A sistematic test for myopic loss aversion and the equity premium puzzle

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Abstract

Myopic loss aversion, or the combination of frequent portfolio evaluation and loss aversion, has been argued to possibly be one of the factors behind the equity premium puzzle. Still, the current method for testing this theory - using simulations to determine the equilibrium portfolio evaluating frequency - lacks power. This paper offers an alternative systematic test that looks at the relationship between inflation and equity premium. Assuming that nominal returns are an important benchmark for prospective utility evaluation, loss aversion leads to an negative relationship between inflation and equity premium, as higher inflation leads to lower probability of nominal losses. We construct a 50-countries database ranging from the last 20 years to test this theory. In order to do that, we use two different approaches: fixed effect techniques on short term returns and long term least squares regression. We argue that both identification hypothesis may be too strong to be entirely true, but macroeconomic theory - specifically the diminished relationship between inflation and business cycles in the long run - and the efficient market hypothesis helps to believe that those methods are not meaningless either. Moreover, we argue these approaches have different strengths and weaknesses, which bolsters our conclusion if we find similar results in both methods. We do find evidence for a negative relationship between inflation and equity premium in both methods, which supports for myopic loss aversion theory. The magnitude of the coefficients are also relevant ranging from -0.23 to -0.80. However, we show that these effects explains only a small part of equity premium observed variation, and are more prevalent in non-industrialized countries, which limits the scope of this theory

Keywords: Equity Premium Puzzle, Myopic Loss Aversion, International Comparison

JEL Classification: D03, G11

1 Introduction

It has been more than thirty years since the seminal equity premium puzzle paper has been written in Mehra and Prescott (1985), and we still have not

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found a consensual solution for this question[1]. In the last decades, the literature have developed several possible explanations for this puzzle, ranging from simply stating that we have no puzzle at all, to all kinds of modifications of the Mehra and Prescott (1985) model, or the developing or new, alternative models. None of the explanations however seems to be completely satisfactory[2].

One of the most promising attempt seems to be related to behavioural biases, especially those associated with prospect theory, like loss aversion[3]. Benartzi and Thaler (1995) argued that *myopic loss aversion* might be responsible for the equity premium puzzle. By their logic, if investors truly behaves as prospect theory would predict, they do possess loss aversion. As such, they would be more inclined to buy risky assets (such as stocks) if they evaluate their inventory less often[4]. After recognizing this, they proceed to calculate how often investors would have to evaluate their portfolios to make them indifferent between stocks and T-Bills under plausible prospect theory assumptions. They find that investor behavior is, roughly speaking, consistent with yearly evaluations of portfolio, which they argue to be feasible in the real world, thus making this fact an evidence for a potential prospect theory explanation to the equity premium puzzle[5]. The term *myopic loss aversion* is referred to the combination of loss aversion and frequent portfolio evaluation.

Although promising, this theory also has its critiques, which comes from two main sources. The first, focus on issues on the theoretical explanation, arguing that evidence of individual behaviour may be inconsistent to loss aversion (Blavatskyy and Pogrebna, 2009) and that institutional investors should present a lower level of loss aversion[6]. These critiques, although interesting, seems not to completely undermine the theory. Indeed, there are experimental evidence that people not only behaves as the theory predicts, but professional traders do it to a higher degree than mere students[7]. The second source of critiques focus on the absence of a real test for the theory, as the original evidence of yearly portfolio found in Benartzi and Thaler (1995) might be considered vague

This paper aims to contribute to that second venue of criticism by offering an alternative systematic test to the *myopic loss aversion* theory as a potential explanation for the equity premium puzzle. The idea is to use the predicted negative causal relationship between inflation and equity premium under the presence of nominal portfolio evaluation to test the theory.

[1]The term *Equity Premium Puzzle* refers to the fact that stock market returns are not only higher than bond returns; it is much higher. In fact, it is higher to the point that it is not explained through models with complete markets, rational agents and standard degrees of risk aversion - hence the "puzzle". Thus, the equity premium puzzle is important is economics because it directly questions the standard models of decisions over uncertainty, in particular the expected utility model, which is a workhorse of traditional microeconomics.

[2]That are several surveys of those attempts made throughout the years. See, for instance Kocherlakota (1996), Mehra and Prescott (2003) and Mehra (2008)

[3]For more information on prospect theory see the seminal paper on Kahneman and Tversky (1979) or the more recent review on Tversky and Kahneman (1992)

[4]With a long evaluation frequency the returns distribution of an asset is closer to the long term average than with a short frequency. As such, if the long term average return is positive, long evaluation frequency diminishes the probability to observe negative returns, which would generate a disproportionally bad utility in an individual with loss aversion

[5]There is some evidence that this result may be exported for European countries as well, at least until the last 10 years - see Christensen (2011) - although the literature seems scarce for countries in developing world.

[6]See Christensen (2011) for a summary of the critiques

[7]See Haigh and List (2005) and Larson et al. for examples

The negative causal relationship between inflation and equity premium is well documented in Thaler et al. (1997). In this paper, the authors offered experimental evidence for the presence of *myopic loss aversion*. They asked subjects to participate in an investment game where they had to choose between an allocation on two different funds in different scenarios. One of the funds had its returns drawn from a distribution that mimics those of bonds, and the other had returns drawn from the stock market. The key point in the study is the different investment periods evaluation. *Myopic loss aversion* predicts that the lower the evaluation portfolio frequency is, the higher is the demand for bonds. Table 1 shows the result of these experiment[8].

