Determinants of Manufacturing Firm Profitability under Uncertainty and Macroeconomic Volatility: Evidence from an Emerging Market

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Abstract

Using bi-annual data from 1993 to 2003 for 172 manufacturing firms in Turkey, the paper explores the impacts of macroeconomic uncertainty, country risk and external shocks on profitability of real sector firms after controlling for the share of financial investments in total assets. Based on a portfolio choice model we ague that in order to sustain profit margins in the face of higher risks, uncertainty and competition real sector firms increasingly invest on liquid financial assets rather than long term fixed assets. Thus, while we expect a negative relationship between risk and uncertainty, and firm profitability, the effect is anticipated to be asymmetric based on the share of financial investments in total asset allocation. The empirical findings based on dynamic panel estimation techniques confirm that increasing uncertainty, country risk, real interest rates and capital flow volatility have a significantly negative effect on manufacturing firm profitability. In contrast, increasing short-term financial investments are found to be reducing the negative effects of risk, volatility and higher interest rates at a significant level. Overall, firms appeared to be using short-term investments as a way of hedging against risks and uncertainties in the market.

I. Introduction

The liberalization wave of the 1980s has bought forward significant changes in the world economy including a radical surge in the frequency and magnitude of financial transactions vis-à-vis stock values. During this period, the gap between real and financial sector activities has widened drastically such that annual FX trading to world trade ratio has increased from 2/1 in 1973 to 90/1 in 2004 with daily foreign exchange (FX) trading amounting to 1.9 trillion dollars (BIS, 2004; WB). As a result, there is a growing body of research analysing the impacts of these changes on private firm operations in the post-liberalization period. However, a majority of this research, especially at the micro level, has so far focused only on the developed country experiences, resulting partly from data mining problems in developing countries. Yet, even in the case of developed countries, there is an apparent lack of analysis of the effects of macroeconomic uncertainty and volatility on firm-level profitability. Therefore, the current paper aims to fill these two gaps in the current literature by focusing on the effects of macroeconomic uncertainty and volatility on firm profitability in a major emerging market, Turkey.

The expansion of international capital flows, in theory, may bring substantial benefits to developing countries. In this respect the impacts of financial liberalization on real sectors of the economy have been an attractive yet unresolved topic for researchers for the last two decades. In this debate, a consistently popular field of research has been the effects of financial liberalization on capital market imperfections and real sector investment performance. Accordingly, financial liberalization was (and is) seen as a way of correcting such distortions and eliminating any hierarchy of finance. Also, liberalized financial markets have offered multiple investment outlets to investors to hedge their risks in the face of higher volatility and uncertainty.

Yet, despite new financial engineering methods and hedging instruments, the new era of financial liberalization has also meant indisputably higher risk and uncertainty in firm profitability (Wei and Zhang, 2006). As a result, recently a new line of research developed that can be called the *financialisation thesis*, which suggested that following financial liberalization real sector firms faced a portfolio allocation problem between fixed and financial assets. The intuition is that increasing volatility and uncertainty in macroeconomic environment, increasing real interest rates, lack of credit availability, and increasing product market competition when combined with the availability of increasing rates of return in the financial markets created a strong incentive favouring short-term financial investments at the expense of long-term fixed investments (e.g. Crotty, 2005; Dumenil and Levy, 2005). Thus, in order to sustain profit margins in the face of higher risks, uncertainty and competition real sector firms increasingly invest on liquid financial assets rather than fixed assets.

As a result, one would expect an asymmetric effect of uncertainty and risk on firm profitability based on the share of financial investments in their overall assets. Based on a portfolio choice model we develop in section IV, profits from operational (i.e. operating profits) and nonoperational activities (i.e. financial profits) have different response functions to increasing risk and uncertainty. Hence, we expect to find diverging profitability rates between firms with limited and those with full access to financial markets and different investment options.

To the best of our knowledge, this is the first empirical study, which; compares the differences in the reaction of real sector firms' operating and net profits to changes in macroeconomic uncertainty, country risk and external shocks, and; explores the effects of financial investments on total profitability. While we expect a negative relationship between risk and uncertainty, and profitability variables, the effect is anticipated to be asymmetric based on the share of financial investments in total asset allocation. Accordingly, while increasing risk reduces operating profits and increases short-term liabilities, it does increase financial profits. As a result, the net effect on total profits will be dependent on the share of financial assets, which may negate the negative effect on operating profits and liabilities. If the findings support both hypotheses then this will have significant implications for the modelling of real sector firm profitability in emerging markets.

The paper is organized as follows: Section II offers an outline of the structural changes in the Turkish economy. Section III briefly reviews the literature on the determinants of firm profitability and the effects of structural changes in world economy. Section IV provides the theoretical and empirical model including key hypothesis of interest. Section V describes the data and estimation methodology. Section VI presents the results and section VII concludes the paper.

II. A Brief Account of Turkish Liberalization Experience

Following a major balance of payments (BOP) crisis in late 1970s, Turkey emerged as a test case for the newly implemented World Bank-International Monetary Fund joint structural adjustment and stabilization program programme involving cross conditionality. The new economic model aimed at reducing the size of the public sector involvement and the degree of intervention in the organization of the market activities while liberalizing the goods[1] and assets markets. The final stage of restructuring was in 1989 with the liberalization of capital account of BOP. On the other hand, in terms of success of the reforms in attracting foreign investment and investor confidence, the overall performance is well behind other emerging markets such as Mexico. While Real Short-term Capital Inflows by nonresidents (RSCF) and Real Foreign Direct Investment (RFDI) inflows (in 2000 prices) have reached 146 and 203 billion dollars in Mexico between 1990 and 2005, they have only been 17 and 26 billion in Turkey during the same period. On the investment front, the performance was not any better: comparatively low growth rates with high

[1] For an in-depth discussion of the effects of trade liberalization on Turkish manufacturing firms see Metin-Ozcan, *et al.* (2002).

volatility and steadily declining fixed capital formation led Unctad (2003) to include Turkey in the group of deindustrilisers among other developing countries. The gross fixed capital formation as a percentage of GDP remained at 22 percent between 1980-89 and 1990-2005 and is below the 25 percent minimum that Unctad (2003:61) identified as the required threshold to generate high and sustained growth in middle-income developing countries.

