Equity Home Bias Among Czech Investors: Experimental Approach

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Abstract:

Equity home bias is a situation on equity market where domestic investors prefer invest too much into domestic equities despite the possible gains from diversification into foreign equities. Equity home bias can arise as a result of institutional or behavioral factors. In this paper I will compare the evidence with the prediction of the model of optimal portfolio with three different utility functions (Markowitz, Exponential and CRRA) the results of the investment experiment and the evidence from OECD (2009). The results have shown that in total the Czech investors are home biased (they hold 85 % of domestic equities in their equity portfolios). However, in experimental lab conditions were the students rather foreign biased. They have chosen only 14 % of Czech equities as opposed to the model recommendation of 22-54%. The possible reasons for foreign biasness in experimental conditions can be the absence of transaction and informational cost and explicit FX risk. Furthermore, I have discovered that the successful experimental investors have higher investment knowledge and that they trust in intuition.

Keywords: Investment experiment, equity home bias, behavioral finance, optimal investment portfolio

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I.   Introduction

Equity home bias is a situation on a market when investors hold an unreasonably high share of their portfolios in domestic equities. If the equity investors in one country hold higher percentage of domestic equities despite the evident losses from ignoring the possibility of diversification in foreign equities, then they are home biased. Since Levy and Sarnat (1970) there has been vast number of studies that confirmed the existence of the home bias not only in US, but also many other countries in the world. Tesar and Werner (1995) presented international investment positions of USA and Canada in the period 1975-1990, pointing out the home biasness of investors in these two countries. Cooper and Kaplanis (1994) showed the extent of equity portfolios concentration with domestic equities among 8 world major economies. Further evidence of home bias was provided by Adler and Dumas (1983), Lewis (1994), Lewis (1999)[1] who used in their studies the optimal portfolio framework based on utility maximization of investors. This approach will be replicated in this paper on 12 different stock indices. I prefer this approach to the original approach of Obstfeld-Rogoff (1996) according to which all investors around the world should have exactly same portfolio weights based on the market capitalizations. According to this approach Czech investors should hold less than 1 % of their portfolios in Czech equities. This prediction is based on a very strong assumption of the world with perfectly integrated markets. If we compared this prediction with reality it would lead us to the conclusion that they are strongly home biased. In this paper I assume investors are rational in the sense they know that the markets are not perfectly integrated. Therefore the utility maximizing approach is, in my opinion, closer to the real world investors.

The interesting contributions to the evidence of the equity home bias are the papers by Oehler et al. (2008) and Barker D. and T. Loughran (2007). The first paper recognizes a strong "Europe bias" among German mutual funds. The second paper introduces the "geographical bias". The study provides evidence that the closer the companies are to each other the more are their stock returns correlated. The recent papers do not focus mainly on providing only other proofs of the HB puzzle, but they try to view the puzzle from different perspectives and value the possible impacts of different factors. From the simplest perspective we can divide these factors into two groups: institutional and behavioral. Institutional factors of the existence of home bias are stemming from the violation of the main assumption of traditional

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[1] See Lewis (1999) for a survey of early literature about home bias puzzle.

finance: the"perfect" markets. There should not be barriers to entry, transaction or information costs and asymmetric information problems. Studies by French and Poterba (1991), Zalewska (2005), Warnock (2002), Kang and Stulz (1997), Coval and Moskowitz (1999) and Matsen (2002) examined the effects of various institutional factors, but none alone was prooved to be sufficient to explain the equity home bias puzzle. On the other hand, the behavioral finance researchers tried to find the reason of home biasness in the psychological biases[2] as optimism and overconfidence of investors, e. g. Fellner and Maciejovski (2003), loss aversion and narrow framing[3] (Magi 2007) and social identity, e. g. Fellner and Maciejovski (2003). The results of these studies have shown that these factors influence the equity home biasness of investors. I have re-examined the effects of transactions and information costs, exchange rate risk and psychological biases such as overconfidence, familiarity and social identity during the investment experiment.

In this paper, I will present a different methodological approach to the equity home bias puzzle. In the literature I could not find any attempt to provide an evidence of home biasness tested on experimental group of investors. Experimental[4] finance is increasing on importance in recent years. The reason for the experimental laboratory approach is that we can eliminate most of the institutional factors and see if there are behavioral factors behind the home biasness. In the experiment I presented an investment game to a group of university students. The task was to create a portfolio from 12 different stock indices. The group was divided into two parts: one did know the names of the countries of the indices, the second did not. Before and after the experiment I run questionnaires to get information about their investment knowledge and opinions and in the section III. I will present the most important findings and experimental hypothesis. Surprisingly, the students were rather foreign biased and winners had better investment knowledge and trusted in their intuition.

