INFLATION RISK AND DEFAULT RISK

IN A DYNAMIC GENERAL EQUILIBRIUM

ASSET PRICING MODEL

FOR AN EMERGING MARKET ECONOMY

A Master's Thesis

by

M. FATİH EKİNCİ

Department of Economics

Bilkent University

Ankara

September -2002

I certify that I have read this thesis and have found that it is fully adequate, in scope and quality, as a thesis for the degree of Master of Arts in Economics.

Assistant Professor Dr. Erdem Başçı
Supervisor

I certify that I have read this thesis and have found that it is fully adequate, in scope and quality, as a thesis for the degree of Master of Arts in Economics.

Associate Professor Dr. Farhad Husseinov
Examining Committee Member

I certify that I have read this thesis and have found that it is fully adequate, in scope and quality, as a thesis for the degree of Master of Arts in Economics

----

Assistant Professor Dr. Levent Akdeniz

Examining Committee Member

Approval of the Institute of Economics and Social Sciences

Professor Dr. Kürşat Aydoğan

Director of Institute of Economics and Social Sciences

ABSTRACT

"Inflation Risk and Default Risk in a Dynamic General
Equilibrium Asset Pricing Model for an Emerging Market Economy"

Ekinci, Mehmet Fatih

M.A., Department of Economics

Supervisor: Assistant Prof. Erdem Başçı

September 2002

In this thesis, the difference between the T-Bill returns and common stock returns in Turkey is examined. It is observed that there is a bond premium in Turkey unlike the equity premium observed in developed countries. To understand this surprising observation, inflation-risk and default-risk are incorporated to the Mehra-Presscott (1985) dynamic asset pricing model. Inflation-risk alone is found to be insufficient to explain this bond premium. Only after allowing for a perceived default-risk, the observed bond premium of Turkish T-Bills over Turkish common stocks can be explained by such a model.

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

ÖZET

Gelişmekte olan bir Piyasa Ekonomisi için Dinamik bir Genel Denge Varlık Fiyatlandırma Modelinde Enflasyon ve Default Riski

Ekinci, Mehmet Fatih

Master, İktisat Bölümü

Tez Yöneticisi: Yrd. Doç. Dr. Erdem Başçı

Eylül, 2002

Bu tez, Türkiye'deki hazine tahvili getirileri ve borsa getirileri arasındaki fark üzerine bir çalışmadır. Türkiye'de gelişmiş ülkelerdeki hisse primlerinin aksine bir bono primi olduğu gözlenmiştir. Bu beklenmeyen tespit üzerine Mehra-Presscott (1985) dinamik varlık fiyatlandırma modeline enflasyon riski ve default riski uygulanmıştır. Enflasyon riskinin bu bono primini açıklamakta yetersiz kaldığı tespit edilmiştir. Ancak default riski dahil edildiği zaman Türkiye'deki hazine tahvillerinin borsa getirilerini aşması açıklanabilmiştir.

Anahtar Kelimeler: Hisse Primi Açmazı, Default riski, Enflasyon Riski, Varlık Fiyatlandırma, Bono Primi.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude, first and foremost, to Assistant Professor Erdem Başçı for his continuous support throughout this study and the support and supervision he provided during the entire course of this study. I also wish to thank Assoc. Prof. Farhad Husseinov and Asst. Prof. Levent Akdeniz for their helpful comments.

I am truly grateful to my family for their strong encouragement during my education. I am also indebted to my colleagues at the State Planning Organization.

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SECTION 1 : INTRODUCTION

The difference between the average return on common stocks (a risky asset) and the average return on govenrment securities (Treasury bills, T-bills) is called “equity premium”. Possible reasons for this difference is first disscussed by Mehra and Presscott (1985) in a dynamic general equilibrium model. A variation of Lucas’ (1978) asset pricing model is used by Mehra and Presscott. 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,[1] namely 6.18 percent over the 1889-1978 period. This unexplained excess return from common stocks is called “Equity Premium Puzzle” . This premium is even more pronounced over the post-war period as 7.8 percent in the 1947-2000 period.[2] The finding of significantly high excess return on common stocks is not unique to US economy. Campbell (1999) also 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 attemps to resolve the puzzle over the past 17 years.[3] Two main methods are proposed in these attemps. 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

[1] Mehra and Presscott(1985).
[2] Siegel (1998).
[3] See Kocherlakota (1996) and Mehra (2001) for the vast literature on the Equity premium Puzzle.

utility approach of Gül (1991), and Benartzi and Thaler (1995) proposes the mypoic loss 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.

