Housing Wealth Effects Mechanism and the Monetary Policy Transmission in Turkey

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Abstract

Mustafa Haluk Guler: Housing Wealth Effects Mechanism and the Monetary Policy Transmission in Turkey
(Under the direction of Richard T. Froyen)

It is commonly presumed that significant movements in wealth can often have wider economic impacts in consumer spending. This study first investigates the impact of housing wealth on aggregate consumer spending in the context of Turkey using a Vector Error Correction Method (VECM) under the structural break with quarterly data for the 1991Q1-2011Q1 period. Furthermore, to improve the robustness to instability in the long-run relationship between the variables, we also estimate an alternative econometric model based upon Carroll (2004). Both the VECM and Carroll's method suggest that permanent changes in housing wealth have considerable effects on aggregate consumption after 2001 while there is no significant financial wealth effect for the same period. Since our VECM results indicate that housing wealth does play a role in determining consumption, the next step is to find out whether there is a linkage between monetary policy and housing wealth and if so, how this relationship operates. For this purpose, we employ a kind of counterfactual experiment. Our results show that interest rate affects the housing market considerably and house prices play an important role in the monetary transmission.

This dissertation is dedicated to my wife Esra, for her love, support, and understanding.

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Chapter 1

Introduction

Household consumption is a function of not only income but also wealth, such as housing and stock ownership. When the prices of houses or financial assets increase, the owners' wealth increases and this can spur aggregate consumption, even as income remains the same. Such change in consumption due to a change in housing or stock prices is called 'wealth effect'.

With respect to the wealth effect of housing, the last decade has witnessed dramatic rise in house prices, followed by substantial price collapse. From 1995-2006, housing wealth soared globally, with an acceleration after 2000 supported by the combination of lower interest rates and abundant liquidity. Between the mid 1990s and 2006, the growth rate of real house price rises in many mature economies reached double-digit figures (Table A.1).

As the favorable conditions for housing ended with the tightening of monetary policy in response to global inflationary pressures, housing markets, especially the subprime mortgage market in the US, came under severe stress. Combined with deficiencies in the mortgage industry, house prices started to fall dramatically. As measured by the Standard & Poor's Case-Shiller index, average home prices in the U.S. were down 32.2 percent as of March 2009 after a peak in the second quarter of 2006. As the subprime crisis intensified in the US, it damaged the broader economy and eventually triggered a worldwide economic downturn. Consumer spending in OECD countries was cut back and the global output contracted worst since the Great Depression (G-20 Progress Report, 2009).

Since consumption is inherently connected with households' saving decisions which could affect price levels and output, in the light of the recent global developments in housing, it is vital for monetary authority to understand the relationship between housing wealth and consumption as well as the channels through which such a link might operate.

Overview of Selected International Studies

There have been numerous academic and government researches that examine housing wealth effects, particularly for advanced economies. Most, but not all, studies indicate consensus that rising house prices stimulate consumers to spend more than they would without such price increases (Case et al. (2005), Ludwig and Slok (2004), Girouard and Blondal (2001), Carroll et al. (2004)). However, the empirical literature is inconclusive about the estimates of the marginal propensity to consume out of housing wealth. These estimates vary substantially across studies. The dispersion in the findings with respect to the magnitude and timing of the wealth effects stems from the use of different types of consumption and wealth data and/or different estimation techniques that are used to test the wealth effects. The differences may also stem from the unstable nature of wealth effects over time.

In recent literature, Case et al. (2005) did a pioneering work in assessing the wealth effects. The study covered measures of housing wealth for both a panel of 14 developed economies for the period of 1975-1999 and a panel of all US states from 1982 through 1999. The results of the study suggest that housing wealth effect on consumption is statistically significant and it is rather large compared to financial wealth for both panels of data. For the US, the estimate of the elasticity of consumption to housing wealth is found around 0.04-0.06 while for the international panel, it is about 0.11-0.14. The authors report that the estimated effects for the US are substantially stronger after the mid 1980s due to the tax reform that favored the use of home equity loans for consumption.

Another multi-country study is conducted by Ludwig and Slok (2004) for the IMF examining a panel of quarterly data from 1960 through 2000 for 16 OECD economies divided into bank-based (e.g. Germany, Italy) and market-based (e.g. US, UK) credit market systems. The authors estimated a larger effect of financial wealth than that from housing wealth with an MPC of about 8 percent which is twice as large as the elasticity of house prices. However, due to the use of a single equation approach and data deficiencies for some countries in the data set, the results are cautioned to be at best, tentative.

Among the studies that have found a role for housing wealth, Girouard and Blondal (2001) also suggest positive effect of housing wealth for the period 1970-1999 for the US, the UK, Japan, France as well as Canada with MPCs ranging from 0.02 for the US to 0.18 for Canada, whereas the authors found negative effect of housing wealth for Italy.

Considering the potential instabilities in an economic environment, Carroll et al. (2004) introduces a new methodology based on the sluggishness of aggregate consumption growth to measure wealth effects for shorter period of time. This method distinguishes between immediate (next-quarter) and eventual wealth effects. According to Carroll et al.(2004)'s estimation of stock and non-stock wealth effects on consumption for the US through 1960-2003, while 'immediate' wealth effects on consumption are very small with an MPC out of housing wealth around 2 cents, 'eventual' effects are much larger after several quarters with an MPC amounting to 9 cents.

The Case of Turkey

Although there is a wide range of empirical work, the vast majority of empirical evidence, refers to advanced economies, particularly the US. However, considering the increasingly deregulated and deepened financial systems, the accelerated aggregate consumption as well as rising property values in emerging economies, extending the existing literature to assess the inter-relationship between housing and consumption is critically important.

Turkey is a case in point in this matter. Studying the link between consumption and housing wealth in Turkey is first motivated by the very high rates of homeownership and the predominance of housing in total household wealth. The earlier experiences of very high inflation and shallow financial markets have made the housing asset one of the most preferred forms of wealth accumulation in Turkey. In addition to that, real price of housing and the housing stock have followed an increasing trend. Between 2001 and 2011, housing wealth increased approximately 10% annually in real terms. Furthermore, as the country's macroeconomic environment has become more stable after 2001, there has been an expansion of financial products including long-term housing credits. More importantly, there is a growing interest in mortgage lending which led to the passage of the new Mortgage Law by the Parliament as of 2007. This legislation is expected to increase the share of housing wealth in wealth composition via raising either the housing stock (home ownership ratio) or housing prices, ceteris paribus. Due to the recent developments, future housing wealth effects in Turkey are likely to become more pronounced.

However, to our knowledge, there are only a few contributions which study the Turkish case in depth. Employing weak empirical methodologies and bad proxies for housing asset value which is due to the lack of data on house stocks and house prices, existing studies on the housing wealth effect has generally produced poor results. Even more importantly, none of the studies take the structural change in Turkish economy during the 2001 crisis into account.

Chapter II of this dissertation aims to improve the deficiencies of the methodologies employed in earlier studies by using a system approach that takes the structural break into consideration, namely the Vector Error Correction Model (VECM), and introduces a new proxy for housing wealth. Examining the effect of housing wealth as well as financial wealth upon aggregate consumption in Turkey for the period 1991Q1-2011Q1, our study indicates that disposable income is the major factor that determines consumption in Turkey in the long run. However the effect of disposable income decreases after the 2001 crisis whereas the long-run consumption effects of housing wealth get stronger in the post-crisis period. It is also found that financial wealth is positive before the 2001 crisis while it gets insignificant after the crisis. Furthermore, as an alternative to the cointegration approach, we employ Carroll (2004)'s methodology for the post-crisis period (after 2001) for estimating the short term and medium term wealth effects on consumption, which does not require stability in cointegrating vectors. The results based on Carroll (2004)'s method conclude that both in the short term and medium term, income and housing wealth have sizeable impacts on consumption whereas no significant effect is found for financial wealth. The findings of the cointegration approach and Carroll's methodology are found to be parallel.

Since consumption is affected by housing wealth, as shown for the Turkish case in Chapter II, and house prices are influenced by interest rates, there is a channel of monetary policy transmission through house prices and it is important to search how this link operates. In this regard, Chapter III examines such linkage between monetary policy and housing wealth and to investigate the role of house prices in monetary transmission mechanism in Turkey for the period 1991Q1-2011Q1. For this purpose, we employ a kind of counterfactual experiment. The results show that house prices do play a considerable role in consumption and residential investment in only the medium term (2 year period) before 2001 whereas they play a crucial role in only the long term (five year period) after 2001. Our study suggests that before 2001, following a contractionary interest rate shock, the increase in house prices is responsible for almost all decreases seen in consumption and residential investment in the medium term. During this period, a house price change has no long-term effects on consumption and residential investment. After 2001, in response to a contractionary interest rate shock, a decrease in house price has long-term effects accounting for 33 percent of the fall in consumption and 75 percent of the fall in residential construction.

The final chapter of this dissertation explores the implications of the findings of previous chapters for the conduct of monetary policy and presents the conclusions.

Chapter 2

Wealth Effects on Consumption: An Empirical Study on Turkey

It is commonly presumed that significant movements in wealth can often have wide economic impacts in consumer spending. This chapter examines the effect of housing wealth and financial wealth upon aggregate consumption in Turkey for the period 1991Q1-2011Q1 by using a system approach, namely the Vector Error Correction Model (VECM). The study includes the structral break in the model and improves on the methodologies presented in previous studies which mostly employed Engle-Granger single equation estimation. Having reviewed the earlier methods' deficiencies to measure housing wealth, this study also introduces a new measure as a proxy for housing wealth. The results of the paper indicate that disposable income is the major factor determining consumption in the long run for Turkey. Also, in the long run, consumption effects of housing wealth and financial wealth are both found to be positive before 2001. After the 2001 crisis, housing wealth effect gets larger whereas financial wealth effect becomes insignificant.

This chapter is organized as follows. Section 1 reviews the possible wealth-consumption transmission channels and the arguments on the differences between housing and financial wealth with respect to their consumption effects. Section 2 briefly reviews the theoretical framework. Section 3 discusses the estimation methodology while Section 4 summarizes the empirical literature on Turkey. Section 5 and 6 provide the empirical analysis. Lastly, Section 7 presents the conclusions.

2.1 Wealth Effects: Housing Wealth and Financial Wealth

In modern literature, deriving from the permanent income hypothesis developed by Friedman (1957) and the lifecycle model, developed by Modigliani and Ando (1960) and Ando and Modigliani (1963), consumption theory suggests that the level of household consumption is a function of permanent income, demographic variables and physical wealth that includes both housing and financial wealth. As suggested by the standard life-cycle model, in response to an unexpected increase in the value of a household's assets such as stocks or housing value, a household will increase its spending.

This basic idea and theoretical link between wealth and consumption have been extended in a number of directions to obtain a more realistic view of consumption behavior. In particular, the so-called collateral effect, which implies an increase in borrowing capacity, is considered to be an important channel through which accumulated wealth can stimulate consumer spending. Given the asymmetric information about borrowers that requires them to provide collateral in credit markets, when there is a rise in wealth, it will increase the value of the collateral. This will potentially leads to more borrowing to finance extra consumption using the appreciated asset as collateral. In other words, the increase in financial wealth or housing wealth can lead to higher consumption by increasing the borrowing capacity of previously credit-constrained households. This collateral channel underpins much of the empirical work on the consumption and housing wealth link for developed countries like the US and the UK where there is easy access to mortgage lending and home equity loans. However, this effect is also becoming significant in emerging countries like Turkey as the mortgage market and relevant financial products are developing rapidly, which may be interpreted from Figure B.1. According to Figure B.1, the share of consumer credit with housing collateral in total consumer credits has risen dramatically in recent years. This may show that the collateral effect of housing wealth has begun to play an increasing role on consumption behavior of households.

Another extension to the basic predictions is related to the role of uncertainty and the precautionary motive for saving. Households may choose to hold some assets as a precaution against negative income shocks. However, when households experience an increase in wealth, this will lead the value of their "buffer-stock" of wealth to rise and will allow such households to increase their spending.

In the standard life-cycle view, it is argued that housing and financial wealth effects are about the same in the long-run. However, this argument is being challenged with the idea that housing and financial wealth may have different implications for spending. One of the reasons why the effects could differ is that housing wealth is considered less liquid than financial wealth because of the high transaction costs with trading in the housing market. As homeowners are less likely to liquidate their houses in response to a house price increase, the housing wealth effect on consumption tends to be smaller than the financial wealth effect.

Another key difference results from the bequest motive which is more important for housing wealth. For many households, homeownership may be an end in itself due to the physiological value they attach to the housing asset and their intent to leave their houses as bequests. Such homeowners who plan to live in their house also obtain a service from their homes in addition to using their housing assets to accumulate wealth. For them, a rise in the price of their housing assets may make them to feel wealthier, but this is not automatically followed by a rise in their consumer spending as the implicit cost of consuming housing has also increased and they still need housing services in the future.[1] Also, many homeowners usually appear to be reluctant to trade down into less expensive houses. Furthermore, for those who intend to buy a house or who are renters, there will be a negative effect on their wealth as a result of rising house prices. The net housing wealth effect would depend on the relative share of these categories of population and

1. Buiter (2008) discusses the wealth effect of the housing asset in some detail. He assumes that housing wealth is the present discounted value of the consumption of future housing services. He concludes that housing has no wealth effect on consumption and house prices can affect consumption only through (1) redistribution effects if the marginal propensity to spend out of wealth differs between those long housing and those short housing and (2) collateral or credit effects due to the collateralisability of housing wealth.

the relative size of their responses to changes in house prices; thus, housing wealth could be more ambiguous and potentially weaker as compared to the financial wealth effect.

One other reason for a more modest effect of housing wealth on consumption relative to that of financial wealth relies on the idea that changes in stock prices more clearly indicates future increases in a country's productivity potential whereas a rise in house prices may be experienced simply due to supply-side constraints which clearly does not indicate that the overall economy is better off (Mishkin, 2007).

Despite these theoretical arguments which suggest a smaller impact of housing wealth on consumption, several empirical studies have found greater consumption effects of housing wealth. One of the reasons behind these findings is the above mentioned collateral effect. Since housing is by far the most important collateral asset for most households due to the more evenly spread homeownership compared to the ownership of financial assets which is highly concentrated in a certain population segment, housing wealth can have stronger impacts on consumption. Moreover, as changes in house prices are much less volatile than changes in stock prices, the housing wealth effect tends to be more permanent than financial wealth effect; thus, its impact on spending could be relatively greater.

2.2 Theoretical Background

The key theoretical link between wealth and consumption, the so-called lifecycle model developed by Ando and Modigliani (1963) suggests that households use their wealth to keep their consumption in its planned level. However, it is crucial to solve the nature of the contemporaneous correlation between changes in wealth and consumption in order to assess the long-run implications of changes in asset prices.

Following Campbell and Mankiw (1989), Lettau-Ludvigson (2001) first formalized the idea that consumption, income and wealth move together in the long run. They formulated the standard budget constraint of the consumer in a log linear form and showed that if consumption growth and returns on wealth are stationary, then the log consumption, wealth and labor income should be cointegrated. Following Lettau-Ludvigson (2001), we present the theoretical framework of this cointegration with the accumulation of wealth equation, in other words the budget constraint:

$$W_{t+1} = (1 + R_{w,t+1})(W_t - C_t) \tag{2.1}$$

where W_t is aggregate wealth, C_t is consumption and $R_{w,t}$ is the net return on aggregate wealth. Campbell and Mankiw (1989) showed that if the consumption to wealth ratio is stationary, taking the first Taylor approximation of this equation gives the following;

$$\Delta w_{t+1} \approx k + r_{w,t+1} + (1 - 1/p_w)(c_t - w_t) \tag{2.2}$$

where lowercase letters denote log variables, $p_w = 1 - \exp(c - w)$, k is a constant and $r = \log(1 + R)$. Solving this equation forward, the consumption wealth ratio may be written as;

$$c_t - w_t = \sum_{i=1}^{\infty} p_w^i (r_{w,t+i} - \Delta c_{t+i}) \tag{2.3}$$

We can also take this term's conditional expectation and express it as;

$$c_t - w_t = E_t \sum_{i=1}^{\infty} p_w^i (r_{w,t+i} - \Delta c_{t+i}) \tag{2.4}$$

Total wealth can be written as;

$$W_t = FW_t + Y_t + HW_t \tag{2.5}$$

where FW is the financial wealth, Y_t is the human wealth and HW_t is the housing wealth. Since human wealth is unobservable, labor income or disposable income are used as a proxy in the literature. Thus, we can approximate the logarithm of wealth as follows:

$$w_t = \gamma f w_t + \theta y_t + (1-\gamma-\theta) h w_t \tag{2.6}$$

where γ, θ and $(1-\gamma-\theta)$ are respectively the steady state shares of financial wealth (FW/W), disposable income (Y/W) and housing wealth (HW/W) in total wealth.

Then, return to aggregate wealth can be expressed as

$$(1+R_{w,t+1}) = \gamma(1+R_{fw,t+1}) + \theta(1+R_{y,t+1}) + (1-\gamma-\theta)(1+R_{hw,t+1}) \tag{2.7}$$

where RW_t is the return of total wealth, RFW_t is the return of financial wealth, RY_t is the return of human wealth and RHW_t is the return of housing wealth. Taking logs of both sides and linearizing around the means give;

$$rw_t = \gamma rfw_t + \theta ry_t + (1-\gamma-\theta) rhw_t \tag{2.8}$$

If we insert Equations (2.6) and (2.8) to the Equation (2.4), we get;

$$c_t - \gamma f w_t - \theta y_t - (1-\gamma-\theta) h w_t = E_t \sum_{i=1}^{\infty} p_w^i (\gamma r f w_{t+i} + \theta r y_{t+i} + (1-\gamma-\theta) r h w_{t+i} - \Delta c_{t+i}) \tag{2.9}$$

The equation above shows that the consumption to wealth ratio (left hand side of the equation) is a function of expected returns and expected changes in consumption (right hand side of the equation). We can assume that consumption growth (Δc_{t+i}) and the real returns of the wealth components $(rfw_{t+i}, ry_{t+i}$ and $rhw_{t+i})$ are stationary. Since the right hand side of the equation is presumed stationary, the consumption to wealth ratio should also follow a stationary path, in other words, consumption and wealth should be cointegrated. It is important to note that the consumption to wealth ratio changes in the short run according to the expected changes in the right hand side variables. However, this equation does not tell us whether consumption or wealth changes in the long run for the correction of the long run disequilibrium.

2.3 Estimation Methodology

Following Lettau-Ludvigson (2001), recent macroeconomic studies have analyzed the consumption function using logarithmic approximation of the budget constraint and searched for the cointegration relationship between consumption, income and wealth that is shown in Equation (2.9). The steady state share coefficients γ and θ in the equation also give the long run elasticities of consumption with respect to different forms of wealth. This in turn helps to derive the marginal propensity from the given values.

In the short run, it is more likely to have some deviations from the long-run relationship. Thus, the system moves to restore the equilibrium. In order to investigate the short-run dynamics that include the variables' adjustments to restore the long run equilibrium and the time taken in this process, the Engle-Granger single equation estimation method (ECM) is often used by researchers.

The Engle-Granger approach is applied in two steps. In the first step, the long run relationship is identified. Using this long run relationship in the second step as one of the regressors, a short run function of one of the endogenous variables is estimated. In the literature, the Engle-Granger method is used to estimate the consumption function by assuming that both income and wealth variables are weakly exogenous. In other words, it is assumed that only consumption is affected from the disequilibrium and it performs the adjustment while income and wealth do not. However, this is not always the case and it is also not supported by the theoretical framework (Lettau and Ludvigson, 2001). Equation (2.9) gives no guidance about how the adjustment occurs. If in reality, income and/or wealth in addition to consumption are affected from the disequilibrium, the Engle-Granger approach is likely to suffer from simultaneity. For this reason, rather than the Engle-Granger method, we should use a framework that allows for the possibility that any or all variables perform this adjustment. Thus, we assume that all variables are endogenous and estimate them in a system of equations, namely the VECM.

2.3.1 Johansen (1988) Estimation Procedure

In order to formulate the VECM, first we write the VAR model assuming that the VAR(m) model only contains m endogenous I(1) variables;

$$y_t = \mu_1 y_{t-1} + \mu_2 y_{t-2} + \ldots.. + \mu_k y_{t-k} + \varepsilon_t \tag{2.10}$$

where "ε_t"s are unobservable i.i.d. zero mean white noises with $\varepsilon_{it} \sim (0, \sigma^2_{\varepsilon_{it}})$ and $\Sigma_{\varepsilon_t \varepsilon'_t} = V$. The model can be reparameterized by subtracting y_{t-1} from both sides. By rearranging them, we get the following VAR model;

$$\Delta y_t = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots.\Gamma_{p+1} \Delta y_{t-p+1} + \varepsilon_t \tag{2.11}$$

where $\Pi = \sum_{i=1}^{p} \mu_i - I_m$ and $\Gamma_i = -\sum_{j=i+1}^{p} \mu_j$.

If there are stationary linear combinations of the m endogenous non-stationary variables, in other words, if the non-stationary variables are cointegrated, then;

$$|I_m - \mu_1 \lambda^1 - \mu_2 \lambda^2 - \ldots. - \mu_k \lambda^k| = 0 \tag{2.12}$$

for $\lambda = 1$. Since the endogenous variables are cointegrated, then the rank(Π)= $r < m$, thus, Π can be decomposed as α, adjustment coefficients, and β, cointegration coefficients, where both are mxr full column rank matrices. Thus, the model can be reinterpreted as VECM where cointegration relationship $\beta' y_{t-1}$ (error correction term) is one of the regressors in the system;

$$\Delta y_t = \alpha \beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots.\Gamma_{p+1} \Delta y_{t-p+1} + \varepsilon_t \tag{2.13}$$

The variables in β show the long-run relationships among the endogenous variables whereas α measures the impact of deviations from this long-run equilibrium in the short term. Π can be estimated from Equation (2.11) directly by using OLS. However, in order to estimate the elements of Π; α and β separately, we need to have some identifying restrictions. In this regard, we follow Johansen (1988, 1991) by using the restrictions that β includes eigenvectors, in other words, the cointegrating vectors that are orthogonal to each other.

In Johansen's algorithm two set of regressions are estimated;

$$\Delta y_t = \hat{\Pi}_0 + \hat{\Pi}_1 \Delta y_{t-1} + \hat{\Pi}_2 \Delta y_{t-2} + ... + \hat{\Pi}_{p-1} \Delta y_{t-p+1} + \hat{u}_t \tag{2.14}$$

$$y_{t-1} = \hat{\Psi}_0 + \hat{\Psi}_1 \Delta y_{t-1} + \hat{\Psi}_2 \Delta y_{t-2} + ... + \hat{\Psi}_{p-1} \Delta y_{t-p+1} + \hat{v}_t \tag{2.15}$$

where $\hat{\Pi}_i$ and $\hat{\Psi}_i$ denotes (nxn) matrices of OLS coefficient estimates. Next step is to calculate the sample variance-covariance matrices of the OLS residuals $\hat{u}_t$ and $\hat{v}_t$;

$$\hat{\Sigma}_{uu} = (1/T) \sum_{t=1}^{T} \hat{u}_t \hat{u}_t^{\prime} \tag{2.16}$$

$$\hat{\Sigma}_{vv} = (1/T) \sum_{t=1}^{T} \hat{v}_t \hat{v}_t^{\prime} \tag{2.17}$$

$$\hat{\Sigma}_{uv} = \hat{\Sigma}_{vu} = (1/T) \sum_{t=1}^{T} \hat{u}_t \hat{v}_t^{\prime} \tag{2.18}$$

From these variance-covariance matrices, the eigenvalues of the matrix

$$\hat{\Sigma}_{vv}^{-1} \hat{\Sigma}_{vu} \hat{\Sigma}_{uu}^{-1} \hat{\Sigma}_{uv} \tag{2.19}$$

are found with the eigenvalues ordered. After these calculations, maximum likelihood estimates of the parameters (e.g. α and β) can be derived.

