

# **BOND PREMIUM IN TURKEY**

## **Inflation Risk or Default Risk?**

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### **Abstract**

In this paper we examine the difference between T-Bill returns and common stock returns in Turkey. We observe that there is a bond premium in Turkey unlike the equity premia in developed countries. As an attempt to explain this surprising observation, we incorporate inflation risk and default risk to the Mehra and Prescott (1985) dynamic asset pricing model. Calibration with reasonable parameter values indicate that the inflation risk alone is not sufficient to explain the observed bond premium. However by allowing for the presence of a perceived default probability, we can explain the observed bond premium on Turkish T-Bills over Turkish common stocks.

Keywords: Equity Premium Puzzle, Default Risk, Inflation Risk, Asset Pricing, Bond Premium.

JEL Classification: E21, E31, G12 .

## 1. Introduction

The the excess return from common stocks over government securities (T-bills) is known as “equity premium”. Possible reasons for a positive equity premium is first addressed in a dynamic general equilibrium model by Mehra and Prescott (1985). However, this theoretical model, when calibrated with US data, can produce a maximum of 0.4 percent equity premium, which is very far from the historically observed equity premium in US data, namely 6.18 percent over the 1889-1978 period. This hard to explain excess return from common stocks, since then, is called the “Equity Premium Puzzle” . The premium is even more pronounced over the post-war period namely 7.8 percent.<sup>1</sup> The finding of significantly high excess return on common stocks over bonds is not unique to US economy. Campbell (1999) reports equity premium puzzles for Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom. Since these countries account for more than 85% of the capitalized global equity value, the puzzle can not be overlooked easily.

There have been many attempts to resolve the puzzle over the past 17 years.<sup>2</sup> Two main methods are proposed in these attempts. First is to impose modifications in the utility function. Campbell and Cochrane (1999) use a habit formation utility function in the model. Another approach is to model the investors’ risk aversion as asymmetric between gains and losses. Ang, Bekaert and Liu (2001) uses the disappointment aversion utility approach of Gül (1991), and Benartzi and Thaler (1995) proposes the myopic loss

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<sup>1</sup> Siegel (1998).

<sup>2</sup> See Kocherlakota (1996) and Mehra (2001) for the vast literature on the Equity premium Puzzle.

aversion utility which are typical examples of these attempts. Second is to use market imperfections, transaction costs and investor heterogeneity to address the puzzle. Fischer (1994) imposes transaction costs to the Mehra-Presscott model and an equity premium in the order of 3-4 percent is generated with the plausible values of the transaction cost parameters. Telmer (1993) modifies the model to incorporate heterogeneous agents and incomplete markets. Ebrahim and Mathur (2001) model investor heterogeneity, market segmentation and optimal leverage (with complete markets, ignoring the transaction costs). Thereby, they investigate the puzzle without a preference modification.

The current paper is the first attempt to explore the presence or absence of equity premium puzzle in the Turkish Capital Market. But the model of Mehra and Presscott is not directly applicable with Turkish data. In Mehra and Presscott (1985) inflation-risk on real T-bill returns are ignored. However due to the high and volatile inflation in Turkey, it may not be appropriate to set this risk to zero a priori. The Mehra and Prescott (1985) assumption can be justified by the negligible correlation between unanticipated inflation and the real growth rate of consumption in US data. A close examination of the Turkish data, however, reveals that this assumption is not valid for Turkey.<sup>3</sup> Therefore the same model is not applicable for a study in a high-inflation country like Turkey. Since the asset pricing model must include inflation risk components, the model is restated in nominal terms. As a result of this modification, the model is capable of explaining the inflation risk on bonds and as well as that on stocks.

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<sup>3</sup> See Section 4 for data analysis.