This thesis is the first attemp 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 alternatively be stated as zero correlation between unanticipated inflation and the real growth rate of consumption. A close examination of the Turkish data reveals that this assumption is not valid for the case of Turkey.[4] 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.

[4] See section 4 for data analysis.

Bonds obviously do not provide any hedge against surprise inflation. In contrast, the classical Fischer model implies that stocks provide a hedge against inflation [5]. Stocks provide a hedge against inflation when investors are completely compensated for the increases in the price level through increases in nominal stock returns, thereby leaving real stock returns uneffected. In most of the literature, the estimated relation between short-term nominal stock returns and inflation is insignificant and may even be negative[6]. Ely and Robinson (1997) test the inflation-hedge hypothesis for 16 OECD countries, and as a result they find that stocks do not hedge against inflation in the short-run.

This fact contradicts with the classical Fischer model. This model states that real stock returns are determined by real factors independently from the rate of inflation. This contradiction is named as "stock return-inflation puzzle". Fama (1981) explains this puzzle by a supply side explanation to this anomalous relationship. He states that in an economy with a vertical long-run supply curve, demand shocks don't have any impact on output growth. On the other hand, the opposite is true for the supply shocks. This hypothesis states that only the component of inflation due to supply shocks will be significantly and negatively correlated with real stock returns because a favorable supply shock simultaneously reduces inflation and increases market value of firms.

Other than inflation risk, a second source of uncertainity 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

[5] Gallagher and Taylor (2002).
[6] see e.g. Fama and Schwert (1977), Gültekin (1983).

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 in this period.

Dooley (2000) focuses on the debt management policy for governments of developing countries. He claims that since default-risk is not relevant for the developed countries, debt management policies of developed countries can not be a useful guide for developing countries.

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 thesis, 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 thesis 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 thesis.

SECTION 2: MODEL

2.1.Model with inflation risk:

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

$$W = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) \right] \qquad \textbf{(1)}$$

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

Agents budget constraint is given by

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

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,

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

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

$$\max_{b_t, z_{t+1}} \; W$$

$$\textit{subject to}$$

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

In this maximization problem, *first order conditions* are

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

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

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,

$$q_t = b\mathrm{E}_t\left[\frac{u(c_{t+1})'}{u(c_t)'}\frac{g_t}{g_{t+1}}\right] \quad \textbf{(6)}$$

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

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

By using (4),(6) and (7), nominal price of bonds is rearranged as[7],

$$q_t = b\left[\mathrm{E}\left[\left(\frac{c_t}{c_{t+1}}\right)^s\right]\mathrm{E}\left[\left(\frac{g_t}{g_{t+1}}\right)\right] + \mathrm{cov}\left(\left(\frac{c_t}{c_{t+1}}\right)^s, \left(\frac{g_t}{g_{t+1}}\right)\right)\right] \quad \textbf{(8)}$$

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

$$i = {}^{1}\!/_{q} - 1, \quad \textbf{(9)}$$

---

[7] $\left(\frac{g_t}{g_{t+1}}\right)$ is equal to the gross deflation rate. It can also be expressed as $\left(\frac{1}{1+p_{t+1}}\right)$ where p_{t+1} is the inflation rate in period t+1.

and the real interest rate of bonds can be calculated as

$$r = \frac{1+i}{1+\bar{p}} - 1 \qquad \textbf{(10)}$$

where $\bar{p}$ is the 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,

$$\frac{p_t}{g_t} u(c_t)' = b\mathrm{E}_t \left[\frac{p_{t+1} + y_{t+1}}{g_{t+1}} u(c_{t+1})' \right] \qquad \textbf{(11)}$$