Following capital account liberalization Turkey also faced an increase in the volatility of RSCF that is mostly driven by the availability of large arbitrage opportunities (Cimenoglu and Yenturk, 2005). The net arbitrage gain (calculated using the uncovered interest parity condition as the difference between domestic annualised monthly T-bill rates deflated by the next period average depreciation of domestic currency, and the US T-bill rate) has increased from negative numbers during pre-liberalization era to as high as 57 and 82 percent on average in 2001 and 2003 with a maximum of 466 percent in May 1994 and 362 percent in March 2001. The real interest rates also remained very high in international standards at 10.5 percent on average between 1990-2005 with a peak at 132 percent in May 1994. The simple annual correlation coefficient between RSCF and net financial arbitrage has been .33 between 1990-2000 and .52 and 2000-2005 respectively. Similarly, the correlation between Current Account balance (CAB) and net financial arbitrage has been .48 between 1990-2005. The presence of such large arbitrage gains seems to be one of the key reasons why both real and financial sector firms increasingly invest on liquid financial assets, especially in the form of government debt securities. This process also led to serious currency and maturity mismatch in the balance sheets of real and financial sector firms as a result of borrowing from abroad in foreign currency with S-T loans at low interest rates and then lending to the government. The real sectors also join this cycle either by buying debt securities directly or via repurchase agreements intermediated through banks. As of 2005, around 37% of total interest income of private commercial banks came from public sector securities (TBB). Similarly, the share of financial revenues in overall profits of top 500 manufacturing firms jumped up to 547% in 2001 from around 15% in 1982 (ISO).

III. Literature Review

Unlike the case in developing countries, there is growing research analysing the determinants of firm-level profit variation in industrialized countries where one of the major issues has been the nature of product market competition and the role of concentration, economies of scale and the presence of outside competitive forces in the form of entry-exit barriers on firm profitability (Porter, 1980; Slater and Olson, 2002). As reviewed by Geroski (1990) and Goddard *et al.* (2005), a second issue that took considerable attention is the examination of the time-series behaviour of firm profitability using the so-called of persistence of profitability method. Accordingly, the central question is to what extent any divergence of a firm's profitability rate from the market average is corrected through the presence of competitive forces.

In the case of developed countries, empirical evidence on the strength and duration of persistence of above the average profitability is presented by various papers including Godard *et al.* (2005) for four EU countries, McDonald (1999) for Australia, Goddard *et al.* (2006) for the UK, and by Mueller (1990)[2], Ismail and Choi (1996), Waring (1996), McGahan and Porter (1999), and Gschwandtner (2005) for the USA. The overall findings of this literature suggest that there are differences between firms' long-run equilibrium profit rates and changing degrees of yearly persistence, possibly reflecting the influence of both industry-level and firm-level factors.

The only research in this field that focused exclusively on developing country experiences are Glen *et al*. (2003) for a subset of emerging markets, Kambahampati and

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[2] Mueller (1990) (ed) includes a collection of articles on persistence of profit analysis for USA, UK, Canada, Germany, France and Japan.

Parikh (2003) for India, and Yurtoglu (2004) for Turkey. In particular, Glen *et al*. (2003) analyse the impact of competition in the product markets on firm profitability using the persistence of profitability methodology in the case of Brazil, India, Jordan, Korea, Malaysia, Mexico and Zimbabwe. Similarly, Kambhampati and Parikh (2003) and Yurtoglu (2004) conduct a similar analysis in the case of India and Turkey using panels of manufacturing firm data.

Regarding the changes in macroeconomic volatility following financial liberalization, there are contrasting findings in developed and developing countries. Accordingly, the existing empirical evidence shows a declining trend in macroeconomic volatility in developed countries. McConnell and Perez-Quiros (2000), for instance, found a declining GDP volatility in the US since mid 1980s. Similar results are reported for developing countries although with higher variance. Montiel and Serven (2004), for example, reported a decline in the standard deviation of per capita GDP growth from 4 percent in the 1970s and 1980s to about 3 percent in the 1990s, which even then remained well above the 1.5 percent in developed countries. Also, they reported that the reduction in volatility was not uniform and one third of 77 countries analyzed did actually see an increase in growth volatility in the 1990s relative to the 1980s. Among others, in Turkey the standard deviation of real GDP growth has steadily increased from 3.5 to 5.2 and 6.1 between 1980-89, 1990-1999, and 2000-2005 respectively. Also, Kose, Prasad, and Terrones (2003) found an increase in consumption volatility in emerging markets during the 1990s. In contrast, there has been a general increase in the uncertainty and volatility of key macro prices as well as capital flows in developing countries in the post financial liberalization era that had a direct impact on firm profitability.

In terms of macro fluctuations, Calvo *et al.* (1993) concluded that foreign factors accounted for 30-60 per cent of the variance in real exchange rates and reserves in ten Latin American countries, which may help explain why Montiel and Serven (2004) found that developing countries faced much higher real exchange rate volatility than developed countries during the 1990s. Similarly, in the case of resource flows, Fernandez-Arias (1994) showed that external factors explained more than half of portfolio inflows to 13 developing countries during the 1990s. In the case of changes in the volatility of capital flows, Gabriele *et al*. (2000) found that between late 70s and 90s "capital flows to developing countries are characterized by high, rising and unpredictable volatility" (p.1051). During this period we also see an increase in the volatility of GDP growth in Turkey with an increasing dependence on private short-term capital inflows as an engine of growth.[3] Following the capital account liberalization in 1989 the simple correlation coefficient between current account balance (CAB) and real GDP growth rate (RGDPG) has been .75 between 1990-93 while that of RSCF and RGDPG was .79 for the same period. The overall correlation for 1990-2005 between CAB and RGDP has been .70 while that of RSCF and RGDP has been .23 respectively. Furthermore, as Weller (2001) pointed out emerging markets appear to be systematically becoming more vulnerable to both currency and banking crisis after financial liberalization that may help explain the increasing need for hedging risks via the use of financial assets. In addition, following capital account liberalization, Frenkel and Ros (2006) showed that free capital mobility caused the appreciation of domestic currencies in Latin American countries and led to a shift in relative prices against tradables together with a profitability squeeze in the real sectors.

Regarding microeconomic uncertainty and volatility, we see parallel changes in both developed and developing economies. Wei and Zhang (2006), Comin and Mulani (2006) for the US and Thesmar and Thoenig (2004) for France, discovered an increase in sales, earnings and individual stock volatility for the last three decades. Thesmar and

[3] Cimenoglu and Yenturk (2005) found a positive impact of foreign capital inflows on private consumption demand and private investment spending in Turkey.

Thoenig (2004) also explained the rise in firms' sales growth uncertainty with the development of financial markets in France. Likewise, Grabel (1995) for a group of emerging markets found a direct link between financial liberalization and stock market volatility.

