FURTHER ASPECTS OF THE EQUITY PREMIUM PUZZLE

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This paper is a sequel to a previous article by the same author published in issue 2012/5 of *Hitelintézeti Szemle* ("A kockázati prémium rejtélye Magyarországon" [*The equity premium puzzle in Hungary*]). Previously it was revealed where the puzzle comes from, and a comprehensive overview presented of explanations offered to date. The main objective of the article was to examine the Hungarian features of the puzzle. In the first part, this study expands the scope of analysis and presents the characteristics of the puzzle in the context of the CEE Stock Exchange Group (CEESEG), a group crucial to the Hungarian economy. In the second part, it presents the author's ideas, offering a solution to the equity premium puzzle. Finally, the author sums up the most important results.

JEL codes: D11, D12, G11

Keywords: theoretical and empirical research in consumer behaviour, investment decisions

INTRODUCTION

In his previous article, the author of this article was unable to discuss every aspect of the equity premium puzzle[1] due to the lack of time and space. The analysis of Hungarian data and their comparison with theoretical limits might have seemed like an end in itself. Firstly, I shall seek to redress this and investigate the chronology of risk aversion[2] calculable from the data of six countries, including Hungary. The reason for selecting the specific countries in this analysis is that Hungary is part of the Central and Eastern Europe Stock Exchange Group (CEESEG; together with Austria, the Czech Republic and Slovenia). Consequently, it is extremely important for Hungary to have an awareness of investor behaviour in these countries. However, not wanting to confine my research to the realization of theoretical limits (or failure thereof), I involved as benchmarks Poland (as the most powerful Eastern European country with an independent stock exchange) and the United States (the most important economic power in the world) where I also explored the equity premium puzzle.

1 The first publication of the equity premium puzzle: Mehra and Prescott (1985).

2 CRRA: constant relative risk aversion. For the theoretical background see Arrow (1965) and Pratt (1964).

The other topic superficially discussed in the previous paper was the issue of using ex ante and ex post premiums in analysis. An entire chapter will be devoted to the issue in this paper.

While researching the topic, naturally I gave much thought to what might cause the phenomenon. Having reviewed the many explanations that have been proposed, I have come up with a view of my own. Collecting my thoughts, I arrived at a solution that removed anomalies in all of the examined countries and might even provide an explanation to the mystery.

1. DATA

Firstly, I would mention that as opposed to other works on this topic, but in keeping with my previous article, due to the shortness of the examined time span (31.12.1996–28.06.2013) I used quarterly data in my analyses. That does not affect conclusions and deductions, since *A* is a value existing in a given moment, and it is this very property – due to the greater frequency of observation – that makes it suitable for drawing more accurate conclusions. The choice of the starting date was based on the fact that by 1997 almost all of the examined countries had relevant returns data (such as Hungarian discount T-bill returns data from 1997 onwards), and that was around the time when stock exchange turnover increased considerably in Easter Europe, making it possible to draw more generally valid conclusions about investor behaviour and motivation.

The data and sources used in this analysis are listed in the Appendix. Quantifying risk aversion requires information about real returns, calculating which involved the use of leading stock exchange indices (as an Re source), as well as short-term risk-free interest rates[3] (as an Rf source) available from the OECD statistical data base. Calculation of the latter was based on interbank interest rates on loans shorter than 3 months, that is, they can truly be regarded as risk-free. Although consumers cannot trade in such products, this proved to be a relevant data source in the course of calculations, in that comparing OECD data for Hungary with returns calculable from the RMAX index data (indicating the average exchange rate fluctuation of short-term government bonds) revealed a 0.02 percentage point average deviation, which is so low that it has no substantial effect on the value of *A*.[4]

3 The OECD database is incomplete in places. The method for filling in these gaps will be discussed for the countries concerned.

4 The 2012 article used different data sources (primarily Hungarian Central Statistical Office data); however, because foreign input was required for an international comparison, this research used standard OECD statistical data.

The use of stock exchange indices (HUN: **BUX**; AUT: **ATX**; CZE: **PX**; SVN: **SBI 20** and **SBITOP**; POL: **WIG 20**; USA: **S&P 500**; CEESEG: **CEESEG** and **CEETX**) is warranted by the fact that they consist of the weighted portfolios of the major stocks of the given exchange, and consequently they are good indicators of the given market, they serve as a basis of transactions and therefore reveal actually realisable returns.

Naturally, these calculated returns reveal changes in the full value, that is, they represent nominal values. In an effort to gain real returns, it also necessary to reduce the resulting returns by inflation. I calculated current inflation on the basis of consumer price index, also on the basis of OECD statistics. Determining the value of the

$$E_t(Re_{t+1}) - Rf \approx Acov_t(\ln\left(\frac{c_{t+1}}{c_t}\right), Re_{t+1})^5 \quad (1)$$

equation requires the real change in per capita consumption. The source of that data was the OECD for European countries and the Bureau of Economic Analysis for the United States. In every case I used current-price data adjusted by inflation. All the required data was now available for performing the analysis.

To determine parameter *A*, following from the logic of the deduction, for every *t* + 1 date, the premium used for the calculations was the average of share premiums for 1; …; *t* dates. Using quarterly data comes with an issue that does not pose a problem with yearly data: that of the time delay. By this I mean that when calculating the covariant in equation (1) the fact that consumption characteristically reacts slower to economic change than stock-exchange returns must be taken into consideration. A consumer cannot be expected to instantly react to changes of returns caused by real economic change. The reason is that selling and buying incur transaction fees and other costs (such the alternative cost of time expenditure), and consumers have other income sources and financial reserves they can temporarily draw on to finance their consumption, investment losses notwithstanding.

Still, however, the covariance of returns and consumption makes sense over shorter periods of time, too; albeit some adjustment is necessary. Imagine the consequences of a prolonged, significant crisis (such as the 2008 crisis) on consumption. When the crisis broke, the population's consumption did not drop immediately, and investors did not instantly start "saving". It takes time for change in returns to influence consumption at the level of savings.[6] This period is also important because minor (very low) fluctuations in rates can level out, leading to more constant and predictable consumption.

5 For the deduction see BÉLI (2012).

6 To borrow a term from macroeconomics, the risky returns and the change of consumption can be regarded as lead-lag compensators (not according to the strict definition).

The data confirm this in that due to the crisis major stock-exchange indices closed well below zero as early as in Q3 and Q4 of 2008 (stock-exchange indices in the examined countries dipped by 15% in Q3 and over 30% in Q4), the drop in consumption followed behind later (the first major drop being in Q1 of 2009 in most countries).

Consequently, in an effort to achieve more accurate results, in calculating covariance, time delays need to be given consideration and the data adjusted accordingly. This delay in itself affords much interesting information about consumer and investor behaviour. In countries where this time delay is the shortest (for example, in Hungary and the United States no delay was observed) the reasons need to be explored. It could partly be due to investor attitude and behaviour; meaning that investors are "more anxious" and react to change more sensitively or they simply more consciously adjust their investment decisions to their consumption habits; possibly, the population generally lacks other types of major savings and are therefore more vulnerable to the change in returns. This leads to the fact that even within the span of a quarter they will react to changes. In countries, however, where the delay is greater (such as in Austria where it is six months), the opposite is likely; investors are more prudent and savings across the population are larger.

Choosing the right time delay might also cause problems. Fortunately this is not a very serious challenge either, due to the fact that the wrong choice of delay produces a rather strange result: negative covariance. That would assume we increase consumption expenditures when suffering losses to our investments. Naturally that is perfectly absurd, so such possibilities can be excluded. Next, we need to find the first match available with the slightest time delay, where covariance is positive (possibly for every date) and that will be the extent of time delay. Naturally if we were to continue this shifting procedure, we would find situations with positive results, but that would be more due to seasonality. (For example, if in every Q4 returns are higher than average, followed by higher consumption in Q1, then examining all possible time matches would lead to similar covariance in every four quarters, that is, 1, 5, 9, etc. quarterly delays would also lead to positive covariance.)

It is important to note that I have not come across such time delays in the topic, but that is due to the fact that in exploring premiums the literature (almost exclusively) calculates with, and analyses, annual data. Naturally, then, delays do not make much sense in the case of annual data, since consumption has time to adjust, and also, in the course of a year substantial changes can neutralise one another. This is supported by the fact that nowhere in the analyses I produced did delays longer than a year occur, because everywhere consumption levels reacted

to change faster than that. (To be precise, when examining the phenomenon on a yearly basis, using the data of the given year is a smaller error than using the data of the following year.)