In addition to inflation risk, a second possible source of uncertainty on T-bill returns is the possibility of default on government debt. There is a vast literature on the debt dynamics and default risk. Sylla and Wallis(1998) draws attention to the US State defaults in 1840s, caused by the fall in revenues. Eichengreen and Portes (1986) focuses on the interwar default experiences. Tanner (1995) examines domestic debt and financial indexation in Brazil for the 1976-1991 period. The case of Brazil in 80s is also examined by Tanner (1994), by arguing the implicit domestic default on indexed debt in this period. Drudi and Giordano (2000) argues the relationship between inflation, indexed domestic debt, and default probability. Hernandez-Trillo (1995) builds a model to estimate the probability of default with the data of 33 debtor countries. Merrick (2001) examines the implied default recovery ratio and default probability using Eurobond data of Russia and Argentina. Therefore, as a sovereign emerging market economy, Turkish government securities might not be considered by the market participants as fully default-risk free. The bond premium observed in Turkish data confirms the default-risk idea as well.

In this paper, first, historical data on stock and bond returns for the 1990(1)-2002(1) period is constructed. Quite strikingly, the presence of a 'bond premium' is observed in the last decade of the twentieth century. Then a theoretical variant of the Mehra-Prescott (1985) dynamic asset pricing model is constructed for a high inflation country which includes inflation-risk components. Finally, default-risk is also considered as a second variation to the model. Thereby implied default probabilities are calculated for a reasonable range of parameter values.

Organization of this paper is as follows. Section 2 introduces the model. Section 3 gives information about the data. Section 4 presents the results of the model calibrated with Turkish data. Finally Section 5 concludes the paper.

## 2. The Model

### 2.1. The Model with inflation risk:

A variation of Mehra and Prescott (1985) model is used which incorporates nominal bonds to the original model. This is a representative agent model. The agent has preferences given by

$$W = E_0 \sum_{t=0}^{\infty} \beta^t [u(c_t)] \quad (1)$$

where  $0 < \beta < 1$  and  $u(.)$  is strictly increasing, strictly concave and twice differentiable.

The sequence of budget constraint is given by

$$g_t c_t + q_t b_t + p_t z_{t+1} = b_{t-1} + p_t z_t + y_t z_t \quad (2)$$

where  $g_t$ ,  $c_t$ ,  $q_t$ ,  $b_t$ ,  $z_t$ ,  $y_t$ ,  $p_t$  denote respectively price of consumption good, real consumption, nominal price of one period maturity bond at time  $t$  which is pays 1 unit of currency at time  $t+1$ , quantity of bonds purchased at time  $t$ , quantity of shares, nominal

dividend received per share, and nominal price per share of the common stock. The utility of the agent is defined as typical constant relative risk aversion utility function,

$$u(c) = \frac{c^{1-\sigma} - 1}{1-\sigma} \quad (3)$$

The interest here is to determine the competitive equilibrium prices. *Consumer's maximization problem* is

$$\text{maximize}_{b_t, z_{t+1}} W$$

*subject to*

$$g_t c_t + q_t b_t + p_t z_{t+1} = b_{t-1} + p_t z_t + y_t z_t$$

In this maximization problem, *first order conditions* are

$$\frac{\partial W(\cdot)}{\partial b_t} = 0 \quad (4)$$

$$\frac{\partial W(\cdot)}{\partial z_{t+1}} = 0 \quad (5)$$

When the first order conditions (4) and (5) are applied, expressions about the real interest rate and stock returns are obtained. The agent decides his position for the next period in the stock market and bond market at the same time as current consumption decision. By

substituting consumption in the budget constraint (2) and imposing the first order condition (4), the nominal price of bonds is obtained after some rearrangements, as of time t,

$$q_t = \beta E_t \left[ \frac{u(c_{t+1})' g_t}{u(c_t)' g_{t+1}} \right] \quad (6)$$

Since the covariance between two random variables, x and y is given by,

$$\text{cov}(x, y) = E[xy] - E[x]E[y] \quad (7)$$

By using (4),(6) and (7), nominal price of bonds is rearranged as<sup>4</sup>,

$$q_t = \beta \left[ E \left[ \left( \frac{c_t}{c_{t+1}} \right)^\sigma \right] E \left[ \left( \frac{g_t}{g_{t+1}} \right) \right] + \text{cov} \left( \left( \frac{c_t}{c_{t+1}} \right)^\sigma, \left( \frac{g_t}{g_{t+1}} \right) \right) \right] \quad (8)$$

Sample values of all of the expressions in the equation are computable with given time series data. If the relevant sample moments on the right hand side of equation (8) are used, the theoretical value of nominal bond price will be obtained. The implied nominal interest rate of bonds, then, is found by

$$i = \frac{1}{q} - 1, \quad (9)$$

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<sup>4</sup>  $\left( \frac{g_t}{g_{t+1}} \right)$  is equal to the gross deflation rate. It can also be expressed as  $\left( \frac{1}{1 + \pi_{t+1}} \right)$  where  $\pi_{t+1}$  is the inflation rate in period t+1.

and the real interest rate of bonds can be calculated as

$$r = \frac{1+i}{1+\bar{\pi}} - 1 \quad (10)$$

where  $\bar{\pi}$  is the average inflation rate over the sample period.