In addition to increased risk and uncertainty, a second factor that had a direct impact on firm profitability in developing countries is capital market imperfections, high real interest rates and lack of long-term credit availability. In the case of Turkey private firms continue to face strict credit rationing and as a result have to finance their investment spending mostly from internal sources or from short-term barrowing. As of 2005, the share of short-term debt in total debt of top 500 manufacturing firms in Turkey was around 70 percent (ISO). In the case of capital market deepening, money markets in private securities remained quite underdeveloped such that as of 2004 around 98 per cent of secondary market transactions were of government securities (SPK, 2004).

Despite such explicit linkages, there is a lack of research on the effects of uncertainty and instability on firm profitability in developing countries. The existing research regarding the effects of uncertainty has focused on the investment and uncertainty relationship[4] without an in-depth exploration of the links between profitability and

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[4] In contrast, there is substantial theoretical and empirical research on the effects of uncertainty and volatility on firm level investment. While on the theoretical front as surveyed by Aiginger (1987), Serven (1998) and Pindyck (1993), the existing research gives opposing results depending on assumptions regarding production functions, the empirical evidence is quite robust on the negative effect of uncertainty on investment. For evidence from both developed and developing countries see, Federer (1993) for the US, Price (1996) for the UK, and for developing countries Aizenman and Marion (1999) and Serven (1998).

uncertainty. The only exceptions are Jorion (1990), Amihud (1993), Bartov and Bodnar (1994), Bailey and Cheung (1995) and Bartov, *et al*. (1996), all with an exclusive focus on US multinational firms. There is a parallel line of research regarding the effects of uncertainty and volatility on output and GDP growth using macro data. Grier and Grier (2006) showed that inflation uncertainty significantly lowers industrial output growth in Mexico. Similarly, Ramey and Ramey (1995) and Judson and Orphanides (1999) for a panel of 119 countries found a negative effect of inflation volatility and several other macroeconomic volatility measures on per capita income and economic growth.

On the theoretical front, while Shapiro (1974) and Dumas (1978) developed models that show a negative effect of exchange rate uncertainty and volatility on firm profitability, Baum *et al*. (2001) pointed out an indeterminate effect of exchange rate volatility on firms' profit growth rates.

IV. A Portfolio Choice Model

We argue that in order to sustain profitability levels in the face of; increasing risk and volatility, lack of credit availability, capital market imperfections and increasing product market competition, real sector firms invest on liquid financial assets. There is also growing macro evidence that shows this transformation in the case of developed countries such as the US where non-financial corporations' (NFC) portfolio income to cash flow ratio rose from around 14% in 60s to around 37% towards the end of 90s in the US (Crotty, 2005, p.107).

Such a transformation in firms' investment decisions underlines the need for caution when analysing the determinants of firm profitability in the presence of such market changes. Accordingly, the analyses of papers such as Glen *et al.* (2003) and Yurtoglu (2000) for developing countries may be incomplete especially given the profitability measure used, which was defined as net profits after tax divided by total assets. However, the net profits variable is highly misleading in the case of developing countries such as Turkey. Apart from different accounting conventions that lead to non-economic profit measurements[5], the effect of non-operational activities is of considerable magnitude in developing countries. For example, in the case of Turkey, the average ratio of revenues from financial asset in net profits of top 500 manufacturing firms increased from around 23% between 1982 and 1989 to around 112% between 1990-2002 with a maximum of 547 in 2001 (ISO). Therefore, firms with more access to financial markets and financial investment opportunities will have higher profitability ratios independent of product market competition they face. Therefore, to the extent that non-operational financial investments are not industry specific and are independent of other market characteristics such as entry barriers, a separate analysis of profits is needed for operational and non-operational activities.

A similar problem is related with the use of total assets as the denominator for normalizing the profitability rate. Other than a few counties such as Argentina till 1995 and Mexico, most developing countries do not use inflation accounting despite high inflation rates[6] that leads to large distortions in the measurement of total assets that include items the valuation of which is highly dependent on the time it was recorded, such as land, investment in subsidiaries and other firms, etc. As a result relatively new acquisitions, and/or newly established firms will have relatively high asset values that will deflate the profitability measures asymmetrically and cause substantial bias.

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[5] For example in Mexico because of inflation accounting non-cash income variables are included in the profit measurement such as the projected effect of inflation on assets and liabilities, for a detailed discussion see Gordon (2001).

[6] The average consumer inflation was 50 percent and 71 percent in Turkey between 1980-89 and 1990-2002.

Therefore, we argue that there are three adjustments that need to be made for a correct analysis of profitability rates in emerging markets: a) given that non-operational activities are of significant importance in overall profitability, any analysis of firm profitability should separate operational profits from non-operational ones. This would also solve the problem caused by non-economic accounting conventions, b) the regression estimations need to be controlled for the effect of non-operational (i.e. financial) investments on net profitability of the firm, c) instead of total assets, fixed asset would be a better measure for normalizing the profitability variable.

As a result, based on the relationship between risk and return in financial assets, we suggest that there exist two separate profit response functions to risk and volatility based on underlying investments in fixed and financial assets. We can highlight the differences in firms' portfolio allocation decisions and the ensuing profits from different investments using a modified version of the model by Le and Zak (2006). Accordingly, we can apply a portfolio choice model of investment decision to our analysis of asset allocation between fixed and financial assets by real sector firms. Our simplified model includes a large number of identical agents living in a developing country where they consume their returns from wealth invested in one-period investment projects in fixed (i.e. factories) or financial assets (i.e. T-bills). For simplicity there is only one type of investment in each type of assets that can be considered as a portfolio of multiple investment assets (i.e. machinery, building etc for fixed assets; and T-bills, stocks, bonds and foreign exchange assets for the financial assets). We also assume a single homogenous good produced, and the immobile population is normalized to one with a zero growth rate.

Let I_t^k be fixed investment assets at time t with a rate of return r_t^k. Investment in fixed assets is risky, $r^k \sim N(\mu, \sigma^2)$. Agents can also invest I_t^f in financial assets with a risk-free time-invariant rate of return r^f (that is equal to riskless rate of return on financial assets such as 3-month US T-bills). This can also be interpreted as riskless financial asset return *plus* exchange rate risk and country risk. Both types of investments are undertaken at the beginning of time *t* using the initial wealth of W_0. The standard maximization by a representative firm of the expected utility from such investments gives us:

$$\underset{W_t}{Max}\, E\sum_{t=0}^{\infty}\beta^t U(W_t) \tag{1}$$

s.t.

$$W_t = (1+r_t^k)I_t^k + (1+r^f)I_t^f \tag{2}$$

where *U(W)* is strictly increasing, continuous and concave.