Table 1: Percent allocation to Bond Fund in the Thaler et al. (1997) experiment

Feedback Group	n	mean	SD	SE
Monthly	21	59.1	35.4	7.73
Yearly	22	30.4	25.9	5.51
Five-Yearly	22	33.8	28.5	6.07
Inflated-Monthly	21	27.6	23.2	5.07

Source: Thaler et al. (1997)

One striking feature of this paper that has received little attention from the literature is the last simulation table in 1. In this simulation, the authors asked the subjects to once again make the decision between investing in bonds or stocks, evaluating their portfolios monthly, but now in a high inflation environment (10% per month), so that it was virtually impossible for both assets to pose negative nominal returns[9]. As can be seen, in this scenario the investment allocations change drastically compared to the one without inflation. In fact, in the presence of high inflation, subjects seems to make their monthly-evaluated portfolio decisions very similarly to those they made without inflation but with a five year evaluation frequency.[10]

This offers a testable hypothesis for the *myopic loss aversion* theory: assuming that the zero nominal return is indeed a good reference point for prospect theory evaluation[11], myopic loss aversion predicts that when we analyse two identical countries in every relevant aspect but inflation, the one with higher inflation should have a lower equity premium.

Testing for *myopic loss aversion* in such systematic way is essential because the current method used in the literature to support this theory - that is, checking if the evaluation frequency that makes investors indifferent between holding

[8]The participants were unaware of the difference of those funds: they had to learn which one was better for their allocation through experience. After setting up their allocation, subjects saw a bar graph showing up the aggregated returns of each fund and their portfolio for the period invested

[9]In this scenario, subjects were told that nominal returns were high because of high inflation, but were not told exactly what was the inflation level

[10]See Gneezy and Potters (1997) for a contemporaneous and independent experiment that found similar results

[11]While a possible issue with this statement might be the assumption that agents care about nominal losses and not real ones, it bears to note that nominal evaluations get support not only from Thaler et al. (1997) fourth simulation, but also from a large literature that shows that nominal prices matter - look at Shafir et al. (1997) and Weld et al. (2009) for examples. It is not the intent of this paper to discuss this assumption but rather look for consequences to the myopic loss aversion theory is its presence.

bonds or stocks is reasonable in the real world - provides a range that is too wide to be of practical use. For example, suppose that Benartzi and Thaler (1995) found that investors would have to evaluate their portfolio quarterly instead of yearly to be indifferent between stocks and bonds. Would that be a reasonable portfolio evaluation frequency? It is hard to argue that it would not - most companies publish their results in a quarterly fashion for example. What about an evaluation frequency of 2 years? Moreover, all these results are extremely sensitive to the parameters used in the utility functions, especially the coefficient of risk aversion[12], which is an unknown parameter that is estimated only through experimental data. This obviously increases the range of "reasonable outcomes" even further. Clearly then, the current way of evaluating this theory lacks power.

Checking for a negative link between inflation and equity premium seems more promising. In fact, it is hard to think about another theory that would link inflation and equity premium in a causal way, so if a causality claim can me made, it would offer strong evidence for myopic loss aversion.

At first glance this seems to be a difficult test for *myopic loss aversion* theory to sustain, as the literature suggests that simple correlation measures between inflation and equity premium are positive - see Beirne and Bondt (2008) and Kyriacou et al. (2006) for examples. However, there is no good theoretical evidence to support this relationship, and the data on those studies focus solely on developed world. We hope to improve on this subject by moving the discussion away from correlation to causality issues, and by augmenting the present empirical evidence on the matter with information about a larger range of countries. Anecdotal evidence suggests that this expansion to non-industrializes countries is relevant. Take, for instance, the Brazilian case. Brazil is clearly a country with high inflation, and its equity premium seems to be either small or negative[13]. Also, there is evidence that worldwide equity premium seems to be smaller than the one found in US - see Dimson et al. (2008) - which also supports this idea as US is a country with small inflation.

However, in order to make truly causal inference between inflation and equity premium we will most certainly have to invoke some kind of exogeneity assumption, which is in practice is hard to fully believe, as we will be dealing with macroeconomic variables which are prone to be endogenously determined. We do not hope to completely solve this problem, but rather to surround the issue looking for evidence using different approaches in the hope it all points to a single direction (that is, either inflation causes equity premium or it does not). In order to do that we will do two different analysis of the links between those variables: the first using fixed effect techniques in and the second using traditional cross section techniques in longer frequency data. As the exogeneity hypothesis in those techniques are different - and they are likely to have problems for different reasons - we hope that one method serve as a robustness check of the other. In our view, even tough this approach still require some faith to

[12]See Christensen (2011) for a discussion of this point

[13]See Bonomo and Domingues (2002) or Gomes et al. (2013) for evidence supporting the claim that Brazilian equity premium puzzle measures is either close to zero or negative. This is not entirely consensual as Cysne (2006) finds evidence for higher premiums, although even in this last study we note that Brazilian equity premium puzzle is substantially lower than the consensual estimate for the U.S.

deliver a true check of myopic loss aversion theory[14] it is better than the current one that focuses on "reasonable outcomes" for the portfolio evaluation period.

This paper is organized as follows. Section 2 describes the data sources. Section 3 discusses the empirical strategy. Section 4 shows the main results. Section 5 provides some robustness checks. Finally, section 6 provides a discussion and concludes.