The second F.O.C. is related with the common stock holdings,  $z_{t+1}$ . By substituting for consumption in equation (1) from the budget constraint (2) and applying the first order condition (5), the expression about the stock prices becomes,

$$\frac{p_t}{g_t} u(c_t)' = \beta E_t \left[ \frac{p_{t+1} + y_{t+1}}{g_{t+1}} u(c_{t+1})' \right] \quad (11)$$

After some rearrangements, equation (11) takes form,

$$1 = \beta E_t \left[ (1 + r_{s,t+1}) \left( \frac{c_t}{c_{t+1}} \right)^\sigma \right] \quad (12)$$

where  $r_{s,t+1}$  is the real stock return<sup>5</sup> at time t+1. If we use the covariance expansion (7), equation (12) becomes,

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<sup>5</sup>  $(1 + r_{s,t+1}) = \frac{p_{t+1} + y_{t+1}}{p_t} \frac{g_t}{g_{t+1}}$

$$\frac{1}{\beta} = \text{cov}\left(1 + r_{s,t+1}, \left(\frac{c_t}{c_{t+1}}\right)^\sigma\right) + E[1 + r_{s,t+1}]E\left[\left(\frac{c_t}{c_{t+1}}\right)^\sigma\right] \quad (13)$$

Rearranging this equation, implied real stock returns can be expressed as,

$$E[r_{s,t+1}] = \frac{\left(\frac{1}{\beta} - \text{cov}\left(1 + r_{s,t+1}, \left(\frac{c_t}{c_{t+1}}\right)^\sigma\right)\right)}{E\left[\left(\frac{c_t}{c_{t+1}}\right)^\sigma\right]} - 1 \quad (14)$$

By the same method used for the calculations of the nominal interest rate on bonds, theoretical equilibrium real stock returns can be computed by using the available data.

In Mehra and Prescott (1985) the assumption which states that unanticipated inflation and the real growth rate of consumption are uncorrelated (or negligible) with the real growth rate of consumption, does not hold for Turkish data<sup>6</sup>. Therefore the same model is not applicable for a study in a high-inflation country like Turkey.

Since the asset pricing model must include inflation risk components, the model is written in nominal terms including the price level. As a result of this modification, the model is capable of explaining the inflation risk on bonds as well as on stocks.

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<sup>6</sup> See section 4 for data analysis.

## 2.2. Model with default risk:

Inflation is not the only possible source of risk for Turkey. Default risk may also be considered as one of the reasons for observed high real interest rates. To test the significance of this argument, a time invariant default risk can be incorporated in this model. If the budget constraint (2) is modified as

$$g_t c_t + q_t b_t + p_t z_{t+1} = \rho b_{t-1} + p_t z_t + y_t z_t \quad (2a)$$

where  $\rho$  is a discrete and random variable, which takes values

$$\rho = \begin{cases} 0, & \text{if default, with probability } p_d. \\ 1, & \text{if no default, with probability } (1 - p_d). \end{cases}$$

Equation (6) changes as

$$q_t = \beta E_t \left[ \rho \frac{u(c_{t+1})'}{u(c_t)'} \frac{g_t}{g_{t+1}} \right] \quad (6a)$$

and with the assumption of independence between  $\rho$  and other random variables, nominal price for bonds<sup>7</sup> become,

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<sup>7</sup> By the introduction of the random variable  $\rho$ , a time invariant default risk with no recovery of face value is included in the model. With the assumption of independence of consumption growth rate, inflation, real stock returns, from default risk, this modification effects only the real interest rates.

$$q_t = \beta \left[ (1 - p_d) E \left[ \left( \frac{c_t}{c_{t+1}} \right)^\sigma \right] E \left[ \left( \frac{g_t}{g_{t+1}} \right) \right] + \text{cov} \left( \left( \frac{c_t}{c_{t+1}} \right)^\sigma, \left( \frac{g_t}{g_{t+1}} \right) \right) \right] \quad (8a)$$

### 2.3. Implications of the model:

Regarding the bond prices, first, if future utility is highly discounted, which means  $\beta$  is low, the nominal bond prices are low and therefore the nominal interest rates are high.