2. RESULTS BASED ON HISTORICAL DATA

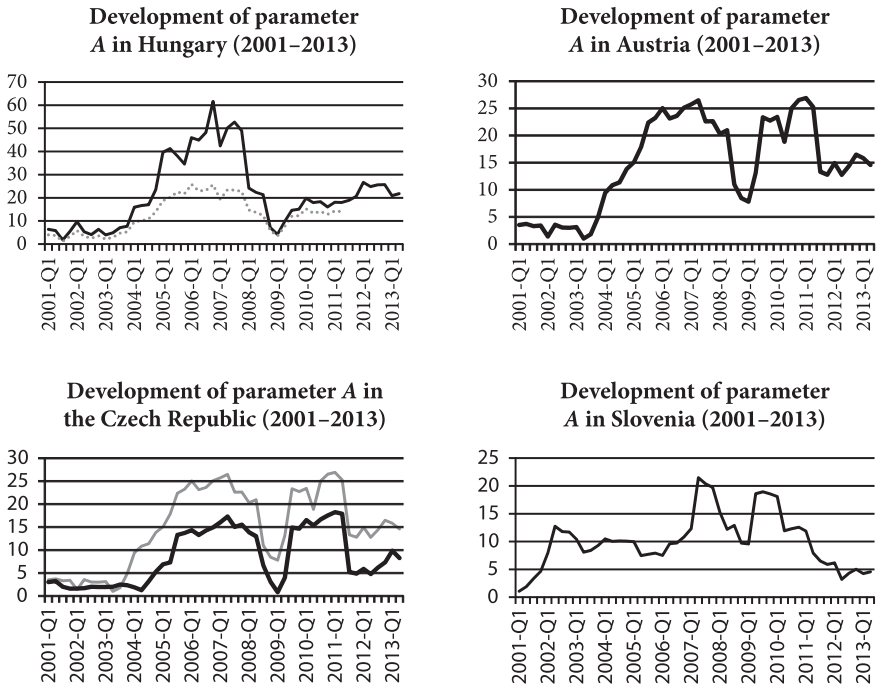
This chapter will first demonstrate the phenomenon for the CEESEG members (Hungary, Austria, the Czech Republic and Slovenia), based on historical data. Secondly, it will briefly examine two indices describing the CEESEG group. Finally, it will present characteristics of the puzzle in Poland and the United States.

2.1. The CEESEG group

The equity premium puzzle can be observed in all of the CEESEG members. Proof of the phenomenon is the unrealistically high value of the only variable in equation (1), *A*, the constant relative risk aversion (CRRA). Figure 1 shows how the calculated value of CRRA in Hungary[7] was higher than 60 in Q4 of 2006! That is completely inconsistent with expectations, and similarly to other examined countries, it is higher than the generally accepted maximum value of 10. (For a detailed description of the acceptable level of the CRRA, see *Mehra* (2008) and *Béli* (2012).

7 In the case of Hungary, the OECD database did not provide data for risk-free returns. These missing values were replaced with returns calculated from the RMAX index, on account of the fact that, as mention above, the difference between the two returns at quarterly level is just 0.02 percentage points.

Figure 1
The development of parameter *A* in Hungary, Austria, the Czech Republic and Slovenia between Q1 2003 and Q2 2013



Note: The results were produced with the 2012 methodology for Hungary are marked with dotted lines (*Béli*, 2012). The discrepancy is due to the fact that I estimated the change of per capita consumption from changes of the consumption of the entire population and linear approximation of changes in the numbers of the population. The present study uses the OECD database that uses a more sophisticated methodology to estimate change in per capita consumption than the linear approach. I believe it is right to discuss this discrepancy, in particular since, as the figure reveals, the curve itself has not changed, only the amplitude of change has increased in consequence of the different methodology.

The Austrian results are represented by the grey line in the figure for the Czech Republic.

The average share premium in Hungary in the examined period was 4.23%; risk-free real returns 3.4%; while the real change in consumption just 1.18% per annum. I analysed in detail changes in risk aversion in Hungary in my previous article, and although the levels of the curve differ, the conclusions described are still valid. Briefly, below is a summary of these conclusions:

- the curve refers to continuous excessive risk aversion;
- the crisis only temporarily affected investor behaviour; and
- the figure clearly reveals the development of the capital market and the optimistic atmosphere of early 2000s.

It should also be pointed out that the changes in risk aversion in Hungary can be considered to be outstanding even in the context of the countries examined, which could be related to the time delay described in the previous chapter. Specifically, in the case of Hungary, there is no time delay between changes in returns and the consumption at quarterly level, meaning that either consumers do not have adequate savings or they react more vehemently to capital-market changes (hence the drop in the curve when the crisis broke).

Comparing the results for Austria with the Hungarian curve reveals that changes in the risk-aversion coefficient are similar in the two countries. There are, however, two fundamental differences. Firstly, the Austrian curve is lower all along, and secondly, differences occur after the 2008 crisis due to the fact that although the *A* parameters for both countries continue to rise to similar levels up to 2011, a decrease can be observed for Austria, that is, risk acceptance is higher there while in Hungary risk aversion did not decrease. That is exemplified by the fact that in recent years the Hungarian investment environment was less stable than its Austrian counterpart and consumers were likely to invest for greater investment premiums in Hungary.

The fact that even before the crisis risk aversion was higher in Austria suggests that the capital market has a greater "tradition" in that country, meaning that consumers are willing to invest for lower premiums. That is natural, given the historical differences between the Hungarian and Austrian stock exchanges.

However, it can also be seen that even in the case of Austria, the value of the risk-aversion coefficient is considerably higher than might be expected on the basis of the models or empirical tests.

Like in Hungary, it can be seen that prior to 2004 the value of risk aversion was lower, but gradually increased in 2004; in other words, the trend in Hungary can be regarded as a regional phenomenon. The development of investment culture and the optimistic mood in 2004 did not constitute a country-specific phenomenon.

The regional character of the phenomenon suggests that very similar results can be expected in the case of the Czech Republic. (To better demonstrate this, the Austrian results are represented by the grey line in the figure for the Czech Republic.)

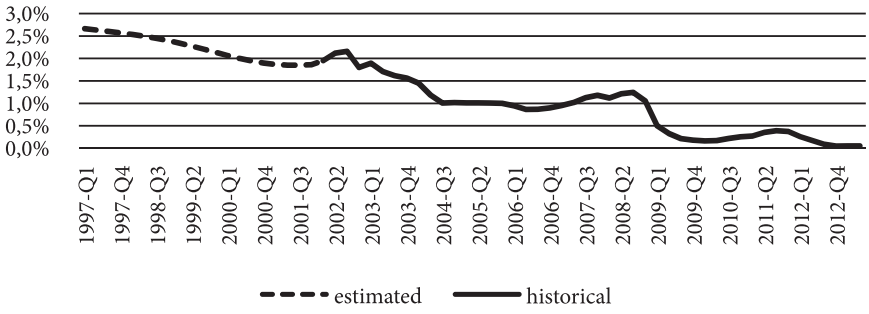
It can be seen that the two curves run almost entirely together and the difference is in the levels only. That firstly suggests that everything that was said about Austria and Hungary holds up in the Czech Republic too, and secondly, that investors deem the Czech Republic to be a safer place with respect to risk acceptance than Austria, and will accept a lower premium for the same amount of risk.

The effects of the 2008 crisis can be seen in both the Czech Republic and Austria, when implicit risk aversion dropped to the "right" level. In the Czech Republic *A* had decreased to 0.85 by Q1 2009. That is lower than expected and suggests that in the wake of the crisis share returns decreased to the point that, historically, risk premium almost entirely disappeared. However, over the examined time span, the average value of *A* is still 8.52, which might be lower than 10 but is still significantly higher than the expected average of 3.

Analysing the fourth CEESEG member, Slovenia, posed a considerable problem in that no risk-free returns data were available from before 2002. Due to the standard frame of analysis, I had to decide either to only take into consideration post-2002 data, or try and make up for lacking data for Slovenia. If had gone for the first option, a considerable amount of information would have been lost, so instead I decided on the lesser of two evils and went for the second option and applied, using risk-free returns data, an ARMA (3;3) model with a linear trend to the chronology.[8] (In an effort to achieve the best results, I used monthly data for the model.) The model cannot be refuted at a significance level of 3%; residuals do not contain autocorrelation and their distribution can be regarded as normal.