After some rearrangements, equation (11) takes form,

$$1 = b\mathrm{E}_t \left[(1 + r_{s,t+1}) \left(\frac{c_t}{c_{t+1}} \right)^s \right] \qquad \textbf{(12)}$$

where $r_{s,t+1}$ is the real stock return[8] at time t+1. If we use the covariance expansion (7), equation (12) becomes,

---

[8] $(1 + r_{s,t+1}) = \frac{p_{t+1} + y_{t+1}}{p_t} \frac{g_t}{g_{t+1}}$

$$\frac{1}{b} = \mathrm{cov}\left((1 + r_{s,t+1}), \left(\frac{c_t}{c_{t+1}} \right)^s \right) + \mathrm{E}\left[(1 + r_{s,t+1}) \right] \mathrm{E}\left[\left(\frac{c_t}{c_{t+1}} \right)^s \right] \qquad \textbf{(13)}$$

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

$$\mathrm{E}\left[r_{s,t+1} \right] = \frac{\left(\frac{1}{b} - \mathrm{cov}\left((1 + r_{s,t+1}), \left(\frac{c_t}{c_{t+1}} \right)^s \right) \right)}{\mathrm{E}\left[\left(\frac{c_t}{c_{t+1}} \right)^s \right]} - 1 \qquad \textbf{(14)}$$

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 Presscott (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[9]. 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.

[9] 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

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

where r is a discrete and random variable,which is takes values

$$r = \begin{cases} 0\,, \textit{if default}, \textit{with probability } p_d . \\ 1\;, \textit{if no default}, \textit{with probability } (1 - p_d). \end{cases}$$

Equation (6) changes as

$$q_t = b\mathrm{E}_t\left[r \frac{u(c_{t+1})'}{u(c_t)'} \frac{g_t}{g_{t+1}} \right] \qquad \textbf{(6a)}$$

and with the assumption of independence between r and other random variables, nominal price for bonds[10] become,

[10] By the introduction of the random variable r, 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.

$$q_t = b\left[(1-p_d)\mathrm{E}\left[\left(\frac{c_t}{c_{t+1}}\right)^{s}\right]\mathrm{E}\left[\left(\frac{g_t}{g_{t+1}}\right)\right] + \mathrm{cov}\left(\left(\frac{c_t}{c_{t+1}}\right)^{s}, \left(\frac{g_t}{g_{t+1}}\right)\right)\right] \qquad \textbf{(8a)}$$

2.3.Implications of the model:

Regarding the bond prices, first, if future utility is highly discounted,which means b 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 (s) is effective through the impact on real consumption growth. As the agent becomes more risk averse, which means that risk aversion parameter (s) 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, b, effects real stock returns in negatively. If future utility is highly discounted, which means b 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 (s) is effective on the impact of real consumption growth. As the agent becomes more risk averse, which means that risk aversion parameter (s) 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.

SECTION 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 thesis. 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[11] is obtained from the electronic database of the Central Bank of the Republic of Turkey. In order to

[11] The list of treasury auctions is available in Appendix B.

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[12].

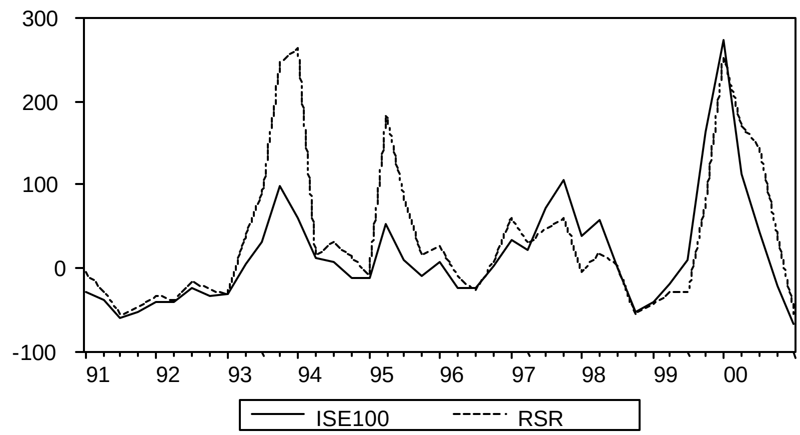

Figure 3.1. Real Stock Returns calculated from ISE100 index and the index (RSR) generated with selected stocks. Returns are deflated with the TÜFE price level.