2.3.2 Estimation of the Cointegrating Vector under the Structural Break

As known, the cointegration approach comes from the log-linear approximation to the consumer's intertemporal budget constraint that we have written before as

$$c_t - \gamma f w_t - \theta y_t - (1 - \gamma - \theta) h w_t \approx 0 \tag{2.20}$$

where γ, θ and $(1 - \gamma - \theta)$ are respectively the steady state shares of financial wealth, disposable income and housing wealth in total wealth. As seen, this equation is preference-free since it is derived simply from the budget constraint. In order to have a stationary consumption-wealth ratio, some fundamental parameters that determine this cointegration relationship should not change permanently over the time frame for which the relationship is examined. However, if there are major changes in some of those fundamental parameters such as taxes, productivity growth, demographics, financial structure, etc., the theory implies no such stability.[2] Thus, such breaks may lead to misspecification of the long-run properties of a system and may result in an inadequate estimation.

The Johansen (1988) model we discussed above does not include a potential shift in the cointegration vector. If there is a break between the varibles in the cointegration vector, we should estimate that cointegration vector with another framework that accounts for a break. Andrade et al. (2005) deals with this type of a problem in the context of a one-time change in the cointegration vector at a known date. Along the lines of Johansen (1988), they rewrote the model in the following form;

$$\Delta y_t = 1_{t \leqslant t_0}[\alpha_0 \beta_0^{'} y_{t-1}] + 1_{t > t_0}[\alpha_1 \beta_1^{'} (y_{t-1} - y_{t_0})] + \Gamma_1 \Delta y_{t-1} + ...\Gamma_{p+1} \Delta y_{t-p+1} + \varepsilon_t \tag{2.21}$$

whete t_0 is the date of break which does not occur at the limit points of the sample and, $1_{t \leqslant t_0}$ and $1_{t > t_0}$ determines the regime that currently runs at date t. When estimat-

2. Turkish economy was introduced a comprehansive economic reform program in 2001Q2.

ing the cointegration vector, Andrade et al. (2005) distinguished two cases; in the first one, only the loading coefficients are unchanged across two regimes whereas in the second case, the loading coefficients and the cointegration space may both change. In their algorithm, three set of regressions are estimated;

$$\Delta y_t = \hat{\Pi}_0 + \hat{\Pi}_1 \Delta y_{t-1} + \hat{\Pi}_2 \Delta y_{t-2} + ... + \hat{\Pi}_{p-1} \Delta y_{t-p+1} + \hat{u}_t \tag{2.22}$$

$$1_{t \leqslant t_0} y_{t-1} = \hat{\Psi}_0 + \hat{\Psi}_1 \Delta y_{t-1} + \hat{\Psi}_2 \Delta y_{t-2} + ... + \hat{\Psi}_{p-1} \Delta y_{t-p+1} + \hat{v}_t \tag{2.23}$$

$$1_{t > t_0} [y_{t-1} - y_{t_0}] = \hat{\Upsilon}_0 + \hat{\Upsilon}_1 \Delta y_{t-1} + \hat{\Upsilon}_2 \Delta y_{t-2} + ... + \hat{\Upsilon}_{p-1} \Delta y_{t-p+1} + \hat{\mu}_t \tag{2.24}$$

where $\hat{\Pi}_i$, $\hat{\Psi}_i$ and $\hat{\Upsilon}_i$ denote (nxn) matrices of OLS coefficient estimates.

First Case: Cointegration Vector Changes while Loading Coefficients do not Change In the first case, where the loading coefficients do not change, the residuals in Equation (2.22) are regressed by the residuals in Equations (2.23) and (2.24) in order to get the $\hat{\epsilon}_t$, estimate of the error term in Equation (2.21);

$$\hat{u}_t = \alpha_{nx1} [\beta_0^{'} \beta_1^{'}]_{1x2n} \begin{pmatrix} \hat{v}_t \\ \hat{\mu}_t \end{pmatrix}_{2nxT} + \hat{\epsilon}_t \quad t = 1, 2...., T \tag{2.25}$$

Next step is to calculate the sample variance-covariance matrices of all these OLS residuals $\hat{u}_t$, $\hat{v}_t$, $\hat{\mu}_t$ and $\hat{\epsilon}_t$;

$$\hat{\Sigma}_{\epsilon\epsilon} = (1/T) \sum_{t=1}^{T} \hat{\epsilon}_t \hat{\epsilon}_t \tag{2.26}$$

$$\hat{\Sigma}_{uu} = (1/T) \sum_{t=1}^{T} \hat{u}_t \hat{u}_t \tag{2.27}$$

$$\hat{\Sigma}_{uv} = (1/T) \sum_{t=1}^{t_0} \hat{u}_t \hat{v}_t \tag{2.28}$$

$$\hat{\Sigma}_{u\mu} = (1/T) \sum_{t=t_0+1}^{T} \hat{u}_t \hat{\mu}_t \tag{2.29}$$

$$\hat{\Sigma}_{vv} = (1/T) \sum_{t=1}^{t_0} \hat{v}_t \hat{v}_t \tag{2.30}$$

$$\hat{\Sigma}_{\mu\mu} = (1/T) \sum_{t=t_0+1}^{T} \hat{\mu}_t \hat{\mu}_t \tag{2.31}$$

From these variance-covariance matrices, we find the eigenvalues of the matrix

$$\hat{\Sigma}_{\epsilon\epsilon}^{-1/2} \left[\hat{\Sigma}_{uv} \left(\hat{\Sigma}_{vv} \right)^{-1} \hat{\Sigma}_{uv}^{'} + \hat{\Sigma}_{u\mu} \left(\hat{\Sigma}_{\mu\mu} \right)^{-1} \hat{\Sigma}_{u\mu}^{'} \right] \hat{\Sigma}_{\epsilon\epsilon}^{-1/2} \tag{2.32}$$

with the eigenvalues ordered. After these calculations, maximum likelihood estimates of the parameters (e.g. α, β_0, β_1) can be derived.

Second Case: Both Cointegration Vector and Loading Coefficients Change In the second case, different from the first case, the residuals in Equation (2.22) are regressed by the residuals in Equations (2.23) and (2.24) separately for the two regimes in order to get the $\hat{\epsilon}_t$, estimate of the error term in Equation (2.21);

$$\hat{u}_t = \alpha_0 \beta_0^{'} \hat{v}_t + \hat{\epsilon}_t \quad t = 1, 2, ..t_0 \tag{2.33}$$

$$\hat{u}_t = \alpha_1 \beta_1^{'} \hat{\mu}_t + \hat{\epsilon}_t \quad t = t_0 + 1, ..T \tag{2.34}$$

From the calculated variance-covariance matrices in Equations (2.26)-(2.31), the eigenvalues of the matrix

$$\hat{\Sigma}^{0}{}_{uu}^{-1/2} \hat{\Sigma}_{uv} \left(\hat{\Sigma}_{vv} \right)^{-1} \hat{\Sigma}_{uv}^{'} \hat{\Sigma}^{0}{}_{uu}^{-1/2} \tag{2.35}$$

are found for the estimation of α_0 and β_0 , and the eigenvalues of the matrix

$$\hat{\Sigma}^{1\,-1/2}_{uu}\hat{\Sigma}_{u\mu}\left(\hat{\Sigma}_{\mu\mu}\right)^{-1}\hat{\Sigma}'_{u\mu}\hat{\Sigma}^{1\,-1/2}_{uu} \tag{2.36}$$

are found for the estimation of α_1 and β_1 where $\hat{\sum}^0_{uu}$ is the variance-covariance matrix of the period $t \leqslant t_0$ and $\hat{\sum}^1_{uu}$ is the variance-covariance matrix for the period $t > t_0$.

2.4 Empirical Literature on Turkey

While there is growing need to test the link between housing wealth and consumption in Turkey, the relevant literature is sparse. One of the main limitations of research on Turkey is the lack of data on house prices.

Among the few empirical studies that attempted to incorporate housing wealth in consumption function for Turkey, Akkoyunlu (2002) employed the Engle-Granger single equation estimation using annual data for the period of 1962-1994. In order to approximate the real house prices, Akkoyunlu (2002) used the private housing investment and housing stock and assumed that real house prices increased 3.25 percent per annum for the entire period of the study. Thus, her analysis is based on a constant real increase in housing prices, which clearly does not reflect a realistic view for such a long period since Turkey had encountered a number of deep economic crises during that period. The study found that housing wealth has a significant effect on consumption expenditure in Turkey, although it is marginal compared to financial wealth effect which is approximated with the M2/GNP ratio.

In a similar strand of research as Akkoyunlu (2002), Ozer and Tang (2009) recently estimated the consumption function via Engle-Granger single equation estimation and studied the financial and housing wealth effects on aggregate private consumption in Turkey for the period of 1987-2007. Their study employed a proxy for housing wealth by constructing a quarterly housing price index as a weighted average of the housing investment deflator and the lagging rental price index and by multiplying this price index by the housing stock series. The study's findings are that disposable income is the major factor determining private consumption in Turkey, with elasticity over 0.90 and both financial wealth and housing wealth have positive effects on consumption, with elasticities of 0.077 and 0.046 respectively while there is not enough evidence to show that one effect is stronger than the other.

Another recent study that analyzed financial and housing wealth effects on consumption for Turkey was conducted by Binay and Salman (2008) for the period of 1990-2005. They used the percentage change in rent price index as a proxy for housing wealth without taking the dwelling stock into consideration, which is widely accepted as an important driver of housing wealth in Turkey. The estimation by Binay and Salman (2008) is based on a simple consumption equation by least square estimator through which they found that housing wealth has a significant effect on total consumption, with an elasticity of 0.2 while financial wealth has no significant effect on total consumption.

In another recent study, Aydede (2008) analyzed the unfunded social security system's effect on consumption for Turkey and used a single equation estimation introducing instrumental variables. In the study, the link between housing wealth and consumption is also analyzed by using the rental income from dwellings as a proxy of housing wealth. However, this proxy includes only dwellings that provide rental income for their owners; thus, it only measures the benefit stream of a particular form of housing asset rather than the stock value of all housing assets. The study suggested that housing wealth has a sizeable positive effect on consumption whereas the financial effect on consumption is negative (possibly due to increased savings).

Differing from the methods in the afore mentioned studies, Akin (2008) looked at the consumption effects of stock market, housing wealth and financial wealth by estimating a VECM by using quarterly time series data for the 1987-2006 period. Akin (2008) constructed a housing wealth series considering residential floor area costs as a proxy for the house prices. However, it is seen that Akin's measure does not include the cost of land, which is an important factor that drives house prices. Akin (2008) suggested that in the long run, housing wealth has a positive effect on the non-durables consumption (0.27 percent) in contrast to durables consumption. On the other hand, she found that stock market wealth does not have a significant long-run effect on consumption of non-durables, but has strong effect on the durables consumption. Looking at the short-run, Akin (2008) found that while housing wealth has negative effect on non-durables consumption, stock market wealth and financial wealth have positive effects on consumption of both durables and non-durables.

Among all previous studies covering the period after 2001, the effect of a structural change in Turkish economy is ignored and it is assumed that the cointegration relationship between consumption and wealth components remained stable over the time frame for which the relationship is examined. However, in case of major changes in some of those fundamental parameters in the economy such as taxes, productivity growth, demographics, financial structure, etc., the theory implies no such stability. In fact, these major changes may lead to misspecification of the long-run properties of a system and result in an inadequate estimation. Thus, as in the case of the 2001 crisis, if there is a break between the variables in the cointegration vector, we should estimate that cointegration vector with an improved framework that takes the break into consideration.

Also, in all of the reviewed studies, the simultaneous relationship between consumption and wealth is generally not accounted for, except in the study by Akin (2008). In other words, by using methods other than VECM, most studies assumed that only consumption performs the disequilibrium adjustment while income and wealth do not. However, this assumption does not have theoretical support since it is widely accepted that income and wealth also perform the disequilibrium adjustment (Lettau and Ludvigson, 2004). Following the theoretical framework, our study aims to analyze the consumption effect of housing wealth and financial wealth with the VECM.

In this paper, we employed a different approach from Akin (2008) with regard to the proxy for housing prices. Instead of using residential floor area costs as a proxy for housing prices, we chose to use the Rent Price Index (RPI) which is published by the

Statistics Institution of Turkey. (see Figure B.2 for the comparison of two measures)

In order to show that rent price is a reliable proxy for housing prices for Turkey, we used the monthly real estate price and rent data from Reidin's Real Estate Index that is based on sales and rental price levels in the real estate markets of Turkey's 7 major cities, 71 districts, and their 481 sub districts. This index starts at the beginning of June 2007.

A close look at the Figure B.3 indicates that there is high correlation between the rent and price data. The correlation coefficient between the percentage changes of these two variables is 0.89. Binay and Salman (2008) also showed that there is a high correlation between rent and price data. Using data on house prices and rents for Ankara, the capital city of Turkey, for the period of 2000-2005Q2 from TURYAP, the largest real estate broker in Turkey, the authors found that rent prices for Ankara are highly correlated with house prices for the same city. Thus, we conclude that the rent price index is a good proxy for house prices for Turkey. However, as mentioned before, Binay and Salman's (2008) rent price index does not capture the dwelling stocks' effect on housing wealth. To deal with this limitation, this paper introduces the stock data into the index by multiplying the rent price index by the dwelling stock in order to approximate the housing wealth.

2.5 Empirical Analysis

2.5.1 Background of Turkish Economy

In order to get a fuller understanding and better modeling of private consumption behavior in a country, it is important to look at its macroeconomic background and identify major economic events which have undeniable impact on household consumption and saving choices.

In the period over which this analysis is conducted – from 1991Q1 to 2011Q1 Turkey's economy has undergone fundamental changes. Being a country with historically high inflation rates and a constant public sector deficit, Turkey has experimented with many reform policies to lower inflation and further liberalize and stabilize the economy.

The financial crises in 1994 and 2001 as well as the Russian crisis in 1998 were the three major turmoils that affected the Turkish economy. During the early 1990s, in the debt financing of Turkey's high public sector deficit, banks heavily involved in short-term borrowing in foreign currency and the size of their open currency positions got larger. This trend shortened maturity of domestic debt and increased the vulnerability of the financial market causing an upward pressure on real interest rates and the cost of financing of public debt. In such a vulnerable financial structure, in 1994, the government decided to cancel the Treasury's domestic public debt auctions in order to lower interest rates and prevent further rises in cost of servicing the domestic debt. Instead of domestic debt financing, the government relied upon the Central Bank resources in financing the public deficit. Coupled with the downgrading of Turkey's credit rating, this caused turbulence in exchange rate markets and the banking sector that had taken substantial open currency positions went into crisis. With increased uncertainty due to the banking crisis, public rushed into foreign currency, and as a result, the Turkish Lira depreciated sharply. As the Central Bank intervened in the foreign exchange market, its foreign reserves, which were not high enough to effectively manage the crisis, were rapidly diminished. In order to prevent further dollarization of the economy, the interest rates were raised, and consequently consumption and investment spending declined substantially, which led the banking crisis develop into an economic crisis. The government's announcement of an unlimited deposit insurance scheme ended the crisis in the banking sector and restored financial stability.

The Russian default in 1998 had resulted in a massive capital outflow from Turkey as the country's equities were in the same basket as Russian equities. The outflow led to higher interest rates, larger fiscal deficit, credit shortages and a fall in industrial production. Also, the decrease in Russian demand for Turkish exports further deteriorated the country's industrial performance.

Following the Russian crisis, another radical shift in capital outflows in 2001 was triggered by liquidity problems in the banking sector and the political fight between the president and the prime minister. Different from other crises observed in the past, the 2001 crisis brought about substantial changes in Turkey's political and economic systems, and led to the introduction of significant structural reforms and programs. With a view to gain a good understanding of these changes and their implications, it would be useful to summarize why and how the crisis developed.

Basically, there are three main factors that are responsible for the 2001 crisis. The first one is the high public deficit financed by monetization. As a result of very high levels of public deficits and budget deficits in the 1990s, the debt stock saw a rapid increase. Financing this debt through monetary expansion resulted in a hyperinflation-like process. The uncertainty of such an inflationary period and high government spending away from fiscal discipline created short-maturity debt and increases in interest rates which led to a debt-interest rate spiral.

Another factor underlying the crisis is the heightened level of risk observed in financial markets and the increased vulnerability of the banking system. In a system of pegged exchange rates and control policies, banks took excessive risk with their open currency positions and this led to a more fragile financial system. In addition to that, the maturity structure of capital flows remained short due to uncertainty in such a high inflationary period, and combined with this, the large duty losses of public banks that were financing discretionary political spending inevitably increased the vulnerability of the system.

At this point, considering its relevance to households' consumption functions, it is noteworthy to mention that prior to the 2001 crisis, the banking sector's main function of financing the private sector was affected negatively and the private sector credits remained very low in banks' actives. Instead, the banking sector used its resources to finance the short-maturity public debt.[3]

The third main factor behind the 2001 crisis is the unstable political landscape that

3. Data is available at "evds.tcmb.gov.tr" and "www.hazine.gov.tr"

is viewed to have a large influence on the economy. Prior to the crisis, from 1991 to 2001, multi-party coalition governments had been the norm and the average life of these coalition governments were only 16 months compared to 5 years (60 months) after the 2001 period. On February 19th 2001, at the time of weakening economic fundamentals, Turkey's last coalition government faced a severe political crisis as a public dispute between Turkey's Prime Minister and President over the fight against corruption escalated and the Prime Minister made a media announcement that the Turkish state faced "serious crisis". This political tension caused panic in financial markets and triggered a financial crisis. With the run to foreign currency, the Central Bank lost a large share of its reserves and the payment system was locked as the Turkish Lira liquidity decreased and the public banks that had high daily liquidity needs faced a liquidity crisis. Due to these pressures in the financial market, the exchange rate targeting strategy was abandoned and the Turkish Lira was allowed to float freely against foreign currencies as of February 22^{nd}, 2001. During the year of the crisis, Turkey's economy experienced a 9.5 per cent contraction. Subsequent to such a severe recession, the so-called "Strengthening the Turkish Economy" economic reform program was introduced. With the introduction of structural reforms and programs after the crisis, the economy started to grow rapidly, political influence on markets got reduced and the macro economy gained more stability.

Since the reform programs changed the Turkish economy substantially, it is worth to give an overview and analyze their impact on the economy briefly. One of the most important reform areas was the independence of the Central Bank that restructured the relationship between politics and economy. Before 2001, a dependant monetary authority followed politics that helped the financing of the Treasury; therefore, during this period, political institutions had a large influence on the economy. The CB independence after the crisis ended the institutional relationship between the government and the Central Bank which is an important step in weakening political influence on the economy and lowering inflation.

In addition to the CB independence, there were new laws and regulations on the restructuring of the banking sector. First of all, a domestic debt swap was launched in order to ensure an easy liquidity for the Treasury and to lower the risk of banks by closing the banks' open currency positions. These steps taken to strengthen the fiscal environment were combined with legislative and operational regulations on the transparency and the effective supervision of the system. In this context, the Banking Regulation and Supervision Agency, which was established not long before the crisis, was activated and authorized as the sole authority in the banking sector. Through this independent institution, it was aimed to ensure auditing and regulating of the banks. Under the new system, regulations were launched to closely control the banks for excessive risk taking and their open currency positions. Reforms also covered the state banks, and the practice of duty losses of the state banks due to political spending was ended. Instead, the duties given to the state banks have become items of the governmental budget. Moreover, some state banks merged and some of them were liquidated. These changes also played significant roles in weakening the political influence on the economy, and as a result, it reduced the economic uncertainty.

Parallel to the above-mentioned steps, a tight monetary policy and fiscal policy were implemented. The CB announced to follow first the implicit and then the explicit inflation targeting framework. On the fiscal policy aspect, very high primary surplus targets were announced and in order to achieve the targets, regulations were established on various areas in relation to taxation and public spending.

The economic reform program after the 2001 crisis was fruitful to a great extent. The inflation rate that was about 60 percent before the crisis declined rapidly and by 2004, a single-digit inflation was achieved for the first time in decades. With the confidence redeveloped in TL, the currency reform of dropping six zeros from the Turkish Lira was introduced. As a result of increased macroeconomic and financial stability combined with the prospect of EU membership and the positive international conjuncture, capital inflows soared, and consequently, the maturity structure of the debt stock improved significantly. The average maturity of government debt increased from 148 days in 2001 to 550 days in 2010.[4] The positive trend in the economy in the post-crisis period also improved the political stability and the short term coalition governments were replaced with single party governments ruling for longer periods.

The increased capital inflows supported by improved public trust and confidence due to the economic and political stability after 2001 led the banking system, which is growing fast and becoming more liquid, to offer greater resources to the private sector. While the share of consumer credits in banks' actives was only 8 percent in 2001, this rate reached to 38 percent, and in real terms, the consumer credits increased by 315 times.[5]

Considering all the abovementioned developments in Turkey's economy, the consumption function may have been changed in the post-crisis period compared to the period before 2001. Thus, the possibility of such a structural change in consumption should be taken into consideration.

2.5.2 Data

The variables introduced in this empirical model of consumption are the main ones suggested by the theoretical framework: total consumption, disposable income, financial wealth and housing wealth. Our data set is quarterly series and it covers the period from 1991Q1 to 2011Q1. All the variables in the study are converted into real per capita values and transformed into a natural logarithm.

The total consumption variable, denoted by CON, is measured by private consumption expenditure derived from GDP series. The disposable income, denoted by DPI, is taken as a proxy of labor income. The net financial wealth, denoted by FW, is constructed from the sum of M2Y and stocks subtracted by total consumer credits including credit cards. Finally, the net housing wealth series, denoted by HW, are computed by

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4. Author's own calculations is based on data from the Undersecretariat of Treasury in Turkey, available at "www.hazine.gov.tr".

5. Author's own calculations are based on data from the Central Bank of Turkey, available at "evds.tcmb.gov.tr".

multiplying the house price index, which is derived from rent price index (RPI), with the net dwelling stock, and by subtracting total housing credits from the result. All series are deflated by a private consumption expenditure deflator derived from the GDP series (see Figure B.4). Detailed description of the data is given in Appendix C. Since CON and DPI series show strong seasonal patterns, we filter both series by Census X12.

In order to take into consideration the crises of 1994, 1998, 2001 and the U.S. mortgage crisis in 2007, we introduce 5 impulse dummies for 1994Q2, 1998Q3, 2001Q1, 2001Q2 and 2008Q1.

As it is seen from Table A.2, the ADF test shows that none of the variables are stationary in levels, whereas all variables are stationary in their first differences. We also conduct a modified ADF test proposed by Lanne et al. (2002) to account for the possibility of any structural break in data. Critical values are taken from Lanne et al. (2002). As it is seen from the Table A.2, the modified ADF test also shows that none of the variables are stationary in levels, which is parallel to the standard ADF test results, whereas all variables are stationary in their first differences. In conclusion, the evidence of unit root in our variables is found to be strong once we allow for the existence of structural break in our data.

Since all our variables are well represented by I(1) processes, the next step is to search for the cointegration properties of the data and parameterize them in a multivariate model.

2.5.3 Testing for Cointegration

A precondition for cointegration testing and formulation of VECM is that all variables must be non-stationary and integrated of order one I(1). Our ADF test results showed that the integration for all variables was found to be I(1).