In section IV. I will present the evidence of portfolio allocation of Czech investors. The main finding of this paper is that the Czech investors are home biased if we compare the actual OECD (2009) evidence with the results of optimal portfolio model and investment

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[2] More details can be found in a survey of Barberis and Thaler (2002).
[3] These preferences create a special convex-concave (convex for losses, concave for gains) shape of utility fiction that can be found in Kahneman and Tversky (1979).
[4] More details about the history and methods of experimental economics (and experimental finance) can be found in the textbook of Davis and Holt (1993).

experiment. The reasons of home biasness of small investors can be transaction, information costs and FX risk. However, these factors should not influence the institutional investors.

II.   Model of optimal portfolio of Czech investors

II.1. Model selection

In the literature the recognition of equity home bias has been generally taken as a task to evaluate the optimal investment portfolio and compare it with the actual evidence. The early models were applied from portfolio selection framework of Markowitz (1952). The IAPM based on Sharpe (1964) and Lintner (1965) makes a very strong conclusion that all investors should in equilibrium hold equities in same proportions: weighted by the market capitalizations. The home bias puzzle was discovered in the papers of international diversification of investment portfolios (Levy and Sarnat, 1970). Adler and Dumas (1983) proposed an international asset pricing model (CAPM), which resulted in a vector of optimal weights of an investor with a given utility function. This asset pricing approach is based on a mean-variance optimalization. The researchers that try to prove the existence of home bias use concave utility functions and search for their maximum.   The development in this approach introduced Magi (2007) who extended this model with the Kahneman-Tversky utility function over the gains/losses from foreign investments.

In the optimal portfolio model I use three different utility functions: Markowitz (1), CARA (3) and CRRA (5). The resulting optimal portfolio weights will help us to the question whether the Czech investors are biased towards the domestic equities. All utility functions are concave which approximates the preferences of the investors who are risk averse. The difference between the utility functions is that CARA or CRRA utility functions are always increasing, but Markowitz utility function can be also decreasing.

II. 2. Assumptions of the model

The main assumptions of the model are that there are no transaction costs and no barriers to enter on a market. Let us assume that returns are normally distributed. Let us assume that the investors make their expectations based only on the past historical price, e.g. mean and standard deviation and maximize the expected utility with respect to the portfolio weights. Investors are assumed to be rational and cannot 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. All investors have the same utility function. For the sake of simplicity I assume that there is not a risk free investment opportunity other than any investment[5]. 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 also assume that the investors do not take into account the inflation[6]. Finally, let us assume that short selling is not allowed. This assumption is quite reasonable based on the fact that short selling is quite costly.

II. 3. Models of optimal equity portfolio

II. 3. 1. Model with Markowitz utility function
Let us first describe the investors with the Markowitz utility function:

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

where λ is in this model a proxy of risk aversion. Let us denote the vector of expected returns as a (n x 1) vector r , the transposed vector of returns looks like: $r' = (r_1, r_2,..., r_n)$[7], Ω stands for the (n x n) variance-covariance matrix, ω for a (n x 1) vector of desirable weights of the stock indices in portfolio: $\omega' = (\omega_1, \omega_2,..., \omega_n)$ and I for a (n x 1) vector: $I' = (1, 1,...,1)$. Investor is constrained with an equation: $\omega_1 + \omega_2 + ... + \omega_n = 1$. If we rewrite this condition in matrix algebra we get an optimalization constraint: $\omega' \cdot I = 1$. In this model we do not allow for costless short selling so the other constraint is that the weights cannot be negative.
In this notation the investor utility function of the portfolio at the end of next period:

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

we can simplify the equation by the assumption: $W_t = 1$. To solve the maximization problem we need to find a numerical solution[8] of the maximum of utility. It is a standard convex problem on polyhedral feasibility set, which assures that the numerical method has a unique solution[9]. In summary, the optimal portfolio weights are the results of this problem:

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[5] Monthly risk free rate at the time of evaluation on 1.10.2010 is very close to zero. Source : CNB
[6] Inflation on 1.10.2010 is also very close to zero (2 % p.a. , which means 0,16 % per month) Source: CNB

[7] In the model I assume only 1 period investment, therefore I will use henceforth the notation of r instead of $E_t r_{t+1}$.