Second, as the default probability ( $p_d$ ) in the model increases, nominal and real price of bonds decrease, and the nominal and real interest rates increase as expected. This gives more flexibility in explaining the high real interest rates in Turkey. When  $p_d = 0$  the model reduces to the inflation-risk only model which ignores the default risk.

Third, as seen in equation (8a), nominal bond prices are discounted by the expected value of inflation, and the expected value of real consumption growth. The risk aversion parameter ( $\sigma$ ) is effective through the impact on real consumption growth. As the agent becomes more risk averse, which means that risk aversion parameter ( $\sigma$ ) is higher, this effect will be more pronounced, otherwise this effect will be smaller.

Fourth, the covariance term is also important, as it is the distinction of this model from the Mehra-Presscott model, if it is positive, which means that if the consumption growth rate is positively correlated with the inflation, the nominal bond prices will be

high. Because, in this case, bonds provide a good hedge over business cycle fluctuations. Higher nominal bond prices mean lower nominal interest rates. Otherwise, if the consumption growth rate is negatively correlated with the inflation, this effect decreases the nominal bond prices, hence leads to high nominal interest rates.

Regarding the stock prices, the subjective discount rate,  $\beta$ , effects real stock returns in negatively. If future utility is highly discounted, which means  $\beta$  is low, the equilibrium real stock returns are high.

Second, as seen in equation (14), real stock returns are positively related with the expected value of future real consumption growth. The risk aversion parameter ( $\sigma$ ) is effective on the impact of real consumption growth. As the agent becomes more risk averse, which means that risk aversion parameter ( $\sigma$ ) is higher, this effect will be more pronounced, otherwise this effect will be smaller.

Third, the covariance term between the real stock returns and the inverse of the real consumption growth is effective, if it is positive, which means that if the consumption growth rate is negatively correlated with the real stock returns, mean value of the real stock returns decrease. Otherwise, if the consumption growth rate is positively correlated with the real stock returns, which means the covariance term in the equation is negative, equilibrium real stock returns increase.

Comovements of the macroeconomic variables in the model have strong effects on the interest rates and the real stock returns as well. These findings lead us to question whether stock market is a good hedge over the business cycle fluctuations. If the real stock returns have a positive correlation with the consumption growth, stock market is not a good hedge for bad times over the business cycle. To be a good hedge for the fluctuations, stock holdings should give higher returns in the periods during which the consumption growth is low or negative. The covariance term in the equation (14) implies that if stock holdings are a not a good hedge for fluctuations then equilibrium expected stock returns will be high since the stock prices will be discounted heavily by the market.

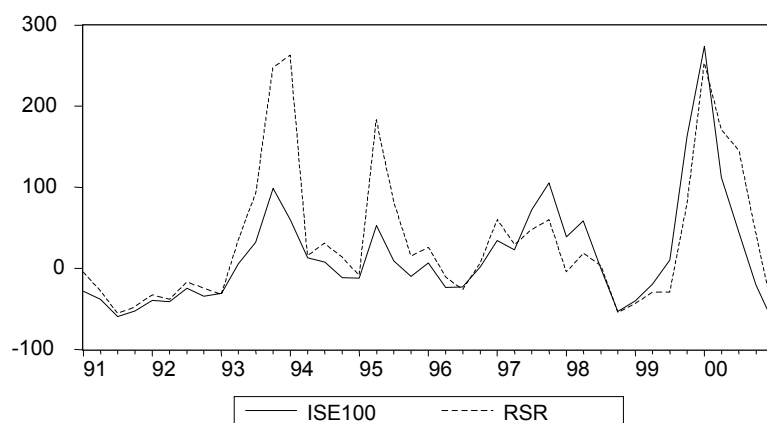
### **3. DATA**

Consumption, stock returns, inflation and T-bill returns are the necessary data series to obtain empirical results from the model. Since the number of observations is limited, instead of yearly data, quarterly data is used in this paper. To find meaningful results with quarterly data, seasonal effects must be eliminated. The traditional filtering mechanisms like HP filter cause loss of valuable information, so the same quarter in the following year is used as the next period in the model. This method, known as seasonal differencing, does not cause loss of information and the strong seasonality in consumption data is safely eliminated.