The first step of the multivariate analysis to be conducted with the I(1) variables is to investigate the cointegration properties of these data to see whether there exist a long-run relationship within the system. If a cointegration vector is detected, than it is optimal to use this information by using VECM.

In cointegration testing and formulation of a VECM, it is first necessary to determine the appropriate lag. To determine the appropriate lag structure (p), we write the unstructured VAR(p) of our model in levels that includes the break (represented by shift and slope dummies) and choose the value for "p" which minimizes the information criteria and can pass from the diagnostic tests. The choice of the maximum lag length may determine the optimum lag, which in turn can affect the cointegration test results. Fitting 6th or higher order lag implies that too many degrees of freedom are lost; thus, we use 5th order as the maximum lag length in the analysis. The SC (Schwarz Criterion), HQ (Hannan-Quinn information criterion) and AIC (Akaike's information criterion) suggest 1, 2 and 4 lags in levels respectively. Values for the information criteria are reported in Table A.3. We also estimate two VAR(p)s for the sub-samples which are 1991Q1-2000Q4 and 2001Q2-2011Q1. All information criteria give 1 to 3 lags for both periods. We base our final choice of the lag length on the criterion which gives us the absence of serial correlation in the residuals. As a result, we use the AIC and select the lag length as 4.[6]

Having determined the appropriate lag length, the next step requires testing for cointegration among the endogenous variables. The cointegration properties of the I(1) variables are investigated in a multivariate system by using Saikkonen and Lutkepohl test (Saikkonen and Lutkepohl, 2000), which is robust to structural break in the cointegration vector, and also employing the Johansen Trace test (Johansen, 1991 and Johansen et al., 2000).[7] It is shown by Andrade et al. (2005) that Johansen Trace test performs well under the structural break even for small samples. Table A.4 displays the results of the

6. Our VECM results do not change much with the lag selection.

7. We did two kind of Trace tests developed by Johansen (1991, 2000). One of them is a classic Trace test (Johansen, 1991) that does not consider any structural break. The second one, explained in Johansen (2000), is the modified Trace test that includes the structural break concept referring to a level shift in the cointegration vector. Since the critical values of the Johansen test (1991) do not include exogenous variables, except the trend and the constant, we should simulate the new critical values for the cointegration test that accounts for a structural break. In our analysis, the critical values as well as the p-values of all Johansen trace tests are obtained by computing the respective response surface according to Johansen et al. (2000) by using JMulti.

tests.

According to the results of the both tests, there is one cointegrating relationship between consumption, income, financial wealth and housing wealth at the 5% significance level. This result is also robust under different lag specifications.

2.5.4 Estimation Results

First, the cointegration vector is previously estimated without any break using the method of Johansen (1981). However, various tests including the Break Point Chow test shows a break in 2001Q1; therefore the stability conditions could not be satisfied for the estimation and Johansen's method becomes not applicable to Turkey for the period of study. Even including a shift dummy into the cointegration vector does not solve the problem. Thus, we suggest that there is a break in the relationship between the variables in the cointegration vector, which is also shown in our ECM estimation results discussed before. As a result, we choose to implement the Andrade et al. (2005) method that accounts for this type of a break. As we mentioned above, Andrade et al. (2005) distinguish two cases; in the first one, only the loading coefficients are unchanged across two regimes whereas in the second case, the loading coefficients and the cointegration space may both change. The results of our estimations based on Andrade et al. (2005) for each case are displayed in Table A.5 and Table A.6. According to our estimations, we get the long-run consumption functions reported in Table A.11.

We see from Table A.11 that after 2001, the effect of income decreases whereas the effect of housing wealth moves in opposite direction. In order to check whether the estimated coefficients in the equations are different from zero or not, Likelihood-ratio (LR) tests are performed on the coefficients of the cointegrating vector and on the loading coefficients . Tables A.7 and A.8 display the results of the tests. The LR test results indicate that the coefficient estimates of the financial wealth after 2001 and the housing wealth before 2001 are not significantly different than zero for the estimations for both cases where loading coefficients change and do not change. Other coefficients in the cointegrating vector are all significantly different than zero for both periods and both cases.

It is also seen that the loading coefficient of the error correcting terms for the change in consumption is negative and this coefficient is significant for both cases and for each period. The loading coefficient of the housing wealth is positive and significant for both estimations and periods, except for the second case before 2001. As for the loading coefficient of income, it is negative and significant only for the second case before 2001. These results indicate that after 2001, deviations from the long-run equilibrium are adjusted by both consumption and housing wealth in the next period. As an other interpretation of these findings, the cointegration vector helps to predict not only consumption, but also the housing wealth growth in Turkey. Thus, our results show that in order to refrain from the simultaneity bias, the long-run consumption function in Turkey should be estimated with a system approach rather than a single equation method.

Following the LR test results, we re-estimate the VECM in a restricted form. According to the results of our estimations displayed in Tables A.13 and A.14, we get the consumption functions reported in Table A.12.

As it is seen from the restricted VECM estimation results, there is not much difference between the estimations where loading coefficients change and do not change. Thus, we interpret only the first estimation results. Before 2001, the estimated income elasticity of the consumption function is 0.83. In other words, a permanent one percent increase in real per-capita disposable income is associated with a 0.83 percent increase in real per-capita consumption in the long-run. For the same period, financial wealth also has a positive effect on consumption with the elasticity of 0.13. However, housing wealth has no significant effect on consumption before 2001.

On the other hand, after 2001, income elasticity of the consumption decreases dramatically to 0.30. Thus, the increase in income affects consumption less compared to the pre-crisis period. This may be explained by an increasing share of consumer credits in the total banking sector credits after 2001. The previously credit-constrainted consumers have become more liquid and thus, they have relied on their income less in making consumption decisions. In the period after 2001, the housing wealth effect becomes significant with the elasticity of 0.28. This means that housing wealth has affected consumers' consumption decisions considerably. This can be explained by the housing wealth's collateral effect. As we saw in Figure B.1, the housing wealth is used more as a collateral in the last years. This is an expected trend since the financial deepening and the financial instruments got stronger in Turkey after the crisis. As for the financial wealth effect on consumption, it is surprising to find that this effect has become insignificant after 2001. It may be partially due to the changing in the financial wealth's composition and its term structure since the interest rates have gradually dropped from double digits to a single digit value after the crisis. We do not aim to give the details of this composition here; however, the lowered effect of financial wealth on consumption is clearly a topic for further empirical work.

For our results to be econometrically valid, our model should satisfy certain conditions in terms of residuals and coefficients. We conduct the diagnostic tests for both the unrestricted and the restricted VECM, and the results can be seen from Tables A.9-A.10 and A.15-A.16. According to these test results, the residuals of both VECM estimations satisfy the conditions of normality, autocorrelation and heteroscedasticity in all equations. Therefore, we can conclude that our VECM is robust.

2.6 An Alternative Approach to Estimate Welfare Effects

The literature typically estimates wealth effects employing cointegrating regressions between consumption, income and wealth. However, according to Carroll (2004), estimations using cointegration analyses are problematic since such analyses assume a long-run trend in consumption and wealth which implicitly implies that the saving rate should be stationary. Yet, as he suggests, the saving rate depends on many variables that clearly change in most of the economies in a short time frame for which the cointegration analysis is conducted. Assuming a constant saving rate is found to be problematic also in the empirical literature recently. (Slacalek 2004) Thus, the cointegration approach suffers from the omitted variable bias.[8]

On the other hand, Carroll (2004) also mentions that it is a misidentified question to search for the long term welfare effects of housing on consumption. It is because a rise in the house price does not increase the amount of real sources. In other words, increasing the price of housing asset does not mean an increase in the economy's ability to produce non-housing goods. Eventually, consumption goods must equal their production in the long run, which is not relevant to rise in asset prices. Thus, it is better to analyze or interpret the effects of housing wealth on consumption in the short or medium term, rather than the long-term effects.

Thus, Carroll (2004) presents his own new methodology for estimating the short term and medium term wealth effects on consumption which does not require stability in cointegrating vectors. He uses the habit formation model (sluggishness of consumption) for describing the consumption function and develops an alternative approach to estimate the short and medium term MPCs which do not depend on the assumption of the existence of a long-term stable cointegrating vector.

2.6.1 Estimation Method Developed by Carroll (2004)

Empirical studies show that consumption growth responds sluggishly to shocks. The sluggishness of consumption growth can be captured in macroeconomic models including habit persistence parameters, rather than the random walk models (Hall, 1978). Therefore, consumption growth can be estimated for a few quarters using models with habit persistence parameters. Based on this finding, Carroll uses the sluggishness of consumption for describing the consumption function and develops an alternative approach

8. Carroll (2004) suggests that the cointegration regression implies that consumption growth depends only on its own lags and the lags of wealth while it is well known that some additional variables like interest rate changes, consumer sentiment, etc. also determine the changes in consumption.

to estimate the MPC in the short and medium term. Following Carroll (2004), we can write the utility function of the form

$$u(C,H) = \frac{(C-\chi H)^{1-\rho}}{1-\rho} \tag{2.37}$$

where χ is sluggishness parameter, H is stock of habits, and the habit stock evolves according to

$$H_{t+1} = H_t(1-\lambda) + (C_t - H_t)\lambda \tag{2.38}$$

The Euler equation of this model can be approximated by

$$\Delta \log C_{t+1} = c_0 + \chi \Delta \log C_t + \varepsilon_{t+1} \tag{2.39}$$

or today's consumption change can be written

$$\Delta \log C_t = c_0 + \chi \Delta \log C_{t-1} + \varepsilon_t \tag{2.40}$$

Thus, sluggishness parameter can be get from the estimated serial correlation in consumption growth. ε_t includes all shocks on consumption growth (one of them is wealth shock). Supposing that the actual measure of consumption contains some transitory measurement error or transitory elements of spending, the measured consumption C^* can be written as

$$\Delta \log C^*_t = \beta_0 + \beta_1 \Delta \log C^*_{t-1} + \upsilon_t \tag{2.41}$$

Since β_1 is the downward-biased estimate of χ, Sommer (2002) shows that using instrumental variables dating $t-2$ or earlier in this regression should largely overcome this problem.

Following Carroll (2004) and Jiri (2009), we can write the consumption shocks in the

Equation (4) as

$$\varepsilon_t = \alpha_1 \partial \log W_t + \alpha_2 Z_t \tag{2.42}$$

where $\partial \log W_t = \Delta \log W_t$ and Z_t is other instrumental variables potentially correlated with the consumption growth.

Rather than estimating Equation (2.40) directly we can write the Equation (2.40) as moving average representation

$$\Delta \log C_t = \frac{c_0}{1-\chi} + \sum_{i=1}^{\infty} \chi^i \varepsilon_{t-i} + \varepsilon_t \tag{2.43}$$

and substitute Equation (2.42)'s lagged values into (2.43) gives

$$\Delta \log C_t = \frac{c_0}{1-\chi} + \alpha_1 \sum_{i=1}^{\infty} \chi^i \partial \log W_{t-i} + \alpha_2 \sum_{i=1}^{\infty} \chi^i Z_{t-i} + \varepsilon_t \tag{2.44}$$

Carroll (2004) modifies the Equation (2.40) and uses the ratio of changes in wealth to an initial level of consumption rather than the wealth growth. Thus, in order to interpret α_1 as the MPC out of wealth we should rescale the consumption with C_{t-5}. To estimate this equation, we can approximate the infinite sum of $\partial \log W_t$ with $\chi(\Delta W_{t-1} + \chi \Delta W_{t-2} + \chi^2 \Delta W_{t-3} + \chi^3 \Delta W_{t-4})/C_{t-5}$, let's name $\overline{W}_{t-1}$, and the infinite sum of Z_t with $\chi(Z_{t-1} + \chi Z_{t-2} + \chi^2 Z_{t-3} + \chi^3 Z_{t-4})/C_{t-5}$, let's name $\overline{Z}_{t-1}$. As a result, we estimate the equation

$$\partial C_t = \frac{c_0}{1-\chi} + \alpha_1 \overline{W}_{t-1} + \alpha_2 \overline{Z}_{t-1} + \varepsilon_t \tag{2.45}$$

where $\partial C_t = \Delta C_t / C_{t-5}$.[9] Thus, we can get the short run MPC (SMPC) or immediate MPC out of a change in wealth α_1 from this estimation. In addition to that, the medium term MPC (MMPC) which is the infinite sum of $\alpha_1 \sum_{i=0}^{\infty} \chi^i = SMPC/(1-\chi)$,can also be

9. Since C_{t-1} and C_{t-5} are highly correlated, ∂C_t and $\Delta \log C_t$ is almost perfectly correlated. Thus, we can use ∂C_t instead of $\Delta \log C_t$.

calculated. As a result we estimate the MPC out of a change in wealth in two stage; first we estimate the Equation (2.40) and get χ, then using χ we estimate the Equation (2.44).

2.6.2 Carroll's Method with Structural Break

Since there is a break in our data, it is better to rewrite the Equations (2.40) and (2.42) in a form that includes the break;

$$\Delta \log C_t = c_0 + (\chi_1 + 1_{t>t_0}\chi_2)\Delta \log C_{t-1} + \varepsilon_t \tag{2.46}$$

and

$$\varepsilon_t = (\alpha_1 + 1_{t>t_0}\beta_1)\partial \log W_t + (\alpha_2 + 1_{t>t_0}\beta_2)Z_t \tag{2.47}$$

Same as shown above, we can rewrite Equation (2.40) as moving average representation;

$$\Delta \log C_t = \alpha_0 + \sum_{i=1}^{t_0}\chi_1^i \varepsilon_{t-i} + \sum_{i=t_0+1}^{\infty} \chi_2^i \varepsilon_{t-i} + \varepsilon_t \tag{2.48}$$

and substituting Equation (2.47)'s lagged values into (2.48) gives;

$$\begin{aligned}\Delta \log C_t = \alpha_0 + (\alpha_1 + 1_{t>t_0}\beta_1)\left(\sum_{i=1}^{t_0}\chi_1^i \varepsilon_{t-i} + \sum_{i=t_0+1}^{\infty} \chi_2^i \varepsilon_{t-i}\right) \partial \log W_{t-i} \\ {}_{i=1} \\ + (\alpha_2 + 1_{t>t_0}\beta_2)\left(\sum_{i=1}^{t_0}\chi_1^i \varepsilon_{t-i} + \sum_{i=t_0+1}^{\infty} \chi_2^i \varepsilon_{t-i}\right) Z_{t-i} + \varepsilon_t\end{aligned} \tag{2.49}$$

Again, in order to interpret α_1(β_1) as the MPC out of wealth, we rescale the consumption with C_{t-5}.

$$\partial C_t = \alpha_0 + \alpha_1 \overline{W}_{t-1}^1 + \alpha_2 \overline{Z}_{t-1}^1 + 1_{t>t_0}\beta_1 \overline{W}_{t-1}^2 + 1_{t>t_0}\beta_2 \overline{Z}_{t-1}^2 + \varepsilon_t \tag{2.50}$$

where $\partial C_t = \Delta C_t / C_{t-5}$, $\overline{W}^i_{t-1} = \chi_i(\Delta W_{t-1} + \chi_i \Delta W_{t-2} + \chi_i^2 \Delta W_{t-3} + \chi_i^3 \Delta W_{t-4})/C_{t-5}$ and $\overline{Z}^i_{t-1} = \chi_i(Z_{t-1} + \chi_i Z_{t-2} + \chi_i^2 Z_{t-3} + \chi_i^3 Z_{t-4})/C_{t-5}$ for $i = 1, 2$.

2.6.3 Estimation Results for Turkey Using Carroll's Method

According to our estimations, before the break, the sluggishness of consumption is not different than zero whereas it is 0.32 after the break. In other words, consumption behavior before 2001 in Turkey cannot be explained by the sluggishness of consumption growth models that include habit persistence parameters. Thus, we estimate the period only after 2001 using Carroll's method and find the SMPC as 32 kurus and MMPC as 47 kurus for income. In other words, one Turkish Lira (TL) increase in income leads to 32 kurus (100 kurus= 1 TL) short run increase in consumption and it yields a 47 kurus increase in consumption in the medium term.

For the housing wealth we find SMPC as 1.6 kurus and MMPC as 2 kurus. Although these MPCs seem small, when the the huge real increase in the housing wealth between 2001Q2-2011Q1 is considered, it can be said that housing wealth also has a considerable effect on consumption. For example, according to our data, in 2001Q2; housing wealth is 2.47 million TL in real terms (87=100) and in 2011Q1; it reaches to 6.23 million TL. Considering the estimated MMPC of 2 kurus in 2001Q2-2011Q1 period, the 3.76 million TL increase in the housing wealth results in a 0.75 million TL increase in consumption. This corresponds to 60% of the consumption increase that is seen in the same period.

Lastly, we did not find any significant effect of financial wealth on consumption for the 2001Q2-2011Q1 period.

It is noteworthy that our findings in Carroll's method are parallel to the findings of the cointegration approach.

2.7 Conclusion

It is now commonly presumed that significant movements in wealth can often have wider economic impacts in consumer spending. Our study assesses the impact of housing wealth on aggregate consumer spending in the context of Turkey for the 1991Q1–2011Q1 period by using a system approach which includes the structural break in the cointegration vector after 2001. The study improves on the methodologies presented in previous literature, which mostly employed Engle-Granger single equation estimation and ignored the structural change in Turkish economy after 2001. Having reviewed the earlier methods to measure housing wealth in the country and their deficiencies, this study also uses a new measure for housing wealth.

One of the main findings of this study is that disposable income is the major factor that determines Turkey's consumption in the long run before 2001. However, this effect decreases after the 2001 crisis and income elasticity to consumption ratio drops from 0.83 to 0.30 according to our VECM estimations. This may be explained by the increasing share of consumer credits in the total banking sector credits after 2001. The previously credit-constrainted consumers have become more liquid and thus, they have relied less on their income in making consumption decisions.

There is also a considerable change in the housing wealth effect after 2001. Housing wealth becomes significant with the elasticity of 0.28 after 2001 whereas this effect is not before 2001. This can be explained by the housing wealth's collateral effect, meaning that housing wealth is used more as a collateral couple of years, as seen in Figure B.1.

As for the financial wealth effect on consumption, it is surprising to find that this effect has become insignificant after 2001. It may be partially due to the huge decrease in interest rates after 2001. This change in interest rates may have altered the composition of financial wealth and its term structure and, thus, may have affected the elasticity of financial wealth in consumption function. The lowered effect of financial wealth on consumption is clearly a topic for further empirical work.

Considering that consumption responds to shocks gradually, this study also employs Carroll et al. (2004)'s methodology based on the sluggishness of aggregate consumption growth to measure wealth effects. This method distinguishes between immediate (next-quarter) and eventual wealth effects. According to our alternative estimation, before the break, the sluggishness of consumption is not different than zero whereas it is 0.32 after the break. Thus, we estimate the period only after 2001 using Carroll's method and find the SMPC as 32 kurus and MMPC as 47 kurus for income. In other words, one Turkish Lira (TL) increase in income leads to 32 kurus (100 kurus= 1 TL) short run increase in consumption and it yields a 47 kurus increase in consumption in the medium term.

For the housing wealth, we find SMPC as 1.6 kurus and MMPC as 2 kurus. Although these MPCs seem small, when the the huge real increase in the housing wealth for 2001Q2-2011Q1 is considered, it can be said that housing wealth also has a considerable effect on consumption. Lastly, we did not find any significant effect of financial wealth on consumption for the 2001Q2-2011Q1 period.

In the light of the empirical findings and recent developments in Turkey's financial sector and housing markets, it is crucial for monetary authority to monitor developments in the consumption-wealth link and adopt strategies accordingly. With the recent mortgage law that was enacted in 2007 and the continuing financial deepening, which provides new financial products, the scope for homeowners in Turkey to borrow against housing collateral may increase over time. Under such a scenario, house prices will tend to rise and the housing wealth may have even larger impacts upon aggregate spending and the macroeconomy.

Chapter 3

House Prices and the Monetary Policy Transmission in Turkey

Economists and central bankers have been interested in studying the consequences of house price changes for several reasons. First, as we described in the first chapter, housing wealth is inherently connected with consumption which could affect price levels and output. In the light of the recent global developments in the housing market, including the large gains and subsequent fall in housing prices, it becomes vitally important for monetary authorities to understand the relationship between housing wealth and consumption. Second, house prices drive the cycles in residential investment, which have been a useful leading indicator of the general business cycle[10] and have been a substantial component of investment.[11] Finally, because house prices and residential investment have apparently been sensitive to changes in interest rates, the housing market is considered an important channel through which monetary policy can influence economic activity.

There are various studies that examine the role of housing wealth in the monetary transmission mechanism (MTM), especially for advanced countries, and most, but not all of these studies indicate that the housing market plays a critical role in MTM through consumption and/or residential investment.[12] However, there has been no study that

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10. R. E. Hall and J. B. Taylor, Macroeconomics (New York: W. W. Norton & Company), 1986, p. 203.

11. In the case of Turkey, private sector's construction expenditure was nearly 6 percent of real GDP and 26 percent of gross fixed capital formation in 2010.

12. Some of the studies are Aoki et al. (2004), Mishkin (2007), Elbourne (2008), Neri and Stracca (2010), Milcheva and Sebastian (2010).

investigates the role of house prices in MTM for Turkey. This is surprising because, based on our findings in the previous chapter and in some other studies in the literature, housing wealth considerably affects consumer spending in Turkey. This is also important in the case of Turkey since housing wealth claims the biggest share in total wealth and this wealth has increased rapidly over recent years.[13]

In this respect, this chapter provides some quantitative evidence in the Turkish context regarding the effect of monetary shocks on house prices as well as the effect of house prices on consumption and residential investment in order to assess the role of house prices in MTM for the period of 1991Q1-2011Q1. Three main questions that this chapter aims to address are: (i) How does monetary policy affect the housing market in Turkey? (ii) How do changes in house prices influence consumer spending and residential investment? (iii) What are the implications of house price developments in Turkey for the transmission mechanism of the monetary policy? In other words, what proportion of the monetary policy shock transmits to consumption and residential investment through housing prices? These are all crucial questions for the monetary policy-maker for determining how to respond to house price shocks when considering how its policy rate would impact house prices.

In order to answer these questions, we employ a kind of counterfactual experiment. This experiment has two steps: First, as a benchmark, we estimate a VECM model. This baseline model can be used to construct standard impulse response functions showing the dynamic response of the variables to an interest rate shock. Such a response gives the total effect of an interest rate shock on other variables, including the effect via the possible influence of that shock on the relevant variable (in our experiment, it is house prices). The second step in the experiment is to simulate the consequences of an interest rate shock under a counterfactual regimen, following the methodology in Bernanke, Gertler, and Watson (1997) and Sims and Zha (2006). In this regimen, after a shock, the actual

13. Real house prices rose by 110% through the 1991-2011 period.

response of the relevant variable is excluded and this variable is set at the baseline level that is implied by the benchmark VAR estimate. In other words, we assume that the response of the relevant variable has kept its value in the absence of the exogenous shock. The difference between the effect of the exogenous shock on the system variables and the estimated effect when the relevant variable response is excluded can then be interpreted as a measure of the contribution of the excluded variable's response. In order to find these dynamics and responses, we use the VECM with changing cointegration vectors framework described in Andrade et al. (2005), since there is a structural change in the Turkish economy in 2001Q1.