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

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

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.

[12] TÜFE is the Consumer Price Index of State Institute of Statistics.

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[13] 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 agent is assumed to carry an equally weighted portfolio of these 25 firms[14]. 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[15] for this new stock index is computed. Real returns from the index generated is calculated as

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

[13] The list of these firms are available in Appendix A.
[14] Monthly portfolio rebalancing to preserve equally weights is assumed.
[15] This quarterly seri is available in Appendix C.

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.

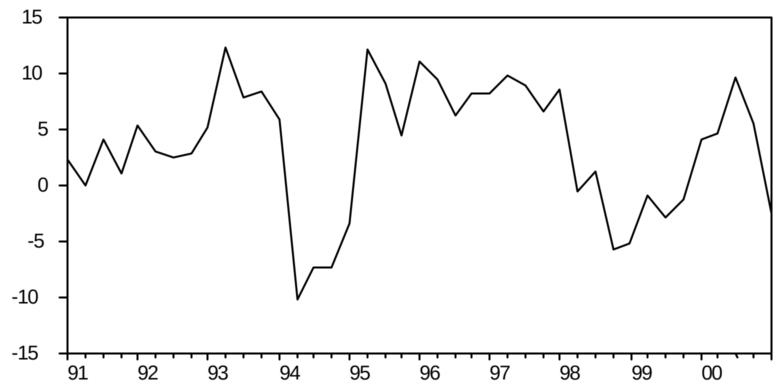

Figure 3.2. Real annual consumption growth calculated with the SIS data. Quarterly private consumption at fixed prices (1987) series is used.

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

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

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[16], geometric average of the three months in every quarter is calculated to find an appropriate price index [17] for the quarter. Inflation is calculated as

$$p_{t+4} = \frac{g_{t+4} - g_t}{g_t} \qquad \textbf{(4)}$$

[16] Urban Places Consumer Price Index Concepts, Methods and Sources (1987=100) , State Intitute of Statistics Prime Ministry Of Turkey.
[17] This series is available in Appendix D.

where p_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.

Table 3.1. Geometric averages of the data series.

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

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.

Table 3.2. Covariances of the data series.[18]

	cg	**rsr**	**inf**	**uinf**
cg	0.0032	0.0183	-0.0035	-0.0029
rsr	0.0183	0.7087	-0.0038	-0.0016
inf	-0.0035	-0.0038	0.0354	0.0343
uinf	-0.0029	-0.0016	0.0343	0.0343

Table 3.3. Correlation coefficients of the data series.

	cg	**rsr**	**inf**	**uinf**
cg	1	0.3822	-0.3152	-0.2815
rsr	0.3822	1	-0.0244	-0.0099
inf	-0.3152	-0.0244	1	0.9852
uinf	-0.2815	-0.0099	0.9852	1

[18] cg : Consumption Growth.
inf : Inflation.
uinf : Unanticipated Inflation.
rsr : Real Stock Returns.

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 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.

SECTION 4 : RESULTS

4.1. Results Under Inflation-Risk on Bonds :

First,the results of the model are studied by taking default risk as zero ($r = 0$). Thereby, the possibility of producing the historically observed negative equity premium is investigated by changing $b \in [0,1]$ and $s \in [0,10]$. 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.