Historical and my estimated risk-free returns are presented in *Figure 2*:

Figure 2
The values of quarterly risk-free returns in Slovenia (Q1 1997 – Q2 2013)



In light of the fact that this is merely an estimation, Slovenian results need to be treated with caution; especially in the case of pre-2002 values; still, however, they afford some valuable conclusions regarding changes in risk aversion.[9]

8 The model was created with the gretl package.

9 It should be mentioned that risky returns between 1997 and the second quarter of 2006 were calculated from the SBI 20 index, and after that risky returns were calculated from the SBITOP index – the reason being that the latter was launched in 2006 and the former discontinued in 2007.

In the case of Slovenia, too, it is noticeable that back-calculated risk aversion exceeds 10 in most cases and is therefore also inconsistent with theoretical models. Noticeably, too, the 2008 crisis had an impact, if not quite to the same extent as in the previous countries. This is largely due to the fact that stock-exchange returns in Slovenia did not soar until 2007, that is, later than the rest of the region. Consequently, the 2008 crisis did not hit a long-established market, thus causing lesser "damage".

Examining risk aversion and the change in returns suggests that in terms of capital market, Slovenia is lagging behind regional capital markets; however, differences have increasingly reduced over the past years. Signs of financial stability are clearly visible and the country shares the Austrian and Czech trend of decreasing risk aversion. (It should be mentioned that implicit risk aversion was around 5 in 2013, which is consistent with the models and of the examined countries only the United States had similar results.)

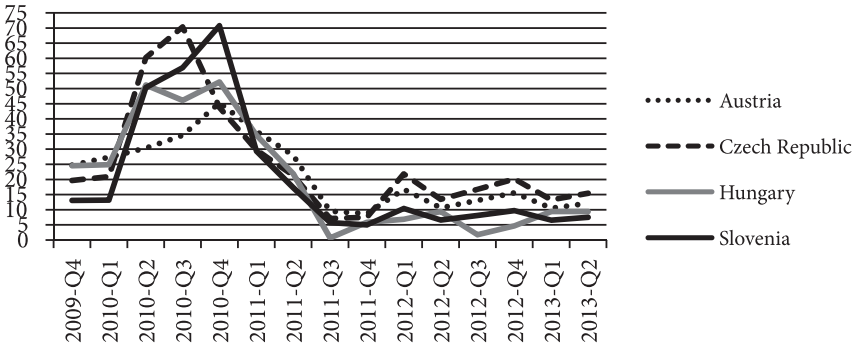
2.2. CEETX and CEESEG indices

Having reviewed the CEESEG members, before analysing change in risk aversion in the two "control" countries, I would discuss two indices that represent the weighted stock-exchange returns of the members of the stock exchange group. These include the CEETX (CEESEG Traded Index) and the CEESEG (CEESEG Composite Index). The former is a capitalisation-weighted index of the average of the 25 most intensively traded and highest capitalised shares; the latter a capitalisation-weighted index of the CEESEG members' stock-exchange indices (ATX, BUX, PX, SBITOP). Both are tradable indices showing realisable returns. Unfortunately, both indices were started in 2009, providing considerably fewer data, which can distort results, thus making it difficult to draw conclusions.

Determining the risk-aversion coefficient also requires data on consumption change and risk-free return(s). In this case it was assumed that since a consumer essentially lives in one country and I compared national risk-free returns and consumption changes with risky returns realisable by trading in the above two indices. The risk-aversion coefficient can then be calculated for the four countries involved, showing the degree of risk a given investor is prepared to take when investing in a "stock exchange group", that is, an average index. Essentially that is indicative of the extent to which consumers consider the entire stock exchange group to be riskier or safer than the stock exchange of their own country.

First, let us examine risk aversion in the CEETX index:

Figure 3
The development of parameter *A* based on the CEETX index between Q4 2009 and Q2 2013

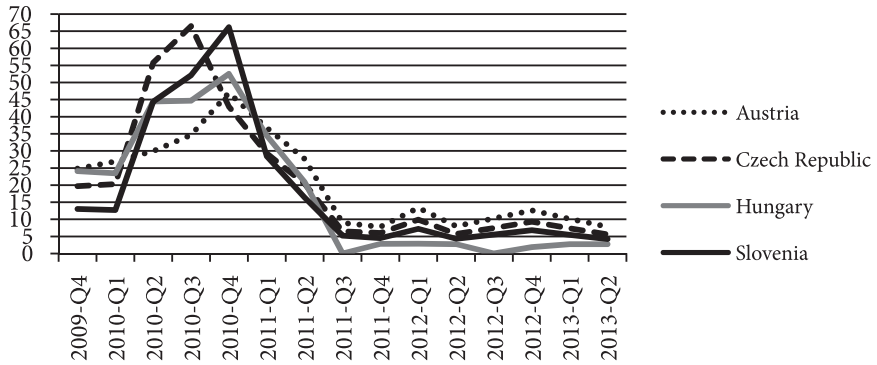


The above figure affords some important conclusions. It can be seen how in all 4 countries *A* is considerable prior to Q3 2011, exceeding 70 in some places. This value remains below 20 in most cases after 2011. Intuitively, this would suggest the population of the stock exchange group's member countries initially considered the joint index and the joint financial market to be significantly risky, which, however decreased over time and stabilised at a lower level. In a different interpretation, because the changes in returns were unconnected in the member countries prior to 2011, the weighted average shifted hectically, whereas in recent years, due to the development of the community, correlation of sorts occurred in the development of returns, which, in turn, became more uniform at group level, too. Consequently, the value of the implicit risk-aversion coefficient significantly decreased and stabilised at a lower level.

The data clearly show how in recent years *A* values developed in the member countries – all except Hungary where *A* changed in an almost contrary direction. (Where in the other three member countries it increased, in Hungary it decreased, and vice versa. The same can be observed at the level of country change, as mentioned above.)

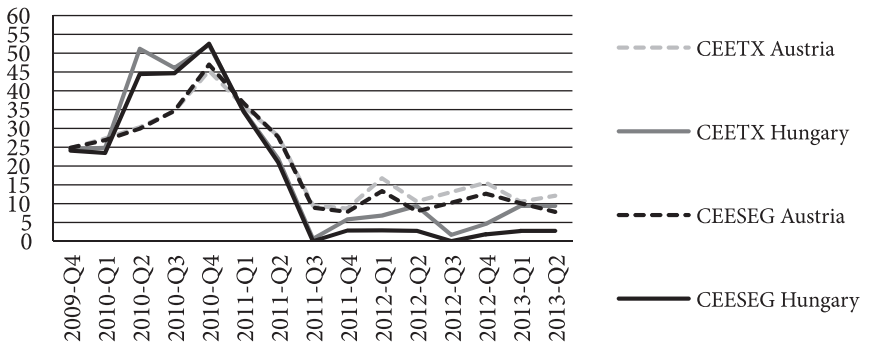
The CEESEG index shows the following results:

Figure 4
The development of parameter *A* based on the CEESEG index between Q4 2009 and Q2 2013



The figure affords two important conclusions. Firstly, the development of risk aversion inferred from the two indices is very similar, and secondly, it more emphatically highlights the fact the value of *A* is often near zero (0.02 at the lowest!) in Hungarian consumers. Knowing risk-aversion in Hungary, the latter can be interpreted to mean that Hungarian consumers believe national investment to be so risky that they would rather invest abroad and forgo any extra premium. (Let us be reminded that at the time of the two near-zero values the value of risk aversion based on the BUX was around 20.)
To illustrate the values calculated from the two indices, let us compare the results for Austria and Hungary:

Figure 5
Comparison of CEETX and CEESEG results (Values *A*)



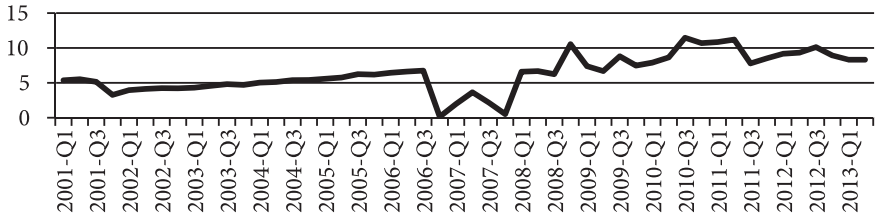
It can be seen that the curves move together; in Hungary's case, however, greater differences can be observed in recent years. Visibly, too, in the case of the index involving a larger stock group (CEESEG) risk aversion is lower, which is in keeping with the principle of diversification.