According to the results of our VECM, interest rate affects the housing market considerably during both periods. While an increase in interest rate results in increases in house prices before 2001, it shows an opposite effect after 2001, resulting in decreases in house prices. In both periods, generally, residential investment presents a fall after an increase in interest rates for both periods. In addition to that, house prices do play a considerable role in monetary transmission mechanism after 2001. Our counterfactual simulation suggests that before 2001, following a contractionary interest rate shock, the increase in house prices is responsible for almost all decreases seen in consumption and residential investment in the medium term (2 year period). After 2001, a decrease in house price in response to a contractionary interest rate shock has long-term effects accounting for 33 percent of the fall in consumption and 75 percent of the fall in residential construction at the end of the fifth year.

The remainder of the chapter is organized as follows: Section 1 discusses the housing wealth-MTM linkage. Section 2 reviews previous studies. Section 3 briefly explains the model. Section 4 reviews the estimation framework. Section 5 presents the data and their properties. Section 6 provides the empirical analysis. Section 7 presents results. Lastly, Section 8 concludes.

3.1 MTM and the Role of Housing Prices in the Economy

The monetary transmission mechanism is a complex topic since there are various channels through which monetary policy operates. Figure B.5 provides a diagrammatic representation of the main types of monetary transmission mechanisms mentioned in the literature.[14]

As shown in Figure B.5, the MTM process begins with the transmission of policy interest rates to consumption and investment (or final targeted variables output and inflation), mainly through the market interest rates, exchange rates and expectations. From there, transmission may proceed through any of the following channels.

The interest rate channel is the primary and direct channel for central banks to affect the economy. Changes in policy interest rates lead nominal market interest rates, expectations and exchange rates to change. Given some degree of price stickiness, movements in nominal market interest rate result in changes in real interest rate, which is the user cost of capital. The changes in the user cost of capital in turn lead to movements in consumption, investment spending, including residential investment,[15] and asset prices such as housing prices. Finally, these movements result in changes in aggregate demand and prices.

Another important channel in MTM is the housing price channel through which central banks affect the economy indirectly.[16] In order to understand the housing price channel, first it is better to look at how the monetary policy affects housing prices, and then examine the impact of housing prices on residential investment and consumption.

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14. Some examples of main MTM channels can be reviewed in the papers of the "Monetary Transmission Mechanism" symposium of fall 1995.

15. Randall (1990), Ryding (1990) and McCarthy and Peach (2002) examined the relationship between interest rates and residential investment and showed that residential investment responds considerably to monetary policy in the U.S.

16. Meltzer (1995), discussing the Japanese economic experience in the 1980s and 1990s, is one of the first/leading studies that mention the housing price channel. Meltzer (1995) suggested that in that period, the Japanese monetary policy had an important impact on the economy through its effect on land and property values.

As seen in Figure B.5, policy interest rate affects housing prices through both the demand and supply sides. From the demand side perspective, monetary policy is transmitted on to the user cost of housing, which is defined as the opportunity cost of purchasing a house rather than renting it. When monetary policy raises the interest rates, the average mortgage rate also experiences a rise, and that leads to a higher user cost of capital for housing. Hence, there will be a fall in demand for housing, which in turn would lead to a decline in housing construction and prices.[17] From the supply side of housing, any change in interest rates may have an impact on housing construction costs, and thereby the residential investment.[18]

This briefly-reviewed linkage between house prices and interest rates, the housing price impact on residential investment and consumption needs to be examined as a next step. As seen in Figure B.5, house prices play a role in the monetary transmission mechanism by affecting the residential investment via the Tobin q channel and the consumption via the wealth and credit channel.[19] Here, the Tobin q channel implies that investment in housing increases when house prices rise. In other words, increased house prices after a fall in interest rates lead to an increase in the market value of houses relative to their replacement costs, with a resulting increase in "q". As a result, investing in housing becomes more profitable leading to an increase in spending on residential investment.

The wealth and credit channel is another important channel in which house prices

17. From the portfolio view, housing wealth, as one of the main assets, is affected by the price changes of other assets and also their returns such as bonds. If there occurs an increase in the return of bonds, households would arrange their portfolio accordingly and they would demand less housing.

18. The interest rate affects both housing demand and supply in the same direction: an increase in interest rates reduces both the demand and supply of housing. Hence, the effect on housing prices is ambiguous: it depends on the elasticity of the housing demand and supply. Generally, the short term elasticity of the housing demand is greater than that of the housing supply. Prices would decrease in the short term in response to an increase in the interest rate. In other words, in the short run, the supply of housing is not elastic due to the nature of residential investment which is determined by a q-type of investment function with a convex adjustment cost. It takes a while to construct new houses; thus, a shock that increases the demand of housing causes house prices to move up. In the long run, Tobin's q plays an important role and stimulates the residential investment and also determines the prices.

19. The role the housing sector in economy has been well documented in the literature (Meltzer, 1995; Mishkin, 1996, 2007).

are in effect the transmission mechanism. Wealth effect comes from the standard life-cycle model, developed by Modigliani and Ando (1960) and Ando and Modigliani (1963). According to the life-cycle model, the level of household consumption is a function of the lifetime resources of consumers, which are made up of permanent income and physical wealth that include housing. When house prices fall, the value of housing wealth, thus, the lifetime resources of consumers decrease, and as a result, consumption should fall. In addition to the wealth channel, there is also the credit channel through which house prices affect consumption. According to this view, housing serves as collateral to lower borrowing cost, which can stimulate consumer spending. When there is a rise in house prices, it would increase the value of the collateral. This will potentially lead to more borrowing to finance extra consumption using the appreciated asset as collateral. In other words, an increase in house prices may lead to higher consumption by increasing the borrowing capacity of previously credit-constrained households.

Last but not least, the exchange rate channel is an important element in open-economy macroeconomic models. After a change in interest rates, exchange rates also move via the uncovered interest rate parity condition. Thus, an increase in the policy interest rate, relative to foreign rates, would lead to an increase in domestic currency and this would result in a reduction in net exports, thus affecting the overall level of aggregate demand and prices.

3.2 Review of the Empirical Studies

As mentioned above, in order to suggest that house prices play a substantial role in MTM, two conditions are necessary. First is the existence of a linkage between house prices and interest rates. Second is the existence of a housing price effect on consumption and residential investment.[20]

There has been a vast literature on modeling the housing market in order to quantify

20. In the second chapter, we concentrate on the housing wealth / consumption linkage and attempt to find the magnitude of this linkage in the long-run.

its importance in the economy. However, these studies usually focus on either the first or the second linkage: the linkage of housing prices with interest rates or with consumption and residential investment. Not many of them attempt to incorporate housing prices' role in MTM, and they examine almost entirely the advanced economies. Despite these limitations in the relevant literature, selected studies can be reviewed according to this categorization.

3.2.1 Housing Prices-Interest Rate Linkage

There are various academic studies suggesting that interest rates affect the house prices. Iacoviello (2000) attempts to identify the main factors behind the fluctuations in house prices in six European countries employing SVAR.[21] He uses quarterly GDP, house prices, money, inflation, and interest rate variables in his estimation and aims to understand how these variables react to shocks in supply, monetary policy, inflation and demand. He shows that monetary shocks and demand shocks play important roles on house price fluctuations over the short run, suggesting a significant negative impact of monetary shocks on real house prices. Parallel to this finding, in a more recent study, Iacoviello and Minetti (2008) employ different VAR specifications for four European countries.[22] Their findings suggest that house prices significantly decline following an increase in the short term interest rate.

Aoki et al. (2002) also show that the house market in the UK is affected by the monetary policy. Using VAR by including output, inflation, oil prices, broad money, short term interest rate, consumption, housing prices and housing investment, this study suggests that a decrease in the interest rate leads to an increase in house prices.

Besides the studies examining the European countries, there are also some studies for the U.S. economy. One of the most recent studies, Jarocinski and Smets (2008) estimates

21. The countries he examined are France, Germany, Italy, Spain, Sweden and the UK.

22. The countries examined are Finland, Germany, Norway and the UK.

BVAR for the U.S. housing market. Using a nine-variable estimation that includes the real GDP, GDP deflator, commodity prices, the federal funds rate, M2, real consumption, real housing investment, real house prices, and the long-term interest rate spread, the monetary policy is found to have significant effects on house prices.

In all these selected studies, it is suggested that there is a significant relationship between interest rates and house prices.

3.2.2 Housing Prices-Consumption and Residential Investment Linkage

There have been numerous studies that examine the effect of the house prices on consumption which we mentioned in the previous chapter. Most of these studies, although not incorporating the housing price-interest rate linkage, indicate that rising house prices stimulate consumers to spend more than they would without such price increases.[23] However, the empirical literature is inconclusive about the estimates of the marginal propensity to consume out of housing wealth. These estimates vary substantially across studies due to the use of different types of consumption and wealth data and/or different estimation techniques to test the wealth effects. The differences also stem from the unstable nature of wealth effects over time.

When it comes to the house prices-residential investment relationship, many papers suggest that housing construction is affected by house prices; thus, Tobin q is a valid argument for residential investment. Since these selected studies do not analyze the Tobin q effect in residential investment by itself and they also include the analysis of the house prices' role in MTM, they are reviewed in the next section among with the literature on house prices and MTM.[24]

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23. Some of the leading studies are Case et al. (2005), Ludwig and Slok (2004), Girouard and Blondal (2001), Carroll et al. (2004).

24. These papers are Mishkin (2007), Musso, Neri and Stracca (2010) and Jarocinski and Smets (2008)

3.2.3 House Prices and MTM

As mentioned above, most of the housing market literature focuses on a particular part of the transmission mechanism. However, there are also studies that attempt to incorporate the housing market's role in MTM in a more general framework.

One of the important studies is the paper by Aoki et al. (2004) that analyzes the transmission of the monetary policy in a general dynamic equilibrium framework. Following Bernanke and Blinder (1988), Aoki et al (2004) considers a general equilibrium model with frictions in the credit markets used by households and shows that housing plays an important role in MTM. In the model by Aoki et al. (2004), housing serves as collateral to lower the borrowing cost. They calibrate their DSGE model and suggest that using housing as collateral amplifies the effect of monetary policy shocks on house prices, residential investment, and consumption.

In another important study, Mishkin (2007) uses the FRB/US model to find the role that housing plays in the monetary transmission mechanism. The model used in this study does incorporate the direct interest rate effect on housing activity through the user cost of capital and the indirect effect through wealth effects from house prices. To illustrate the importance of housing in the transmission mechanism, he first attempts to find how the model responds to a monetary policy shock, and then he isolates the responses generated when the interest rate effect on housing and the housing wealth effects are excluded. He shows that excluding these channels reduces the peak GDP response by about 14 percent of the total response, which indicates that the house prices play a moderate role in the transmission mechanism. Mishkin (2007) also shows that residential investment is affected by house prices. A 20 percent decline in house prices (evenly corresponding to the decline in house prices over the two-year period from 2007 to 2008) leads to a reduction in residential investment of up to 6 percent.

Elbourne (2008) adopts a structural VAR model to understand the effect of monetary policy changes on consumption behavior. He uses consumption, commodity prices, the

Federal Funds rate, house prices, money, inflation and interest rate variables in the estimation. Using a two-step approach and a counterfactual simulation, Elbourne (2008) suggests that about 12-15 percent of the drop in consumption responding to a contractionary monetary policy shock is coming through the changes in house prices.

As a multi-country study, Musso, Neri and Stracca (2010) examine the role of the housing market in the economy in the U.S. and in the Euro area. Using the variables of consumption, residential investment, CPI, the real house price, mortgage lending rate, interest rate and mortgage debt in the SVAR model, they find that housing plays an important role in MTM in both the Euro area and the U.S., with a stronger role in the U.S. Parallel to Mishkin (2007), they also suggest that an increase in house prices leads to a rise in housing construction, indicating the linkage between house prices and residential investment.

In an another multi-country study, Milcheva and Sebastian (2010) estimate a VAR model for 14 European countries, 7 Central and Eastern countries and the U.S. to clarify the role of the housing market in MTM. The variables they use in the estimation include the consumer price index, consumption expenditures, fixed capital formation in housing, house prices and interest rates. They suggest pronounced housing wealth effects in countries that they examined.

On the other hand, there are studies suggesting that the housing market does not play a strong role in MTM. Ludvingson et al. (2002) review the role of household wealth in MTM for the U.S. Estimating a small VAR, they find that both stock wealth and non-stock wealth, which is the proxy of housing wealth, have minor roles in MTM. In a more recent study, Jarocinski and Smets (2008) review the role of the housing market and monetary policy in U.S. business cycles. Although they find that monetary policy has significant effects on housing investment and house prices as we explained above, house prices do not play an important role in MTM according to their findings. Parallel to Mishkin (2007) and Musso, Neri and Stracca (2010), Jarocinski and Smets (2008) also suggest that house prices affect residential investment. According to their study, house prices explain a large fraction of the changes in residential investment between 2001Q1-2007Q2 (except 2004) implying that Tobin q is in effect in those years.

3.3 Model

In order to analyze the role of housing prices in the monetary policy transmission mechanism, we first require a model. With a view distinct from that of the wealth channel, the role of monetary policy in affecting overall economic activity, which is based on the credit channel, can be modeled similar to a financial accelerator mechanism. In that model, interest rates affect housing prices and this price change possibly amplifies the effect of interest rates on the economy. The model of this kind of a credit channel of housing wealth is developed by Aoki et al. (2004). Applying the financial accelerator model of Bernanke and Blinder (1988), Aoki et al. (2004) considers a general equilibrium model with imperfections in credit markets resulting in significant monitoring costs for lenders. Lenders, therefore, charge a premium over the risk-free interest rate to borrowers. Thus, borrowers' net worth affects the probability of default which in turn changes the external finance premium. As a result, using housing as collateral lowers the borrowing cost. Based on this relationship, Aoki et al. (2004) show that the collateral channel amplifies the effect of monetary policy shocks on consumption and residential investment. As we show using the schematic representation of this type of model in Figure B.5, the equations and the explicit form of the model are not included here.

3.4 Estimation Methodology

A VAR is a convenient device for examining the short run dynamics of an economy and for computing the dynamic response of the variables to the fundamental shocks. We can write the structural VAR in the following way;

$$AY_t = B(L)Y_{t-1} + C(L)X_t + e_t, \tag{3.1}$$

where Y_t is the vector of endogenous variables, X_t is the vector of exogenous variables and e_t is the vector of structural shocks with $e_{it} \sim (0, \sigma^2_{e_{it}})$ and $\Sigma_{e_t e'_t} = I$. By premultiplying A^{-1} by both sides of structural VAR, the reduced form VAR can be expressed by;

$$Y_t = \Phi(L)Y_{t-1} + \Omega(L)X_t + u_t, \tag{3.2}$$

where $\Phi(L)$=A^{-1}*$B(L)$, $\Omega(L)$=A^{-1}*$C(L)$ and $u_t = A^{-1} * e_t$ with $\Sigma_{u_t u'_t} = V$. As it is seen like structural shocks, "e_t"s, "u_t"s are also an unobservable i.i.d. zero mean white noises. On the other hand, although "u_t"s are serially uncorrelated, unlike the "e_t"s, they are correlated across equations. However, consistent estimates of Φs and Ωs can be obtained by OLS and also variance-covariance matrix V can be estimated from the fitted residuals if the variables are stationary. If the variables are not stationary, it is better to search for the overall stationarity of the system; in other words, we have to look at the cointegration properties of the variables first.

Even after estimating the VAR as in Equation (3.2) consistently, it is not possible to compute the dynamic response of Y_t to a particular economic shock. This is because there is no reason to assume that any element of u_t corresponds to a particular economic shock e_t. Among various ways to identify the structural model, we use Choleski decomposition as suggested by Sims (1980) to identify the shocks by imposing lower triangular structure on matrix A.

3.5 Data and Their Properties

3.5.1 Data

We use 6 variables to model the dynamics of MTM. Bearing in mind the potential risk of omitting important information by using small model, we try to save degrees of freedom since our sample size is not large. The variables that are included can be seen in Figure B.6 and are; log of real consumption (CON), log of residential investment (RIV), log of

Consumer Price index (CPI), policy interest rate (INT), log of exchange rates (EXC) and log of Real House Price Index (RHP). Like the data set we use in the previous chapter, our data set here is a quarterly series and covers the period from 1991Q1 to 2011Q1. Detailed description of the data is given in Appendix C. Since CON and CPI series show seasonal patterns, we filter both series by Census X12.

In order to take into consideration the crises of 1994, 1998, 2001, and the U.S. mortgage crisis in 2007, we introduce 7 impulse dummies for 1994Q1, 1994Q2, 1998Q3, 2000Q4, 2001Q1, 2001Q2 and 2007Q3.

As it is seen from Table A.17, the ADF test shows that none of the variables are stationary in levels, whereas all variables are stationary in their first differences.[25] We also conduct a modified ADF test proposed by Lanne et al. (2002) to account for the structural break in data. As is seen from the Table A.17, the modified ADF test also shows that none of the variables are stationary in levels, which is parallel to the standard ADF test results, whereas all variables are stationary in their first differences. In conclusion, the evidence of unit root in our variables is found to be strong.

Since all our variables are well represented by I(1) processes, the next step is to investigate the cointegration properties of these data to see whether there exists a long-run relationship within the system. If a cointegration vector is detected, it is more efficient to estimate our VAR in a VECM framework that takes this long-run relationship into consideration.

3.5.2 Testing for Cointegration

In cointegration testing,first it is necessary to determine the appropriate lag. To determine the appropriate lag structure (p), we write the unstructured VAR(p) of our model in levels that includes the break (represented by shift and slope dummies) and the trend since CPI is trend stationary in its first difference, and we choose the value for "p" which

25. Since CPI shows quadratic trend, it is trend stationary in its first difference.

minimizes the information criteria and that can pass from the diagnostic tests. Fitting 5th or higher order lag implies that too many degrees of freedom are lost; thus, we use 4th order as the maximum lag length in the analysis. The SC (Schwarz Criterion), HQ (Hannan-Quinn information criterion) and AIC (Akaike's information criterion) suggest 1, 4 and 4 lags in levels respectively. Values for the information criteria are reported in Table A.18. We base our final choice of the lag length on the criterion which gives us the absence of serial correlation in the residuals. As a result, we use the HQ and AIC and select the lag length as 4.

Having determined the appropriate lag length, the next step requires testing for cointegration among the endogenous variables. Parallel to Chapter II, the cointegration properties of the I(1) variables are investigated by a series of tests. They are Saikkonen and Lutkepohl test (Saikkonen and Lutkepohl, 2000), which is robust to structural break in the cointegration vector, and Johansen Trace tests (Johansen, 1991 and Johansen et al., 2000).[26] As we mentioned before, it is shown by Andrade et al. (2005) that Johansen Trace test performs well under the structural break. Table A.19 displays the results of the tests.

According to the results of both tests, there are three cointegration vectors between the variables at the 5% significance level.

3.6 Estimation

As we did in the previous chapter, we choose to implement the Andrade et al. (2005) method that accounts for the break in 2001. The estimated cointegration vectors for the

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26. We did two kind of Trace tests which are developed by Johansen (1991, 2000). One of them is a classic Trace test (Johansen, 1991) that does not consider any structural break. The second one, explained in Johansen (2000), is the modified Trace test that includes the structural break concept referring to a level shift in the cointegration vector. Since the critical values of the Johansen test (1991) do not include exogenous variables, except the trend and the constant, we should simulate the new critical values for the cointegration test that accounts for a structural break. In our analysis, the critical values as well as the p-values of all Johansen trace tests are obtained by computing the respective response surface according to Johansen et al. (2000) by using JMulti.

periods 1991Q1-2001Q1 and 2001Q2-2011Q1 based on the Andrade et al. (2005) method can be seen in Table A.20.[27]

Since we are searching for the short run dynamics of the system in order to get response functions, we do not need to identify the coefficients of the long-run relationship between the variables. Thus, we do not normalize the cointegration vectors.[28]

For our results to be econometrically valid, our model should satisfy certain conditions in terms of residuals and coefficients. We conducted the diagnostic tests for the VECM, and the results can be seen from Table A.21. According to these test results, the residuals of VECM estimations satisfy the conditions of normality, autocorrelation and heteroscedasticity in all equations.

3.6.1 Identification of the Structural Shocks

As we mentioned above, in order to identify structural shocks, we apply the recursiveness assumption by imposing a lower triangular structure on matrix A. In our benchmark specification, the endogenous vector is ordered as Y_t={ real consumption, residential investment, real house price, price level, exchange rate, interest rate}.[29]

We have three main blocks in our ordering; macroeconomic variables, prices and policy rate. In our identification scheme, we assume that macroeconomic variables are slow-moving variables that are not contemporaneously affected from the other variables. Thus, we write investment and consumption variables as the first two variables in our ordering. Having consumption in the first column of the ordering can be justified with the permanent-income type of behavior. According to this type of behavior, the log of consumption is close to a random walk. In other words, consumption growth cannot be

27. We just display the general case results where both loading coefficients and the cointegration vector changes.

28. Normalizing the cointegration vector requires the theoretically ordering of the variables in the cointegration vector.

29. Actually, the order of these elements does not change our results. We show this in the robustness section below.

predicted, meaning that consumption is not contemporaneously affected from the other variables.[30] In the identification scheme, we write the prices after the macroeconomic variables. This ordering implies that after consumption and investment decisions are taken, it is the price that clears the market. It is also important to note that ordering the house price after consumption is also a valid argument. Since housing is an asset, it is normal to assume that housing wealth, like other wealth components, is taken as a given variable at the beginning of the period by the consumers. Hence, it can be assumed that consumption is not influenced contemporaneously by house prices. At the end of our ordering, we write the policy rate. We can see that this way of ordering implies that monetary authority is assumed to observe other endogenous variables; as a result, the level of policy rate is affected by other variables in the same quarter. Some may argue that house price is an asset price which can react almost instantaneously to the news or interest rate. However, it is worth noting that the opposite also seems plausible: monetary policy is likely to respond within a quarter to movements in asset values. In the benchmark scheme, we follow the second argument. We also impose an ordering that takes the first argument into consideration where house prices contemporaneously react to interest rates in the robustness section.

3.6.2 Impulse Responses and Counterfactual Experiment

Since we have different cointegration vectors for each period, we should estimate each period's impulse responses separately.[31] In order to do that, we use the cointegration vector of the period that we are going to estimate the impulse responses for.[32] We calculate the current period's impulse responses using only the pre-estimated cointegration vectors of

30. Consumption growth is not, of course, exactly a random walk if the households are credit-constrained. Thus, there is predictable component in consumption growth which means that consumption is contemporaneously affected by other variables such as prices and interest rates.

31. As we display in Table A.20, we have three cointegration vectors for each period.

32. It is important to note that, as we already showed in Chapter 2, with the estimation framework that we use following Andreda et al. (2005), we assumed that the short run parameters are constant between periods whereas only the cointegration vector (and its loading coefficients) change between periods.

that period, their loading coefficients and the other short-run variable coefficients within the structure that is shown in Equation (3.2).

Since we aim to estimate the contribution of the house prices to the changes in consumption and residential investment, following Bernanke, Gertler and Watson (1997) and Sims and Zha (2006), we tighten the focus of our investigation by adopting a "shut down" approach. In this approach, after a shock, the response of the relevant variable is shut down and set at the baseline level that is implied by the VAR estimates. In other words, the response of the relevant variable is kept at its initial value in the absence of the exogenous shock and the impulse responses of the other variables are recalculated. The difference between the effect of the exogenous shock on the system variables and the estimated effect when the relevant variable response is shut down can then be interpreted as a measure of the contribution of the excluded variable's response.[33]

In our study, since we examine the transmission of monetary policy into residential investment and consumption via the monetary policy's influence on house prices, the counter factual experiment that we describe above is conducted as follows: First, as a baseline, we estimate a model that includes all six variables that we mentioned before. Using this six-variable system as a benchmark, we construct standard impulse response functions (IRFs) showing the dynamic responses of residential investment and consumption to an interest rate shock. Such responses give the total effect of the interest rate shock on residential investment and consumption, including the effect via the influence of that shock on real house prices.