The demise of restrictions on capital movements in 1989 has an important effect on the asset prices in Turkey. Since this is an important structural change in Turkish

economy, data sample starting with the first quarter of 1990, and ending with the first quarter of 2002 is used.

Historical values of bond returns and the stock returns are the key variables for the empirical test of the model. Bond returns are calculated from the treasury auctions series. The method for constructing T-bill returns is to simulate a representative agent who purchases bonds from the treasury auctions and keeps reinvesting the principal and the interest obtained. To find the bond returns, series of treasury auctions is obtained from the electronic database of the Central Bank of the Republic of Turkey. In order to keep the average maturity as close to three months (a quarter) as possible, the auctions of three months maturity are picked whenever available. If not, the auctions closest to three months maturity are picked. The gaps in timing are filled with data from Istanbul Stock Exchange (ISE) secondary bond market and overnight repo market of ISE. After this exercise, the geometric average of annual real bond returns is found as 14.12 percent where nominal returns are deflated by TÜFE<sup>8</sup>.



**Figure 3.1.** Real Stock Returns calculated from ISE100 index and the index (RSR) generated with selected stocks. Returns are deflated with the TÜFE price level.

<sup>8</sup> TÜFE is the Consumer Price Index of State Institute of Statistics.

On the other hand, real stock returns from ISE can be calculated as

$$r_{t+4, ISE100} = \frac{ISE_{t+4} - ISE_t}{ISE_t} \frac{g_t}{g_{t+4}} \quad (1)$$

where  $ISE_t$  is the nominal level of ISE-100,  $g_t$  is the TÜFE (CPI) price level and  $r_{t, ISE-100}$  is the real return of ISE-100 at time t. Quarterly nominal level of ISE-100 is found by taking the arithmetic average of the ISE-100 index at the end of the days in the quarter.

ISE composite market index does not include the dividend payments, it only gives an idea about price level of stocks. The ISE index is adjusted for stock splits and rights offerings but not for dividends. Therefore the composite index of ISE is not reflecting the returns of a representative stockholder. The geometric average annual real returns of ISE-100 index is found as -4.80 percent during the sample period. Since the dividend payments are not included in this index, another index which includes the dividend payments is constructed and used since it is more reasonable to simulate a representative agent's stock returns by taking dividends into consideration.

In constructing the index, the stockholders are assumed to reinvest in the same stocks when they receive a dividend from a particular stock. A total of 25 firms<sup>9</sup> are chosen which have been continuously traded in the stock market during the whole period between the foundation of the stock market (January 1986) and today (April 2002). The

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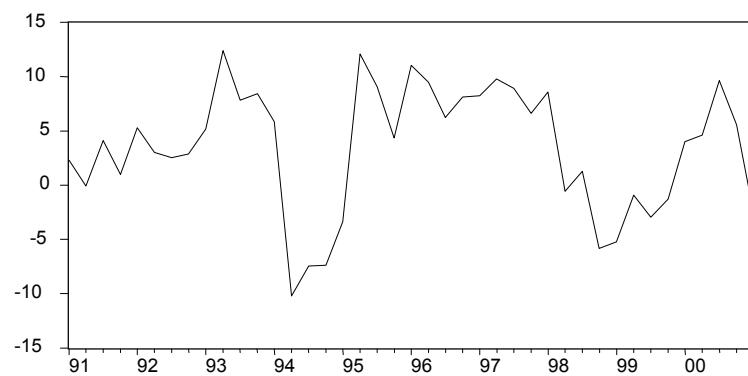
<sup>9</sup> The list of these firms are available in Appendix A.

agent is assumed to carry an equally weighted portfolio of these 25 firms<sup>10</sup>. A nominal dividend inclusive monthly stock price index is computed with this assumption. By taking the geometric average of this monthly index, a quarterly series for this new stock index is computed. Real returns from the index generated is calculated as

$$r_{t+4} = \frac{P_{t+4} - P_t}{P_t} \frac{g_t}{g_{t+4}} \quad (2)$$

where  $P_t$  is the level of nominal index generated,  $g_t$  is the TÜFE (CPI) price level and  $r_t$  is the real returns of the generated index at time t.