To save space, we refer to Huang and Litzenberger (1988) and Le and Zak (2006) for a derivation of this standard portfolio choice model. Using (1) and (2) and applying the Stein's Lemma[7] the optimum allocation equation becomes:

$$I_t^{k*} = \frac{E(r_t^k - r^f)}{\gamma Var(r_t^k)} \tag{3}$$

taking natural log of (3) yields:

$$\ln(I_t^{k*}) = \ln(E(r_t^k - r^f)) - \ln\gamma - \ln(Var(r_t^k)) \tag{3'}$$

where $Var(r_t^k)$ is the variance of the rate of return on fixed investments that is interpreted as economic uncertainty, and $\gamma \equiv -(E[U^{''}(W_t)]/E[U^{'}(W_t)])$ is the risk aversion that is assumed to be constant. (3') suggests that fixed investments increases as a) rate of return on fixed assets (that is operating profitability) increase, and/or rate of return on financial assets (i.e. non-operational asset profitability) decrease, and b) economic uncertainty decreases.

The aggregate capital $K^a{}_t$ invested in the economy includes both fixed and financial capital:

$$K_t^a = I_t^{k*} + I_t^f \tag{4}$$

[7] That is *Cov(g(x), y) = E (g'(x))Cov(x, y).*

Rearranging (4) and substituting I_t^{k*} from (3) gives us the equilibrium financial investment:

$$I_t^f = K_t^a - \frac{E(r_t^k - r^f)}{\gamma Var(r_t^k)} \tag{5}$$

after dividing both sides of equation (5) by $K^a{}_t$ we get

$$\frac{I_t^f}{K_t^a} = 1 - \frac{E(r_t^k - r^f)}{\gamma K_t^a Var(r_t^k)} \tag{5'}$$

and after taking the natural log of both sides and approximating ln(1-x) with -ln(x) for x<1, we get:

$$\ln(\frac{I_t^f}{K_t^a}) = -\ln(E(r_t^k - r^f)) + \ln(\gamma) + \ln(Var(r_t^k)) + \ln(K_t^a) \tag{5''}$$

which shows that, in contrast to fixed investments, the share of financial investments in aggregate investment increases as; a) rate of return on fixed investments (r_t^k) decrease and rate of return on financial investments increase (r^f), and b) economic uncertainty increases. In other words, the portfolio allocation choice of the real sector firm depends on the rate of return on fixed and financial assets, and economic uncertainty and volatility.

Utilizing the portfolio choice theory above, we aim to test: a) the effect of uncertainty and risk together with external shocks in the form of capital flow volatility on operating profits and overall profits, and b) the effect of financial investments on overall profitability under risk, uncertainty and external shocks. In empirical estimation, we adopt a modified version of Goddard *et al*. (2005). Accordingly, we estimate the following profit equations for operating profits and net profits separately;

$$\begin{aligned}\pi_{i,t}^k &= \alpha_i + \alpha_1 \pi_{i,t-1}^k + \alpha_2 \pi_{i,t-2}^k + \alpha_3 KO_{i,t} + \alpha_4 Share_{i,t} + \alpha_5 Size_{i,t} + \alpha_6 Sales_{i,t} \\ &+ \alpha_7 Risk_t + \varepsilon_{i,t}\end{aligned} \tag{6}$$

$$\begin{aligned}\pi_{i,t} &= \beta_i + \beta_1 \pi_{i,t-1} + \beta_2 \pi_{i,t-2} + \beta_3 KO_{i,t} + \beta_4 Share_{i,t} + \beta_5 Size_{i,t} + \beta_6 Sales_{i,t} \\ &+ \beta_7 Risk_t + \beta_8 Risk_t * fk_{i,t} + \nu_{i,t}\end{aligned} \tag{7}$$

where $\pi^{k}_{i,t}$ is the profitability from operational activities measured as the operating profits divided by net fixed assets, and $\pi_{i,t}$ is the total profitability variable measured as net profits before taxes divided by net fixed assets. We have included lagged dependent variables to control for the speed at which market competition erodes above (or below) profitability.

$KO_{i,t}$ is the capital output ratio to control for capital intensity and capacity utilization of firms as in Glen *et al.* (2001) and Kambhampati and Parikh (2003).

The ratio of company sales to industry sales ($Share_{i,t}$) is included to control for market share with industries classified at two-digit level. Increasing market share and market power is expected to increase profit margins. Alternatively, a positive relationship may as well result from a positive link between productive efficiency and firm size.

$Size_{i,t}$ measured as natural log of end-of-period net fixed assets (net of depreciation and land) is included to control for size. Depending on the scale and scope economies, a positive relation is expected. Or, as reviewed by Goddard *et al*. (2005), if growing firm size tends to lead to diseconomies of scale, the size–profit relationship can be negative.

$Sales_{it}$ is the firms' net sales growth representing the effect of sales and market demand growth on profitability with an expected positive sign.

In both equations (6) and (7) $Risk_t$ is used to test for the effects of uncertainty and risk as well as external shocks on firms' operating profits and includes country risk, macroeconomic uncertainty, real interest rates, and short-term capital flow volatility variables. As the country risk measure, Institutional Investor Composite Country Risk Index (*IICRP*) is employed, which is being published by the *Institutional Investor* since 1979. The index is in the range of 0 and 100, with 100 representing the least risky country.[8] We also

[8] IICRP scores can be interpreted as probabilities, which then allows a logistic transformation on the credit rating such that IICRP: ln((ICRG/100)/(1-(ICRG/100))).

included volatility of short-term capital flows measured as biannual standard deviation of monthly capital inflows by non-residents[9] to control for external shocks and any disturbances they create (i.e. boom-bust cycles via sudden expansion/contraction of domestic credit, appreciation/depreciation of domestic currency, inflation, changes in country risk and interest rates as well as aggregate demand and growth).

Regarding uncertainty and instability measures, there is no consensus in the literature over what is uncertainty and what is sample variation. While the former is caused by unpredictable innovations to the variable of interest, the latter includes predictable innovations from past behaviour as well. Therefore, we included only uncertainty as our control variable and calculated it for manufacturing inflation and real exchange rates, which are used as a proxy for overall macroeconomic uncertainty. The variables are measured by: a) bi-annual average standard deviations of monthly innovations to a forecasting equation based on an AR(1) process including a time trend and monthly dummies, b) bi-annual average monthly variance from a GARCH (1,1) process based on the equation below:

$$\begin{aligned} x_t &= \alpha_0 + \alpha_1 t + \sum_{i=1}^{11} \lambda_i d_t + \alpha_2 x_{t-1} + \varepsilon_t \\ h_t^2 &= \beta_0 + \beta_1 h_{t-1}^2 + \beta_2 \varepsilon_{t-1}^2 \end{aligned} \tag{8}$$

where *X* is the variable of interest (manufacturing inflation), t is time trend, d is a monthly dummy variable, h_t^2 is the conditional variance of ε_t and is our uncertainty measure. In the regression results we reported only the ones from GARCH estimation method given it is

[9] The net short-term capital inflows by nonresidents is measured using the BOP statistics of Central Bank of Turkey as the sum of equity and debt securities liabilities, other investment liabilities-loans-banks and other sectors, other investment currency deposits-banks and other investment-other liabilities.

more close to the true meaning of uncertainty. However, the results from (a) were not significantly different.