[8] Run in Excel.
[9] As it is explained in textbook of Chong and Zak (2001).

$$\max_{\omega} U = (1 + \omega' \cdot r) - \lambda \cdot \omega' \cdot \Omega \cdot \omega, \text{ so that: } \omega' \cdot I = 1 \text{ and } \omega_i \geq 0,. \ i = (1,...n) \quad (2)$$

The results of the model with the levels of risk aversion λ are presented in the section II. 5. 1.

II. 3. 2. Model with exponential (CARA) utility function

The CARA utility function:

$$U = -E\exp(-\alpha W_{t+1}) = -E\exp(-W_t \alpha \omega'(1+r)) \quad (3)$$

where α is the coefficient of absolute risk aversion. For simplicity, let us again assume that $W_t = 1$. The assumption of the normally distributed returns leads to a log normal distribution and we search for the expected value:

$$E(LN(\bar{r}, \overline{\Omega})) = \exp(r, \frac{\overline{\Omega}}{2}), \bar{r} = -\alpha \omega' r, \overline{\Omega} = \alpha^2 \omega' \Omega \omega$$

Finally, the utility maximizing problem is:

$$\max_{\omega} U = -\exp(-\alpha \omega' E(r) - \frac{\alpha^2 \omega' \Omega \omega}{2}) \text{ so that: } \omega' \cdot I = 1 \text{ and } \omega_i \geq 0,. \ i = (1,...n) \quad (4)$$

The results of the model provided by the method of numerical solution with different levels of risk aversion α are presented in the section II. 5. 2.

II. 3. 3. Model with CRRA utility function

Constant Relative Risk Aversion utility function:

$$U = E\frac{W_{t+1}^{1-\gamma}}{1-\gamma} = E(\frac{W_t^{1-\gamma}}{1-\gamma}\omega'(1+r)), \quad \gamma \neq 1 \quad (5)$$

where γ is the coefficient of relative risk aversion. In this case, the maximization problem is:

$$\max_{\omega} U = \frac{W_t^{1-\gamma}}{1-\gamma} E\frac{(\omega'(1+r))^{1-\gamma}}{1-\gamma} \text{ so that: } \omega' \cdot I = 1 \text{ and } \omega_i \geq 0,. \ i = (1,...n) \quad (6)$$

To calculate the portfolio weights let us use a numerical approximation of the integral of expected value of the utility function:

$$E(U(x) = \int_{-\infty}^{\infty} U(x)f(x)dx = \frac{W_t^{1-\gamma}}{1-\gamma}\int_{-\infty}^{\infty}\frac{(1+\omega'r)^{1-\gamma}}{1-\gamma}f(x;\omega'r,\omega'\Omega\omega)dr$$

where $f(x;\mu,\Sigma)$ is density of normal distribution with parameters μ and Σ. This utility maximization problem with the CRRA utility is irrelevant on absolute wealth. Portfolio

weights will be same with investments 1 CZK or 1 mil CZK. the results with different levels of risk aversion γ are presented in the section II. 5. 3.

II. 4. Data description

To investigate the home bias puzzle in Czech Republic we need to simulate a world equity portfolio. In the model we use more than 13 years of monthly data starting in July 1997 and finishing in October 2010[10]. For Czech investors the world equity market comprises of 11 foreign[11] and one domestic stock index[12]. Foreign equity indices were converted into CZK and the monthly continuous compounding returns are calculated by the formula: $r_t = \ln P_t - \ln P_{t-1}$ [13].

II. 5. Results of the optimal portfolio model[14]

In following sections you can find the results of the optimization problems (2), (4) and (6). Optimal portfolio model is presented with 3 utility functions and restriction on short selling.

II. 5. 1. Results with Markowitz utility

Let us now discuss the model for different levels of risk aversion between 1/3 and 4/3. For higher levels of risk aversion the investor would prefer not to invest (the maximum of expected utility would be less than 1, which would be lower than utility of the W_t).

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[10] The monthly data were taken as the opening prices of the month, starting at the beginning of July 1997 and finishing at the beginning of October 2010.

[11] The markets of the important developed economies were selected: USA, Japan, Germany, UK, and Switzerland. Equity markets from different regions: Brazil, India, Hungary, Russia, Israel, and Hong Kong.