From this index, annual geometric average nominal stock return in Turkey is calculated as 90.96 percent in the sample period. After adjusting for inflation, the geometric annual average real stock return in Turkey is found to be 9.84 percent in the sample period.



**Figure 3.2.** Real annual consumption growth calculated with the SIS data. Quarterly private consumption at fixed prices (1987) series is used.

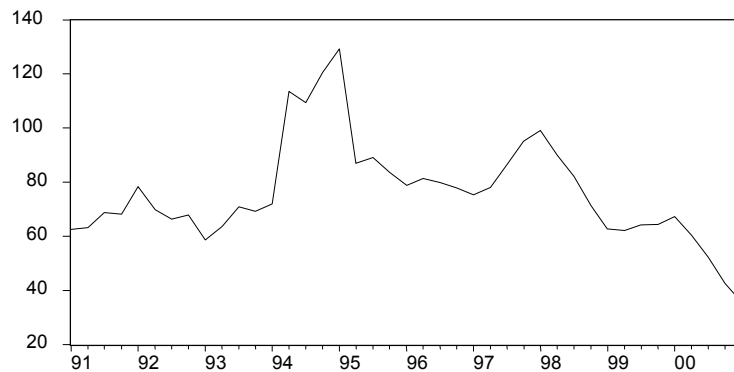
<sup>10</sup> Monthly portfolio rebalancing to preserve equally weights is assumed.

Consumption data is taken from the State Institute of Statistics (SIS). Both annual and quarterly consumption series are reported by SIS. Quarterly data, which is more suitable for our purposes is chosen in this study. The model requires the use of the real consumption, therefore the series of private consumption at fixed prices (1987) is taken.

Consumption growth is calculated as

$$cg_{t+4} = \frac{C_{t+4} - C_t}{C_t} \quad (3)$$

where  $C_t$  is the consumption,  $cg_t$  is the consumption growth at time t. Annual geometric average of consumption growth is 3.36 percent during the sample period.



**Figure 3.3.** Annual inflation in the sample period. Consumer Price Index (TÜFE) of SIS is used to calculate inflation data.

Monthly reported Consumer Price Index (1987=100) of SIS is used to calculate an appropriate quarterly inflation series. Since this monthly price index is reflecting the

average level of prices collected at various instances in a month<sup>11</sup>, geometric average of the three months in every quarter is calculated to find an appropriate price index for the quarter. Inflation is calculated as

$$\pi_{t+4} = \frac{g_{t+4} - g_t}{g_t} \quad (4)$$

where  $\pi_t$  is the inflation,  $g_t$  is the TÜFE (CPI) price level at time t. Annual average inflation rate is found to be 73.86 percent during the same period.

	<b>Geometric mean</b>
<b>Consumption growth</b>	3.36
<b>Inflation</b>	73.86
<b>Real Stock Returns</b>	9.84
<b>ISE-100 Real Returns</b>	-4.80
<b>Real T-Bill Returns</b>	14.12

**Table 3.1.** Geometric averages of the data series.

The average values of the consumption growth, T-bill interest rates, inflation and real stock returns are computed as geometric averages to be compatible with their theoretical counterparts in the model.

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<sup>11</sup> Urban Places Consumer Price Index Concepts, Methods and Sources (1987=100) , State Institute of Statistics Prime Ministry Of Turkey.