2.3. Poland

A more accurate interpretation of the results so far will necessarily require some sort of a benchmark value for reference. To that end, I firstly examined the phenomenon in Poland. The choice fell on Poland because the Warsaw Stock Exchange is the only stock exchange in Central and Eastern Europe that is not a member of any group and still has a large turnover and considerable capitalisation, attracting a large number of investors. Consequently, individual distortions influence to a lesser extent the overall picture, providing a more general view of phenomenon.

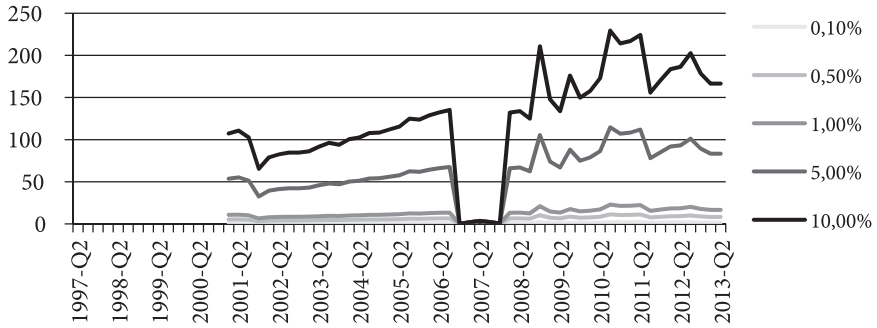
Implicit risk-aversion coefficients for Poland are indicated in *Figure 6*.

Figure 6
The development of parameter *A* in Poland between Q1 2001 and Q2 2013.



It is important to note that over the examined time span (1997–2013) ex post average premium on the Polish market was negative in many cases. Consequently, a positive ex ante premium value is required where the average of ex post returns is negative, because investors always make ex-ante plans for positive premiums. In Figure 6 the value of that is 0.5% per quarter. The choice was based on the historical averages of the examined countries. Use of a different ex-ante premium in the analysis would give the following values:

Figure 7
The value of *A* in Poland as a function of ex-ante quarterly premium



The figure shows that the ex-ante premium applied only essentially alters the level of the curve, not its form. However, if a quarterly 0.5% premium value is accepted, Figure 6 can be interpreted. Two conclusions can be drawn. Firstly, in Poland too the value of *A* exceeds the estimations of theoretical models; secondly, it can be seen that the curve is behaving completely differently compared to what we have seen so far. Typically, CEESEG members a considerable increase on that front up to the break of crisis; a drop followed during the crisis, and stabilisation thereafter. In contrast, in Poland it was the crisis that gave the implicit risk-aversion coefficient a boost. I put this down to the fact that, as it was mentioned above, the Warsaw Stock Exchange had stood out in the region to the point that investors were willing to invest for lower returns, not believing the Polish stock exchange to be that risky. Consequently, in the period between 2006 and 2008 the value of *A* was sometimes lower than 1. The crisis had a different effect on the Polish Stock Exchange compared to the CEESEG countries. While in the latter the main lesson of the crisis was that excessive premiums were not sustainable in the long run, Polish investors were forced to concede that they were not entirely safe either, and that investment on the Warsaw Stock Exchange could also be a risky matter. It follows, therefore, that the value of implicit *A* increased during the crisis and has not decreased since, but stabilised at around 10.

2.4. The United States

Using the United States of America as the other benchmark was an obvious choice, possessing as it does the most important stock exchanges and the most influential economy.

Figure 8
Then development of parameter *A* in the United States between Q1 2001 and Q2 2013.

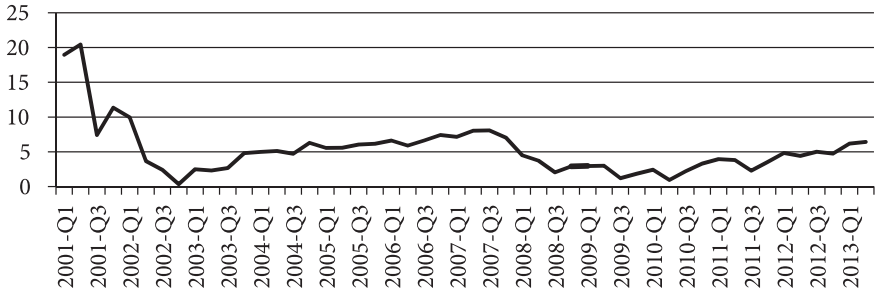


Figure 8 shows how the development of *A* in no way resembles the trend seen in the CEESEG or the Polish timeline. As it can be seen, the risk-aversion coefficient was around 5 in 2002 which is consistent with the models, and regarding the period between 2002 and 2013, there would be no puzzle to talk about in the United States. The reason why *A* is higher in 2001 is related to the fact that the puzzle was identified in the USA (in 1985), previously *A* values had been higher and subsequently reduced to an acceptable level.

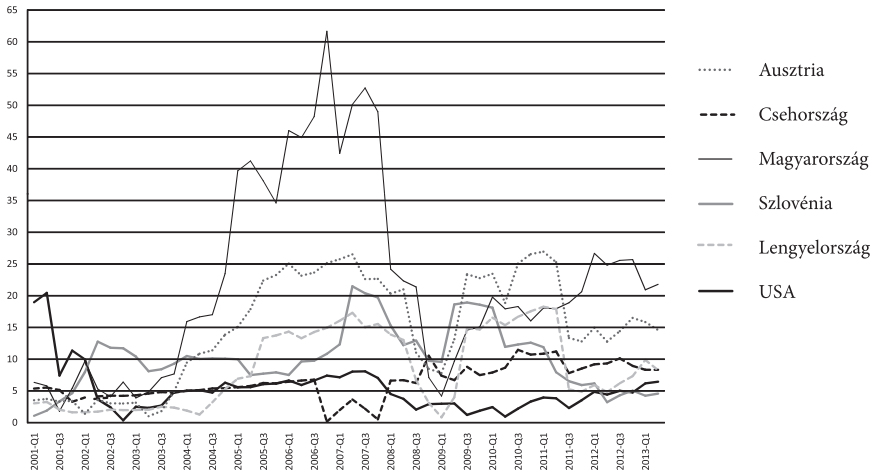
Subjectively, the reason of this decrease is that the American market is increasingly "mature" with increasingly better models and sophisticated investors. Reality has, therefore, approximated the fictitious reality described in models, and possibly the puzzle arises from the simple fact that the conditions of the model are excessive in comparison with investor reality.

The figure clearly shows how the 2008 crisis did not significantly affect the risk-aversion coefficient, that is, investors did not change their behaviour in consequence of the crisis. (Possibly because the United States has survived many serious crises and investors were aware this one was just another passing state.)

2.5. Comparison

In the following, I shall briefly compare the results so far. First I shall illustrate in a figure the timeline of risk-aversion coefficients, which might seem complicated at first glance, but an explanation will follow.

Figure 9
The development of parameter *A* in the examined countries between Q1 2001 and Q2 2013



Noticeably, the curves for Poland and the United States (grey lines) are below the other curves most of the time. That means that, living up to expectations, countries with "more developed" stock exchanges have lower values of risk aversion, that is, investors in smaller stock exchanges are more averse to risk and are only ready to invest for higher premiums.

The figure also confirms the above-described phenomena that risk aversion in Hungary is outstandingly high and that the curve has taken a different course in recent years.

The figure affords another interesting observation. The risk aversion of the CEESEG members runs relatively parallel in time even at the start of the time span, even though the CEESEG was only officially established in 2009 and the Viennese Stock Exchange had not acquired a majority stake in all of the countries concerned until 2008. It might sound as an exaggeration at first, but one might come to the conclusion that the establishment of a stock exchange group like this was expected on the grounds that investor behaviour followed similar patterns in the countries concerned. It would be interesting to perform the analysis in the other countries of the region, which could lead to suggestions as to where the CEESEG might expand. Naturally that would require substantial further research, and one cannot ignore the fact that there are presumably higher priorities than expansion. This investigation would go beyond the scope of this study, but it should provide food for thought. However, in support of my previous claim that the founding of the CEESEG was predictable, let us examine the correlation between the risk-aversion coefficients.