[12] Domestic index: PX. Foreign equities: United States: SP 500 (US), Japan: Nikkei 225(JA), Russia: RTS $ (RS), India: Bombay Sensex (IN), Brazil: Brazil Bovespa (BZ), Germany: DAX (GE), UK: FTSE 100 (UK), Hong Kong: Hang Seng (HK), Switzerland: SMI (CH), Israel: TA 100(IS) Hungary: BUX (HU). Sources: PSE, Yahoo finance, BSE, RTS

[13] P_t is the opening monthly price of index after the conversion into CZK. Monthly exchange rates were taken from ČNB and www.exchange-rates.org. For several currencies we had to calculate the cross exchange rate via the exchange rates of local currency and USD and CZK/USD. Because ČNB announces the exchange rates at the end of working day, we used the monthly closing exchange rate instead of the exchange rate on the first working day in month (closing exchange rate of previous month is equal to opening exchange rate of the new month).

[14] The data and computations can be found in Bata - optimal portfolio model and information for experiment.xls.

Table 1: Optimal monthly portfolio weights (Markowitz utility)

Risk aversion	CZ	IN	BZ	GE	UK	HK	JA	CH	US	IS	HU	RU
1 1/3	**45%**	**4%**	0%	0%	0%	0%	0%	**9%**	0%	**42%**	0%	0%
1	**50%**	**3%**	0%	0%	0%	0%	0%	0%	0%	**47%**	0%	0%
1/2	**53%**	0%	0%	0%	0%	0%	0%	0%	0%	**47%**	0%	0%
1/3	**54%**	0%	0%	0%	0%	0%	0%	0%	0%	**46%**	0%	0%

As we can see in the Table 1, Czech investors with Markowitz utility would invest between (45-54 %) in the Czech equities. The reasons for this high portfolio weights can be found in relatively good performance of Czech market in the selected period (1997-2010) and foreign exchange rate risk, which makes the foreign indices more risky.

II. 5. 2. Results of the model with exponential utility

In this section I present the results of the model with exponential utility. I use different levels of risk aversion including the estimations of the coefficient of risk aversion from the paper of (Bliss and Panigirtzoglou, 2004): $\alpha = 0,91$.[15]

Table 2: Optimal monthly portfolio weights (exponential utility)

Risk aversion	CZ	IN	BZ	GE	UK	HK	JA	CH	US	IS	HU	RU
0,91	**53%**	0%	0%	0%	0%	0%	0%	0%	0%	**47%**	0%	0%
2,00	**50%**	**3%**	0%	0%	0%	0%	0%	0%	0%	**47%**	0%	0%
3,00	**43%**	**3%**	0%	0%	0%	0%	0%	**15%**	0%	**39%**	0%	0%

Again we can find a high share of domestic equities (43 -53 %) in the portfolio of Czech investors with the exponential utility.

II. 5. 3. Results of the model with CRRA utility

Thirdly, let us have a look on the resulting weights from the model with. Friend and Blume (1975) argue that the coefficient of risk aversion should be even in excess of two. Bliss and Panigirtzoglou, (2004) proposes the $\gamma = 4,05$ [16]. As we can find in the Table 3 the changes in coefficient of relative risk aversion create the smallest differences among the three utility functions. I used also the negative coefficients[17] with the similar results.

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[15] This is an option-implied coefficient for 4 weeks (1 month) period on 95 % level of significance.

[16] This is an option-implied coefficient for 4 weeks (1 month) period on 95 % level of significance.

[17] For γ lower than -1 we have to search for minimum instead of maximum of the utility function.

Table 3: Optimal monthly portfolio weights (CRRA utility)

Risk aversion	CZ	IN	BZ	GE	UK	HK	JA	CH	US	IS	HU	RU
2	**22%**	**2%**	0%	0%	**11%**	0%	0%	**52%**	0%	**13%**	0%	0%
3	**22%**	**2%**	0%	0%	**11%**	0%	0%	**52%**	0%	**12%**	0%	0%
4,05	**22%**	**2%**	0%	0%	**12%**	0%	0%	**52%**	0%	**12%**	0%	0%
0	**23%**	**2%**	0%	0%	**9%**	0%	0%	**53%**	0%	**14%**	0%	0%
-2	**23%**	**2%**	0%	0%	**6%**	0%	0%	**54%**	0%	**15%**	0%	0%
-4	**24%**	**3%**	0%	0%	**4%**	0%	0%	**54%**	0%	**16%**	0%	0%

These results of the model with CRRA are perhaps the most reliable, because the CRRA model is independent on absolute value of wealth, e.g. it does not make a difference if the investor invest 1 CZK our 1 million CZK.