	<b>cg</b>	<b>rsr</b>	<b>inf</b>	<b>uinf</b>
<b>cg</b>	0.0032	0.0183	-0.0035	-0.0029
<b>rsr</b>	0.0183	0.7087	-0.0038	-0.0016
<b>inf</b>	-0.0035	-0.0038	0.0354	0.0343
<b>uinf</b>	-0.0029	-0.0016	0.0343	0.0343

**Table 3.2.** Covariances of the data series.<sup>12</sup>

	<b>cg</b>	<b>rsr</b>	<b>inf</b>	<b>uinf</b>
<b>cg</b>	1	0.3822	-0.3152	-0.2815
<b>rsr</b>	0.3822	1	-0.0244	-0.0099
<b>inf</b>	-0.3152	-0.0244	1	0.9852
<b>uinf</b>	-0.2815	-0.0099	0.9852	1

**Table 3.3.** Correlation coefficients of the data series.

The covariance statistics of the series are reported in Table 3.2 and the correlations between the series are reported in Table 3.3. The main purpose is to investigate the validity of the assumption of uncorrelatedness of consumption growth and unanticipated inflation made by Mehra-Presscott (1985). The unanticipated inflation seen in the tables is obtained from the residual series of the regression of current annual inflation on the last year's annual inflation. The correlation between consumption growth and unanticipated inflation is -0.2815. In bad years for consumption, inflation tends to be unexpectedly high and vice versa. It is obvious that the Mehra-Presscott assumption of uncorrelatedness does not hold with Turkish data. Therefore, bonds are not a good

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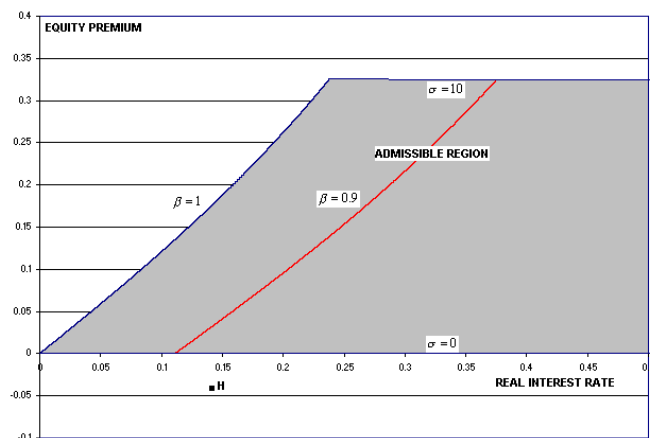
<sup>12</sup> cg : Consumption Growth.  
inf : Inflation.  
uinf : Unanticipated Inflation.  
rsr : Real Stock Returns.

hedge against business cycle fluctuations. Also, the positive correlation between the real stock returns and consumption growth supports that stocks do not provide a good hedge against business cycle fluctuations in Turkey.

## 4. Results

### 4.1. Results Under Inflation-Risk on Bonds :

First, the results of the model are studied by taking default risk as zero ( $\rho = 0$ ). Thereby, the possibility of producing the historically observed negative equity premium is investigated by changing  $\beta \in [0,1]$  and  $\sigma \in [0,10]$ . The admissible region for equity premium and real T-Bill interest rate seen in the Figure 4.1 is obtained by using the model parameters in these intervals. Since the historically observed average real interest rate on Turkish T-Bills is 14.12 percent and the average real stock returns is 9.84 percent, observed equity premium in the sample period turns out to be  $-4.28$  percent. Point H shows these historically observed values as a point on the real interest rate-equity premium plane.



**Figure 4.1.** The points which are theoretically possible under only inflation-risk on the real interest rate-equity premium plane. Point H shows the historically returns

When  $\sigma = 0$ , representative agent has a linear utility function which corresponds to the risk neutral case. Equity premium becomes zero in this situation, since stocks and T-Bills are perfect substitutes under risk neutrality. Therefore these values form a lower-bound for the equity premium in the admissible region. When the curvature of the utility function is increased (as  $\sigma$  increases), the agent becomes more risk averse. This increases the equity premium. In this model, it also increases the real interest rate on T-Bills, since T-Bills are subject to inflation-risk. In contrast Mehra and Prescott ignores the inflation-risk on T-Bills, therefore in their version the value of  $\beta$  alone determines the risk-free interest rate. Under inflation-risk on T-Bills, as  $\beta$  decreases, real interest rate increases and the iso-beta line shifts to right as seen in Figure 4.1.