2 Data

The most commonly used database for international analysis on the equity premium is the DMS database. This database contains standardized information on key financial variables for several developed countries ranging back more than 100 years[15]. However, for the purpose of our study this database is not adequate, as it does not adequately covers non-industrialized countries, which are precisely the ones in which we expect to find large part of the variation in the inflation measure[16]. Thus finding a new database is essential.

Fortunately, if we limit ourselves to the last two decades, public data sources such as the World Bank and IMF databases contains enough information for our objectives, including data on several non-industrialized countries. This limitation is terrible for most studies in the field, as the equity premium puzzle is viewed a long run phenomena. However, for the purpose of this research, such a constraint is not as devastating, as we are more interested in comparing countries with similar attributes than on long run analysis. Moreover, in terms of empirical techniques used, both the fixed effects and the traditional cross section approach does not need a large number of time observations to deliver consistent estimators.

The data used is constructed as follows. For the equity premium measure we collected information about the S&P Global Equity indexes available at the World Bank website for all countries that possess such an index since at least 1996[17]. The equity return measured on those indexes is then transformed to local currency using information about exchange rate found on the IMF website. This is the domestic equity total return measure used in this paper.

The series for the bond returns comes from IMF data. For the countries that the IMF provide information about their International T-Bills Rate this was the measure used[18]. This variable is good for our purposes as it measures return on sovereign short term bond market, which is exactly what we are looking for, and is directly comparable to classic measures used in the literature for the equity premium puzzle. However, the IMF publishes this information only for a

[14] That is, to believe that either exogeneity assumption is correct or to believe that by covering multiple aspects of the relationship between inflation and equity premium we are moving closer to the true causal relationship

[15] See Dimson et al. (2008) for details

[16] DMS database offers information about 23 countries only, with 20 of these countries belonging to the OECD

[17] The S&P Global Equity index is a rules-based float-adjusted market cap weighted stock market index. It measures total return on U.S. dollar for stock market of countries covered by the S&P/IFCI and SP/Frontier BMI country indexes in a standardized way. For more information about the index, including its availability and methodology see http://us.spindices.com/indices/equity/sp-global-bmi-us-dollar

[18] For more information see http://data.imf.org/?sk=5477AD05-460D-4C91-9690-11E99B1ED935

selected number of countries. To increase our sample, we also used the central bank policy rate provided by the IMF when the first series was unavailable. This package of the international T-Bills Rate and the central bank policy rate is our measure of choice for the bond market return. Note that both series used to construct our fixed income return are highly correlated: the country average correlation between those variables in our study is of 0.86 on an yearly basis. Thus, we feel that not much is lost by using the central bank policy rate as a substitute for a real short term bond market variable

The equity premium is then constructed as the difference of the domestic equities total return series from the domestic bond market return series. Using the procedure just outlined we get information on equity premium for 50 countries in at least some periods of the last 20 years[19]. Table 2 details the countries and number of yearly observations included in this study

Table 2: Countries and number of observations for the equity premium measure

Countries	N. Obs
Israel, Malaysia, Philippines, Sweden, Mexico, Switzerland, New Zealand,UK, Hungary, US South Africa, Canada, Brazil, Japan, Australia Ireland, Chile, Indonesia, Norway and Denmark	20
Jamaica, T. and Tobago, Italy, Greece, France, Kenya Belgium, Spain, Ghana, Bulgaria, Germany and Bangladesh	19
Singapore and Portugal	18
Czech Republic, Lithuania, Turkey and Netherlands	17
Poland, Namibia, Thailand, Slovenia, Finland and Austria	16
Mauritius, Latvia and Romania	15
Slovakia	14
Peru	13
Russia	9
Total Sample	909

Source: Calculations made by the authors with data from IMF and World Bank

Note: Information about T-Bills is unavailable for the following countries for all years: Chile, Indonesia, Norway, Denmark, Netherlands, Slovenia, Finland, Austria, Slovakia and Peru.

This method for calculating international equity premium generates similar results to DMS database for the period of 2000 to 2015 for the countries in which they overlap, as it is shown in table 3[20]. Simple correlation measures

[19]When we restrict ourselves to the International T-Bills Rate as the solely measure of the domestic bond market return we get only 41 countries in our study. The results for these 41 countries - which are available but not included in this paper - are similar to the ones found for the 50 countries in this study

[20]DMS database for selected periods is publicly available in Dimson et al. (2016). The only of such periods that we can use to compare this database to our metric is 2000-2015

between our variables and the DMS database for total equity return and short term bonds points to 0.89 and 0.95 respectively.

Our measure of inflation is the CPI inflation, which is collected from the World Bank database[21].

We will also need a set of control variables to bolster our causality claims as strongly as we can. The choice for which variables to use as controls was made using elements of the finance and development literature. In the standard theory of asset evaluation, the main determinants of the preferences between stocks and bonds are the volatility of consumption and the age of the agent[22]. Moreover, it seems only natural to control by the initial level of development of the country, as undeveloped countries tend to have higher inflation and differences in this variable might lead to differences in risk aversion and financial education, all of which might affect the equity premium. Finally, we controlled for metrics of country risk, as this is certainly correlated with inflation and possibly affects local companies - hence their stocks - in a different way than it affects the sovereign bonds.