We also included real interest rates in equation (7) to determine the effect of changes in interest rates on net profits after controlling for the share of financial assets. We expect that increasing real interest rates, by raising cost of debt servicing and new borrowing, will have a negative effect on net profits.

In equation (7), $Fk_{i,t}$ is the share of financial assets in total assets measured as financial assets divided by the sum of net fixed assets and financial assets (i.e. I^f/K^a as in (5''))[10]. Increasing $Fk_{i,t}$ ratio may help the firm hedge against risks and benefit from increasing returns in the financial markets while increasing its speed of reaction to sudden changes in the business environment. This last point was also suggested by Nickell and Nicolitsas (1999) and Goddard *et al.* (2005) such that increasing liquid assets as a share of total assets help decrease the vulnerability of the firm to sudden changes in its balance sheet. Thus, in equation (7) we controlled for the interaction between financial investments, risk and net profitability by including an interactive variable of $risk_t{*}fk_{i,t}$. Accordingly, increasing share of financial investments is expected to reduce the negative effect of risk on net profitability through its effect on financial profits.

V. Data and Methodology

The dataset is from the audited financial accounts of publicly traded manufacturing firms in Turkey using the Istanbul Stock Exchange Market database and are unbalanced.

[10] Financial assets include current assets (cash, bank deposits, other current assets, checks) and short-term investments (stocks, t-bills, government bonds, private sector bonds, REPO and other short term investments). The sum reflects total marketable and liquid monetary assets held by the firm. Long-term financial fixed assets in other firms are excluded given that under Turkish GAAP they are recorded at historical cost.

The period analysed is biannual and cover 1993:1-2003:2. The primary reason for using biannual data is to capture the effects of sudden changes in profitability and risk conditions in the market on the profitability and investment positions of the firms (especially regarding financial investments and profits). In the unbalanced panel, there are 172 manufacturing firms with ISIC (number of firms in parenthesis) 15(27), 17(38), 20(2), 21(9), 22(4), 23(2), 24(13), 25(5), 26(28), 27(7), 28(6), 29(11), 30(1), 31(4), 32(3), 34(11), 36(1). We used the unbalanced dataset rather than forcing it to be balanced for two reasons: a) to control for the effects of uncertainty and risk on small and large, new and old firms alike given that they may get market listing only if they satisfy certain conditions, which may be related with their response functions to changing levels of uncertainty, and b) to control for the effects of different financial investment and financial profit weights in the portfolio allocations of the firms that may be directly related with the firm size and age as well as the firm's entry and exit in and from the market. In sum, given the objective of the study, we incorporated the systematic element in the sample selection with the bias it introduces (if any) so that we can determine any asymmetric effects of uncertainty and financial asset weights to operating, financial and net profits of small and large, new and old firms.

However, for robustness we repeated the analysis also with two *balanced* subsets of the original unbalanced panel: one for the entire period (1993:1-2003:2) using 58 firms for which the data were available, and a second one for a shorter period using 115 firms for the period of 1996:1-2003:1. We reported results for the unbalanced and the balanced panels for the entire period yet those with the balanced panel for 1996:1-2003:1 were not significantly different than those reported.

A quick look at Table 1 and 2 reveal a steady decline in the median operating profitability margins (defined as operating profit to net sales ratio) that dropped from around 20% in 1993 to less that 4 % in 2003, probably reflecting increased product market competition resulting from entry of new firms and elimination of barriers of entry of foreign firms, and import competition after trade liberalization.[11] We see a similar downward trend in median operating profit to fixed assets ratio ($\pi_{i,t}^{k}$) as well. This may also help explain the increasing dependence of real sector firms on financial investments as implied by equations (3') and (5''). In contrast, the financial profitability ratio ($\pi_{i,t}^{f}$) increasingly became a significant source of profits at times exceeding those from operational activities as was the case after February 2001 crisis. Confirming the risk/return relationship, in both panels the financial profitability variable made its peak in 1994:1 and 2001:1, the periods of two of the most serious financial crises in Turkey. Not surprisingly, the covariance between financial profits ($\pi_{i,t}^{f}$) and operating profits ($\pi_{i,t}^{k}$) to capital ratio are found to be 0.0086 (in the unbalanced panel) that highlight their different determinants.

<Table 1>

<Table 2>

Regarding the estimation methodology, in order to correct for parameter endogeneity resulting from the presence of unobserved firm-fixed effects as well as to correct for the correlation between the lagged profitability variable and the firm specific effects and the error term, we used the augmented Generalized Method of Moments (GMM) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998), that is also known as "system GMM".

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[11] One should note, however, that the impact of trade liberalization and import penetration on profit margins in Turkish manufacturing firms is a point of continuing debate. For a discussion, see Metin-Ozcan *et al.* (2002) who found a very weak and sluggish negative impact of trade openness on profit margins and market concentration following trade liberalization.

Accordingly, the system GMM technique estimates a system of equations in the first differences and levels. Arellano and Bover (1995) show that when the original Arellano and Bond (1991) first differencing estimator is used the lagged level values of variables are often poor instruments for first differences. Thus Arellano and Bover (1995) suggested that if the original equations in levels were added to the system additional moment conditions could be added to increase efficiency. Accordingly the system pools (t-s) transformed (first difference) equations with an additional set of (t-s) level equations. While the first difference specification uses the lagged levels as instruments, the level equations utilize the lagged first differences as instruments. In this estimation, if x_i is serially uncorrelated then $x_{i,\, t-s}$ will be uncorrelated with x_{it}^* for $s \geq 2$. This means that if the error term in the investment equation is serially uncorrelated, lagged values of the transformed and untransformed dependent variable and other right-hand side variables dating t-s will be uncorrelated with the error term as long as $s \geq 2$. Thus we used $s \geq 2$ dated variables as instruments in the estimation. The validity of the set of instruments used is tested by the Hansen test of overidentifying restrictions (since the usual Sargan test is not robust to heteroskedasticity or autocorrelation). Also, another key assumption that there is no serial correlation in the disturbances is tested by a second order serial correlation test in the first-differenced residuals (first-order correlation is expected in the first differences) (Arellano and Bond, 1991; Bond, 2002).