In the second step, we simulate the consequences of an interest rate shock under a counterfactual experiment where we exclude the house price channel by setting the coef-

33. This kind of experiment, where most equations are held fixed while some are changed, is obviously subject to the Lucas Critique since we are ignoring the fact that agents modify their expectations and behave differently under new conditions. In order to accommodate the Lucas Critique, Sims and Zha (1995) argue that since the agents are conditioned by past experiences and reluctant to initiate an arduous learning process, it takes some time for agents to learn that the apparently permanent condition may be quite otherwise. The Lucas Critique may not be a major concern in the experiment that is conducted in this section, especially for short run analysis.

ficients of the other variables in the house price equation zero. In other words, we keep their values in the absence of an exogenous shock and the impulse responses of the other variables are simulated under this restriction. The difference between the estimated effect of an interest rate shock on consumption and residential investment in the baseline model and that in the counterfactual experiment is then can be interpreted as a measure of the contribution of the house prices channel in MTM.

3.7 Results

3.7.1 Results of Benchmark Model

Figures B.7, B.8 and B.9 show the effect of a contractionary monetary policy shock for the two periods, pre-2001 and post-2001. As it is seen from Figure B.9, the responses to an interest rate shock differ between both periods. For more solid understanding, it is better to analyze the pre-2001 and post-2001 periods separately.

Figure B.7 shows the effect of a one point increase in interest rate as a contractionary monetary policy shock for the pre-2001 period. As is expected, we find that consumption and the exchange rate fall after an interest rate shock. On the other hand, consumer prices and house prices tend to increase for the same period, which shows that there are consumer price and house price puzzles present before 2001. These contradictions may be explained by the existing cost channel of the monetary policy before 2001. For the house price puzzle, the demand of housing before 2001 does not rely on interest rates due to the unavailability of mortgage credits whereas the supply of housing is still affected by interest rates through the cost of capital channel. For the consumer price puzzle, the upward movement may be explained by the fragile debt structure before 2001. Since the interest payment in government debt is very high during that time period (13 percent of GDP on average), a rise in interest rates increases the debt burden resulting in a higher monetization which in turn leads to a persistent high inflation process that is typical in the pre-crisis period.[34] When the residential investment is examined, it shows a slight increase after an interest shock for the first three quarters, and then, it begins to decrease until the 10th quarter. The unexpected increase in the first three quarters may be explained by the fact that expectations about increasing house prices stimulate residential investment and offset the negative cost effect of an interest shock. After the third quarter, the residential investment begins to decrease.

When the post-2001 period is examined, we can see that, contrary to the pre-2001 period, puzzles in the prices are gone, and the house prices and consumer prices (although these are statistically insignificant) decrease after an increase in interest rates. (Figure B.8) In addition to that, in contrast to the pre-2001 period, residential investment shows a fall and the consumption becomes more responsive. Consumption decreases further for a longer period after a contractionary interest shock during this period. On the other hand, in contrast to the pre-2001 period, the exchange rate puzzle is present after 2001. This may be explained by the rapid decrease in the risk premium of the country after the crisis. A decrease in the risk premium may drive both exchange rates and interest rates down for this period. Since our model does not include the risk premium variable, it is not surprising to see exchange rate puzzle in our results.[35]

Before analyzing the role of house prices in the transmission mechanism, it is important to check the effect of a real house price shock on the other variables. Figures B.10 and B.11 show the responses to a real house price shock for the two periods separately. It is important to note here that in both periods a rise in house prices results in a statistically significant increase in both consumer prices and interest rates in a one year time. After one year, this effect becomes statistically insignificant. Before 2001, both consumption and residential investment fall after an increase in house prices. These falls can be explained by the inflationary pressure of the house prices. In other words, as we mentioned

34. The average annual inflation between 1991 and 2001 is 55 percent that implies a high monetization.

35. An 80% decrease in EMBI spread has been seen after 2001.

above, increases in house prices cause consumer prices and interest rates to rise. These increases in prices and interest rates dominate the expansionary effect of house prices on residential investment and consumption. Thus, residential investment and consumption present decreases after an increase in house prices. The fall in the consumption can also be partially explained by the absence of the collateral effect of housing wealth before 2001. As we mentioned in Chapter 2, consumer credits have very low shares in banking credits and housing is generally not used as collateral before 2007. Considering these, the only link through which house prices affects consumption is the wealth channel.

Contrary to pre-2001, after 2001, consumption increases after an increase in house prices in the first two quarters. After that, consumption begins to decrease; however, this fall is statistically insignificant. On the other hand, unlike the decrease during pre-2001, residential investment becomes unresponsive to house price shock after 2001. The limited increase in consumption and unresponsiveness of residential investment in post-2001 again can be explained by the rising consumer prices and interest rates as a result of the increase in house prices.

3.7.2 Counterfactual Experiment

In order to understand the role of house prices in the transmission mechanism more clearly, we do a counterfactual experiment by excluding the house price response from the system. Thus, the role house prices play in the transmission mechanism can be understood from the comparison of the previous main impulse responses with the new simulated ones.

As seen in Figure B.12, for the pre-crisis period, housing prices have a statistically significant effect on residential investment and consumption in the medium term (nearly in the first two years). In other words, when we exclude the house price increase in response to a contractionary interest rate shock from the system, consumption and residential investment decrease less. At the end of the second year, the house price increase is responsible for almost all decreases seen in consumption and residential investment.

On the other hand, since the interest rate shock has no statistically significant effect on residential investment and consumption, we can not say anything about the house price effects on these variables' responses to an interest rate shock.

As for the post-crisis period, housing prices have statistically significant effects on residential investment and consumption in the long term. (Figure B.13) At the end of the fifth year, the peak responses of residential investment and consumption to an interest rate shock change from -0.9 to -0.2 and -0.22 to -0.15 respectively when the housing price effect is eliminated. Thus, it can be inferred that once the house price response is excluded from the system, after a positive interest rate shock, 0.07 percentage points (about 33 percent) of the fall in consumption and 0.7 percentage points (about 75 percent) of the fall in residential investment are due to the decrease in house prices in the long term.

3.7.3 Robustness

There are other possible orderings that we can identify the structural shocks with. In order to check our results' robustness to the identification of the shocks, we did a variety of alternative orderings. Since we got similar results, to save space, we are going to present only two of them here.

Our benchmark model that we present above implies that monetary authority observes other endogenous variables; and thus, the level of policy rate is affected by other variables in the same quarter. On the other hand, this presumption also implies that all variables react to an innovation in the interest rates with a lag. This assumption may be reasonable for "sluggish" macroeconomic variables and some prices, but it is clearly less plausible for asset prices like house prices, which can react almost instantaneously to news about monetary policy. We take this argument into consideration and we impose an ordering that reflects this argument. In this alternative specification, the endogenous vector is ordered as Y_t={ real consumption, residential investment, price level, exchange rate, interest rate, real house price }

As we remember from the benchmark ordering, we assume that consumption is not contemporaneously affected by the other variables. Another alternative ordering can be made for another argument that consumers are credit-constrained; thus, consumption may be affected by the other variables contemporaneously. This kind of assumption also contains the argument that housing has a collateral value; thus, house price affects consumption contemporaneously. Following these arguments, we do an alternative specification and we order the endogenous vector as Y_t={residential investment, real house price, price level, exchange rate, real consumption, interest rate }

For each alternative specification, Figures B.7, B.8, B.14 and B.15 report the effects of a 1 point interest rate shock under the standard VECM estimation allowing house price effects on other variables in the model. Figures B.12, B.13, B.16 and B.17 present the counterfactual experiment results for these two specifications in which the house price channel is shut off by fixing the house price at its baseline value.

Overall, both specifications give similar estimated impulse response functions. For both specifications, the counterfactual experiment shows that house prices play an important role in determining residential investment and consumption. Shutting off the house price response tends to reduce the negative effect of the interest rate shock on residential investment and consumption in both orderings, by magnitudes that are similar across specifications.

3.8 Conclusion

This chapter aimed to provide some quantitative evidence on the role of house prices in MTM for Turkey, which was not previously investigated. In this respect, we employed a 6 variable VECM model of the effect of monetary shocks on house prices and the effect of house prices on consumption and residential investment in order to assess the role of house prices in MTM for the period 1991Q1-2011Q1. The main question that the chapter aimed to address is what proportion of the monetary policy shock transmits to consumption and residential investment through housing prices. This is a crucial question for the monetary policy maker who needs to understand how to respond to house price shocks and how their policy rate impacts house prices.

The impulse responses of our model indicate that the interest rate affects the housing market considerably during both periods. While increases in interest rate results in increases in house prices before 2001, it shows an opposite effect after 2001, which results in decreases in house prices. As for residential investment, it generally presents a fall after an increase in interest rates for both periods. In addition, we found that house prices do play a considerable role in consumption and residential investment in only the medium term (2 year period) before 2001 whereas they play a crucial role in only the long term (five year period) after 2001. Our study suggests that before 2001, following a contractionary interest rate shock, the increase in house prices is responsible for almost all decreases seen in consumption and residential investment in the medium term. During this period, a house price change has no long-term effects on consumption and residential investment. After 2001, in response to a contractionary interest rate shock, a decrease in house price has long-term effects accounting for 33 percent of the fall in consumption and 75 percent of the fall in residential construction. Thus, we conclude that house price is an important factor that determines consumption and residential investment in Turkey.

Chapter 4

Conclusion

Analyzing the role of housing wealth on economic activity is of fundamental importance to monetary authority if its goal is to achieve price stability and sustainable economic growth. Given the recently rising house prices and predominance of housing in total household wealth in Turkey as well as the impact of housing meltdown on macroeconomic stability in some of the world's leading economies recently, it is vital for the monetary authority to understand the linkage between housing wealth and consumption and the role of housing in monetary transmission mechanism.

This study first investigated the impact of housing wealth on aggregate consumer spending in the context of Turkey using a system approach that takes the structural break into consideration with quarterly data for the 1991Q1–2011Q1 period. Our estimation is believed to have advantage over the existing studies in the literature which mostly employed Engle-Granger single equation estimation using poor proxies for housing wealth and not including the structural break in the Turkish economy in 2001 into their estimations. Another contribution to the existing studies is that we estimated an alternative econometric model based upon Carroll (2004) in order to improve the robustness to instability in the long-run relationship between the variables. Both models suggested that permanent changes in housing wealth have considerable effects on aggregate consumption after 2001 whereas financial wealth has no effect on consumption in the same period. We estimated that a permanent one percent increase in real per-capita housing wealth is associated with a 0.28 percent increase in real per-capita consumption in the long run.

Since our VECM results indicated that housing wealth does play a role in determining consumption, the next step was to find out whether there is a linkage between monetary policy and housing wealth and if so, how this relationship operates. For this purpose, we estimated a 6 variable VECM model for Turkey on the effect of monetary shocks on house prices and the effect of house prices on consumption in order to assess the role of house prices in MTM for the period of 1991Q1-2011Q1. The main question that the chapter aimed to address is what proportion of the monetary policy shock transmits to consumption through housing prices. This is a crucial question for the monetary policy making in order to respond to house price shocks appropriately and to understand how its policy rate affects house prices. The impulse responses we found indicated that housing prices do play a considerable role in the consumption and residential investment. Our study suggested that following a contractionary interest rate shock, the change in house prices is responsible for almost all decreases seen in consumption and residential investment in the medium term. After 2001, in response to a contractionary interest rate shock, a decrease in house price has long-term effects accounting for 33 percent of the fall in consumption and 75 percent of the fall in residential construction. Thus, we concluded that house prices play an important factor that drives consumption and residential investment in Turkey.

In the light of the empirical evidence and the recent developments in Turkey's financial sector and housing markets, it is crucial for monetary authority to closely monitor trends in the consumption-wealth link and to craft policies accordingly. With the recent mortgage law that was enacted in 2007 and the continuing financial deepening, which provides new financial products, the scope for homeowners in Turkey to borrow against housing collateral may also increase over time. Under such a scenario, house prices will tend to rise and the housing wealth may have even larger impacts upon aggregate spending and the macroeconomy.

Appendix A

Tables

Table A.1: Annual % Change in Real House Prices for Some Countries

	1995-2000	2001	2002	2003	2004	2005	2006
USA	2.3	5.0	5.2	4.5	7.8	9.6	7.3
Japan	-2.6	-3.4	-3.8	-5.2	-6.1	-4.6	-4.4
Germany	-1.6	-1.9	-3.3	-2.0	-3.8	-1.9	-2.0
France	2.1	6.0	6.2	9.4	12.6	13.2	10.9
Italy	-0.9	5.7	6.8	7.3	7.5	5.2	4.4
UK	8.2	6.8	14.6	14.2	10.4	3.4	2.3
Canada	0.0	2.0	7.7	6.5	7.5	7.6	9.1
Australia	3.5	6.5	15.3	15.0	4.1	-1.1	1.5
Denmark	6.7	3.4	1.3	1.1	7.9	15.6	22.4
Spain	2.6	6.5	12.9	16.4	14.8	10.9	6.9
Finland	7.8	-3.5	8.3	4.5	5.9	5.1	9.8
Ireland	17.6	4.1	5.6	11.4	9.1	9.4	11.7
The Netherlands	11.6	5.6	4.3	2.4	2.9	3.3	3.1
Norway	9.3	3.9	3.6	-0.7	9.6	6.6	8.4
New Zealand	1.7	-0.8	6.6	17.3	9.6	11.1	6.7
Sweeden	6.3	5.1	4.3	4.2	15.2	8.1	11.5
Switzerland	-2.5	0.9	4.0	2.3	8.2	-0.1	1.8

Source: Girouard et al. 2006

Table A.2: Unit Root Tests (Chap. 2)

ADF Test for Unit Root

Level	Model		*t-stats*
	Deterministic Part	Lags$^{\Upsilon}$	
con	c,sd,nt	1-8	-0.67
	c,sd,t	1-8	-1.95
dpi	c,sd,nt	1-8	-1.00
	c,sd,t	1-8	-1.70
fw	c,nsd,nt	1-5	-1.15
	c,nsd,t	1-5	-2.24
hw	c,nsd,nt	0	0.09
	c,nsd,t	0	-2.18
First Differenced			
Δcon	c,sd,nt	1,2	-6.66***
	c,sd,t	1,2	-6.76***
Δdpi	c,sd,nt	1,2	-8.46***
	c,sd,t	1,2	-8.47***
Δfw	c,nsd,nt	1-4	-5.15***
	c,nsd,t	1-4	-5.12***
Δhw	c,nsd,nt	0	-9.65***
	c,nsd,t	0	-9.62***

ADF Test for Unit Root with Structural Break#

Level	Model		*t-stats*
	Deterministic Part	Lags$^{\Upsilon}$	
con	c,sd,nt	1,2	-0.48
	c,sd,t	1	-2.75
dpi	c,sd,nt	1-3	-0.63
	c,sd,t	1-3	-1.60
fw	c,nsd,nt	1-5	-1.55
	c,nsd,t	1-5	-2.48
hw	c,nsd,nt	0	0.10
	c,nsd,t	0	-2.21
First Differenced			
Δcon	c,sd,nt	1,2	-5.00***
	c,sd,t	1,2	-6.16***
Δdpi	c,sd,nt	1-3	-4.18***
	c,sd,t	1,2	-4.15***
Δfw	c,nsd,nt	1-4	-2.70*
	c,nsd,t	1-4	-2.91*
Δhw	c,nsd,nt	1,2	-2.76*
	c,nsd,t	0	-9.67***

ϒ: Lags are determined according to AIC and diagnostic test results.
***, **, ***:** denotes 10%, 5%, 1% significance respectively.
#: Shift dummy was used as a break

Table A.3: Information Criteria (Chap. 2)

Lag Order Selection

VAR(p)	Information Criteria		
	AIC	SC	HQ
p=1	-30.997	**-29.242**	-30.314
p=2	-31.234	-29.121	**-30.627**
p=3	**-31.268**	-28.941	-30.061
p=4	-30.867	-25.765	-29.467
p=5	-30.123	-24.765	-28.654

Lag Order Selection (includes structural break) #

VAR(p)	Information Criteria		
	AIC	SC	HQ
p=1	-29.838	**-28.232**	-29.197
p=2	-30.065	-27.947	**-29.220**
p=3	-29.943	-27.308	-28.893
p=4	**-30.113**	-26.951	-28.855
p=5	-30.023	-26.327	-28.554

#: VAR includes; shift and slope dummies.

Table A.4: Cointegration Test Results (Chap. 2)

Saikkonen&Lutkepohl [1]

H_o:rank=r	H_1:rank>r	LR	p-value	90%	95%	99%
r=0	**r>0**	47.61	0.007	37.04	40.07	46.20
r=1	**r>1**	20.12	0.154	21.76	24.16	29.11
r=2	**r>2**	8.02	0.239	10.47	12.26	16.10
r=3	**r>3**	3.01	0.098	2.98	4.13	6.93

Johansen Trace Test [1]

H_o:rank=r	H_1:rank>r	LR	p-value	90%	95%	99%
r=0	**r>0**	75.63	0.000	50.50	53.94	60.81
r=1	**r>1**	33.31	0.078	32.25	35.07	40.78
r=2	**r>2**	11.92	0.464	17.98	20.16	24.69
r=3	**r>3**	4.93	0.301	7.60	9.14	12.53

Johansen Trace Test [2]

H_o:rank=r	H_1:rank>r	LR	p-value	90%	95%	99%
r=0	**r>0**	101.56	0.000	55.89	58.12	62.47
r=1	**r>1**	37.78	0.031	36.92	38.87	42.70
r=2	**r>2**	18.23	0.329	21.89	23.61	27.07
r=3	**r>3**	5.63	0.550	11.05	12.85	16.69

1: includes; intercept, 4 lags in level and impulse dummies.

2: includes; intercept, 4 lags in level, shift dummy and other impulse dummies. Response surface that gives the critical values are computed via Jmulti.

Table A.5: VECM Results for Case 1

Unrestricted VECM for Case 1					
Estimated cointegration relations:					
		con	dpi	fw	hw
$ec_{t \le t0}$		1.00	-0.80	-0.11	-0.04
$ec_{t > t0}$		1.00	-0.30	-0.03	-0.25
		Δcon(t)	**Δdpi(t)**	**Δfw(t)**	**Δhw(t)**
Loading coefficients					
α_t		**-0.07**	0.14	0.09	**0.22**
	p-value	[**0.02**]	[0.21]	[0.87]	[**0.00**]
Lagged endogenous terms					
$\Delta con_{(t-1)}$		0.09	0.35	-0.23	**-0.48**
	p-value	[0.64]	[0.15]	[0.54]	[**0.03**]
$\Delta dpi_{(t-1)}$		0.07	**-0.27**	-0.33	-0.05
	p-value	[0.43]	[**0.04**]	[0.43]	[0.34]
$\Delta fw_{(t-1)}$		**0.07**	0.02	-0.04	0.04
	p-value	[**0.01**]	[0.76]	[0.23]	[0.65]
$\Delta hw_{(t-1)}$		-0.08	**-0.32**	0.08	0.06
	p-value	[0.34]	[**0.01**]	[0.56]	[0.89]
Deterministic terms					
c		**0.00**	**0.01**	**0.01**	**0.01**
	p-value	[**0.01**]	[**0.02**]	[**0.05**]	[**0.01**]
d94Q2		**-0.05**	-0.05	-0.05	**-0.06**
	p-value	[**0.01**]	[0.64]	[0.12]	[**0.00**]
d98Q3		-0.02	-0.03	**-0.16**	-0.03
	p-value	[0.67]	[0.64]	[**0.01**]	[-0.32]
d99Q4		0.00	-0.03	**0.06**	**-0.05**
	p-value	[0.66]	[0.64]	[**0.05**]	[**0.03**]
d01Q1		**-0.03**	**-0.14**	-0.07	**-0.04**
	p-value	[**0.02**]	[**0.01**]	[0.18]	[**0.01**]
d01Q2		**-0.04**	-0.02	-0.03	**-0.02**
	p-value	[**0.04**]	[0.54]	[0.23]	[**0.01**]
d98Q1		**0.03**	0.00	0.00	0.02
	p-value	[**0.02**]	[0.64]	[0.21]	[0.32]

Table A.6: VECM Results for Case 2

Unrestricted VECM for Case 2

Estimated cointegration relations:

	con	dpi	fw	hw
$ec_{t\leq t0}$	1.00	-0.82	-0.11	-0.02
$ec_{t>t0}$	1.00	-0.27	-0.12	-0.20

		Δcon(t)	Δdpi(t)	Δfw(t)	Δhw(t)
Loading coefficients					
$\alpha_{t\leq t0}$		**-0.02**	**0.13**	-0.68	0.13
	p-value	[**0.03**]	[**0.03**]	[0.41]	[0.18]
$\alpha_{t>t0}$		**-0.10**	0.01	0.47	**0.21**
	p-value	[**0.01**]	[0.64]	[0.30]	[**0.00**]
Lagged endogenous terms					
$\Delta con_{(t-1)}$		0.09	**0.45**	-0.21	**-0.48**
	p-value	[0.51]	[**0.04**]	[0.42]	[**0.01**]
$\Delta dpi_{(t-1)}$		-0.05	**-0.36**	-0.14	0.04
	p-value	[0.43]	[**0.00**]	[0.38]	[0.78]
$\Delta fw_{(t-1)}$		**0.07**	0.03	-0.09	0.01
	p-value	[**0.03**]	[0.53]	[0.34]	[0.87]
$\Delta hw_{(t-1)}$		-0.07	**-0.38**	0.18	0.06
	p-value	[0.35]	[**0.01**]	[0.23]	[0.46]
Deterministic terms					
c		**0.00**	**0.01**	**0.02**	**0.01**
	p-value	[**0.01**]	[**0.02**]	[**0.01**]	[**0.01**]
d94Q2		**-0.06**	**-0.03**	-0.05	**-0.06**
	p-value	[**0.01**]	[**0.01**]	[0.17]	[**0.00**]
d98Q3		-0.02	**-0.03**	**-0.16**	**-0.03**
	p-value	[0.62]	[**0.03**]	[**0.01**]	[**0.03**]
d99Q4		0.01	-0.03	**0.06**	**-0.05**
	p-value	[0.54]	[0.64]	[**0.02**]	[**0.03**]
d01Q1		**-0.04**	**-0.14**	**-0.07**	**-0.09**
	p-value	[**0.00**]	[**0.01**]	[**0.08**]	[**0.00**]
d01Q2		**-0.03**	**-0.02**	-0.03	**-0.05**
	p-value	[**0.02**]	[**0.04**]	[0.68]	[**0.00**]
d98Q1		**0.03**	**-0.01**	0.05	**0.03**
	p-value	[**0.02**]	[**0.03**]	[0.94]	[**0.02**]

Table A.7: LR Tests for Case 1

Case 1: Loading Coefficients (α) do not Change

LR tests on β Coefficients in the Cointegration Vector

Before the Break			After the Break		
Hypothesis	**χ^2 stat**	**p-value**	**Hypothesis**	**χ^2 stat**	**p-value**
Ho: $\beta_{dpi} = 0$	**3.10**	**0.06**	**Ho: $\beta_{dpi} = 0$**	**10.57**	**0.00**
Ho: $\beta_{fw} = 0$	**2.71**	**0.10**	**Ho: $\beta_{fw} = 0$**	0.13	0.85
Ho: $\beta_{hw} = 0$	0.17	0.83	**Ho: $\beta_{hw} = 0$**	**5.55**	**0.02**