The data used to form the variables also comes mostly from the IMF and the World Bank database. To control for the initial level of development the share of local GDP per capita in PPP terms to that of the United States was used. To control for demographics, we used the share of population with 65 or more years over the total population. Finally, the ratio of the standard deviation to the mean - i.e. the relative standard deviation - of domestic real GDP growth was used to control for overall riskiness to consumption when dealing with long term average. In the fixed effects regression, due to the shorter term horizon - see section 3 for details - we also included the real per capita GDP growth as a control for business cycle movements. Finally, the country risk measure was made using the spread of each country's bond returns to that of the U.S. in the IMF government bond returns[23]. Unfortunately, this data do not covers all the countries in our study, so we also used the JPMorgan Emerging Market Bond Index Plus (EMBI+) to enhance our country coverage[24]

Finally, as this paper deals with inflationary variables, it is possible that the existence of outliers might be relevant to our analysis. In fact, if one or more countries in our sample experienced regimes that may resemble hyperinflation, we may have problems performing typical least squares regressions, as

[21] We also ran versions of the results using the GDP deflator as the measure of inflation. The results - ommited from this paper but available under request - do not differ much from those presented here

[22] Assets that display negative correlation between its returns and consumption are more valuable, as risk-averse individuals want to smooth consumption. Moreover, risky assets are more valuable the longer the investment period is, which is obviously correlated with age. See Mehra and Prescott (2003) for more details

[23] This series provides information about long term bond returns, and thus are different from the International T-Bills rate used to form the equity premium measure. For example, the value for 2015 United Stated bond return is 2.14 in this series and 0.06 in the T-Bills series

[24] Even after this addition we still did not find enough data to form the country risk measure for all countries and years in our analysis. In fact, from the original 50 countries and 909 yearly observations, we we only get information for country risk for 47 countries and 747 observations. We got no observations whatsoever for country risk for Isreal, Trinidad and Tobago and Kenya, and lost some years of data for Philippines, Hungary, Chile, Indonesia, Jamaica and Bangladesh. Nonetheless, the results without these observations are similar to the ones reported for our full sample in the regressions made without the country risk variable (unreported, but available under request) so we feel not much is lost by this omission

Table 3: Constructed measures of Equity Premium vs DMS database - 2000 to 2015

Country	Total Equity Return DMS	Constructed Total Equity Return	T-Bills Return DMS	Constructed Short Term Bond Return	Equity Premium DMS	Constructed Equity Premium
Australia	4.8	5.2	1.6	1.5	3.1	3.6
Austria	4.0	3.8	-0.1	-0.1	4.1	3.8
Belgium	3.6	1.2	0.0	-0.2	3.6	1.3
Canada	3.3	4.3	0.3	0.2	3.0	4.0
China	2.5	4.4	0.8	N/A	1.7	N/A
Denmark	8.9	9.7	0.4	0.1	8.5	9.6
Finland	-1.1	-4.2	0.8	0.2	-1.9	-4.5
France	1.3	-0.6	0.4	0.4	0.9	-1.0
Germany	2.0	3.6	0.5	0.4	1.5	3.2
Ireland	2.3	1.9	0.4	-0.2	1.9	2.1
Italy	-1.7	-3.4	0.2	0.4	-1.9	-3.7
Japan	0.8	1.3	0.1	0.1	0.7	1.2
Netherlands	-0.6	0.1	0.0	0.0	-0.6	0.1
New Zealand	6.3	6.1	2.6	2.4	3.6	3.6
Norway	6.2	4.9	1.4	2.0	4.7	2.9
Portugal	-2.5	-4.4	-0.2	-0.2	-2.3	-4.2
Russia	-0.2	-0.8	-3.5	N/A	3.4	N/A
South Africa	9.0	5.4	2.2	1.9	6.7	3.4
Spain	2.3	-0.5	-0.1	0.1	2.4	-0.6
Sweden	4.9	3.7	0.9	0.9	4.0	2.8
Switzerland	3.3	4.6	0.5	0.2	2.8	4.5
UK	1.7	-0.9	0.8	0.7	0.9	-1.5
US	2.3	-0.1	-0.4	-0.5	2.7	0.4
Bangladesh	N/A	4.0	N/A	-0.1	N/A	4.1
Bulgaria	N/A	3.6	N/A	-2.1	N/A	5.8
Brazil	N/A	3.3	N/A	7.2	N/A	-3.6
Chile	N/A	4.2	N/A	1.0	N/A	3.2
Ghana	N/A	-11.3	N/A	3.8	N/A	-14.6
Greece	N/A	0.0	N/A	0.2	N/A	-0.2
Hungary	N/A	0.9	N/A	2.3	N/A	-1.3
Indonesia	N/A	3.6	N/A	1.7	N/A	1.9
Israel	N/A	1.4	N/A	1.7	N/A	-0.3
Jamaica	N/A	-1.5	N/A	2.9	N/A	-4.3
Kenya	N/A	4.2	N/A	-1.3	N/A	5.6
Mexico	N/A	4.0	N/A	1.9	N/A	2.1
Malaysia	N/A	2.8	N/A	0.6	N/A	2.1
Philippines	N/A	4.5	N/A	0.3	N/A	4.2
Slovenia	N/A	0.0	N/A	0.2	N/A	-0.2
Sweden	N/A	3.7	N/A	0.9	N/A	2.8
Thailand	N/A	6.3	N/A	0.0	N/A	6.3
T. and Tobago	N/A	1.2	N/A	-2.4	N/A	3.7
Turkey	N/A	-8.3	N/A	2.9	N/A	-10.9

Source: Dimson et al. (2016) for DMS data. Authors calculations based on IMF and World Bank data for constructed series. See text for details

these countries would distort our relevant coefficients in a huge way. This is a bit subdued in fixed effects estimation as in this case we are dealing with within country variation, but is potentially a major concern in the cross section analysis, which deals with between country estimation[25].