III.   Investment experiment[18]

III.1. Motivation and main hypotheses

Experimental studies by Smith et al. (1988) and Camerer (1987) for example, used the experimental settings to investigate the formation of expectations and decision making on markets. However, there was not done a study that had tried to prove the existence of equity home bias among an experimental group of investors. There are two types of experiments: "field" and "lab". The first type has the advantage that it is tightly linked to a reality, the second type, on the other hand, has the advantage that we can make an ideal setting to isolate specific aspects.

To investigate the home biasness of Czech investors I decided for the laboratory experiment. The design was set so, that there were no institutional barriers and experimental investors could trade free of charge 12 different stock indices. All investors got the same information about the historical performances as used for the optimal portfolio model in section II. Also the task of model and experimental investors was the same: create a portfolio for one month. Therefore, I can compare the results from the model and from the experiment. **Hypothesis 1** is that if the experimental investors are home biased the resulting weights should be significantly higher than the model weights. In the experiment there are no transaction costs and higher portfolio weights for Czech Republic (or any country) would be a proof of equity home (specific country) bias as a result of some behavioral factor.

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[18] Design of the experiment and the main hypotheses were discussed during a round table discussion on the IAREP/SABE/ICABEEP conference in Cologne in September 2010.

I designed two versions of the experiment: Version 1 with the known names of countries and Version 0 without the names. **Hypothesis 2** is if the knowledge of the country has the impact on the decision making process, these two versions should result in different weights. A sign of home (country) biasness would be if the knowledge of a country name resulted into significantly different portfolio weights for Czech (other country) stock index.

The further research interest of this experiment was the other factors behind the investment decisions (sex, experience, education, social identity preference, etc.). In particular, my interest is in finding the personality traits of successful investors. Therefore, two questionnaires accompanied the experimental game and the findings will be discussed in section III. 5.

III.2. Pilot version

Pilot version of the experiment was done on a group of high school during a class of Economics. 31 students were given a similar experiment that will be described in the following section. The only main difference is that they did not get real money (gains nor losses) from the investment. To motivate them they were competing with each other, because only the three best investors were given a small financial reward. I got some important feedback from this pilot version and thereafter reformulated task of the experiment and questions to be clear and more understandable. Most importantly, on the data was done a test to see the minimum number of participants to be able to answer the hypotheses. I used the design g power 3 technique, so the power was higher than 0,8 for the 95% significance level. I assumed that the parameters of distribution for the pilot experimental group would be same as for the experimental group of students. Secondly, I assumed that the effect size would be at least average (according to Cohen convention in Sheskin (2004) the Cohen´s d index should be at least 0,5). The analysis based on this d test has shown that at least 28 students are needed to get appropriate results of the experiment.

III. 3. Design and organization of the experiment

Experimental group of students[19] of Charles University was divided in two subgroups: the first was formed by the master students of economics (experts) and the second by the students

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[19] This group was selected by anonymous organizer (author of this paper) to assure that the participants could not know the exact purpose of this experiment.

from different (non-economic) faculties.[20] The experiment was done on 12/11/2010 at the Institute of Economic Studies of the Faculty of Social Sciences. The experimental procedure was divided in 5 steps:

1) Introduction and explanation of the investment game
2) Investment questionnaire
3) Investment experimental game
4) Additional questionnaire
5) Payment of the reward

The questionnaire before the experimental game was designed to scan the general knowledge, opinion and experience of the participants about trading on equity markets. The questionnaire after the game was strongly connected to this specific investment game. The questionnaire before was more about personality traits, the questionnaire after was more about the way the participants made their decisions.

The main part of the experiment was the investment game with time limit of 30 minutes. Participants had to choose between 12 different equity indices and create a portfolio with 100 units of equity indices[21]. All of them received historical information of past 13 years of monthly data (charts with historical prices, mean, standard deviation, maximum and minimum a correlation matrix). This data was identical to the data used for computation of the optimal portfolio weights in portfolio models in section II. They were told that all indices are computed in national currency (CZK) and that they have to invest for one month[22] (without any transaction costs). The reward for participation was 500 CZK + gains (-losses). Guaranteed minimum reward was 250 CZK. The results of their choices are summarized in Table 4.

III.4. Individual investment portfolios[23]

In total 32 students participated in the investment game[24]. They were equally divided into two subgroups and each was given a different version of the experimental game. In the version 1, they did know the names of the countries, in the version 0 they did not know (indices were

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[20]The group of experts consisted of 14 students. The group of non-economic students consisted of 15 students of Natural Sciences (PRF UK), 1 student of philosophy (FF UK), 1 student of medicine (LF UK) and 1 student of mathematics (MFF UK).

[21] All indices were normalized to 100 CZK a unit at the final date (1/10/2010).