Table 1

The correlation of risk-aversion coefficients between Q1 2001 and Q2 2013.

	Austria	Czech Republic	Hungary	Slovenia	Poland	USA
Austria	–	**0.94**	0.73	0.47	0.26	*– 0.16*
Czech Republic	**0.94**	–	0.63	0.50	0.21	*– 0.11*
Hungary	0.73	0.63	–	0.27	*– 0.26*	0.11
Slovenia	0.47	0.50	0.27	–	*– 0.17*	*– 0.41*
Poland	0.26	0.21	*– 0.26*	*– 0.17*	–	*– 0.35*
USA	*– 0.16*	*– 0.11*	0.11	*– 0.41*	*– 0.35*	–

Note: **bold**: higher than 90%; underlined: 90–40%; regular: 40–0%; *italics*: negative correlation

The table reveals that Austrian and Czech figures closely correlate and that in the four countries of the CEESEG correlation is higher than 47%, discounting the Hungarian–Slovenian relation. (If the Slovenes are treated separately on the grounds that, as it has been mentioned, a temporal shift can be observed in the value of *A*, then the correlation between the other 3 members is higher than 63%.) However, both Polish and American figures completely stand apart from the CEESEG countries (correlations between 26% and -41%), and no significant correlation can be observed between the American and Polish markets (-35% correlation). This would confirm my view that, consciously or not, investor behaviour assumed a role in the emergence of the CEESEG group.

3. SURVEY-BASED RESULTS

The most often voiced criticism about the equity premium puzzle is that in the course of quantifying risk aversion the value of *A* is back-calculated from ex post data. Chapter 3 will examine whether this view is true or not. Many take the view that if *A* was calculated from ex ante data (that is, investor expectations), no puzzle would exist. To verify this statement we need a specific return expected by investors. The best way of measuring this expectation is by questionnaire. *Fernández* et al. (2010; 2011; 2012; 2013) did just that, asking investors in several countries around the world, including the countries in this paper. Their method was straightforward: they sent out an electronic questionnaire to company executives, coaches and financial experts. The main question was how much risk premium the respondent expected to receive in that year? Interestingly, the majority of respondents referred to the estimations of *Damodaran*, *Ibbotson* and *Morningstar* where it came to determining premium (in 2012 some 30% of respondents

named them as a source). Considerably fewer provided their own estimations or drew on historical data (fewer than 16%).

The following two subchapters will present concrete results, but I would discuss the calculation methodology now. The risk aversion coefficients were consistently calculated with the help of equation (1), but I replaced historical risk premium values on the left side of the equation with the average results of the surveys. The covariance on the right hand side was naturally calculated from the historical data. Since all of the four surveys used had been carried out in the spring, I replaced Q1 data with them for the *A* values. In every calculation I used just one ex ante premium data (for example, only the data for 2013 in the calculation of *A* for 2013), because real data were available to replace the data used in the previous survey. This resulted in risk aversion coefficients for four dates, calculated from ex ante premiums, which I was able to compare with results based on historical data.

Before discussing the results, I should mention the many doubts that have been raised about analyses of this kind by myself and countless renowned economists and psychologists (including, not exhaustively, *Daniel Kahneman, Amos Tversky*, *Herbert Simon*, *Earl Babbie*, *Gerd Gigerenzer*, *László Mérő* etc.). The first – and I believe most important – observation is that respondents to such and similar surveys tend to be excessive and voice their "dreams" rather than put real values to their expected returns. The other problem with survey-based estimations is that they are highly influenced by the events of the recent past. Accordingly, in the wake of a major crisis, respondents tend to underestimate premiums even after the capital market has weathered the storm and started to soar. (In other words, investors are more pessimistic than the market.) Yet another problem is that respondents are evidently influenced by external factors such as who is asking the question (whether an authority in the field or a student) and in what way the question is put. The following two questions are unlikely to elicit the same response:

- *How much more returns would you expect if you chose to invest in stocks rather than government bonds?*
- *How much surplus returns would you be prepared to forgo by investing in government bods rather than stocks?*

Furthermore, the problem is not only about who is asking the question, but also who the respondent is. Obviously, a theoretical expert and investment professional would give different answers. Many more problems could be identified, but the point is already obvious: the results of the survey cannot be regarded as the Holy Grail in solving the equity premium puzzle. (This will be especially true in light of the results.) To quote *Damodaran*, "As technology aids the process, the number and sophistication of surveys of both individual and institutional inves-

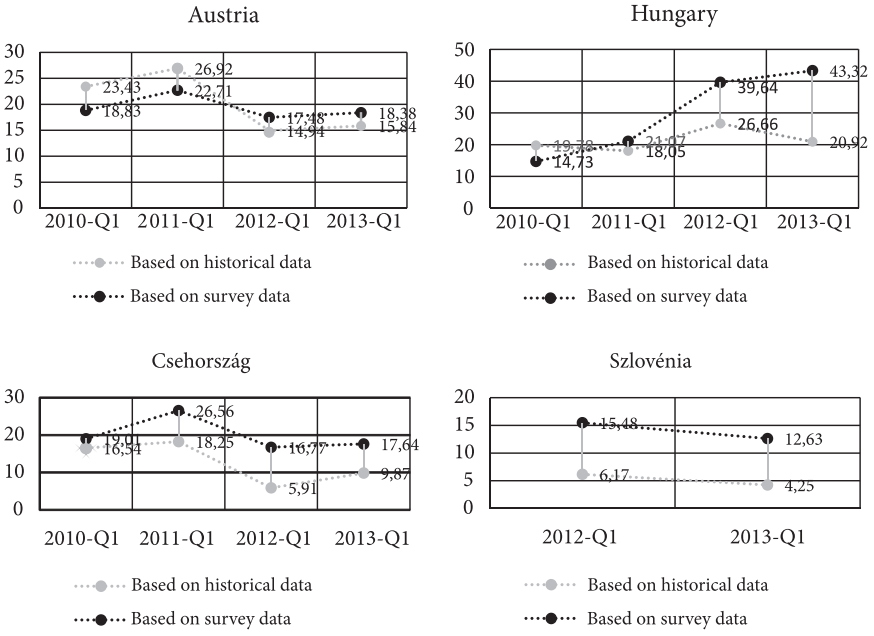
tors will also increase. However, it is also likely that these survey premiums will be more reflections of the recent past rather than good forecasts of the future." (*Damodaran*, 2011, p. 17).

Naturally, one cannot declare that analysis using historical data is more accurate or better; but I do believe that the fact that it contains fewer unknown factors makes it in many ways more reliable.

3.1. The CEE Stock Exchange Group

In light of the above I recalculated the risk aversion coefficients for four dates (except Slovenia where survey data were available for only two years). The results are summed up in *Figure 10*.

Figure 10
The difference between results based on survey data and historical data in the countries of the CEESEG



It can be seen how in the majority of cases *A* calculated from ex ante expectations (black dots) exceed results based on historical data (grey dots). Consequently, the

hypothesis can be dismissed that the mystery merely arises from the fact that research is based on ex post data. In fact, this way the mystery is even greater.

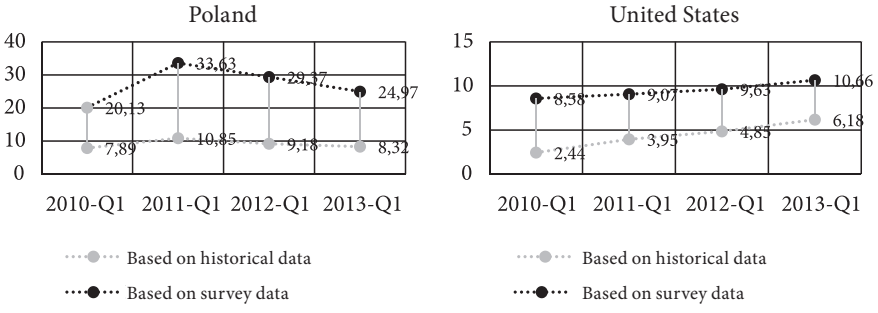
The resulting even greater risk aversion is clearly due to survey-based premium being higher than estimated from the historical data. That goes back to the idea raised at the beginning of the chapter, namely that survey respondents are prone to express their hopes rather than the facts. It can be seen in the case of Hungary and Austria that that survey-data-based risk aversion in 2011–2012 was lower than historical-data-based risk aversion. That would suggest that market players were more pessimistic than the expectation hypothesis would have us believe. That is presumably due to the economic and political situation at the time.