We address this problem in two ways. First we compute the range of the long term inflation distribution for all countries in our sample. This is displayed on table 4. Visual inspection of this table shows us that not country in our sample was really struggling with hyperinflation in the period we analysed, so the outlier concern should not be relevant

Table 4: Range of average inflation for years 2000-2015

Inflation Measure	Minimum	Maximum
CPI	0	16.6
	(Japan)	(Turkey)
GDP Deflator	-0.9	22.6
	(Japan)	(Ghana)

Country names in parenthesis

Moreover, we performed median regression analogs to those obtained in section 4 section and found no major differences. Those are omitted from this paper but available under request.

3 Empirical Strategy

As discussed in the first section, we aim to investigate the possibility of a causal relationship between equity premium and inflation. In order to do that, we will use two different techniques for identification. The first is to use fixed effects techniques on higher frequency data and the second to perform least squares regression long-term averages. While both methods requires rather strict hypothesis to deliver causal relationships, we argue that they complement each other by having different strengths and weaknesses. Moreover, economic theory help us mitigate some of the concerns regarding our identification hypothesis.

To understand those points, consider first the fixed effect approach. As is well known, fixed effects identification rests on the strict exogeneity assumption, that is, the assumption that our error and the set of independent variables are uncorrelated across every period of time[26]. This should not be valid at full face value in our specification, as we are dealing with macroeconomic variables which are known to possess significant amount of endogeneity and serial correlation due to business cycles. Still, we argue that this assumption is also not far from the truth, as our dependent variable is composed from market variables, and thus are under the effect of arbitrageurs. Therefore, its lag effects are likely to be small[27], and we are hard pressed to think about potential unobservables that are doubly correlated with both equity premium and inflation that are not already accounted by our fixed effects structure. Moreover, we performed our

[25] See section 3 for details

[26] See Wooldridge (2010) and Angrist and Pischke (2009) for good reviews of fixed effect panel regressions

[27] They are in fact zero if one is to assume a strong version of the Efficient Market Hypothesis

main analysis using 5-year periods instead of the more natural yearly approach in order to further decrease the correlation between inflation and economic activity[28]. These steps make us confident that our identification hypothesis should not miss by much. As the fixed effect estimator bias is proportional to how distant we are from the strict exogeneity hypothesis, we believe this approach is relevant in this particular case.

Nonetheless, long term least squares may help us alleviate some of the problems of the fixed effects assumptions. As explained before, the main reason to doubt fixed effects estimation at face value is the possibility of endogeneity between inflation and equity premium due to business cycles issues. But macroeconomic theory tells us that the relationship between inflation and real variables in the long run is at least smaller than in the short run, and in the case of some models non-existent[29]. We propose to leverage this idea by performing standard OLS regressions of long term country average equity premium on long term country average inflation and controls. Note that this method uses different information from the fixed effects technique. Indeed, its well known that the fixed effects estimator uses "within" country information, while by doing long term country averages we are using "between" country variation.

The problem here is that, by resorting to traditional cross section analysis we lose the fixed effects structure that allowed us to control for important unobservables that are fixed in time. Thus our control variables rises to a greater importance in this approach, as we are merely performing control on observables on this approach.

The important point to notice here is that when we compare our two methodologies we get different strengths and weaknesses. The fixed effects strength is that it effectively control for more relevant variables - both observables or not - that are likely doubly correlated with our measures of interest. Its weakness is that, as we are dealing with shorter term macroeconomic variables, it is more difficult to us to deal with reverse causation problem. On the other hand, traditional cross sectional analysis has the strength to allow us to be more assertive on the reverse causality front by using macroeconomic theory to our benefit, but is weaker to the problem of unobservables affecting our regression. Our empirical strategy is therefore to minimize each of the individual weaknesses by using a combine of the two methods in the hope of getting the same results. If this is indeed reached, we would conclude that we have compelling evidence for or against myopic loss aversion theory[30].

A final comment is in order about our error structure. In order for our inference to be valid we also need correct assumptions about the variance covariance matrix of our error terms. The classical "no autocorrelation trough the cross-sectional terms" assumption is likely to be false in our case. This is true not only because financial variables tends to have cross country correlation, but because we have a group of countries in our sample - the Eurozone - that have the same central bank policy rate and exchange rate for all its members.

[28]This is an idea that we will further explore in the cross section analysis, the next paragraph should explain it better

[29]Models with neutrality of money. The main frictionless macro models used as the benchmark usually possess such property, but this is not restricted to those models. Recently, behavioral macro models are also claiming to possess money neutrality. See Gabaix (2016) for a recent example

[30]Note however, that proceeding in such a manner we can get inconclusive results if one approach supports myopic loss aversion, but the other does not

Therefore, in order to make correct inference we will used clustered standard errors in the level of country, with members of the Eurozone being defined as a single country[31].