As seen in the figure, the model with only inflation-risk on T-Bills can not produce a negative equity premium, so it is not capable of explaining the historically observed negative value of the equity premium in Turkish data<sup>13</sup>.

## **4.2. Results under inflation and default risk :**

As a sovereign emerging market economy, Turkish government securities might not be considered as fully default-risk free. There has been considerable discussion in the Turkish press on the possibility of “consolidation” during the 90’s. This also indicates the possibility of a perceived default-risk on Turkish T-Bills by the market participants.

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<sup>13</sup> Although negative equity premium observed in Turkish economy is not possible according to this covariance structure, it may be worth while exploring inflation-risk on bonds to address the equity premium puzzle in US economy.

In this study, the default probability considered is the implied probability of a zero-recovery default. The investors who have purchased T-Bills are assumed to lose the amount they invested. The default-risk values in Table 4.1 are the probability of a zero-recovery default. These are calculated by equation (8a) in Section 2. Also it is possible to do this work with a partial-recovery assumption. If a partial-recovery default probability were investigated, the implied probability of default turn out to be higher than these values.

In Table 4.1, the value of  $\beta$  is fixed and the value of  $\sigma$  is calibrated so as to match the historically observed value of the real stock returns. After this procedure, the value of the real interest rate on T-Bills is calibrated with the default probability. By this method, the values of  $\rho$  and  $\sigma$  are obtained which match historically observed real stock returns and real interest rate on T-Bills for a given  $\beta$ .

**Table 4.1.** Model Parameters that produce the historically observed values of real stock returns and the real interest rate on T-Bills.

$\beta$	$\sigma$	$\rho$
1.00	2.08743	0.084169
0.99	1.87065	0.079162
0.95	0.96338	0.058654
0.910427	0	0.0375295

The values of the model parameters with selected subjective discount rates which explains this bond premium are seen in the Table 4.1. The minimum possible  $\beta$  is 0.910427 to obtain the historically observed real stock returns from the model. This

corresponds also to the minimum default probability to explain the bond premium observed. The average default probability changes from 3.75 percent to 8.42 percent depending on the chosen value of  $\beta$ . After this empirical analysis, it is obvious that inflation-risk is not sufficient to explain the bond premium. The model is not able to explain the negative equity premium in Turkish economy without allowing the presence of a perceived default risk of about 4 to 8 percent in probability.

## **5. Conclusions**

In this paper, an asset pricing model for a high inflation emerging economy is constructed. By this model, Turkish bond premium observed during the 1990-2001 period is examined. Allowing for inflation-risk on bonds and stocks is considered as a first contribution to the Mehra-Presscott model. Default-risk is also introduced as a second variation to the model. A zero-recovery default is assumed when default-risk calculations are made.

Calibration results for Turkey are obtained with inflation-risk and default-risk possibilities allowed for. Inflation-risk is found to be insufficient to explain the negative equity premium observed in Turkish data. Imposing a default-risk, however, brings a theoretical explanation to the Turkish bond premium.

As further work, the situation in other emerging market economies may be investigated. Perceived default-risk in these countries may be examined by the model developed here. Also the neglected inflation-risk in the Mehra-Presscott model seems to be promising to address the equity premium puzzle in the US and other developed economies. Another promising line of research is, by means of some modifications to the

model, to obtain the time-varying perceived default default probabilities in emerging markets. Also a more reasonable recovery rate assumption may be imposed by using the historical default experiences.

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## APPENDIX A

### LIST OF THE FIRMS IN THE STOCK INDEX

ANADOLU CAM  
ARÇELİK  
BAGFAŞ  
BRİSA  
ÇELİK HALAT  
ÇİMSA  
DÖKTAŞ  
ECZACIBAŞI YATIRIM  
EGE GÜBRE  
EREĞLİ DEMİR ÇELİK  
FORD OTOSAN  
GÜBRE FABRİKALARI  
HEKTAŞ  
İZMİR DEMİR ÇELİK  
İZOCAM  
KARTONSAN  
KAV  
KOÇ HOLDİNG  
KORDSA  
OLMUKSA  
PİMAŞ  
PİRELLİ KABLO(SIEMENS)  
SARKUYSAN  
ŞİŞECAM  
T. DEMİR DÖKÜM