LR tests on α Coefficients

1991Q1-2011Q1 (entire period)		
Hypothesis	**χ^2 stat**	**p-value**
Ho: $\alpha_{con} = 0$	**4.54**	**0.02**
Ho: $\alpha_{dpi} = 0$	2.01	0.14
Ho: $\alpha_{fw} = 0$	0.41	0.74
Ho: $\alpha_{hw} = 0$	**8.90**	**0.00**

Table A.8: LR Tests for Case 2

Case 2: Loading Coefficients (α) do Change

LR tests on β Coefficients in the Cointegration Vector

Before the Break			After the Break		
Hypothesis	**χ^2 stat**	**p-value**	**Hypothesis**	**χ^2 stat**	**p-value**
Ho: $\beta_{dpi} = 0$	**6.31**	**0.01**	**Ho: $\beta_{dpi} = 0$**	**10.92**	**0.00**
Ho: $\beta_{fw} = 0$	**3.99**	**0.03**	**Ho: $\beta_{fw} = 0$**	2.01	0.13
Ho: $\beta_{hw} = 0$	0.13	0.85	**Ho: $\beta_{hw} = 0$**	**3.61**	**0.05**

LR tests on α Coefficients

Before the Break			After the Break		
Hypothesis	**χ^2 stat**	**p-value**	**Hypothesis**	**χ^2 stat**	**p-value**
Ho: $\alpha_{con} = 0$	**4.37**	**0.02**	**Ho: $\alpha_{con} = 0$**	**6.78**	**0.01**
Ho: $\alpha_{dpi} = 0$	**6.31**	**0.01**	**Ho: $\alpha_{dpi} = 0$**	0.26	0.23
Ho: $\alpha_{fw} = 0$	0.07	0.99	**Ho: $\alpha_{fw} = 0$**	0.03	0.99
Ho: $\alpha_{hw} = 0$	1.34	0.25	**Ho: $\alpha_{hw} = 0$**	**10.23**	**0.00**

Table A.9: Diagnostic Test Results for Case 1 (Chap. 2)

Diagnostic Test Results for the Unrestricted VECM's Residuals for the Case 1

Test and Hypothesis			Statistics	p-value	*Result*
Test for Autocorrelation	***Portmanteau Test***		***Q-Stat***		
	Ho: "Rh=(r1,...,r16)=0" where R is autocorrelation vector.	u_{con}	10.01	0.83	We cannot reject the null hypothesis. Thus, overall, there is no residual autocorrelations up to lag 16.
		u_{dpi}	14.60	0.56	
		u_{fw}	13.90	0.61	
		u_{hw}	21.80	0.15	
Tests for Nonnormality	***Jarque-BeraTest***		χ^2 ***-stat***		
	Ho: "Residual vector u_i comes from a normal distribution" where i=consa,dpi,fw,hw	u_{con}	0.17	0.92	We cannot reject the null hypothesis. Thus,residual vector comes from a normal distribution.
		u_{dpi}	0.46	0.79	
		u_{fw}	0.43	0.81	
		u_{hw}	0.48	0.79	
Tests for Heteroscedasticity	***ARCH-LM Test***		χ^2 ***-stat***		
	Ho: " There is no ARCH up to order 5 in the residual vector ui " where i=consa,dpi,fw,hw	u_{con}	4.28	0.51	We cannot reject the null hypothesis. Thus,there is no ARCH up to order 16 in the residuals.
		u_{dpi}	1.65	0.89	
		u_{fw}	2.39	0.79	
		u_{hw}	3.64	0.79	

Table A.10: Diagnostic Test Results for Case 2 (Chap. 2)

Diagnostic Test Results for the Unrestricted VECM's Residuals for the Case 2

Test and Hypothesis			Statistics	p-value	Result
Test for Autocorrelation	***Portmanteau Test***		***Q-Stat***		
	Ho: "Rh=(r1,...,r16)=0" where R is autocorrelation vector.	u_{con}	10.03	0.85	We cannot reject the null hypothesis. Thus, overall, there is no residual autocorrelations up to lag 16.
		u_{dpi}	14.35	0.57	
		u_{fw}	13.91	0.61	
		u_{hw}	20.86	0.18	
Tests for Nonnormality	***Jarque-BeraTest***		χ^2 *-stat*		
	Ho: "Residual vector u_i comes from a normal distribution" where i=consa,dpi,fw,hw	u_{con}	0.22	0.90	We cannot reject the null hypothesis. Thus,residual vector comes from a normal distribution.
		u_{dpi}	0.35	0.85	
		u_{fw}	0.50	0.78	
		u_{hw}	0.46	0.79	
Tests for Heteroscedasticity	***ARCH-LM Test***		χ^2 *-stat*		
	Ho: " There is no ARCH up to order 5 in the residual vector ui " where i=consa,dpi,fw,hw	u_{con}	4.32	0.51	We cannot reject the null hypothesis. Thus,there is no ARCH up to order 16 in the residuals.
		u_{dpi}	1.53	0.91	
		u_{fw}	2.30	0.81	
		u_{hw}	3.65	0.60	

Table A.11: Restricted Cointegration Vectors for Case 1 (Chap. 2)

Case	Before 2001	After 2001
Loading coefficients do not change	$con_t=0.80dpi_t+0.11fw_t+0.04hw_t+ec_{1t}$	$con_t=0.30dpi_t+0.03fw_t+0.25hw_t+ec_{2t}$
Loading coefficients change	$con_t=0.82dpi_t+0.11fw_t+0.02hw_t+ec_{1t}$	$con=0.27dpi_t+0.12fw_t+0.20hw_t+ec_{2t}$

Table A.12: Restricted Cointegration Vectors for Case 2 (Chap. 2)

Case	Before 2001	After 2001
Loading coefficients do not change	$con_t=0.83dpi_t+0.13fw_t+ec_{1t}$	$con=0.30dpi_t+0.28hw_t+ec_{2t}$
Loading coefficients change	$con_t=0.84dpi_t+0.13fw_t+ec_{1t}$	$con_t=0.28dpi_t+0.29hw_t+ec_{2t}$

Table A.13: Restricted VECM Results for Case 1

Restricted VECM for Case 1				
Estimated cointegration relations:				
	con	**dpi**	**fw**	**hw**
$ec_{t \le t0}$	1.00	-0.83	-0.13	--
$ec_{t > t0}$	1.00	-0.30	--	-0.28

	Δcon(t)	**Δdpi(t)**	**Δfw(t)**	**Δhw(t)**
Loading coefficients				
α_t	-0.09	--	--	0.25
p-value	[0.02]	[--]	[--]	[0.00]
Lagged endogenous terms				
$\Delta con_{(t-1)}$	--	--	--	-0.37
p-value	[--]	[--]	[--]	[0.01]
$\Delta dpi_{(t-1)}$	--	-0.23	--	--
p-value	[--]	[0.02]	[--]	[--]
$\Delta fw_{(t-1)}$	0.08	--	--	--
p-value	[0.01]	[--]	[--]	[--]
$\Delta hw_{(t-1)}$	--	-0.31	--	--
p-value	[--]	[0.01]	[--]	[--]
Deterministic terms				
c	0.00	0.01	0.01	0.01
p-value	[0.01]	[0.02]	[0.05]	[0.01]
d94Q2	-0.05	--	--	-0.06
p-value	[0.01]	[--]	[--]	[0.00]
d98Q3	-0.02	--	-0.16	--
p-value	[0.67]	[--]	[0.01]	[--]
d99Q4	0.00	--	0.06	-0.03
p-value	[0.66]	[--]	[0.05]	[0.01]
d01Q1	-0.02	-0.12	--	-0.04
p-value	[0.02]	[0.00]	[--]	[0.01]
d01Q2	-0.05	--	--	-0.01
p-value	[0.01]	[--]	[--]	[0.01]
d98Q1	0.03	--	--	--
p-value	[0.02]	[--]	[--]	[--]

Table A.14: Restricted VECM Results for Case 2

Restricted VECM for Case 2					
Estimated cointegration relations:					
		con	**dpi**	**fw**	**hw**
$ec_{t \le t0}$		1.00	-0.84	-0.13	--
$ec_{t>t0}$		1.00	-0.29	--	-0.30

		Δcon(t)	**Δdpi(t)**	**Δfw(t)**	**Δhw(t)**
Loading coefficients					
$\alpha_{t \le t0}$		-0.05	0.15	--	--
	p-value	[0.03]	[0.04]	[--]	[--]
$\alpha_{t>t0}$		-0.12	--	--	0.27
	p-value	[0.01]	[--]	[--]	[0.00]
Lagged endogenous terms					
$\Delta con_{(t-1)}$		--	0.45	--	-0.33
	p-value	[--]	[0.04]	[--]	[0.01]
$\Delta dpi_{(t-1)}$		--	-0.36	--	--
	p-value	[--]	[0.00]	[--]	[--]
$\Delta fw_{(t-1)}$		0.09	--	--	--
	p-value	[0.01]	[--]	[--]	[--]
$\Delta hw_{(t-1)}$		--	-0.38	--	--
	p-value	[--]	[0.01]	[--]	[--]
Deterministic terms					
c		0.00	0.01	0.02	0.01
	p-value	[0.01]	[0.01]	[0.01]	[0.01]
d94Q2		-0.07	-0.03	--	-0.06
	p-value	[0.00]	[0.01]	[--]	[0.00]
d98Q3		--	-0.03	-0.11	-0.03
	p-value	[--]	[0.03]	[0.00]	[0.03]
d99Q4		--	--	0.07	-0.05
	p-value	[--]	[--]	[0.01]	[0.03]
d01Q1		-0.06	-0.14	-0.07	-0.04
	p-value	[0.00]	[0.01]	[0.08]	[0.00]
d01Q2		-0.03	-0.01	--	-0.11
	p-value	[0.01]	[0.01]	[--]	[0.00]
d98Q1		0.03	-0.01	--	0.03
	p-value	[0.01]	[0.02]	[--]	[0.01]

Table A.15: Diagnostic Test Results for Case 1 (Restricted)

Diagnostic Test Results for the Restricted VECM's Residuals for the Case 1

Test and Hypothesis			Statistics	p-value	*Result*
Test for Autocorrelation	***Portmanteau Test***		***Q-Stat***		
	Ho: "Rh=(r1,...,r16)=0" where R is autocorrelation vector.	u_{con}	11.97	0.75	We cannot reject the null hypothesis. Thus, overall, there is no residual autocorrelations up to lag 16.
		u_{dpi}	16.40	0.43	
		u_{fw}	13.90	0.61	
		u_{hw}	16.29	0.43	
Tests for Nonnormality	***Jarque-BeraTest***		χ^2 ***-stat***		
	Ho: "Residual vector u_i comes from a normal distribution" where i=consa,dpi,fw,hw	u_{con}	0.39	0.82	We cannot reject the null hypothesis. Thus,residual vector comes from a normal distribution.
		u_{dpi}	1.39	0.50	
		u_{fw}	0.50	0.78	
		u_{hw}	0.39	0.82	
Tests for Heteroscedasticity	***ARCH-LM Test***				
	Ho: " There is no ARCH up to order 5 in the residual vector ui " where i=consa,dpi,fw,hw	u_{con}	5.13	0.40	We cannot reject the null hypothesis. Thus,there is no ARCH up to order 16 in the residuals.
		u_{dpi}	2.73	0.74	
		u_{fw}	2.28	0.81	
		u_{hw}	4.78	0.44	

Table A.16: Diagnostic Test Results for Case 2 (Restricted)

Diagnostic Test Results for the Restricted VECM's Residuals for the Case 2

Test and Hypothesis			Statistics	p-value	Result
Test for Autocorrelation	***Portmanteau Test***		***Q-Stat***		
	Ho: "Rh=(r1,...,r16)=0" where R is autocorrelation vector.	u_{con}	10.44	0.84	We cannot reject the null hypothesis. Thus, overall, there is no residual autocorrelations up to lag 16.
		u_{dpi}	16.21	0.44	
		u_{fw}	13.28	0.65	
		u_{hw}	17.90	0.33	
Tests for Nonnormality	***Jarque-BeraTest***		χ^2 ***-stat***		
	Ho: "Residual vector u_i comes from a normal distribution" where i=consa,dpi,fw,hw	u_{con}	0.54	0.76	We cannot reject the null hypothesis. Thus,residual vector comes from a normal distribution.
		u_{dpi}	1.40	0.50	
		u_{fw}	0.69	0.71	
		u_{hw}	0.13	0.94	
Tests for Heteroscedasticity	***ARCH-LM Test***				
	Ho: " There is no ARCH up to order 5 in the residual vector ui " where i=consa,dpi,fw,hw	u_{con}	5.22	0.39	We cannot reject the null hypothesis. Thus,there is no ARCH up to order 16 in the residuals.
		u_{dpi}	1.81	0.87	
		u_{fw}	2.10	0.83	
		u_{hw}	5.12	0.41	

Table A.17: Unit Root Tests (Chap. 3)

ADF Test for Unit Root

Level	Model		*t-stats*
	Deterministic Part	Lags[ϒ]	
CONS	c,nt	1-8	-0.67
	c,t	1-8	-1.95
RHP	c,nt	1-5	-1.20
	c,t	1-5	-1.65
CPI	c,nt	1-5	-1.72
	c,t	1-5	-2.45
EXC	c,nt	1-5	-1.33
	c,t	1-5	-2.44
RIV	c,nt	1-5	-2.43
	c,t	1-5	-3.54
INT	c,nt	1-8	0.86
	c,t	1-8	-2.02
First Differenced			
ΔCONS	c,nt	1-2	-6.66***
	c,t	1-2	-6.76***
ΔRHP	c,nt	1-4	-7.34***
	c,t	1-4	-8.17***
ΔCPI	c,nt	1-4	-1.57
	c,t	1-4	-5.74***
ΔRIV	c,nt	1-4	-6.51***
	c,t	1-4	-8.17***
ΔEXC	c,nt	1-4	-5.51***
	c,t	1-4	-7.17***
ΔINT	c,nt	1-7	-6.16***
	c,t	1-7	-6.18***

ADF Test for Unit Root with Structural Break[#]

Level	Model		*t-stats*
	Deterministic Part	Lags[ϒ]	
CONS	c,nt	1-2	-0.48
	c,t	1-2	-2.75
RHP	c,nt	1-3	-1.12
	c,t	1-3	-1.92
CPI	c,nt	1-5	-1.32
	c,t	1-5	-2.73
EXC	c,nt	1-5	-1.12
	c,t	1-5	-2.46
RIV	c,nt	1-5	-1.19
	c,t	1-5	-2.78
INT	c,nt	1-5	0.44
	c,t	1-5	-2.32
First Differenced			
ΔCONS	c,nt	1-2	-5.00***
	c,t	1-2	-6.16***
ΔRHP	c,nt	1-3	-6.18***
	c,t	1-3	-7.15***
ΔCPI	c,nt	1-4	-2.02
	c,t	1-4	-5.91***
ΔRIV	c,nt	1-4	-5.70***
	c,t	1-4	-8.21***
ΔEXC	c,nt	1-4	-4.70***
	c,t	1-4	-7.91***
ΔINT	c,nt	1-7	-5.76***
	c,t	1-7	-8.53***

ϒ: Lags are determined according to AIC and diagnostic test results.
***, **, ***:** denotes 10%, 5%, 1% significance respectively.
#: Shift dummy was used as a break

Table A.18: Information Criteria (Chap. 3)

Lag Order Selection (includes structural break) #

VAR(p)	Information Criteria		
	AIC	SC	HQ
p=1	-37.67	**-33.57**	-36.03
p=2	-38.41	-32.11	-35.89
p=3	-39.52	-30.99	-36.11
p=4	**-42.53**	-31.75	**-38.22**

#: VAR includes; shift and slope dummies.

Table A.19: Cointegration Test Results (Chap. 3)

Saikkonen&Lutkepohl [1]

H_o:rank=r	H_1:rank>r	LR	p-value	90%	95%	99%
r=0	r>0	121.73	0.000	86.64	90.95	99.40
r=1	r>1	94.21	0.000	62.45	66.13	73.42
r=2	r>2	48.85	0.021	42.25	45.32	51.45
r=3	r>3	23.41	0.195	26.07	28.52	33.50
r=4	r>4	16.88	0.032	13.88	15.76	19.71

Johansen Trace Test [1]

H_o:rank=r	H_1:rank>r	LR	p-value	90%	95%	99%
r=0	r>0	169.02	0.000	112.54	117.45	127.04
r=1	r>1	109.94	0.001	84.27	88.55	96.97
r=2	r>2	68.59	0.017	60.00	63.66	70.91
r=3	r>3	32.01	0.394	39.73	42.77	48.87
r=4	r>4	11.94	0.814	23.32	25.73	30.67

Johansen Trace Test [2]

H_o:rank=r	H_1:rank>r	LR	p-value	90%	95%	99%
r=0	r>0	219.47	0.000	140.94	146.48	157.26
r=1	r>1	134.5	0.001	108.59	113.49	123.08
r=2	r>2	84.35	0.051	80.06	84.33	92.73
r=3	r>3	43.66	0.506	55.40	59.02	66.24
r=4	r>4	18.56	0.873	34.41	37.36	43.33

1: includes; intercept, trend, 4 lags in level and impulse dummies.
2: includes; intercept, trend, 4 lags in level, shift dummy and other impulse dummies. Response surface that gives the critical values are computed via Jmulti.

Table A.20: Diagnostic Test Results (Chap. 3)

Diagnostic Test Results for the VECM's Residuals

Test and Hypothesis			Statistics	p-value	*Result*
Test for Autocorrelation	***Portmanteau Test***		***Q-Stat***		
	Ho: "Rh=(r1,...,r16)=0" where R is autocorrelation vector.	u_{con}	15.49	0.49	We cannot reject the null hypothesis. Thus, there is no residual autocorrelations up to lag 16.
		u_{riv}	14.44	0.53	
		u_{rhp}	8.53	0.93	
		u_{cpi}	17.57	0.35	
		u_{exc}	12.71	0.69	
		u_{int}	19.16	0.26	
Tests for Nonnormality	***Jarque-BeraTest***		χ^2 ***-stat***		
	Ho: "Residual vector u_i comes from a normal distribution" where i=consa,dpi,fw,hw	u_{con}	0.44	0.80	We cannot reject the null hypothesis. Thus,residual vector comes from a normal distribution.
		u_{riv}	0.81	0.78	
		u_{rhp}	0.99	0.61	
		u_{cpi}	0.94	0.63	
		u_{exc}	4.77	0.08	
		u_{int}	2.85	0.24	
Tests for Heteroscedasticity	***ARCH-LM Test***		χ^2 ***-stat***		
	Ho: " There is no ARCH up to order 5 in the residual vector ui " where i=consa,dpi,fw,hw	u_{con}	4.91	0.43	We cannot reject the null hypothesis. Thus,there is no ARCH up to order 5 in the residuals.
		u_{riv}	4.82	0.48	
		u_{rhp}	4.24	0.52	
		u_{cpi}	4.03	0.54	
		u_{exc}	1.14	0.95	
		u_{int}	3.64	0.79	

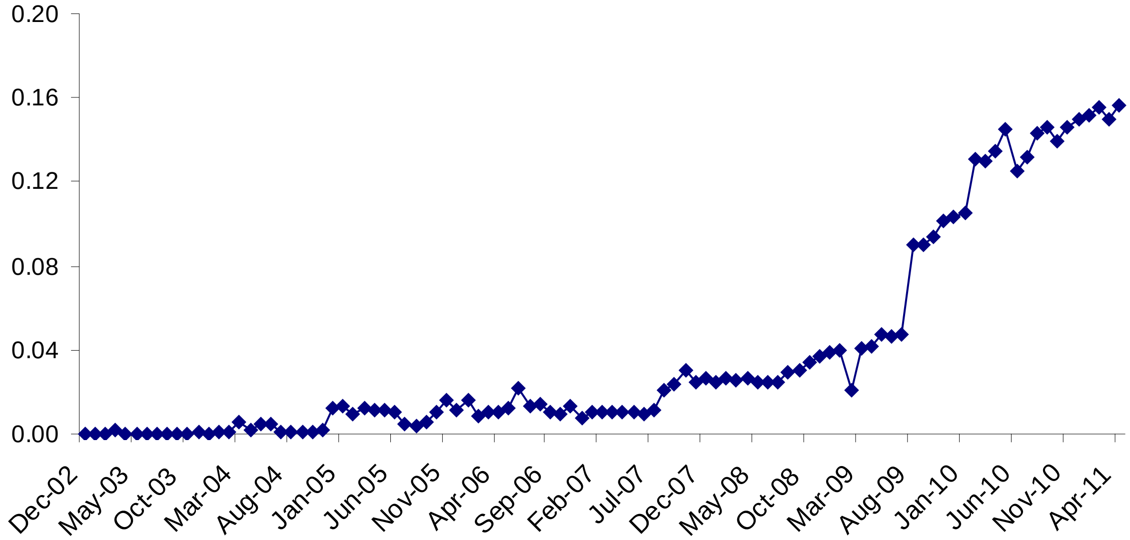
Table A.21: Cointegration Vectors (Chap. 3)

	Before 2001
1st	$ec_{1t}=18.75con_t-8.5riv_t-11.8cpi_t+37.8rhp_t+0.03int_t+52exc_t-2.75trend$
2nd	$ec_{2t}=3.1con_t+1.1con_t-4.7cpi_t-15.2rhp_t+0.11int_t-16exc_t+1.5trend$
3rd	$ec_{3t}=7.1con_t+6.1con_t-4.9cpi_t-1.5rhp_t+0.01int_t-11exc_t+7.5trend$
	After 2001
1st	$ec_{1t}=-72.9con_t+7.42riv_t+37.1cpi_t-0.97rhp_t+0.05int_t-14.4exc_t+0.4trend$
2nd	$ec2_t=-11.4con_t+4.2riv_t+5.2cpi_t+15.8rhpt-0.06int_t-31.6exc_t+0.01trend$
3rd	$ec_{3t}=-1.3con_t+5.6riv_t+4.2cpi_t+13.6rhp_t-0.03int_t-3.6exc_t+0.1trend$