4 Main Results

We start by analysing simple correlations between our variables of interest in order to compare our results to those available on the literature. Table 5 shows the result of simple OLS regressions between the equity premium - calculated both by the DMS database and the process outlined in the previous section - and inflation. We can see that correlation between inflation and equity premium is positive when we use the countries in the DMS database, but negative when use our constructed measure of equity premium. As both equity premium measures are very similar when we restrict ourselves to the same countries, this suggests that the positive correlation between those variables discussed in the literature is likely a phenomena of sample selection[32]

Table 5: Bivariate OLS regressions of equity premium vs inflation

Coefficients	DMS Equity Premium	Constructed Equity Premium
Inflation	0.266	-0.648***
	(0.171)	(0.233)
R-Squared	0.055	0.228

Data for the DMS database comes from Dimson et al. (2016)
Robust standard errors in parenthesis
p<0.01, ** p<0.05, * p<0.1

Moving on to our proposed analysis, we present our main results in table 6, which shows different regressions of the equity premium into inflation. The first two models shows fixed effect regressions using 5 years average[33] equity premium on inflation and clustered standard errors[34]. The first model has no controls other than the fixed effects structure[35] while the second model - which is our preferred specification - adds our set of control variables[36]. The third model repeat the exercise using least squares with our full set of controls on long term average cross section data[37]. The period chosen to construct this

[31] We ran versions of our results without countries that belongs to the Eurozone and found similar results. These versions are omitted from this paper but are available under request

[32] In the next section we will show evidences that this phenomena is likely due to the over-representativeness of industrialized countries in the DMS database, as 20 of the 23 countries covered there belongs to the OECD

[33] The periods we considered were 1996-2000, 2001-2005, 2006-2010 and 2011-2015

[34] Clustered by country level, with members of the Eurozone defined as a single country. See section 3 for details

[35] We use both cross section and time series fixed effects as the latter is important to capture global business cycle movements, like the financial crisis of 2008-2009

[36] Share of population with more than 65 years over total population, real per capita GDP growth rates, relative standard deviation of real local per capita GDP and country risk - see section 2 for details

[37] As explained in section 3, our control variables rise to importance here because our main issue is that of a potential missing variable that is correlated both with equity premium and inflation. Thus we only considered models with controls for the least squares analysis

Table 6: Main Results

Coefficients	Model 1 Fixed Effects	Model 2 Fixed Effects	Model 3 Least Squares
Inflation	-0.576*** (0.098)	-0.230*** (0.074)	-0.802** (0.387)
Controls	No	Yes	Yes
Nº Obs	176	149	36
Nº Clusters	50	47	26
R-Squared	0.316	0.541	0.532

Clustered standard errors in parenthesis
***p<0.01, ** p<0.05, * p<0.1
Table shows different regressions of equity premium over inflation
Model 1 and 2 uses five year average fixed effects. Model 3 uses
2001-2015 average least squares. See text for details

average was the years of 2001-2015. The choice of these particular years was made for two main reasons. The first is that that this period allows us to have information on a larger number of countries that if we used our whole 20 years sample to make the long term average - we have information for 36 countries for the period 2001-2015 and only for 19 countries for the full 20 years that we covered[38]. The second is that for this particular period it is easy for us to compare results with the fixed effects model, as this is precisely the last three time periods from that model.

We can see that the coefficients on the inflation measures for all models are negative and significant for the usual levels. Moreover, their magnitude are relatively high, in the sense that moderate amounts of inflation can have profound impact on equity premium measures[39]. As explained before, as both approaches - fixed effects on 5 year averages and least squares on long term average - delivered negative relationships between inflation and equity premium, we consider these results as supportive of *myopic loss aversion* theory. Note however that in all models predictive power of the models are relatively small - even after the addition of our set of controls - which suggests that our desired effect explains only a small fraction of the *equity premium puzzle*.

To further analyse the importance of *myopic loss aversion* to the explanation of the *equity premium puzzle*, we attempt to construct a counterfactual world dampening the effects of the first to see what happens to the latter. The idea is that if *myopic loss aversion* is truly responsible for the *equity premium puzzle*, we would expect to see a much lower variance in equity premium between countries in the absence of this effect. Table 7 attempts to tackle this issue. To construct our counterfactual world with lower *myopic loss aversion*, we substituted the actual values for inflation for each country by the respective values for the U.S. inflation for the period between 2001 and 2015[40]. Our reasoning is that,

[38]Nonetheless, the results using our full 20 years (omitted from this paper but available under request) are similar to those presented in this section.

[39]For instance, if any given country had 10 p.p. more inflation in the long run, its equity premium would decrease by 2.3 p.p. in the smallest case - model 2 - and 8.0 p.p. in the highest case - model 3

[40]The period chosen is composed by the last 3 five-yearly observations used in the fixed effect models. We chose this period for analysis as we have many missing observations for the

given the relationship between inflation and myopic loss aversion observed in the Thaler et al. (1997) experiment, we can assume that if the country's inflation level were the same, their differences in *myopic loss aversion*'s effects would collapse. Based on this, we made a forecast of the equity premium in these counterfactual world using the models from tables 6. If *myopic loss aversion* is largely responsible for the equity premium puzzle, we expect to find a much lower variance between our predicted values when compared to the actual ones. Moreover, as we used the U.S. inflation as the benchmark, we should also expect to see counterfactual equity premium measures being closer to the actual U.S. one

Table 7 report the results of this exercise. The first column shows the countries names. The second shows the actual average inflation for the 2001-2015 period. The third shows the difference between the countries inflation and the U.S. one. The fourth column shows the actual equity premium for this period. The fifth and sixth columns shows the counterfactual forecast values using the fixed effect models from table 6 - the fitfth column uses the model without controls while the sixty column uses the model with controls - while the last column does the same for the least squares regression. In the bottom of the table we report the standard deviation of each equity premium measure and the sum of the absolute difference between the countries equity premium and the United States' one. We also report ratios of the counterfactual measures from these metrics to the observed ones

This analysis confirms that *myopic loss aversion* do not fully explain the *equity premium puzzle*. Indeed, in all models, the standard deviation of equity premium of the counterfactual forecasts are very close to the one observed in reality - the minimum standard deviation forecast is the long term least squars model (i.e model 3 from table 6) and that still has 86.1% of the observed equity premium standard deviation. Also, the sum of absolute differences between each country's equity premium and the United States' one are very close between each counterfactual simulation and the observed values - the best model in this metric, which is once again model 3 from table 6 still has 89.1% of the observed value for this variable.