VI. Results

<Table 3>

<Table 4>

Table 3 shows that the results are consistent for both balanced and unbalanced panels. Firstly, there is persistency in operating profits from year to year with two period lagged profitability rates being statistically significant at one percent level. Also, similar to Kambhampati and Parikh (2003) for India, capital-output ratio appeared with a negative and highly significant (at one percent level) coefficient suggesting that firms with higher capital intensity earn lower profits possibly reflecting decreasing capacity utilization. In the unbalanced panel, similar to Goddard *et al*. (2005), the size variable appeared with a negative yet mostly insignificant coefficient suggesting a negative relationship between firm size and profitability for the full sample. Yet, the sign became positive for the balanced panel implying that successful firms that received market listing for the entire period benefit positively from size effect. The industry share variable appeared with no consistent sign and is highly insignificant, the reasons of which is beyond the scope of this paper. Consistent with Yurtoglu (2004), sales growth appeared with the expected positive sign at a highly statistically significant level suggesting that firms whose sales grow faster also become more profitable.

As predicted, in both balanced and unbalanced panels we have found a strongly significant negative effect of macroeconomic uncertainty ($Risk^{inf}$), country risk (*IICR*) and short-term capital flow volatility (*SCFV*) on manufacturing firm operating profitability.

In table 4 we see similar results regarding persistency of net profits as in operating profits of Table 3. Capital intensity variable (*KO*), however, appeared with a positive and significant sign in the unbalanced panel while with a negative and significant one in the balanced panel. Size variable, overall appeared to have a positive but insignificant effect in the unbalanced panel while a negative but still insignificant effect in the balanced panel. The industry share variable appeared with a positive and slightly significant effect.

Regarding uncertainty and volatility variables, we have found a significantly negative effect of macroeconomic uncertainty (measured by real exchange rate-Risk^{rer} and inflation uncertainty-Risk^{inf}), country risk (*IICR*) and capital flow volatility (*SCFV*) on net profits of manufacturing firms. Furthermore, the results indicate that increasing financial investments in total assets (*fk*) significantly reduce the negative effect of risk and uncertainty on firm profitability (as seen from the interaction variables $Risk^{rer}*fk$, $Risk^{inf}*fk$, *IICR*fk*, *SCFV*fk*). Accordingly, a negative shock is expected to have an asymmetric effect on manufacturing firms based on the share of financial assets in their asset portfolios.

The results also show the dilemma faced by real sector firms in the era of financial liberalization. According to Dumenil and Levy (2005)'s estimates, 2.4 and 1.7 percentage points of profits of nonfinancial corporations were lost in France and US due to rising interest payments from the mid 1980s to 2001 with a 3.2 and 1.2 percentage points increase compared to 1960-1979 period. Our findings suggest that the real sector firms in Turkey during 1990s (that is the era of capital account liberalization) started using financial investments as a way of hedging against higher risks and rising real interest rates that reached as high as 7,000 percent overnight in 2001 crisis. This explains the significantly positive effect of the interaction variable between real interest rates and financial assets ratio (*Int*fk*) together with the significantly negative real interest rate effect on net profits where increasing interest expense reduce firm profitability.

VII. Conclusion

The empirical findings from the regression analysis indicate that increasing uncertainty, country risk, real interest rates and capital flow volatility have a significantly negative effect on manufacturing firm profitability in Turkey. On the other hand, increasing financial investments by real sector firms are found to be reducing the impacts of such negative shocks at a statistically significant level. Accordingly, firms use the short-term investment opportunities in the financial markets as a way of hedging against risks and uncertainty in the market. Therefore, increasing investment opportunities in the financial markets may play a positive role in firm profitability by diversifying firms' investment portfolios and work as a cushion against unexpected downturns in the market. However, as can be seen from the large share of financial investments in Turkish firms' balance sheets as well as increasing importance of profits from such investments in overall profitability, this transformation may also constrain firms ability and willingness to invest in long-term fixed investment projects that are irreversible and become profitable only in the long run. Hence, as firms hold an increasing share of their portfolios in liquid short-term assets, we may see a transformation in the pattern of specialization of these firms further away from being primarily involved in manufacturing activities.

The results also suggest the need for caution when analysing firm profitability in developing counties especially regarding the measurement of profitability and its specification. Accordingly, we argue that operating profits, profits from non-operational activities (i.e. financial profits) and net profits each have a different response function and therefore may require a different model specification. However, a lack of detailed income statement and balance sheet data at firm level panels in developing counties appear to be the main constraint in controlling for the effects of financial investments on firm profitability.

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Table 1: Summary Statistics for Unbalanced Panel

	Π^k		Π^f		Π		*FK*		*OS*	
	mean	median	mean	median	mean	median	mean	median	mean	median
1993h1	76.16	54.89	20.12	5.02	65.02	40.43	21.93	17.96	18.77	19.16
1993h2	89.04	67.03	23.97	6.61	79.76	49.83	24.15	18.97	19.44	20.64
1994h1	73.85	58.55	34.64	8.93	52.09	30.36	23.65	17.80	25.86	26.72
1994h2	90.46	63.62	26.44	7.55	81.37	48.64	25.04	19.66	21.68	21.02
1995h1	82.43	52.30	26.28	7.16	91.12	54.30	25.72	20.21	21.17	21.37
1995h2	87.00	54.73	27.56	9.27	72.14	43.98	24.58	16.59	14.92	17.04
1996h1	69.00	52.03	30.49	10.93	65.82	39.75	21.58	13.30	17.12	18.85
1996h2	62.99	41.88	23.56	8.13	59.44	38.64	21.95	16.72	15.16	16.16
1997h1	70.83	47.18	23.51	7.78	66.36	34.48	21.12	14.05	17.70	18.52
1997h2	67.12	51.40	23.81	7.41	55.78	30.58	22.01	15.04	16.35	17.82
1998h1	60.70	36.13	25.80	8.92	44.30	24.74	20.06	11.52	22.77	16.11
1998h2	40.92	25.55	24.19	6.08	20.82	12.37	20.04	13.24	10.14	12.05
1999h1	37.88	22.63	23.82	11.35	28.09	9.71	20.51	12.97	10.33	12.26
1999h2	26.38	18.64	28.48	8.02	-2.27	3.93	20.76	13.20	8.82	10.56
2000h1	27.85	18.22	18.31	5.93	15.18	9.29	20.94	14.30	3.71	8.80
2000h2	19.85	10.56	14.25	5.52	12.43	7.72	19.26	12.62	2.97	4.72
2001h1	29.68	24.48	39.64	14.51	-63.76	-12.14	19.82	14.44	-11.1	12.53
2001h2	37.98	18.68	19.48	6.29	12.51	5.42	20.17	14.04	-37.5	11.70
2002h1	28.88	20.81	29.33	9.72	-5.28	6.60	20.34	13.07	-8.03	8.65
2002h2	19.53	18.11	13.69	6.14	-0.07	10.26	20.14	12.84	3.67	6.96
2003h1	12.94	8.85	26.63	9.22	17.49	15.08	18.42	12.38	-4.04	5.22
2003h2	12.61	3.00	11.04	3.60	5.05	-0.21	17.62	9.92	2.36	1.91
1993h1-2003h2	49.20	29.68	24.43	7.66	32.45	19.51	21.22	14.55	7.95	13.49