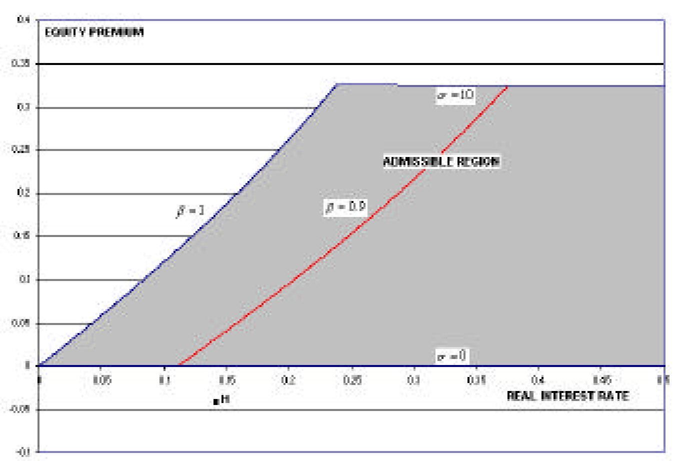

Figure 4.1. The points which are theoretically possible under only inflation-risk on the real interest rate-equity premium plane. Point H shows the historically returns.

When $s = 0$, 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 s 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 Presscott ignores the inflation-risk on T-Bills, therefore in their version the value of b alone determines the risk-free interest rate. Under inflation-risk on T-Bills, as b 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[19].

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.

[19] 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 adress 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 b is fixed and the value of s 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 r and s are obtained which match historically observed real stock returns and real interest rate on T-Bills for a given b.

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

b	s	r
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 b 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 b. After this emprical 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.

SECTION 5 : CONCLUSION

In this thesis, 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 adress 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(SİEMENS)
SARKUYSAN
ŞİŞECAM
T. DEMİR DÖKÜM

APPENDIX B

T-BILL RETURN DATA USED (TREASURY AUCTIONS AND REPOS TO FILL THE GAPS WHEN NEEDED)

Auction No.	Auctions Date	Issue Date	Maturity Date	Days to Maturity	Annualized Simple Interest Rate
452	13-Dec-89	20-Dec-89	21-Mar-90	91	40.76
464	07-Mar-90	14-Mar-90	13-Jun-90	91	40.56
476	30-May-90	06-Jun-90	05-Sep-90	91	40.88
487	22-Aug-90	29-Aug-90	28-Nov-90	91	45.84
499	14-Nov-90	21-Nov-90	20-Feb-91	91	50.36
511	06-Feb-91	13-Feb-91	15-May-91	91	59.60
523	01-May-91	08-May-91	07-Aug-91	91	71.44
535	24-Jul-91	31-Jul-91	30-Oct-91	91	67.60
547	16-Oct-91	23-Oct-91	22-Jan-92	91	72.36
559	08-Jan-92	15-Jan-92	15-Apr-92	91	67.72
571	01-Apr-92	08-Apr-92	08-Jul-92	91	68.44
583	24-Jun-92	01-Jul-92	30-Sep-92	91	76.88
595	16-Sep-92	23-Sep-92	23-Dec-92	91	74.40
607	09-Dec-92	16-Dec-92	17-Mar-93	91	74.76
619	03-Mar-93	10-Mar-93	09-Jun-93	91	65.32
633	26-May-93	31-May-93	01-Sep-93	93	67.12
645	18-Aug-93	25-Aug-93	24-Nov-93	91	65.76
653	13-Oct-93	20-Oct-93	19-Jan-94	91	63.04
REPO		19-Jan-94	24-Jan-94	5	
668	19-Jan-94	24-Jan-94	11-May-94	107	75.49
692	03-May-94	04-May-94	03-Aug-94	91	130.00
730	21-Jul-94	03-Aug-94	02-Nov-94	89	100.08
764	31-Oct-94	02-Nov-94	01-Feb-95	89	82.28
784	25-Jan-95	26-Jan-95	27-Apr-95	91	108.08
801	26-Apr-95	27-Apr-95	27-Jul-95	90	77.36
REPO		27-Jul-95	04-Aug-95	7	
813	02-Aug-95	04-Aug-95	03-Nov-95	89	66.96
REPO		03-Nov-95	09-Nov-95	6	
828	08-Nov-95	09-Nov-95	29-Jan-96	80	92.52
840	24-Jan-96	25-Jan-96	08-May-96	103	112.00
854	07-May-96	08-May-96	06-Nov-96	178	97.42
876	05-Nov-96	06-Nov-96	06-Aug-97	270	94.79
REPO		06-Aug-97	20-Aug-97	14	
904	18-Aug-97	20-Aug-97	10-Dec-97	110	78.36
913	09-Dec-97	10-Dec-97	18-Mar-98	98	89.25
922	17-Mar-98	18-Mar-98	17-Jun-98	89	83.28
930	02-Jun-98	04-Jun-98	02-Dec-98	178	75.98
REPO		02-Dec-98	09-Dec-98	7	