Therefore, we can conclude that while we find statistical support for *myopic loss aversion* theory in the results of table 6, its effects seem very small in practice, as shown by the analysis of table 7.

5 Robustness Checks

In this section we develop additional robustness checks to expand the previous analysis and alleviate some weaknesses. In what follows, it will become clear that those checks will have a negative impact in our sample size, which is already reasonably small. In order to circumvent that, throughout this section we will perform fixed effects estimations on a yearly basis. By doing this, we are effectively making a trade-off between a larger sample size at the cost of lower confidence in our exogeneity hypothesis, as business cycle correlation among macro variables will now be a bigger problem. However, as the intention of this

period between 1996-2000 as explained before. Note that, by doing this, this tables are not directly comparable to the ones reported in table 3, as those also includes the year 2000. The tables includes all countries for which we have forecasts in every model

Table 7: Predicted Values with U.S. Inflation for 2001-2015

Country	CPI	Dif from U.S.	Equity Premium	Fixed Effects No Controls	Fixed Effects with Controls	Long Term Cross Section
Ghana	22.2	20.3	-12.0	-4.4	-9.0	-1.4
Turkey	13.3	11.3	-6.4	1.0	-3.4	3.5
Brazil	8.2	6.2	-2.1	0.7	-1.0	1.5
South Africa	6.9	4.9	5.4	7.5	6.2	8.3
Chile	5.0	3.1	4.8	5.4	5.0	5.6
Mexico	4.9	2.9	4.9	6.1	5.4	6.6
Hungary	4.4	2.4	1.2	2.5	1.7	3.1
Bulgaria	4.2	2.2	8.8	10.1	9.3	10.6
Norway	3.3	1.4	4.1	4.0	4.1	3.9
Malaysia	3.2	1.2	4.3	4.4	4.3	4.4
Australia	3.1	1.1	4.8	5.1	4.9	5.3
Slovenia	2.9	0.9	4.0	4.5	4.2	4.9
Thailand	2.7	0.7	11.5	11.6	11.5	11.7
New Zealand	2.4	0.4	6.1	6.1	6.1	6.1
United Kingdom	2.2	0.3	-0.1	-0.1	-0.1	-0.1
Portugal	2.1	0.1	-3.6	-3.6	-3.6	-3.6
Spain	2.0	0.1	0.8	0.9	0.8	0.9
Denmark	2.0	0.1	9.7	9.6	9.7	9.5
Canada	2.0	0.0	4.4	4.3	4.3	4.2
United States	2.0	0.0	1.5	1.5	1.5	1.5
Italy	1.9	-0.1	-3.5	-3.7	-3.6	-3.7
Austria	1.7	-0.2	5.4	5.4	5.4	5.3
Belgium	1.7	-0.3	2.8	2.7	2.8	2.6
Netherlands	1.7	-0.3	0.9	0.8	0.8	0.7
Sweden	1.7	-0.3	4.7	4.1	4.4	3.9
Finland	1.7	-0.3	-3.8	-4.1	-3.9	-4.3
Greece	1.7	-0.3	-10.1	-10.1	-10.1	-10.0
France	1.5	-0.5	-0.3	-0.7	-0.5	-0.8
Ireland	1.5	-0.5	2.0	1.9	1.9	1.8
Germany	1.3	-0.7	4.6	4.2	4.5	4.1
Switzerland	0.5	-1.5	4.4	3.4	4.0	3.0
Japan	-0.9	-2.8	3.9	2.6	3.4	2.2
Std. Dev			5.2	4.5	4.9	4.5
Ratio				87.2%	93.3%	86.1%
Sum Absolute Dif			128.9	115.4	123.2	114.9
Ratio				89.5%	95.5%	89.1%

Table shows counterfactual forecasts for the models in Tables 6 using U.S. inflation for each country.
See text for details

section is merely to check our previous results, we feel this is a good trade-off to make[41].

The first of these checks aims to offer better evidence against the potential endogeneity problem in the fixed effects estimation. As our argument from the previous section might not satisfy everyone, it is possible that one might still be concerned with inflation being endogeneous in our main fixed effects specification. In this case, an instrumental variable (IV) approach might help. We have a natural set of instruments - lagged values for inflation and economic activity measures - that allow us to estimate table 6 using IV[42]

However, as with the other methods, this approach also has some weaknesses, as it is hard to fully believe in the exclusion assumption in this setting, given that we may have other channels for inflation in the previous period to affect current equity premium other than through this period's inflation. In other words, we still have some endogeneity issues, but now at least we are only dealing with variance in inflation generated by its correlation with past inflation.

Table 8 shows the results of the IV fixed effects model using lagged inflation, GDP growth and country risk measures as instruments for the current values of these respective variables [43]. Both columns replicate model 2 from table 6; the first model of this table uses the IV approach on yearly returns while the second model does the same without the instrumental variables[44]

Table 8: Fixed Effects IV Regressions

Coefficients	Model 1 IV and Fixed Effects	Model 2 Fixed Effects
Inflation	-0.619***	-0.622**
	(0.194)	(0.253)
Controls	Yes	Yes
R-squared	0.60	0.61
Observations	692	734
Weak Id. Test	3.55	N/A

***p<0.01, ** p<0.05, * p<0.1
Clustered std errors calculated by xtivreg2 code in parenthesis. Model 1 shows IV-Fixed effects estimation of yearly equity premium measures while model 2 shows yearly Fixed Effects estimation without IV.
See text for details.