Table 2: Summary Statistics for Balanced Panel

	Π^k		Π^f		Π		*FK*		*OS*	
	mean	median	mean	median	mean	median	mean	median	mean	median
1993h1	74.76	55.87	14.19	4.20	55.44	34.36	21.17	17.00	19.85	19.80
1993h2	90.44	68.06	17.90	6.68	71.57	45.39	21.71	17.37	20.01	20.62
1994h1	79.31	64.25	43.67	10.67	50.68	33.45	22.61	16.84	29.97	30.35
1994h2	93.18	60.12	25.94	7.50	84.45	40.86	26.64	20.50	22.16	20.50
1995h1	66.97	54.82	23.34	9.76	71.32	56.04	26.42	18.95	20.60	20.24
1995h2	79.43	51.98	17.74	11.75	61.89	39.18	24.40	16.80	19.18	18.14
1996h1	61.43	49.79	15.26	9.22	52.23	27.91	20.34	13.89	18.82	17.91
1996h2	61.86	53.27	14.04	6.62	53.76	35.73	19.78	12.15	16.31	18.61
1997h1	68.43	52.93	12.86	10.45	54.81	34.98	19.30	13.17	19.86	18.74
1997h2	68.89	58.40	21.47	9.35	46.16	31.42	21.26	17.08	18.27	19.09
1998h1	51.53	38.23	19.69	9.33	35.72	29.96	19.41	11.20	15.81	16.94
1998h2	38.96	24.57	18.51	6.64	22.05	15.47	17.91	11.40	11.82	12.31
1999h1	26.79	14.87	23.05	10.62	9.24	2.91	18.82	10.95	9.20	10.82
1999h2	27.09	18.17	22.70	8.36	12.62	6.20	20.23	10.92	20.97	10.55
2000h1	18.19	17.61	15.66	5.49	5.83	7.13	19.93	13.89	1.43	7.15
2000h2	27.96	13.33	12.22	6.43	32.98	7.66	17.97	12.01	10.36	5.54
2001h1	22.28	22.56	46.97	17.41	-47.21	-3.20	21.02	14.83	6.12	13.57
2001h2	38.72	18.13	15.08	6.66	46.77	11.72	23.16	19.04	22.29	13.37
2002h1	26.59	23.84	27.10	11.12	-0.34	5.08	22.76	16.79	8.39	8.52
2002h2	30.85	23.99	6.61	6.67	14.16	12.02	22.32	16.69	8.75	9.70
2003h1	9.52	6.99	18.15	8.58	-9.58	12.15	19.35	13.08	4.07	5.86
2003h2	13.29	6.00	6.50	3.62	5.98	0.24	17.17	10.20	5.55	2.86
1993h1-2003h2	48.93	31.23	19.95	7.55	33.21	20.76	21.08	14.30	14.99	14.71

Notes: Values in percentages. Π^k, Π^f, Π are operating profits, financial profits and net profits before taxes to net fixed assets ratios respectively. Financial profits include dividend income from subsidiaries and affiliates plus interest income and other dividends, plus other income from other operations (including gains from foreign exchange transactions etc.) net of losses and expenses from other operations. *KO* is capital-output ratio measured as beginning fixed capital stock to net sales ratio at constant prices. *FK* is financial assets to net fixed assets plus financial assets ratio measured using period averages for both numerator and denominator. *OS* is operating profit to net sales ratio.

Table 3: Dependent Variable: Operating Profitability (Π^k)

	1a	1b	2a	2b	3a	3b
$\Pi^k_{i,\ t-1}$	0.092	-0.050	0.106	-0.011	0.105	-0.016
	(0.103)	(0.131)	(0.105)	(0.143)	(0.104)	(0.131)
$\Pi^k_{i,\ t-2}$	0.173*	0.319*	0.172*	0.327*	0.175*	0.331*
	(0.067)	(0.061)	(0.068)	(0.064)	(0.069)	(0.065)
$KO_{i,\ t}$	-0.563*	-0.511*	-0.526*	-0.457*	-0.52*	-0.446*
	(0.103)	(0.108)	(0.099)	(0.118)	(0.10)	(0.103)
$Size_{i,t}$	-0.050	0.118***	-0.068	0.102	-0.063	0.101
	(0.091)	(0.071)	(0.087)	(0.064)	(0.089)	(0.066)
$Share_{i,t}$	-0.001	-0.012**	0.000	-0.009	0.0002	-0.009
	(0.006)	(0.006)	(0.006)	0.006	(0.006)	(0.006)
$Sales_{i,t-1}$	0.358**	0.280***	0.315**	0.241	0.342**	0.271***
	(0.16)	(0.153)	(0.159)	(0.165)	(0.164)	(0.160)
$Risk^{inf}_{i,t}$	-0.157**	-0.257*				
	(0.064)	(0.082)				
$IICR_{i,t-1}$			0.273*	0.306*		
			(0.056)	(0.079)		
$SCFV_{i,t}$					-0.0001*	-0.0001*
					(0.00002)	(0.00004)
Hansen	0.429	0.361	0.497	0.307	0.377	0.358
M1	0.034	0.187	0.037	0.202	0.035	0.184
M2	0.607	0.837	0.59	0.842	0.558	0.748

Notes: Arellano-Bond dynamic panel-data estimation two-step system GMM results using Windmeijer finite-sample correction method with asymptotically robust standard errors in parenthesis. All regressions include a constant variable. 1a is unbalanced panel including 172 firms, and 1b is balanced panel including 58 firms. (*), (**), (***) refer to significance at 1, 5 and 10 percent levels. (-1) and (-2) refer to lag –1 and -2. Π^k is operating profits to net fixed assets ratio. *KO* is capital-output ratio in natural log, $Risk^{Rer}$ and $Risk^{Inf}$ are real exchange and inflation risk measured by GARCH (1,1) method, *IICR* is Institutional Investor Composite Country Risk Index transformed as described in endnote 8. *SCFV* is short-term capital flow volatility. *Share* is firm's output share in two digit industries. *Size* is net fixed assets in real prices in natural log, *Sales* is real net sales growth measured as log differences. Hansen is Hansen tests of over-identifying restrictions, M1 and M2 are standard AR(1) and AR(2) tests where the null is zero serial correlation, and. All test statistics are given by their p-values. All micro data are converted to fixed prices by Manufacturing Whole Sale Price Index and macro data by general Wholesale Price Index at 1995 January prices.