Naturally, one might wonder what the results would have been if, instead of the countries of the CEESEG, this study had examined two developed and sufficiently large markets. The following subchapter will attempt to answer that.

3.2. Poland and the United States

Performing the analysis in Poland and the United States leads to the same conclusion as with the CEESEG member countries. The risk aversion coefficient calculable from expectations is again considerably higher.

Figure 11
The difference between results based on survey data and historical data in Poland and the United States



The results speak for themselves. In every examined country we come across higher survey-data-based risk aversion. Possibly, of course, certain countries would produce contrary results, but I believe they would be isolated cases, since it can be established that generally speaking, ex ante data suggest an even greater puzzle. (This conclusion is based on the fact that the phenomenon is present in all six countries, including key markets such as the United States.)

4. A SUBJECTIVE EXPLANATION: HETEROGENOUS CONSUMER GROUPS

The theory of heterogeneous consumer groups as an explanation is an original idea that has come up over the years dedicated to studying this phenomenon. In my previous article I explored in detail countless possible explanations and criticisms of their application. I would briefly mention them here. Two types of explanations can be distinguished in the literature. The first includes *risk-based explanations* (theories that focus on how to adjust standard models so that they produce equity risk premiums corresponding to the empirical data in return for assuming non-diversifiable risk); the second *non-risk-based explanations* (which seek to explain the value of equity risk premium by factors other than aggregated risks). The main problem of the former is that due to the inclusion of types of consumer behaviour or other similar parameters linked with assuming risk (such as available assets) in the models makes them tricky to test, and the choice of parameters is in many cases subjective. The main problem of the latter is that the continuous expansion of the models diverts attention from the puzzle, and the model ends up including so many variables that it is no longer clear what causes the change in premium. In any case, the majority of these explanations were discarded by the authors who first published the equity premium puzzle. (For details see *Mehra*, 2008; *Mehra* and *Prescott*, 2008; *Mehra* and *Donaldson*, 2008).

Learning form the strengths and weaknesses of these models, I tried to take a new approach to the mystery and its reasons. My explanation is based on the empirical fact that not everyone invests at the stock exchange, that is, consumers can be grouped as investors and non-investors. My explanation is closely linked to the market participation puzzle that states that in spite of high returns on stocks, the majority of households will be unwilling to allocate more money to buying stocks and shares. They have many reasons to do that, including high transaction fees, excessive (and unfounded) fear of the stock exchange, habits and traditions, the inadequate assessment of risk, little (or lack of) capital to invest, etc. In any case, my explanation is not concerned with why the majority

of consumers chooses not to invest in stocks and shares; what is important is the fact that there are people who do not invest.

Investors are "more conscious" in that they participate in the stock exchange (because they can afford to or because they are aware of the risks, etc.), so it can be assumed that they adjust their consumption habits to their investment success in one way or another.[10] The consumption of non-investors, on the other hand, is influenced by external factors (primarily income). Obviously the risk aversion of non-investors cannot be quantified based on stock returns; that will require a different approach.

4.1. The mathematical structure of my model

There are investors (*I*) and there are non-investors (*NI*). Weighted with their proportion within the population, the average consumption of the two groups in period *t* gives the consumption of the entire population in period *t*:

$$c_t = NB\% * c_{NB,t} + (1 - NB\%) * c_{B,t}. \quad (2)$$

It shall be assumed that the consumption of *investors* fundamentally depends on the success of their investments, that is, their consumption decisions are in keeping (*k*%) with their stock-exchange returns (Re):

$$\Delta c_{I,t} = k\% * Re_{t-1}, ha\ Re > 0, otherwise\ 0. \quad (3)$$

The *k*% determines the extent to which investors' consumption change corresponds to the returns on their risky investments. The condition "larger than zero" is necessary because, again based on empirical facts, it can be said that individuals will only invest when they have savings. Consequently, if their investment suffers losses, rather than reducing their consumption, they will make up for their losses from their savings. Also, for the sake of a better model, it can be assumed that if they suffer losses, they will maintain, not increase, their consumption levels.

Naturally, investors continuously losing on their investments cannot be expected not to reduce their consumption ad infinitum. Therefore the model incorporates a savings amount for investors. Also for the sake of simplicity and better modelling, it was assumed that this savings amount (a kind of safety reserve) equals the entire amount of consumption in the first period. (As far as the model is concerned

10 The "originality" of my explanation arises from this proposal, that is, as opposed to the generally accepted view in theoretical economics that the stock exchange is primarily used by investors to ensure their level of consumption, I am suggesting that stock-market investors are purely motivated by greed of gain.

this saving could be any amount, since it is merely a matter of the proportioning returns. If, for example, savings were quadrupled, in the case of loss the adjustment of consumption change in percentage would reduce savings by a quarter.) I also assumed that the unspent profits of a consumer's investments increases their savings (*s*). Mathematically:

$$m_t = m_{t-1} * \left(1 + Re_t - \Delta c_{B,t}\right) = m_{t-1} * \left[1 + (1 - k\%) * Re_t\right]. \tag{4}$$

(Naturally, if the savings run out, further losses will be reflected in the reduction of consumption, that is, $s_t \geq 0$.)
Since the data of the model need to match historical facts, the consumption of *non-investors* was determined by the leftover principle:

$$c_{NB,t} = \frac{c_t - (1 - NB\%) * c_{B,t}}{NB\%}. \tag{5}$$

The risk aversion of non-investors can be quantified on the basis of Euler's formula (which must provably exist between two periods of time):

$$u'\left(c_{NB,t}\right) = E\left[\beta(1 + r) * u'\left(c_{NB,t+1}\right)\right]. \tag{6}$$

If we assume relative risk aversion to be constant (consistently applied to investors), then $u'\left(c_{NB,t}\right) = c_{NB,t}^{-A_{NB}}$; substituting it:

$$c_{NB,t}^{-A_{NB}} = E\left[\beta(1 + r) * c_{NB,t+1}^{-A_{NB}}\right]. \tag{7}$$

Dividing both sides by $c_{NB,t}^{-A}$ and applying the relations $c_{t+1}/c_t \approx 1 + \ln\left(\frac{c_{t+1}}{c_t}\right)$ and (for a small *z*)$(1 + z)^{\lambda} \approx 1 + \lambda z$:

$$1 \approx E\left[\beta(1 + r)\left[1 - A_{NB} ln\left(\frac{c_{NB,t+1}}{c_{NB,t}}\right)\right]\right]. \tag{8a}$$

Rearrange:

$$A_{NB} \approx -E\left[\frac{1 - \beta(1 + r)}{\ln\left(\frac{c_{NB,t+1}}{c_{NB,t}}\right) - \beta(1 + r)}\right] \tag{8b}$$

Since this is true for all *t* times, it can be assumed that

$$E\left(\ln\left(\frac{c_{NB,t+1}}{c_{NB,t}}\right)\right) = \left(\frac{1}{n}\right)\sum_{s=1}^{n}\ln\left(\frac{c_{NB,t+1}}{c_{NB,t}}\right)$$

and $E(r) = \left(\frac{1}{n}\right)\sum_{s=1}^{n} r$. Furthermore, if we assume that $r = Rf$[11] and, based on *Mehra* and *Prescott* (1985):

$$\ln(1+Rf) = -\ln\left(\beta^{12}\right) + AE\left(\ln\left(\frac{c_{t+1}}{c_t}\right)\right) - \frac{1}{2}A^2\sigma^2_{\Delta c} \tag{9}$$

where the two other members are 0.5% per quarter (the value of the prudence and growth elements[13] of the function, based on historical data), then the value of A_{NB} can be determined from the data. The value of A_B is still determined with equation (1):

$$A_B \approx \frac{E_t(Re_{t+1}) - Rf}{cov_t\left(\ln\left(\frac{\boldsymbol{c_{B,t+1}}}{\boldsymbol{c_{B,t}}}\right), Re_{t+1}\right)} \tag{1a}$$

The value of *A* for the entire population is determined with the help of proportions within the population:

$$A = NB\% * A_{NB} + (1 - NB\%) * A_B \tag{10}$$

Since the values of *c*, *Re* and *Rf* are historical data, the model can be used to establish the values of *A* by determining the proportion of non-investors (*NI*%) and the proportion of investors' consumption development (k%) as a function of Re. Because the system of equations has infinite solutions, some restrictions need to be introduced, as a function of which the values of *A* will be rational numbers. The restrictions are as follows:

1. $\beta \leq 1$, (but approaches 1);
2. Minimally, A_{NI} and A_I are larger than 0;
3. $m_t \geq 0$;
4. $0 \leq NB\% 1$;
5. $k\% \geq 0$;
6. Maximally, A_{NI} and A_I are smaller than 30;
7. $\left(\frac{1}{n}\right)\sum_{s=1}^{n}\Delta c_{NB} > 0$ és $\left(\frac{1}{n}\right)\sum_{s=1}^{n}\Delta c_B > 0$

11 The reason for this condition is that because non-investors do not, by definition, invest at the stock exchange, the returns available to them are risk-free (such accruals on deposits).