	952	08-Dec-98	09-Dec-98	21-Jul-99	222	121.71
REPO			21-Jul-99	28-Jul-99	7	
	986	26-Jul-99	28-Jul-99	27-Oct-99	89	75.06
	996	05-Oct-99	06-Oct-99	24-May-00	228	89.68
	1018	15-May-00	17-May-00	16-Aug-00	89	35.02
	1026	14-Aug-00	16-Aug-00	15-Nov-00	89	28.24
	1034	13-Nov-00	15-Nov-00	14-Feb-01	89	35.20
	1042	13-Feb-01	14-Feb-01	16-May-01	92	57.03
				average maturity	94.26087	

APPENDIX C

COMMON STOCK INDEX LEVEL (DIVIDENDS INCLUDED)

	COMMON STOCK INDEX LEVEL (1.1.1990=100)
1990Q1	138.27
1990Q2	182.36
1990Q3	249.72
1990Q4	200.44
1991Q1	214.17
1991Q2	215.28
1991Q3	187.71
1991Q4	177.80
1992Q1	256.93
1992Q2	226.12
1992Q3	259.55
1992Q4	224.48
1993Q1	275.12
1993Q2	501.39
1993Q3	854.70
1993Q4	1320.89
1994Q1	1716.85
1994Q2	1239.17
1994Q3	2345.23
1994Q4	3319.31
1995Q1	3604.48
1995Q2	6567.55
1995Q3	8036.77
1995Q4	7038.69
1996Q1	8101.99
1996Q2	10665.37
1996Q3	10693.98
1996Q4	13250.08
1997Q1	22750.21
1997Q2	24532.15
1997Q3	29481.26
1997Q4	41375.70
1998Q1	43261.06
1998Q2	55227.36
1998Q3	55421.72
1998Q4	32219.20

1999Q1	39957.07
1999Q2	63178.65
1999Q3	64445.75
1999Q4	95720.64
2000Q1	235981.93
2000Q2	274584.87
2000Q3	240813.33
2000Q4	194376.38
2001Q1	144809.19
2001Q2	167455.43
2001Q3	173868.22
2001Q4	161868.73
2002Q1	222146.67

APPENDIX D

TÜFE PRICE LEVEL

	CONSUMER PRICE INDEX (TÜFE) LEVEL (1.1.1987=100)
1990Q1	378.92
1990Q2	434.89
1990Q3	459.53
1990Q4	543.85
1991Q1	616.13
1991Q2	709.54
1991Q3	775.67
1991Q4	914.43
1992Q1	1098.81
1992Q2	1205.15
1992Q3	1290.20
1992Q4	1535.41
1993Q1	1743.20
1993Q2	1972.91
1993Q3	2204.22
1993Q4	2599.30
1994Q1	2999.64
1994Q2	4215.12
1994Q3	4617.94
1994Q4	5730.48
1995Q1	6882.01
1995Q2	7880.44
1995Q3	8737.18
1995Q4	10523.21
1996Q1	12313.28
1996Q2	14299.67
1996Q3	15717.65
1996Q4	18713.14
1997Q1	21586.07
1997Q2	25455.58
1997Q3	29306.63
1997Q4	36536.66
1998Q1	42974.08
1998Q2	48380.00
1998Q3	53368.22
1998Q4	62635.77

1999Q1	69942.54
1999Q2	78473.66
1999Q3	87639.61
1999Q4	102934.10
2000Q1	117017.90
2000Q2	125896.90
2000Q3	133485.70
2000Q4	146684.90
2001Q1	158801.40
2001Q2	191045.10
2001Q3	210430.80
2001Q4	244675.00
2002Q1	269841.30