of stock indices
$\omega$	Portfolio weights
$\Omega$	Variance-covariance matrix
$\lambda$	Coefficient of risk aversion
$W_t$	Investor's wealth at time t
$U$	Utility function of investors
$L$	Langrange function
$\varphi$	Langrange multiplier

## Appendix:

**Table 14:** Variance-covariance matrix for monthly returns

<i>COV</i>	R CR	R US	R EU	R JA	R RS	R CH	R IN	R BZ	R SA	R NZ
R CR	<b>0,0048</b>	0,0010	0,0015	0,0011	0,0045	0,0042	0,0054	0,0036	0,0018	0,0008
R US	0,0010	<b>0,0030</b>	0,0023	0,0022	0,0037	0,0027	0,0011	0,0035	0,0019	0,0017
R EU	0,0015	0,0023	<b>0,0034</b>	0,0020	0,0043	0,0035	0,0032	0,0046	0,0022	0,0018
R JA	0,0011	0,0022	0,0020	<b>0,0043</b>	0,0045	0,0037	0,0020	0,0031	0,0023	0,0019
R RS	0,0045	0,0037	0,0043	0,0045	<b>0,0223</b>	0,0177	0,0113	0,0109	0,0056	0,0035
R CH	0,0042	0,0027	0,0035	0,0037	0,0177	<b>0,0352</b>	0,0464	0,0103	0,0059	0,0036
R IN	0,0054	0,0011	0,0032	0,0020	0,0113	0,0464	<b>0,0928</b>	0,0079	0,0061	0,0030
R BZ	0,0036	0,0035	0,0046	0,0031	0,0109	0,0103	0,0079	<b>0,0158</b>	0,0048	0,0026
R SA	0,0018	0,0019	0,0022	0,0023	0,0056	0,0059	0,0061	0,0048	<b>0,0069</b>	0,0026
R NZ	0,0008	0,0017	0,0018	0,0019	0,0035	0,0036	0,0030	0,0026	0,0026	<b>0,0035</b>

**Table 15:** Variance-covariance matrix for quarterly returns

<i>COV</i>	R CR	R US	R EU	R JA	R RS	R CH	R IN	R BZ	R SA	R NZ
R CR	<b>0,0172</b>	0,0036	0,0055	0,0058	0,0192	0,0062	-0,0012	0,0177	0,0092	0,0039
R US	0,0036	<b>0,0092</b>	0,0072	0,0082	0,0103	0,0076	0,0038	0,0089	0,0075	0,0048
R EU	0,0055	0,0072	<b>0,0088</b>	0,0077	0,0115	0,0035	0,0002	0,0111	0,0091	0,0049
R JA	0,0058	0,0082	0,0077	<b>0,0144</b>	0,0135	0,0093	0,0088	0,0103	0,0110	0,0047
R RS	0,0192	0,0103	0,0115	0,0135	<b>0,0607</b>	0,0315	0,0219	0,0304	0,0265	0,0083
R CH	0,0062	0,0076	0,0035	0,0093	0,0315	<b>0,0716</b>	0,0529	0,0228	0,0167	0,0038
R IN	-0,0012	0,0038	0,0002	0,0088	0,0219	0,0529	<b>0,0601</b>	0,0067	0,0123	0,0043
R BZ	0,0177	0,0089	0,0111	0,0103	0,0304	0,0228	0,0067	<b>0,0447</b>	0,0149	0,0041
R SA	0,0092	0,0075	0,0091	0,0110	0,0265	0,0167	0,0123	0,0149	<b>0,0233</b>	0,0092
R NZ	0,0039	0,0048	0,0049	0,0047	0,0083	0,0038	0,0043	0,0041	0,0092	<b>0,0085</b>