[22] The data set ended on 01/10/2010 and the evaluation of the profits of the investment was done with the prices one month later (01/11/2010).

[23] Analysis was done in SPSS 16.0.

[24] That is higher than the minimum of 28 as it was recommended after the pilot experimental group.

labeled A, B, C …L). In the Table 4 below you can find the average portfolio weights of the experimental investors.

Table 4: The portfolio weights selected by experimental investors

Group	CZ	IN	BZ	GE	UK	HK	JA	CH	US	IS	HU	RU
Version 1	14%	20%	7%	5%	4%	7%	2%	4%	2%	16%	15%	4%
Version 0	12%	21%	11%	4%	3%	3%	8%	5%	3%	16%	6%	6%
Total	**13%**	**21%**	**9%**	**4%**	**4%**	**5%**	**5%**	**5%**	**2%**	**16%**	**11%**	**5%**

Before evaluating the hypothesis, let us look whether the chosen portfolios were efficient. Based on the historical returns and covariance matrix we can compute an efficient market frontier i.e. combinations of expected returns and variance so that the investors that trade the optimal portfolios cannot gain additional increase in expected returns unless they increase their exposure to risk. We compared the efficient frontier with the portfolio selection of experimental investors. The result was that the investors did not select the efficient portfolios. On average they could gain approximately 0,2 % of increase in expected returns while attaining the level of their exposure to risk (variance). The group of "experts" (students of finance) were even less efficient, because they could gain 0,25 % of expected gain. This result signals that even students of finance do not make their decisions based on the studying materials. Interesting finding of the experiment was that all experimental investors would be closer to the efficient frontier if they invested more in Czech equities. This effect was quite significant, because on average they would have to increase the proportion of Czech equities in their portfolios by 57 % if they wanted to reach the efficient market frontier. Based on these data we can make conclusion that all students are foreign biased, i.e. if they invested only based on historical data they would invest much more in Czech equities.

Hypothesis 1: experiment vs. model

We tested if the portfolio weights of the whole experimental group were significantly different from the optimal model weights. I used the method of GLM multivariate analysis of the difference between the experimental weights and model weights. We also used the nonparametric sign test that has shown if a typical experimental investor invested less than the model for the Czech index.

    a) Markowitz and Exponential[25]

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[25] The resulting weights were almost the same for these two utility functions. See Table 1, 2 and 4.

GLM has shown that we these two weight´s vectors are significantly different.[26]. Also the sign test confirmed this finding on 99,9% significance level.

b) CRRA[27]

The results were the same for all countries even for these results[28], despite the fact that the model weight for Czech index was closer to experimental weight for the index.

These findings were against the hypothesis of home biasness in these settings. On contrary, the students in this experimental environment were "foreign biased", e.g. they favored the foreign equities more than the model that evaluated the same data. These findings with the answers in the questionnaires can imply that the real world investors would invest more into foreign equities if they did not have to face the transaction and informational costs.

Hypothesis 2: difference for two versions[29] based on knowledge of country:

We used the independent sample t test with a result that there was no significant effect for any country[30]. The knowledge of the country did not matter that much to students to make their investment decision.

The most of the students (78 %) thinks that men are better investors. In this experiment it was shown that male participants gained on average more[31]. 88 % of students had made the investment decision judging from charts with historical prices and 60 % believe in trend.

Only 23 % thinks that to be successful in equity investments luck is more important factor than knowledge and experience. This opinion can be interpreted as that the most of investors do not believe in the efficient market hypothesis. If the markets were strongly efficient, the future movements would be random (and only luck would matter). No one could earn abnormal profits based on their knowledge or private information. The experimental investors did not believe even in the weak form efficiency, because they were evaluating the historical movements. The importance of knowledge as a factor of successful investors was confirmed in a classification tree presented in the following section.

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[26] P-value was less than 0,001. Partial eta square 0,969 which signalizes a strong effect.
[27] We compared the weights in Table 3 with the weights in Table 4.
[28] P-value was less than 0,001. Partial eta square 0,992 which signalizes a strong effect

[30] P-value for Czech index was 0,654.
[31] Average gain of female participants was 85 CZK and average gain of male participants was 135 CZK.

III.5. Personality traits of successful investors

The question of interest of this paper was also: "How can we recognize successful investors?" Are there any factors (personality traits, individual past experience and knowledge, sex, etc.) that bear the investors that can systematically beat the market? We have analyzed a classification tree[32] to see what the significant factors behind the profits (gains).