We can see that the IV package changes very little our results. Both models in table 8 have coefficients that are negative and significant coefficients, and

[41]When relevant, we will also report a model that is equivalent to those estimated in the previous section, but using yearly returns rather than five-yearly to facilitate the comparisons

[42]Note that, if we did this in a five yearly basis we would lose one of our 4 periods, which is a huge sample loss.

[43]The first stage equations - omitted from this paper but available under request - seems to be well behaved, altought this is hard to tell as we use a cluster structure and most formal tests of weak instruments operates under the i.i.d. error assumption. We provide the weak identification test by Kleibergen-Paap rk Wald F stat in the bottom of the table and note that in all first stages equation the F test for exclusion of instruments is higher than 10

[44]Hence, the only difference between model 2 from table 8 from its counterpart at table 6 is that in this section we use yearly returns while in the former we used five-yearly returns.

Table 9: Fixed Effects Regressions by Tertiles of Development Level

Coefficients	Model 2 FE		
	1/3	2/3	3/3
Inflation	-0.83***	-0.20	-0.25
	(0.26)	(1.43)	(0.77)
Clusters	16	14	17
R-squared	0.68	0.68	0.76

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Table shows fixed effects estimation of yearly equity premium by tertile of per capita GDP. The 1/3 column refers to the first tertile, the 2/3 to the second and 3/3 to the third. See text for details

the magnitude of the coefficients are very similar. As explained, we take this exercise as a good robustness size.

We now analyze why the results obtained using our constructed database are different than the ones we get using the DMS database. Specifically, we are interested to see if our results might be driven by the presence of different inflation to equity premium regimes between industrialized and non-industrialized countries, rather than by a *de facto* negative causal relationship between inflation and equity premium as *myopic loss aversion* theory predicts.

To understand the previous sentence, consider an hypothetical scenario where industrialized countries have lower inflation and higher equity premium than non-industrialized countries, but inside those groups we find no evidence of a negative causal relationship between those variables. It is easy to see that in such a scenario, our main result comes solely by a regime change between industrialized and non-industrialized countries, rather than the channel we are looking for - i.e. the negative relationship between inflation and equity premium.

To address this problem we split our sample in tertiles by development level - measured by per capita GDP - and re-estimated model 2 from table 6[45]. The results are shown in table 9.

We can see that the negative relationship between inflation and equity premium that we found holds, in general, only for the first tertile of development in our sample (column 1/3). We can safely assume that those countries are the non-industrialized ones, which helps to explain why we found no evidence for a negative relationship between inflation and equity premium in the DMS database. We note, however, that we do find evidence for *myopic loss aversion* at least among those "non-industrialized countries". It is also noteworthy that unlike the simple correlation of table 5, no model shows evidence for a positive relationship between inflation and equity premium once add fixed effects as controls.

[45]Once again note that this approach leaves us with a third of our normal sample in each regression, so we opted for yearly returns regressions

6 Conclusions

This study performed a different check on the theory of myopic loss aversion as a good explanation for the *equity premium puzzle*. Rather than assuming a representative agent with standard prospect theory parameters and looking for equilibrium portfolio evaluation frequency between bonds and equities, we tried to look for a negative causal relationship between inflation and equity premium in several countries. The idea is that higher inflation leads to lower probabilities of nominal losses in any given portfolio evaluation frequency. Thus, in a *coeteris paribus* sense, under nominal price evaluation, prospect utility of stocks are higher in a low inflation environment, which raises demand for this class of assets, leading to a lower equity premium. We find this approach provides a stronger test for myopic loss aversion than looking for equilibrium portfolio evaluation frequencies, as it is hard to tell if any given frequency is "reasonable" or not.

Using a new database collected from public data sources for the last twenty years, we got access to a higher number of countries than most studies that tackles international comparisons of equity premiums. This database seems very similar to standard ones for the countries that they intersect, which suggests that its results are comparable to those using standard datasets.

We used two different approaches to test for a negative causal link between inflation and equity premium: fixed effect panel data on yearly returns and traditional cross section regression on long term averages. While both approaches have identification assumptions that are likely too strong to be entirely valid, we argued they are not far the true. Moreover they have different strengths and weaknesses: fixed effects deal better with the problem of unobserved variables but is more susceptible to reverse causation problem critiques, while long term cross sectional analysis are better equipped to handle reverse causality but is weaker to the problem of unobservable affecting our regression. By grouping them together we believe the bulk of evidence gets more convincing.

The results we found offer partial support for myopic loss aversion theory. Both methodologies suggests the link between inflation and equity premium is indeed negative, as the theory predicts, and the magnitude of the coefficients are relevant, in the sense that moderate amounts of inflation can potentially explain large equity measures of equity premium. However, the effects seem to acount only for a small part of the equity premium observed variation, and concentrated on non-industrialized countries, which is not what the original theory aimed for[46]. Thus we can conclude that *myopic loss aversion* can explain, at best, only part of the story behind the *equity premium puzzle*[47].

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[46]This concentration on non-industrialized countries is hard to explain, considering that our results have controls by development level and country risk, which are likely be the main candidates to explain this difference. We consider this to be a good topic for future research

[47]See Mehra (2003) for other theories that seem to also explain fractions of the puzzle

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