**Table 16:** Mutual funds with the Czech domicile (As of January 2008)

Fund name:	Total Equities Foreign and Domestic in thousands. CZK	Foreign Equities	Domestic Equities	Share of Foreign Equities	Share of Domestic Equities
AKRO akciový fond nových ekonomik	281 607	221 906	0	78,8%	
AKRO balancovaný fond	41 947	16 431	3 112	39,2%	7,4%
AKRO fond progresivních společností	124 669	88 976	4 052	71,4%	3,3%
AKRO globální akciový fond	327 919	35 415	217 345	10,8%	66,3%
AXA CEE Akciový fond	169 603	111 531	75 032	65,8%	44,2%
AXA Realitní fond	155 066	86 759	0	56,0%	
BALANCOVANÝ FOND NADACÍ	789 641	45 246	0	5,7%	
ČPI - OPF Farmacie a biotechnologie	174 284	154 660	0	88,7%	
ČPI - OPF Fond nemovitostních akcií	583 343	447 891	0	76,8%	
ČPI - OPF Fond živé planety	43 008	37 365	0	86,9%	
ČPI - OPF Garant 90	47 612	7 851	0	16,5%	
ČPI - OPF Globálních značek	1 097 819	973 656	0	88,7%	
ČPI - OPF Nových ekonomik	364 112	286 702	0	78,7%	
ČPI - OPF Ropného a energetického prům.	842 633	684 049	38 508	81,2%	4,6%
ČPI - OPF Smíšený	722 757	151 273	40 763	20,9%	5,6%
ČPI - OPF Zlatý	266 462	238 270	0	89,4%	
ČSOB akciový fond – Střední a Východní E	342 146	302 423	34 523	88,4%	10,1%
ČSOB akciový mix	1 531 452	975 229	357 747	63,7%	23,4%
ČSOB bohatství	4 206 167	1 239 557	657 845	29,5%	15,6%
ČSOB bytových družstev	398 159	6 291	10 312	1,6%	2,6%
ČSOB nadační	213 107	4 262	7 437	2,0%	3,5%
ČSOB realitní mix	586 446	515 779	0	88,0%	
ČSOB středoevropský	1 808 523	739 143	305 279	40,9%	16,9%
EuroMax světový garantovaný fond	367 489 393	339 302 957	0	92,3%	
Fénix dynamický	420 076	55 450	344 714	13,2%	82,1%
Fénix dynamický PLUS	357 393	350 031	0	97,9%	
Fénix konzervativní	464 750	81 145	272 158	17,5%	58,6%
Fénix smíšený	4 278 429	555 340	2 954 255	13,0%	69,1%
IKS Akciový PLUS	692 260	468 660	0	67,7%	
IKS Balancovaný – dynamický	5 734 218	1 255 794	1 201 892	21,9%	21,0%
IKS Balancovaný - konzervativní	3 408 421	746 444	714 405	1,24	13,48
IKS Dluhopisový PLUS	803 761	24 997	0	3,1%	

J&T AM PERSPEKTIVA	1 022 071	405 558	7 768	39,7%	0,8%
J&T OPPORTUNITY CZK	582 438	271 591	293 025	46,6%	50,3%
KB Akciový	324 448	92 435	139 967	28,5%	43,1%
KB Ametyst 2	919 941	733 009	0	79,7%	
KB Realitních společností	227 950	161 571	0	70,9%	
MAX 1	890 931	777 872	0	87,3%	
MAX 3 - světový garantovaný fond	628 647	544 031	0	86,5%	
MAX 5 - světový garantovaný fond	485 483	406 641	0	83,8%	
MAX 6 - světový garantovaný fond	840 493	602 465	0	71,7%	
MAX 7 - světový garantovaný fond	854 679	606 566	0	71,0%	
MAX 9 - světový garantovaný fond	894 218	767 776	0	85,9%	
Pioneer - akciový fond	1 164 810	1 058 113	0	90,8%	
Pioneer - dynamický fond	2 708 458	1 585 802	11 646	58,6%	0,4%
Pioneer - růstový fond	847 634	233 862	0	27,6%	
PROSPERITA - OPF globální	1 894 123	435 269	428 640	23,0%	22,6%
RŮSTOVÝ FOND NADACÍ	348 451	99 204	0	28,5%	
<b>Total:</b>	<b>413 401 958</b>	<b>358 993 250</b>	<b>8 120 426</b>	<b>97,8%</b>	<b>2,2%</b>

**Table 17: Investment questionnaire**

CZECH STUDENTS ONLY

**Investment  
questionnaire**

**Task:**

You can invest 1 mil CZK into stock indices of different countries below.

Indices are recalculated in CZK. No transaction costs. No investment barriers.

You know the average returns and monthly volatility for the period of 10 years.

You can invest with a monthly investment horizon. Invest all your wealth.

	CR	US	EU*	JAP	RUS	ČÍN	IND	BRAZ	J. AFR	N.ZEA
Monthly returns:	1,1%	-0,4%	-0,2%	-0,5%	1,5%	0,1%	0,1%	0,8%	0,3%	-0,2%
Standard deviation:	0,07	0,05	0,06	0,07	0,15	0,19	0,30	0,13	0,08	0,06

**Correlation coefficients**

	CR	US	EU	JA	RS	CH	IN	BZ	SA	NZ
CR	1,00									
US	0,26	1,00								
EU	0,37	0,73	1,00							
JA	0,25	0,62	0,51	1,00						
RS	0,44	0,45	0,49	0,45	1,00					
CH	0,32	0,26	0,32	0,30	0,63	1,00				
IN	0,26	0,06	0,18	0,10	0,25	0,81	1,00			
BZ	0,42	0,51	0,62	0,37	0,58	0,44	0,21	1,00		
SA	0,31	0,41	0,46	0,42	0,45	0,38	0,24	0,46	1,00	
NZ	0,20	0,52	0,52	0,48	0,39	0,32	0,17	0,35	0,52	1,00

Your investment:  
in %

CR	US	EU*	JAP	RUS	ČÍN	IND	BRAZ	J. AFR	N.ZEA

\*EU 12 excluding Czech Republic

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