Appendix B

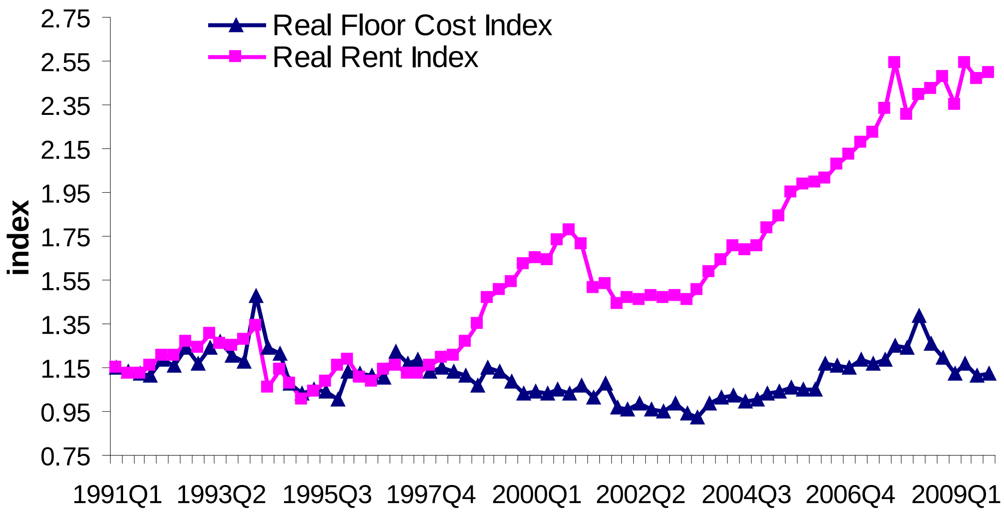
Figures

Figure B.1: Ratio of Consumer Credit with Housing Collateral to Total



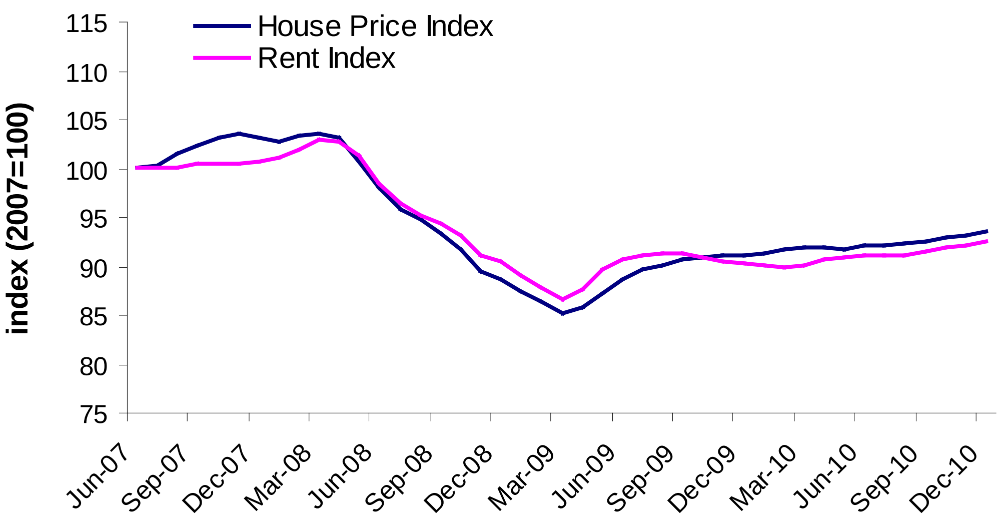
Source: BRSA

Figure B.2: The Comparison of Real Floor Cost and Real Rent



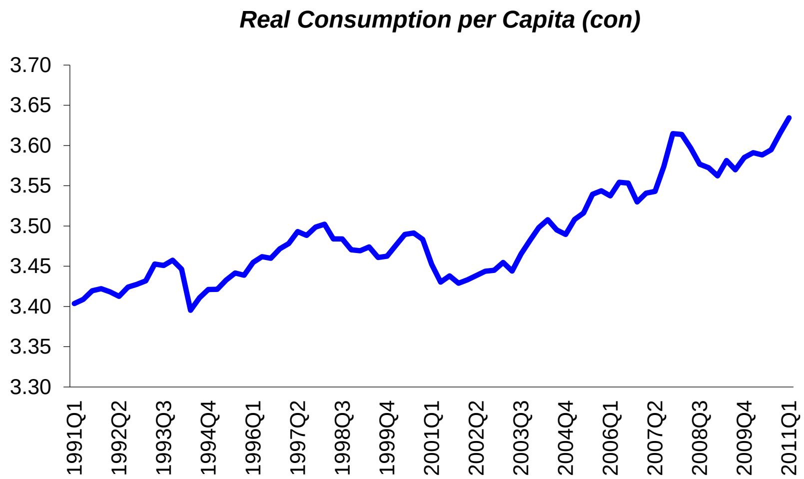
Source: TurkStat

Figure B.3: The Comparison of House Price and Rent



Source: Reidin.com

Figure B.4: Time-Series Data (Chap. 2)



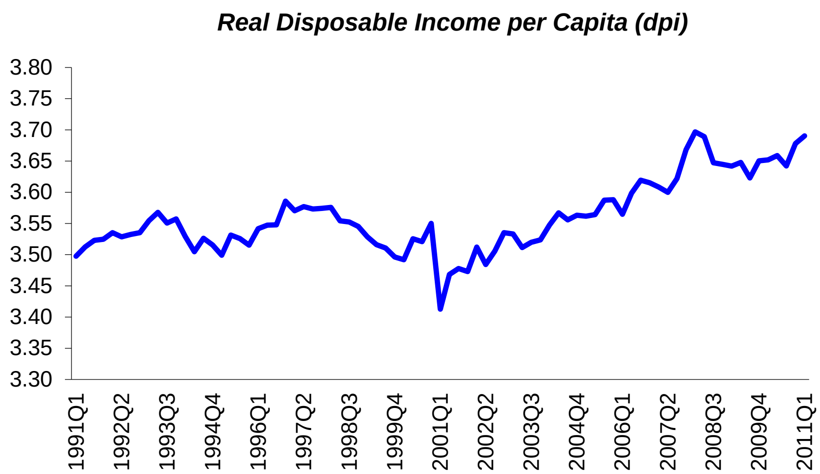
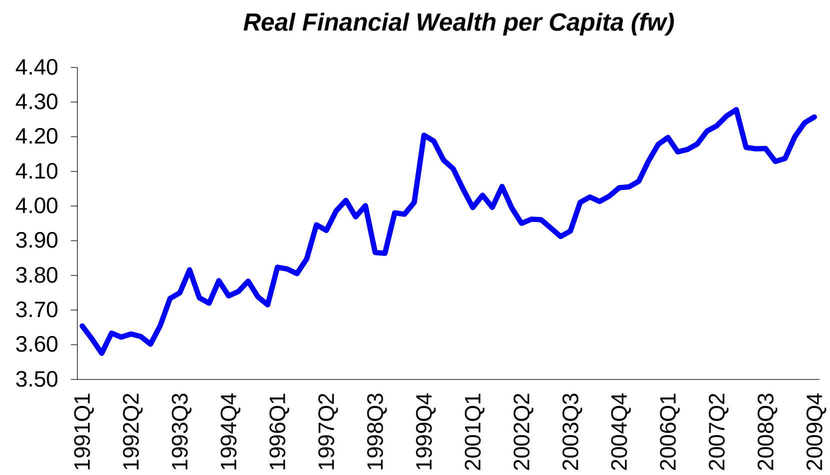


Figure B.4: Time-Series Data (Chap. 2) (continued)



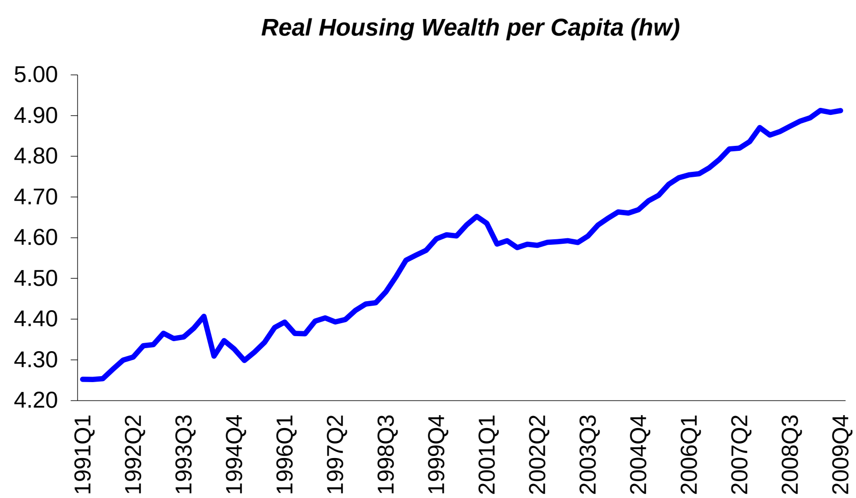


Figure B.5: Monetary Transmission Mechanism

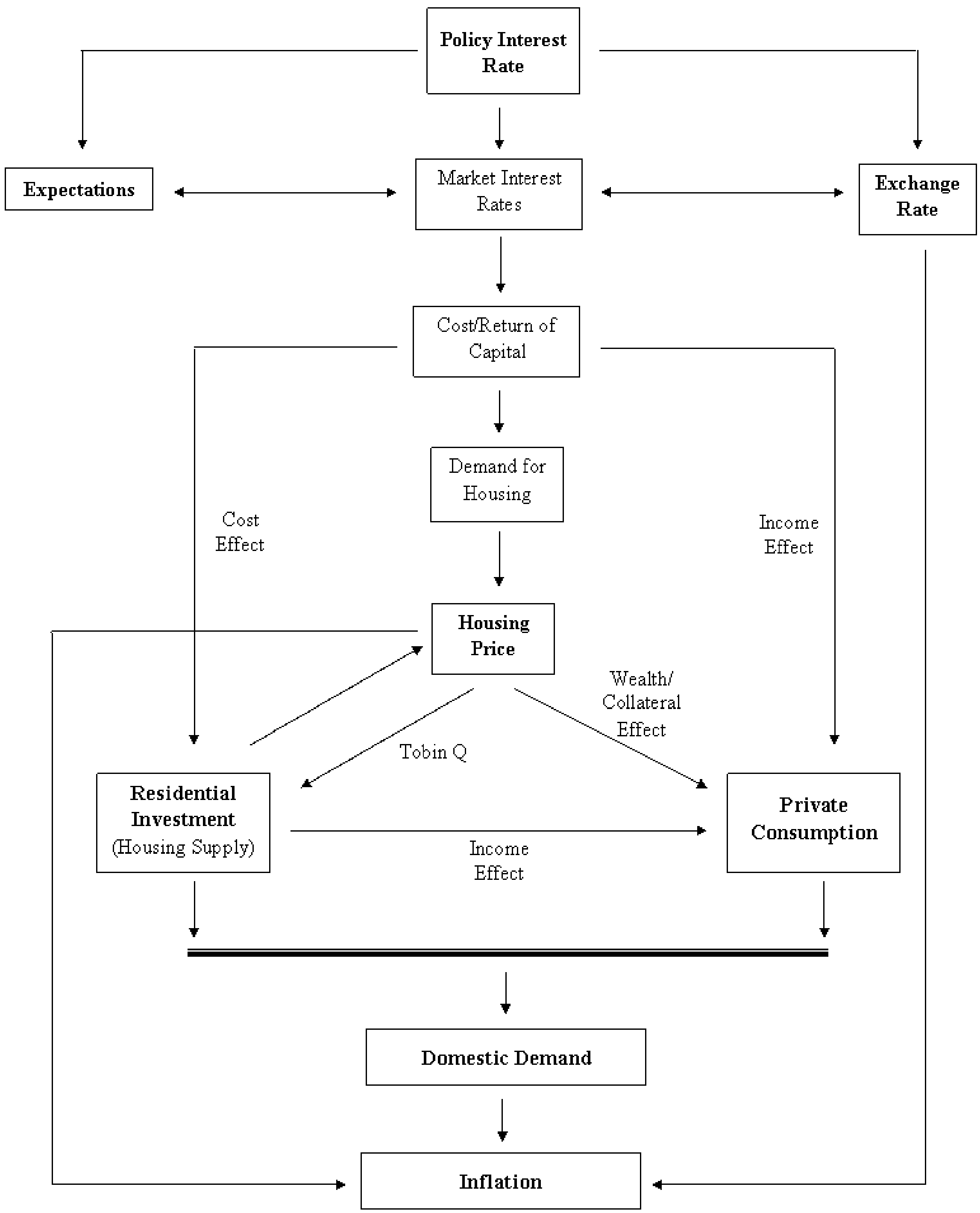
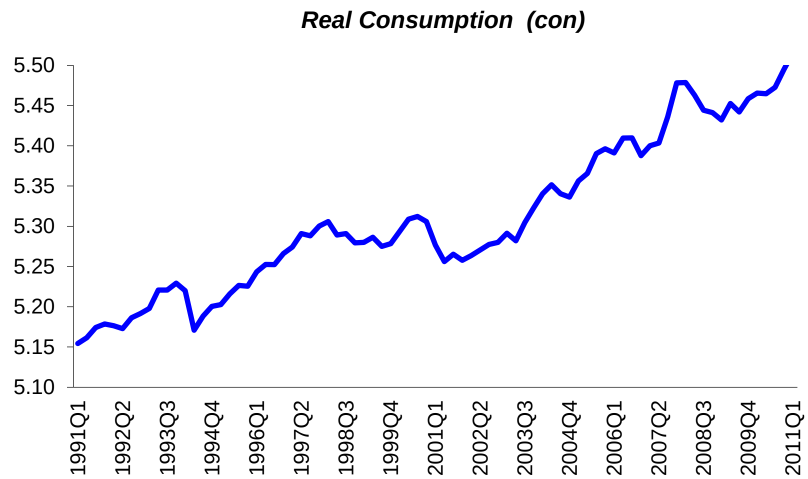
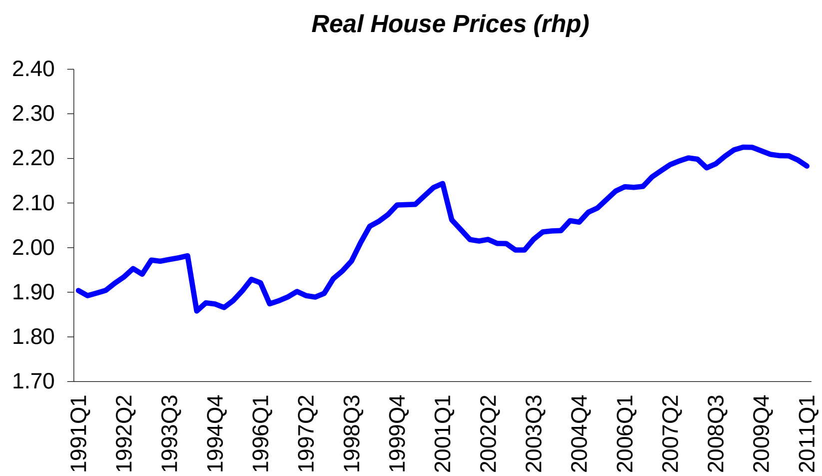


Figure B.6: Time-Series Data (Chap. 3)





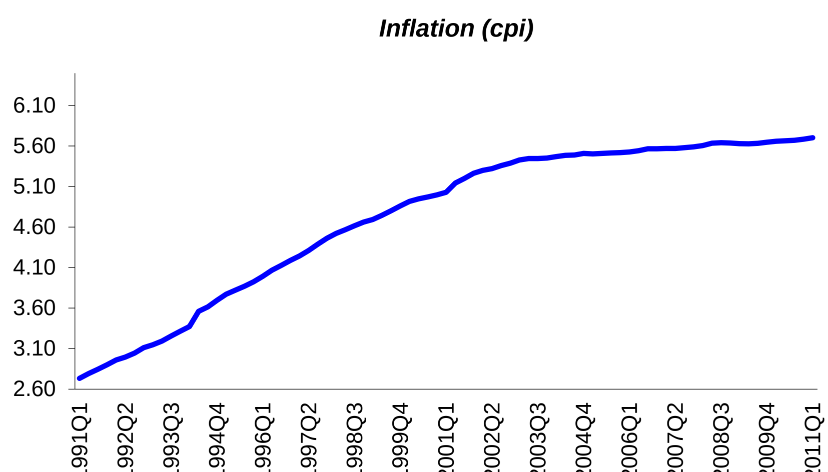
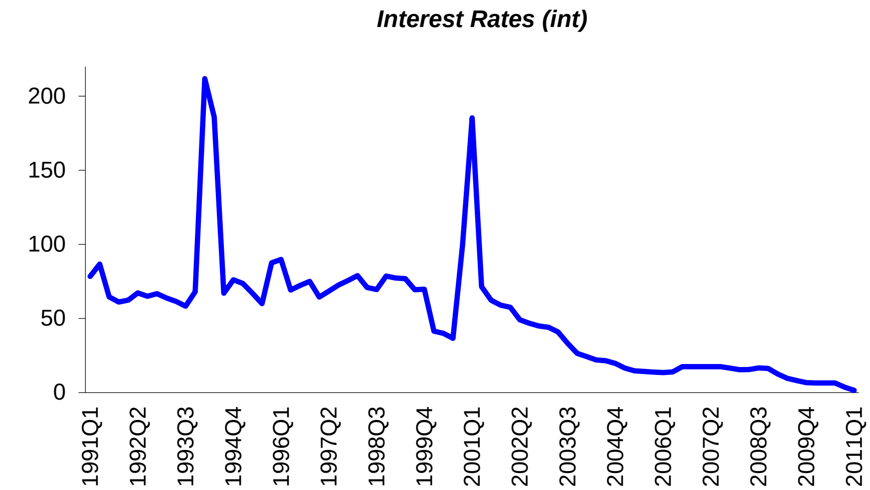
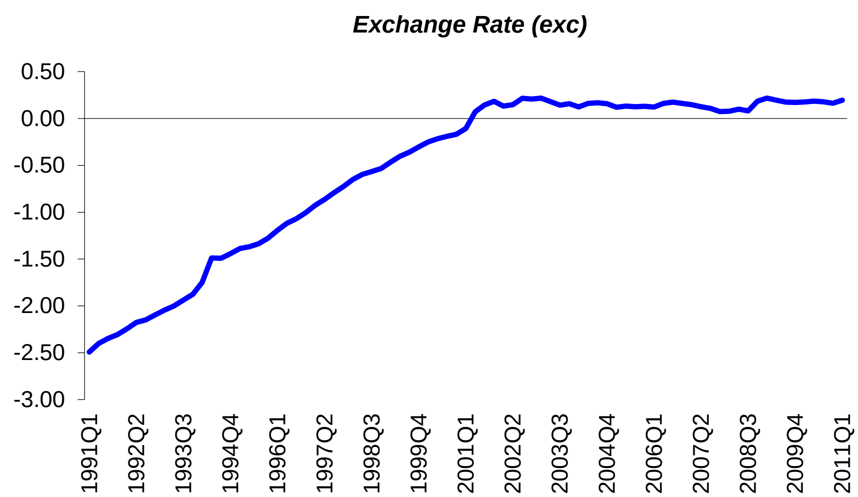


Figure B.6: Time-Series Data (Chap. 3) (continued)





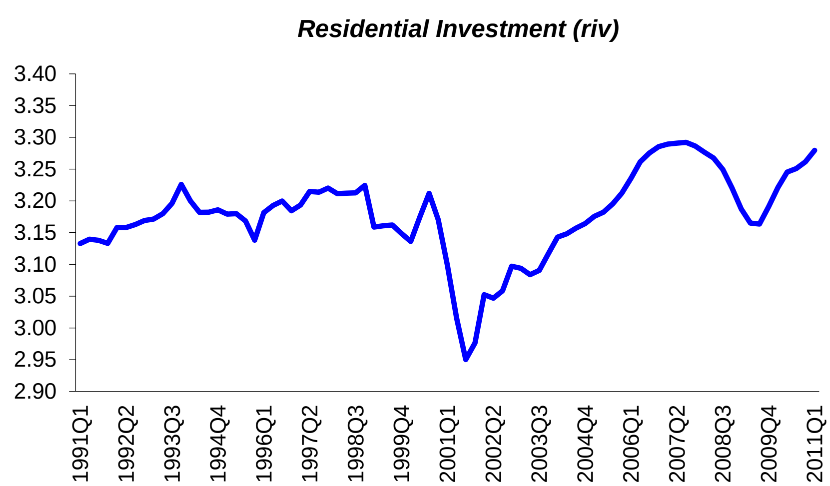
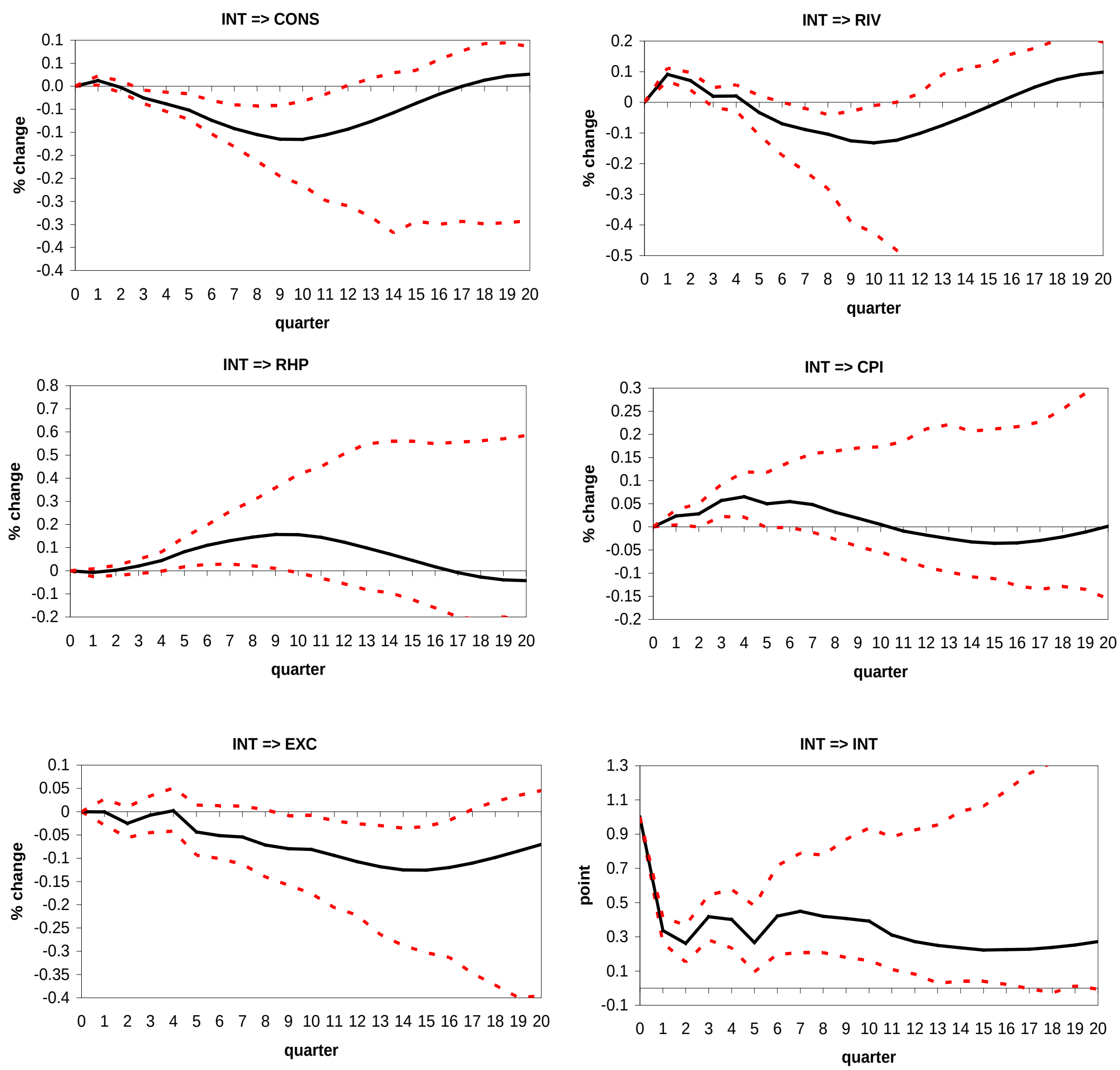
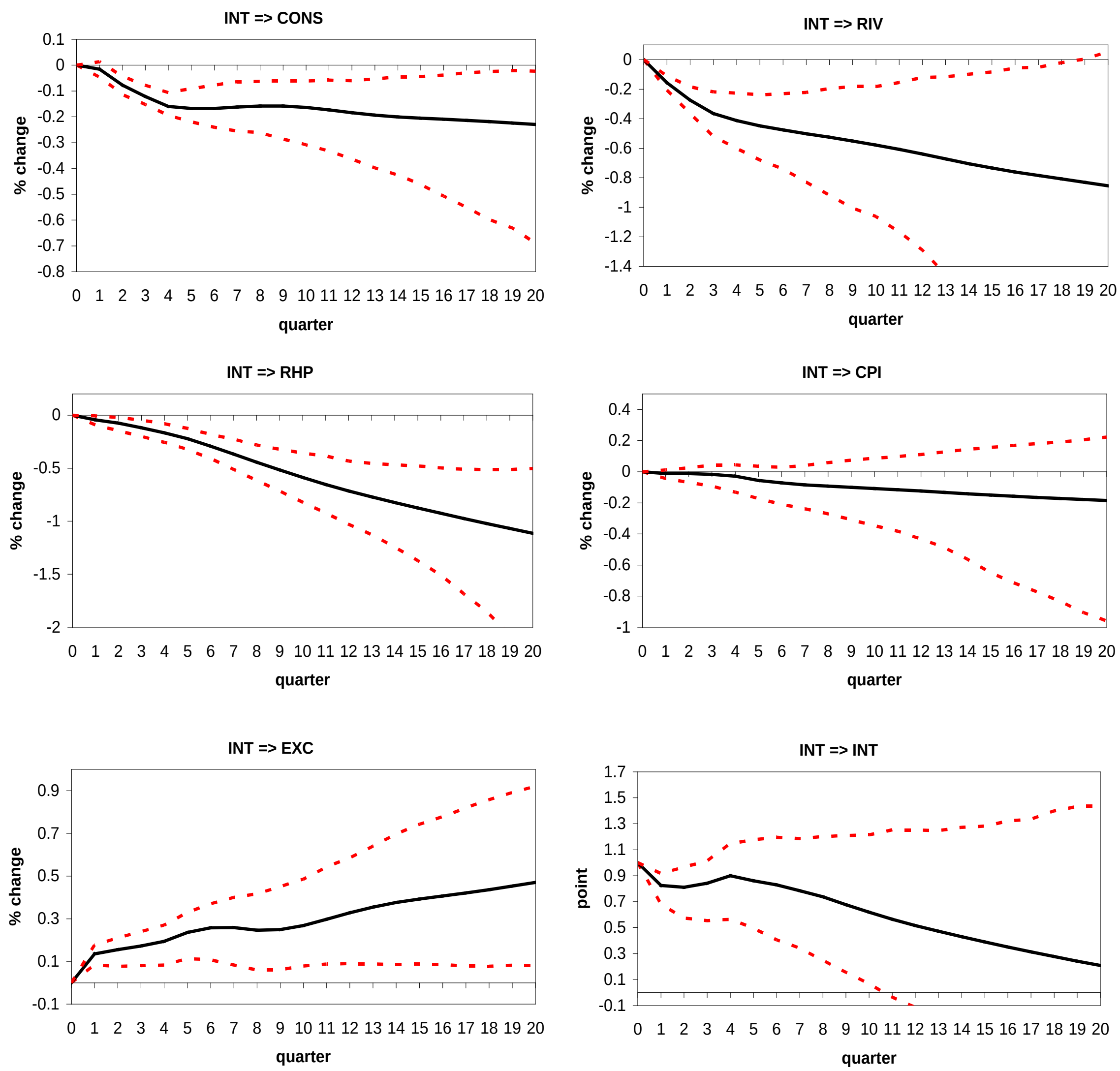