Figure 1: Classification tree of investment gains (Profits of the experimental investors)
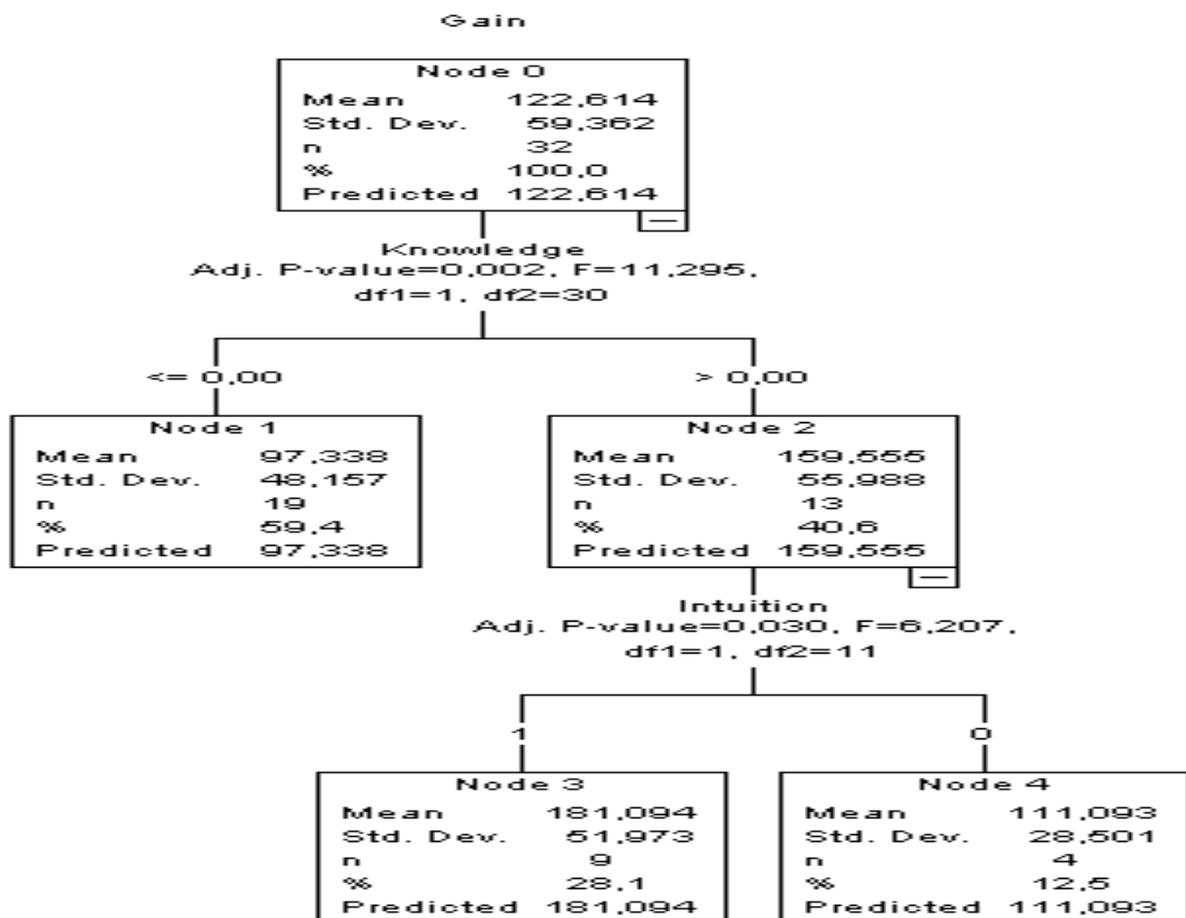
As we can see in the Figure 1, the most important factor was the subjectively perceived level of knowledge about equity investments. Those who thought that their knowledge is above average earned significantly[33] more (62 CZK on average). The other important was the admitted usage of intuition in the investment decision process. From those who had the better

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[32] CHAID growing method parent mode 3, child mode 2
[33] P-value=0,002

knowledge, those who also believed in intuition gained significantly[34] more (70 CZK on average).

Other interesting observation was that those who revealed the social identity attitude [35](patriotism) were not in fact investing significantly more in Czech equities. Furthermore, 41 % students believe that FX risk is higher than the equity risk. However, measured by the standard deviation, the monthly currency exchange rates are approximately half as risky as the indices[36]. The students admitted that if they had to change the currencies they would invest less in foreign indices. And finally, the education itself did not matter. Students of economics did not gain more than students of other faculties[37].