12 Impatience factor – a subjective discount factor of future consumption.

13 For details see BÉLI (2012), Chapter 2.2.

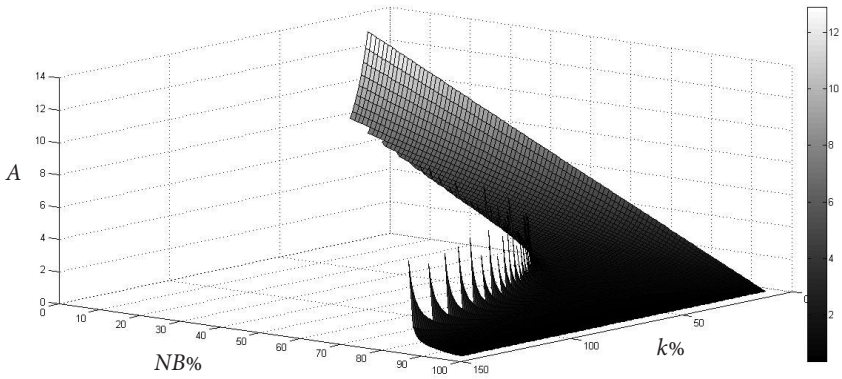
The first four restrictions are obvious: they cannot theoretically exist. The fifth restriction is one that follows from the logic of model. The sixth restriction seeks to eliminate extreme values from the model. The seventh restriction seeks to make the model comply with the empirical fact that consumption levels increase in the long term (general living standards improve).

4.2. The results of the model

One of my model's strengths is that rather than yielding a particular value, it generates a possible set of values. This is due to the fact that the value of *A* depends on two input parameters. Consequently, it can be illustrated in 3D, where axis 1 is the proportion of non-investors, axis 2 the proportion of "correspondence" and axis 3 the *A* values applying to the entire population, calculated from these data. Since I have not previously come across such representation in the literature, this type of illustration lacks a name even. I have decided to call it possible rate of risk aversion (PRRA) in that it represents possible CRRA values as a function of two parameters.

The representation of PRRA for the United States looks like this:

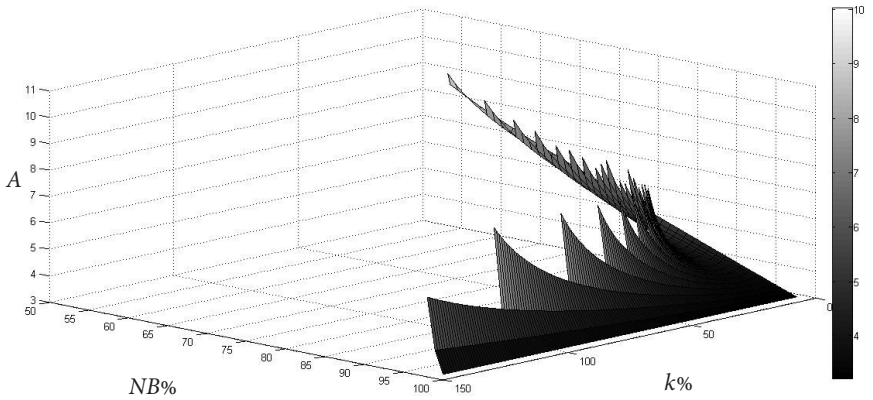
Figure 12
Possible values of *A* in the United States (PRRA surface) between Q1 1997 and Q2 2013



Clearly, the model specification I have established yields several *A* values that meet expectations (the darker area of the surface). For example, if k% is 52% and 63% of the population does not invest in any kind of stock, then the average value of *A* is exactly 3, which is in keeping with expectations. (Moreover, in this specific example the average value of A_B and A_{NB} is also 3; the maximum (any) *A* value in the examined period of 6.45 and the minimal value 0.32 which also corresponds to empirical expectations. The average value of c_I is 2.4% quarterly, while the average c_{NI} is 0.05% quarterly; that is, both are positive.

For Hungary, the PRRA surface is as follows:

Figure 13
Possible values of *A* in Hungary (PRRA surface) between Q1 1997 and Q2 2013



Comparing Hungarian and US results reveals that the PRRA surface in the United States is higher up, meaning Americans are, generally speaking, more risk-taking than Hungarians.

Based on the two figures, the following can be established:

1. An increase in the proportion of non-investors the average value of the risk aversion coefficient reduces;
2. Increasing *k*% initially also reduces *A* values, and where percentages are higher average *A* values increase again (constituting local maximums).

Both observations afford empirical interpretations. The first reflects the fact that where an increasingly small portion of the population invests at the stock market – i.e. there are fewer investors – then the remaining investors will be prepared to take higher risks – i.e. only true risk-takers invest – which, in turn, reduces the risk aversion coefficient for the entire population. The second reflects the fact that if investors do not at all adapt their consumption to their returns – or if they in-

creasingly do so – they will be prepared to take increasingly less risk.

Performing the model's analysis on all of the examined countries yields the following sample values, where it is assumed that 95% of the population in all of the countries will never invest (*NI*%) and the objective is to achieve an average risk aversion value (average A_B) of 3:

Table 2
Values of the model for the given parameters

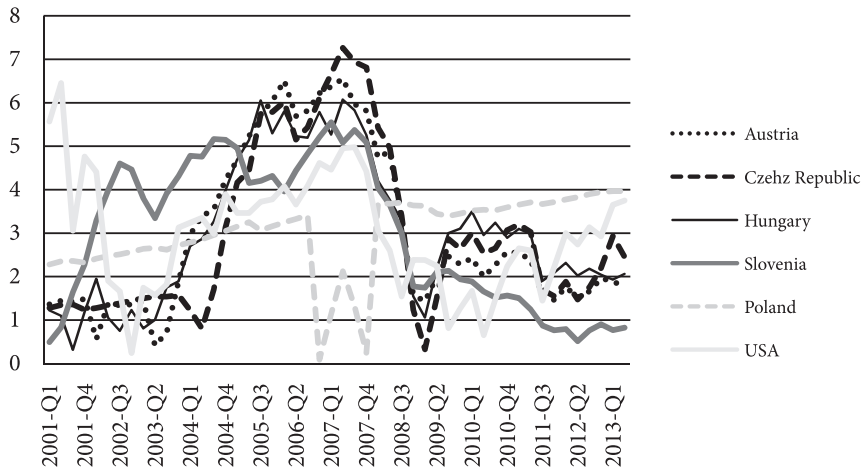
(Fixed parameters are underlined)	Austria	Czech Republic	Hungary	Slovenia	Poland	United States
min A_{NI}	0.98	1.41	1.97	1.80	2.14	0.29
min A_I	0.41	0.33	0.32	0.49	0.09	0.24
average *A*	2.07	2.63	4.18	2.88	3.21	0.52
max *A*	6.56	7.73	9.10	6.62	5.36	6.45
average A_I	3	3	3	3	3	3
average A_{NI}	2.02	2.61	4.24	2.87	3.22	0.39
k%	99.07%	35.98%	37.16%	114.20%	14.29%	52.12%
NB%	95%	95%	95%	95%	95%	95%
c_{NB} average (quarter)	0.07%	0.26%	0.22%	0.25%	0.74%	0.82%
c_I average (quarter)	5.91%	2.17%	3.03%	6.26%	0.92%	2.36%

Note: **bold**: higher than 90%; underlined: fixed parameters

The table shows that in all of the examined countries the values of *A* meet expectations (and naturally the conditions set out above). The highest *A* can be found in Hungary where its value is "only" 9.1. It can be seen that average risk aversion is the lowest in the United States and the highest in Hungary. The value of *k*% is the lowest in Poland (14.29%), that is, investors there are the most indifferent to returns on their stocks (which could be due to the fact that Polish equity risk premium was negative for most of the examined period).