Table 4: Dependent Variable: Total Profitability (Π)

	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b
$\Pi_{i,t-1}$	0.146	-0.184	0.079	-0.221	0.129	-0.190	0.075	-0.256	0.129	-0.204
	(0.104)	(0.159)	(0.102)	(0.160)	(0.105)	(0.171)	(0.108)	(0.162)	(0.106)	(0.167)
$\Pi_{i,t-2}$	0.421*	0.367*	0.395*	0.345*	0.426*	0.374*	0.388*	0.312*	0.411*	0.359*
	(0.054)	(0.109)	(0.057)	(0.104)	(0.057)	(0.11)	(0.054)	(0.11)	(0.058)	(0.111)
$KO_{i,t}$	0.516	-0.26***	0.885**	-0.177	0.473	-0.29***	0.68***	-0.078	0.574***	-0.27***
	(0.333)	(0.146)	(0.394)	(0.127)	(0.308)	(0.151)	(0.396)	(0.124)	(0.352)	(0.162)
$Size_{i,t}$	-0.024	-0.110	0.061	-0.061	0.079	-0.097	0.169	-0.076	0.044	-0.075
	(0.214)	(0.096)	(0.226)	(0.104)	(0.231)	(0.163)	(0.237)	(0.124)	(0.215)	(0.09)
$Share_{i,t}$	0.027**	0.010	0.020	0.005	0.019***	0.008	0.016	0.011	0.020***	0.007
	(0.012)	(0.013)	(0.013)	(0.011)	(0.01)	(0.011)	(0.013)	(0.011)	(0.01)	(0.012)
$Sales_{i,t-1}$	0.637*	0.462*	0.306	0.246*	0.473**	0.327*	0.387**	0.279*	0.360	0.349*
	(0.230)	(0.127)	(0.214)	(0.077)	(0.224)	(0.108)	(0.212)	(0.076)	(0.232)	(0.111)
$Risk^{rer}_t$	-141.73*	-79.59**								
	(54.47)	(37.89)								
$Risk^{rer}_t{*}fk_{i,t}$	3.453**	2.233***								
	(1.727)	(1.198)								
$Risk^{inf}_t$			-0.103	-0.29*						
			(0.164)	(0.113)						
$Risk^{inf}_t{*}fk_{i,t}$			0.009*	0.003*						
			(0.003)	(0.001)						
$IICR_t$					0.721**	0.134				
					(0.336)	(0.174)				
$IICR_t{*}fk_{i,t}$					-0.046*	-0.006				
					(0.017)	(0.004)				
Int_t							-1.87*	-0.58*		
							(0.612)	(0.204)		
$Int_t{*}fk_{i,t}$							0.073*	0.039*		
							(0.027)	(0.012)		
$SCFV_t$									-0.001*	-0.0003*
									(0.0003)	(0.0001)
$SCFV_t{*}fk_{i,t}$									0.00002**	0.000002*
									(0.00001)	(0.000002)
Hansen	0.355	0.478	0.408	0.323	0.417	0.577	0.358	0.754	0.355	0.323
M1	0.052	0.284	0.065	0.294	0.065	0.295	0.065	0.292	0.064	0.29
M2	0.958	0.666	0.847	0.772	0.862	0.805	0.902	0.748	0.958	0.682

Notes: Refer to Table 3. Total profitability (*Π*) is net profits before taxes to net fixed assets ratio. *Fk* is the net financial assets over net financial assets plus fixed assets, Int_t is the real interest rate measured as ln((1+nominal t-bill rate)/(1+inflation rate)).

Proof for the referee (not to be published):

$$\underset{W_t}{Max} E \sum_{t=0}^{\infty} \beta^t U(W_t) \tag{1}$$

s.t.

$$W_t = W_0(1+r^f) + I_t^k(r_t^k - r^f) \tag{2}$$

where *U(W)* is strictly increasing, continuous and concave.

If the initial wealth at time *0* is $W_0 = I_t^f + I_t^k$ then $I_t^f = W_0 - I_t^k$ that gives us (2'):

$W_t = (1+r_t^k)I_t^k + (1+r^f)(W_0 - I_t^k)$ that is

$$W_t = W_0(1+r^f) + I_t^k(r_t^k - r^f) \tag{2'}$$

Using (2') the necessary and sufficient condition for optimal solution to (1) is:

$$E[U'(W_t)(r_t^k - r^f)] = 0 \tag{3}$$

Given that Cov(x,y) = E(x,y) – E(x)E(y), (5) gives us:

$$E[U'(W_t)]E[(r_t^k - r^f)] = -Cov[U'(W_t), r_t^k] \tag{4}$$

Assuming $U'(c_t)$ and r^k_t are jointly normally distributed, using Stein's Lemma, (4) can be rewritten as:

$$E[U'(W_t)]E[(r_t^k - r^f)] = -I_t^k E[U''(W_t)]Var(r_t^k) \tag{4'}$$

Proof:

Stein's Lemma: *Cov(g(x), y) = E(g'(x))Cov(x,y)*, thus

$$\begin{aligned}
& E[U'(W_t)]E[(r_t^k - r^f)] = -E[U''(W_t)]Cov[W_t, r_t^k] \\
& = -E[U''(W_t)]Cov[W_0(1+r^f) + I_t^k(r_t^k - r^f), r_t^k] \\
& = -E[U''(W_t)]Cov[I_t^k(r_t^k - r^f), r_t^k] \\
& = -I_t^k E[U''(W_t)]Cov[(r_t^k - r^f), r_t^k] \\
& = -I_t^k E[U''(W_t)]Cov[(r_t^k, r_t^k] \\
& = -I_t^k E[U''(W_t)]Var[r_t^k]
\end{aligned} \tag{5}$$

Acknowledgements

I am thankful to Jaime Ros, Amitava K. Dutt, Kwan S. Kim, and Kajal Mukhopadhyay, for their helpful comments and suggestions. For financial support and the encouraging environment, I thank the Helen Kellogg Institute for International Studies. All opinions and remaining errors are mine.