IV. Evidence of allocation of Czech equities in portfolios of Czech investors

To determine the home biasness we should look on the financial accounts of Czech Republic from global perspective. According to the model approach we need to calculate the weight of domestic equity investment on total equity investment of Czech investors (including government and financial sector). The portfolio weight for Czech investors according the OECD (2009) statistics at the end of 2008 was 85%[38]. If we compare this weight with the weight from the optimal portfolio model (22% - 53%) and the resulting weight from the experiment (14 %), we can see that the actual share of domestic equities in portfolio of all Czech investors is much higher than the model (or experimental) share.

Baele et al. (2007) and Sorensen et al. (2007) compared the actual portfolio with optimal portfolio to determine the home bias. They used a different formula to determine the actual foreign portfolio of Czech investors. If we use the same formula we get[39]:

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[34] P-value=0,03

[35] They answered yes to: „I would rather invest in Czech equities to support Czech companies".

[36] I calculated the average standard deviation of monthly returns of currency pairs (CZK/USD, CZK/EUR, etc. and compared it with average standard deviation of equity returns in local currencies. Average FX risk for the 13 years data series was 3,6 % as opposed to 7,7 % to average equity risk. The perceived riskiness of currencies might have been caused in the movement in favor of CZK. The monthly mean of currency returns in the period was -0,4 %.

[37] Average profit of a student of economics was 124 CZK and average profit of a non-economic student was 122 CZK.

[38] I used the rows AF51 (shares and other equity without mutual funds) of the National accounts of Czech Republic. All Czech investors (Sector: Total economy) owned 2 506 384 mil CK in Czech equities and 320 836 mil CZK in foreign equities (Sector: Rest of the World).

[39] As for 31.12.2008 the Foreign assets were 189 701 mil CZK, Foreign liabilities 179 775 mil CZK (Fisher et al., 2009) and total Market Capitalization was 1 091 730 mil CZK (BCCP).

$$ACTUALPORTFOLIO = \frac{ForeignAssets}{ForeignAssets + MarketCapitalization - ForeignLiabilities} = 0{,}17$$

Actual foreign portfolio weighted by the market capitalization of Czech Republic is 17%. This indicates the actual domestic portfolio as 83 % which is close to the result of OECD statistics.

IV. Conclusion

The model of optimal portfolio predicted the optimal weights of domestic equities in portfolios of Czech investors to 22%-53%. In the lab experimental conditions students who were given the same information as was processed by the model chose in average only 14 % of Czech equities. This can be interpreted as a foreign biased behavior which can be confirmed also by the comparison between the portfolios on efficient frontier and the portfolios of experimental investors. This behavior can be explained by the specific laboratory conditions that assured that transaction costs, information costs and FX risk would not play role. However, according to the questionnaires these are the same factors that would eligibly distract them from investments in foreign equities.

If we look on the evidence of OECD (2009), there is 85 % of domestic equities in equity portfolios of Czech investors. This is much higher weight than the model, experiment or Obstfeld-Rogoff (1996)[40] proposed. The policy implication of this result is a recommendation for Central Bank and government to sell Czech equities and buy more foreign equities. These institutions do not face the same transaction and information constraints about foreign companies as small investors. Individual investors (households and non financial companies in the OECD statistics) face the higher transaction costs, but mainly the informational and knowledge constraint. For individual investors the cost to learn and keep in touch with the important information on global equity markets are too high, therefore it is rational for them to prefer investments in Czech equities. On the other hand, big institutional investors, Central Bank and government could benefit from the diversification in foreign equities.

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[40] They proposed that Czech investors should hold only a fraction of Czech equities in their equity portfolios. Their optimal weight of domestic equities=Czech market capitalization/world market capitalization.

List of abbreviations and symbols:

BZ	Brazil Bovespa stock index
CH	Swiss SMI stock index
CZ	Czech PX stock index
CZK	Czech crown
GE	German DAX stock index
HK	Hang Seng stock index (Hong Kong)
HU	BUX stock index (Hungary)
IN	Bombay Sensex stock index (India)
IS	TA 100 stock index (Israel)
JA	Nikkei 225 stock index (Japan)
RS	Russian RTS stock index in $
UK	FTSE 100 stock index
US	Standard and Poor's 500

r	Average returns of stock indices
ω	Portfolio weights
Ω	Variance-covariance matrix
λ	Coefficient of risk aversion (Markowitz)
α	Coefficient of absolute risk aversion (Exponential)
γ	Coefficient of relative risk aversion (CRRA)
W_t	Investor's wealth at time t
U	Utility function of investors

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