Illustrating the development of the risk aversion of *investors* by means of these specifications (that is, recalculating Figure 9 on the basis if my model) it can be seen that, firstly, risk aversion meets expectations and, secondly, the shape of the curves changes slightly which, in turn, affords another conclusion:

Figure 14
The development of parameter A_1 on the basis of the model in the examined countries between Q1 2001 and Q2 2013



The figure reveals how in Poland and the United States the curve differs from the CEESEG member countries' curves. More importantly, however, the atypical character of the development of risk aversion in Hungary (and the outstandingly high values thereof) has disappeared, and risk aversion changes in keeping with the other CEESEG countries.

Correlations regarding the curves further support this:

Table 3
The correlation of risk aversion coefficients on the basis of the model, between Q1 2001 and Q2 2013

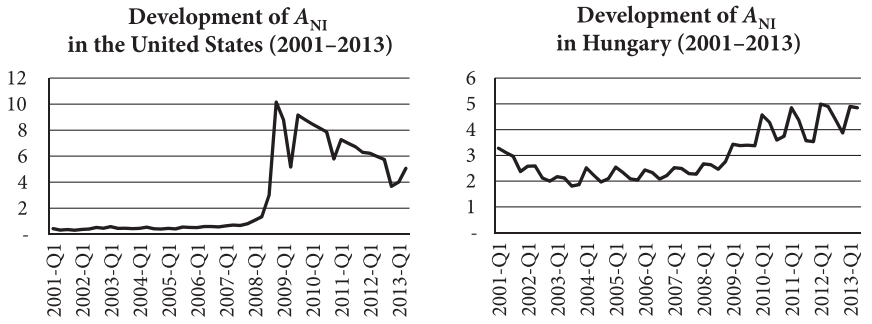
	Austria	**Czech Republic**	**Hungary**	**Slovenia**	**Poland**	**USA**
Austria	–	**0.92**	**0.95**	0.65	*– 0.34*	0.45
Czech Republic	**0.92**	–	**0.92**	0.53	*– 0.36*	0.40
Hungary	**0.95**	**0.92**	–	0.56	*– 0.25*	0.37
Slovenia	0.65	0.53	0.56	–	*– 0.58*	0.20
Poland	*–0.34*	*–0.36*	*–0.25*	*–0.58*	–	*–0.45*
USA	0.45	0.40	0.37	0.20	*–0.45*	–

Note: **bold**: higher than 90%; underlined: 90–40%; regular: 40–0%; *italics*: negative correlation

The correlation values further confirm that Austrian, Czech and Hungarian risk aversion curves practically move together (correlation higher than 90%), while even the fourth member of the CEESEG significantly correlates with the others (higher than 50%). (Lower correlation, in comparison with the others, is probably due to the fact that it "lags behind" for reasons described earlier.) The value of *A* for Poland runs counter to all of the timelines, while the American timeline does not correlate significantly with any of the countries (nowhere does it exceed 50%). This confirms my earlier hypothesis that the establishment of a CEESEG-type group was predictable in the region.

In addition to investor risk aversion, the development of *non-investors*' risk aversion affords important information (assuming A = average, A_{NI} = average and $A_I = 3$):

Figure 15
The development of parameter A_{NI} in the United States and Hungary between Q1 2001 and Q2 2013



The two figures clearly demonstrate the effect of the 2008 financial crisis. The risk aversion coefficient increased both in the United States and in Hungary among non-investors. That is almost natural, since although they did not have any investments, they too felt the effects of the crisis. The increase is considerably more significant in the United States. That is due to the fact that, as the figure also shows, non-investing US consumers had been practically risk-neutral before the crisis; whereas during the crisis their properties too began depreciating in value and their jobs came under threat. That considerably increased risk aversion; however, the trend has reversed since and risk aversion is decreasing. On the contrary, among non-investing Hungarian consumers the starting point was already higher (albeit decreasing), when the crisis turned things round, risk aversion increased – a trend that continues to this day. In other words, Hungarian non-investors are increasingly averse to risk (insecurity in Hungary is growing). (It should also be

mentioned that the Hungarian market is characterised by cycles. Typically, risk aversion is lower in Q3 and Q4.)

On the basis of the above it can be seen that the theory of heterogeneous consumer groups is a good explanation of the equity premium puzzle. Naturally, determining the percentage of consumers investing on the stock market and how investors change consumption habits in function of their returns would require accurate analyses. What can already be seen on the basis of current results is the main message of this explanation: if we assume there are two different consumer groups with different characteristics, the puzzle can be solved.

5. SUMMARY

This article seeks to provide deeper insight into the equity premium puzzle and to present some important and interesting conclusions regarding the capital markets and investor behaviour of certain countries. The analysis chiefly focuses on the CEESEG member countries, since the behaviour of the capital markets Hungary is closest involved with is important with regard to the current and future investment environment.

The paper proposes a possible explanation to the equity premium puzzle, providing mathematical and theoretical reasoning to demonstrate how in all of the countries included in the study the risk aversion coefficient has reduced to an acceptable level, having done so in a way that the shape of the curves representing the chronological development of the index did not change significantly. Consequently, the "explanation" is in harmony with the previous parts of the analysis, whose conclusions therefore hold true.

Finally, I would highlight the fact that risk premium is central to portfolio allocations (what to buy and for how much). If we cannot correctly determine the value of premium, we could make some serious mistakes in our decisions. I have come to agree with *Aswath Damodaran* that "...the debate about equity risk premiums has implications for almost every aspect of our lives" (2011, p. 6).

APPENDIX (DATA SOURCES)

Changes of consumption expenditure

http://stats.oecd.org/

(National Accounts/Quarterly National Accounts/P31S14_S15: Private final consumption expenditure & CQR: Millions of national currency, current prices, quarterly levels)

USA:
http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1

(Table 2.8.1. Percent Change From Preceding Period in Real Personal Consumption Expenditures by Major Type of Product, Monthly)

(date of download: 04.01.2013 and 18.08.2013)

Consumer price index

http://stats.oecd.org/

(Prices and Purchasing Power Parities/Prices and Price Indices/Consumer Prices (MEI)/ Consumer prices - all items & Percentage change from previous period)

(date of download: 04.01.2013 and 18.08.2013)

Risk-free returns

http://stats.oecd.org/

(Finance/Monthly Financial Statistics/Monthly Monetary and Financial Statistics (MEI)/ Short-term interest rates, Per cent per annum)

For Hungary, in some cases:

http://www.portfolio.hu/history/adatletoltes.php (Government bonds/RMAX)

(date of download: 04.01.2013 and 18.08.2013)

ATX index

http://finance.yahoo.com/q/hp?s=^ATX+Historical+Prices

(date of download: 18.08.2013)

BUX index

http://www.portfolio.hu/history/adatletoltes.tdp

(Share index/Indexek/BUX)

(date of download: 18.08.2013)

PX index

http://www.pse.cz/dokument.aspx?k=Burzovni-Indexy

(date of download: 18.08.2013)

SBI 20 index

http://www.bsi.si/pxweb/dialog/varval.asp?ma=I2_9E&ti=2.9.%3A+The+Ljubljana+Stock+Exchange%3A+Slovenian+Stock+Exchange+Index+and+Bond+Index&path=Database/ang/serije/02_fin_trgi/02_borza/&search=SBI&lang=1

(date of download: 04.01.2013)

SBITOP index

http://www.abanka.si/eng/sys/cmspage.aspx?MapaId=1050&action=show_indeks_podatki&indeks=SBITOP

(date of download: 18.08.2013)

S&P 500 index

http://finance.yahoo.com/q/hp?s=^GSPC+Historical+Prices

(date of download: 18.08.2013)

WIG 20 index

http://www.gpwinfostrefa.pl/GPWIS2/en/quotes/archive/1

(date of download: 18.08.2013)

CEETX index

http://www.finanzen.ch/index/historisch/CEETX-EUR

(date of download: 18.08.2013)

CEESEG index

http://www.finanzen.ch/index/historisch/CEESEG-EUR

(date of download: 18.08.2013)

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