Figure B.7: IRFs for Int. Rate Shock (Benchmark Ordering, pre-2001)



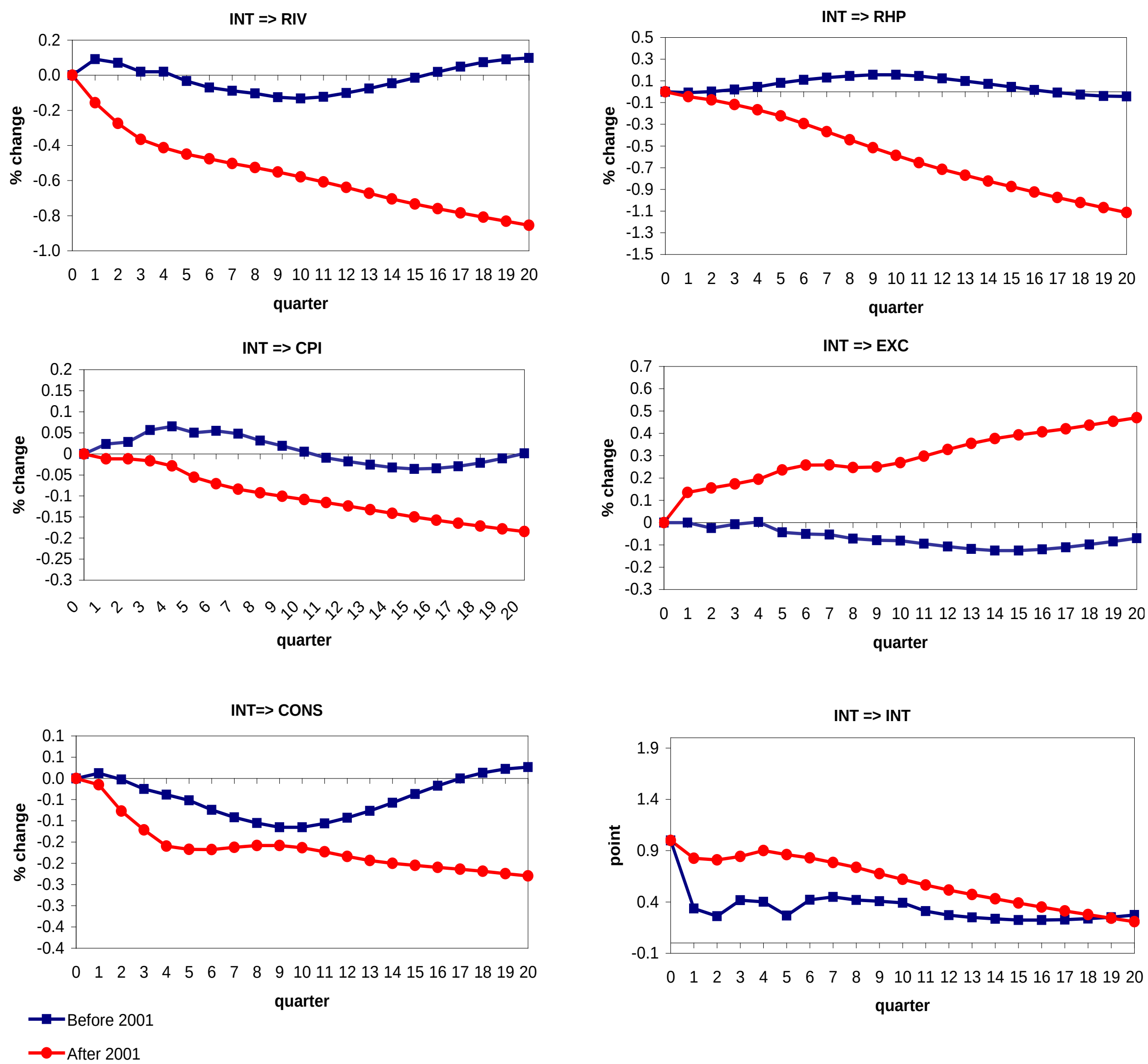
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the pre-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, CONS, RHP, CPI, EXC, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.8: IRFs for Int. Rate Shock (Benchmark Ordering, post-2001)



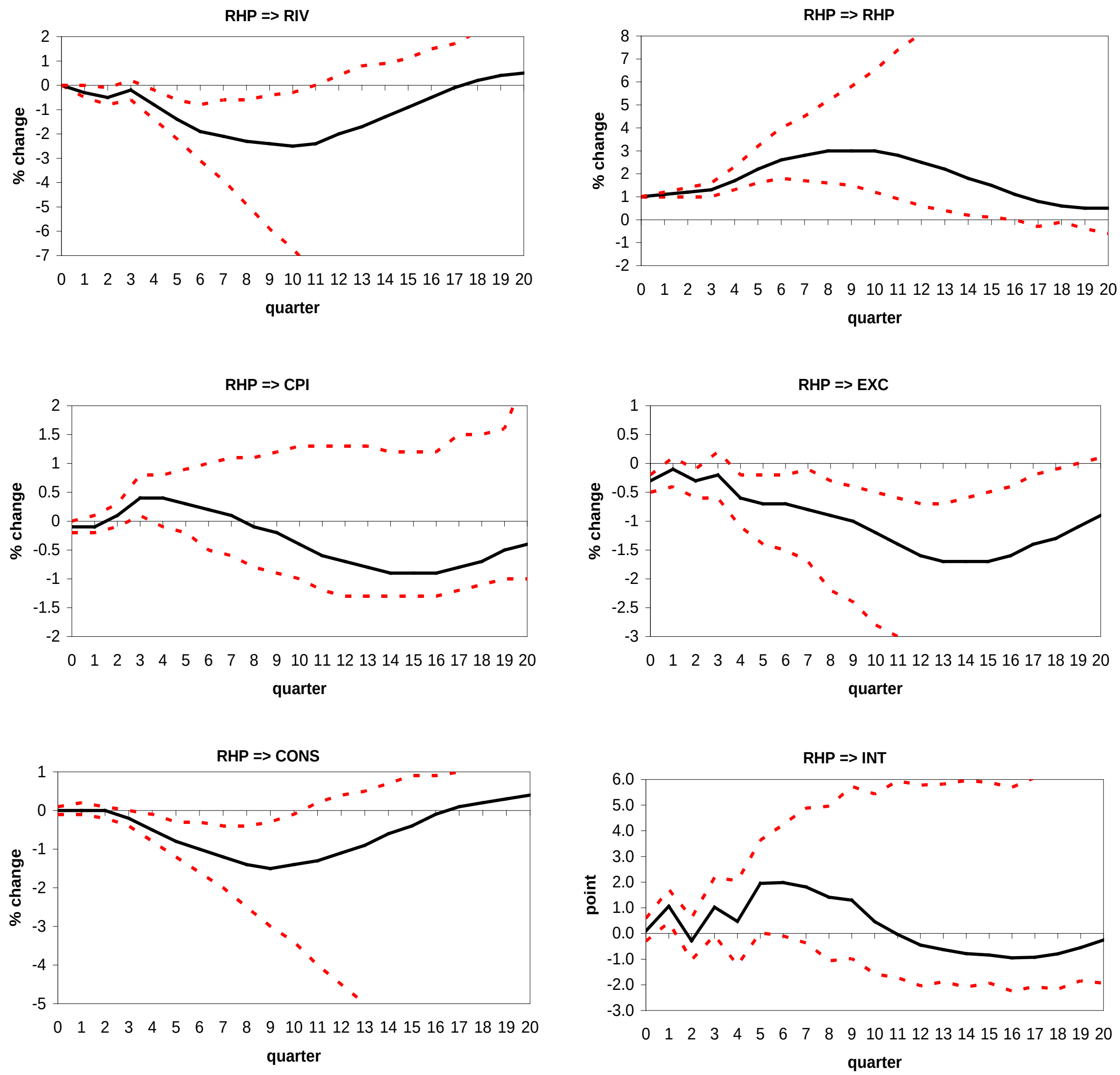
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, CONS, RHP, CPI, EXC, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.9: IRFs for Int. Rate Shock (Benchmark Ordering, 1991-2011)



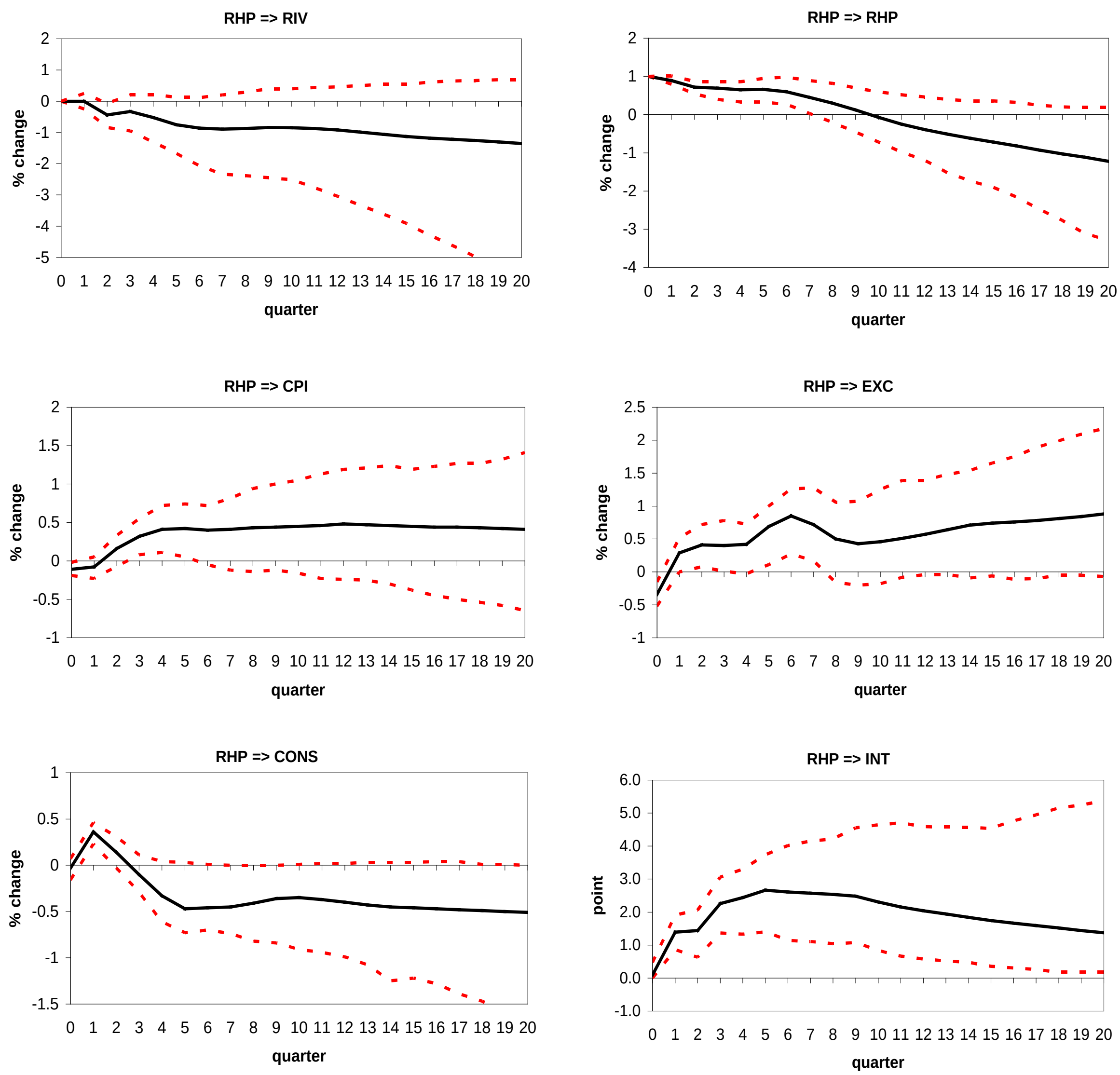
Notes: These graphs show the impulse responses to a contractionary monetary policy for both pre and post-2001 period. RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively. As it is seen from the responses residential investment, consumption and inlation become more responsive (decrease more after a contractionary interest rate shock) to an interest rate shock after 2001. It is also seen that house prices and exchange rates show opposite movements in both periods. Before 2001 house price slightly increase and exchange rate decreases whereas, after 2001, house price decreases and exchange rates increases after an contractionary interest rate shock.

Figure B.10: IRFs for House Price Shock (Benchmark Ordering, pre-2001)



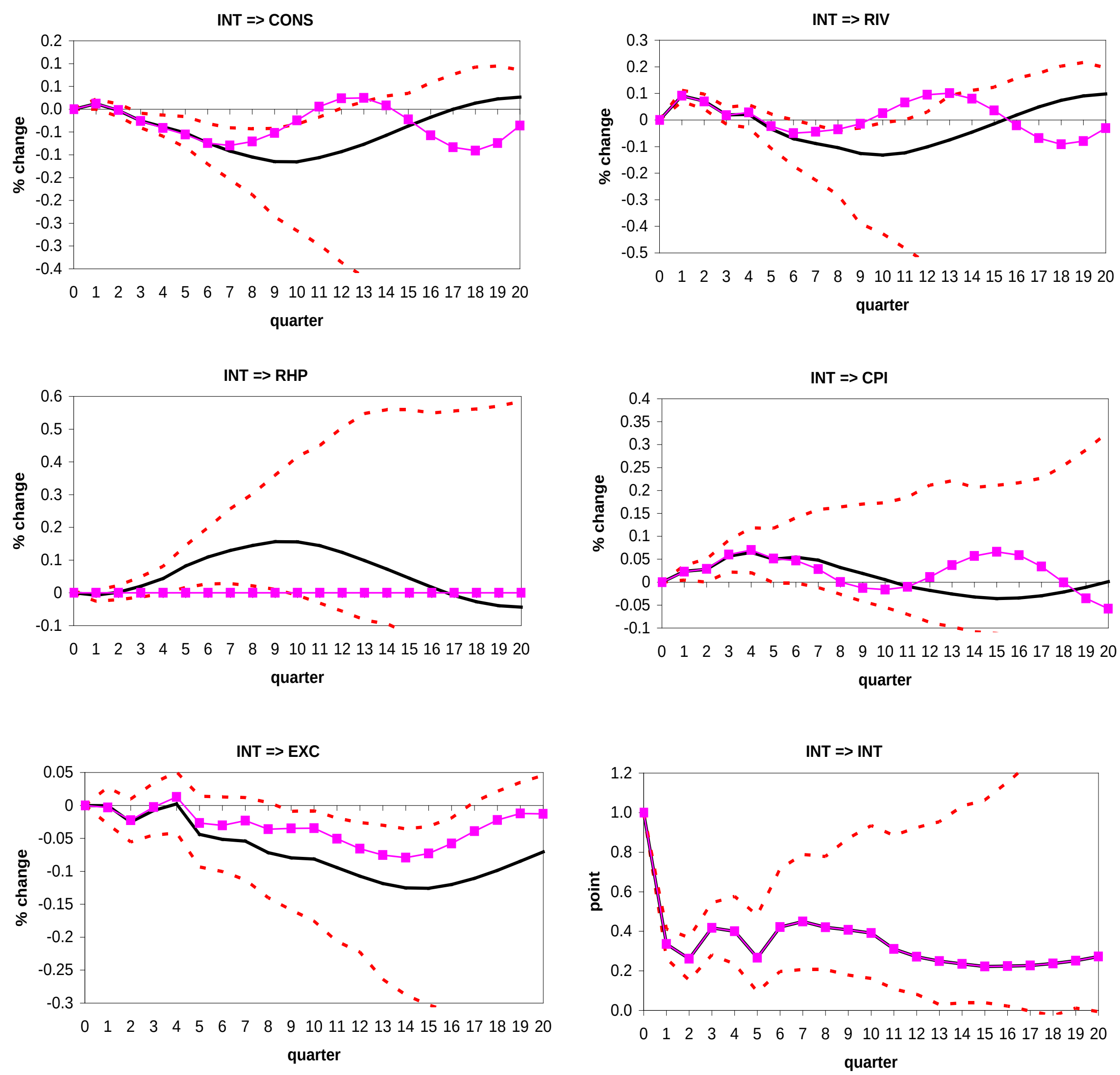
Note: These graphs show the impulse responses to a one unit house price shock for the pre-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, RHP, CPI, EXC, CONS, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.11: IRFs for House Price Shock (Benchmark Ordering, post-2001)



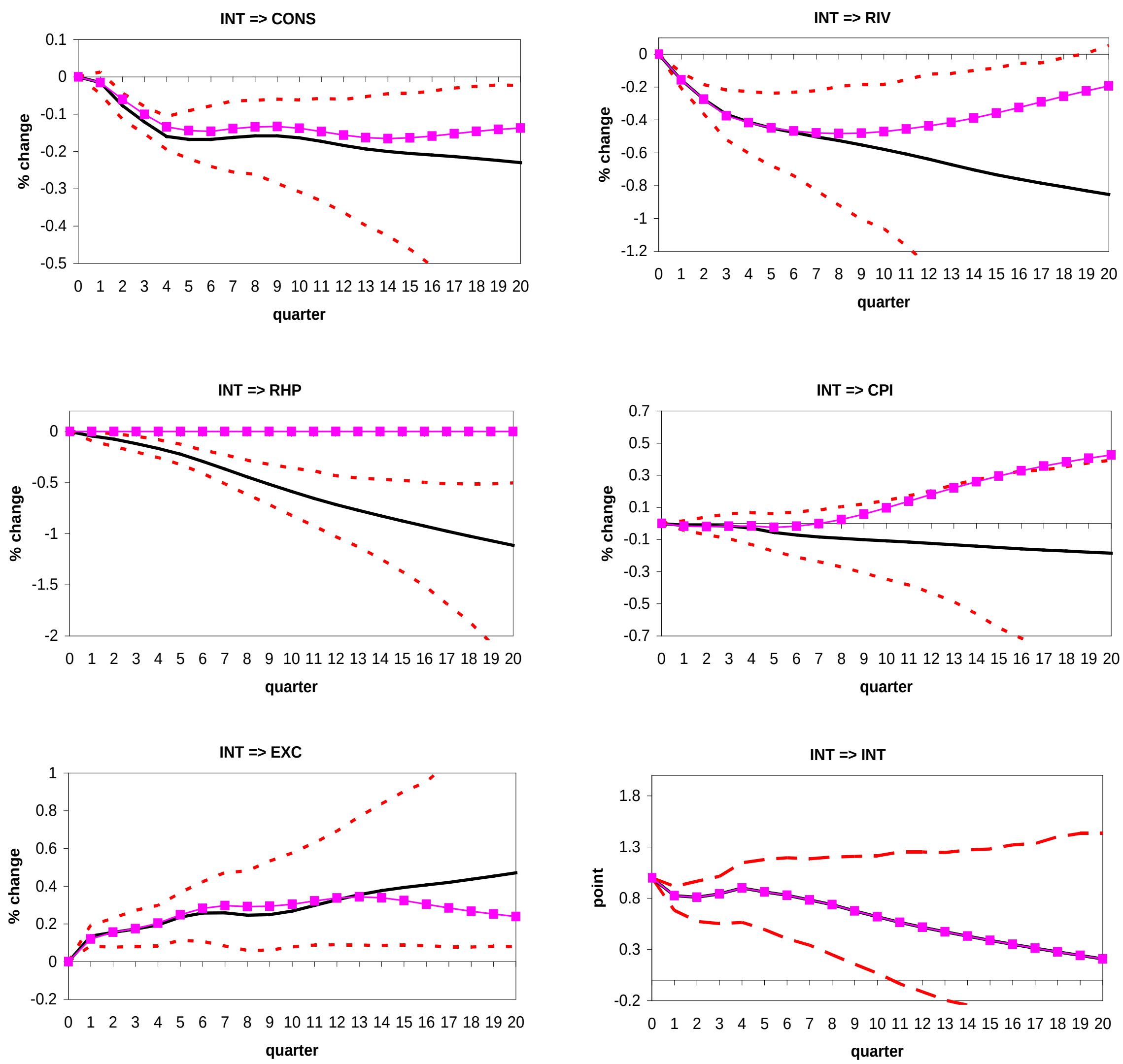
Note: These graphs show the impulse responses to a one unit house price shock for the post-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, RHP, CPI, EXC, CONS, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.12: IRFs for Int. Rate Shock (Counterfactual Exp., Bench. Ord., pre-2001)



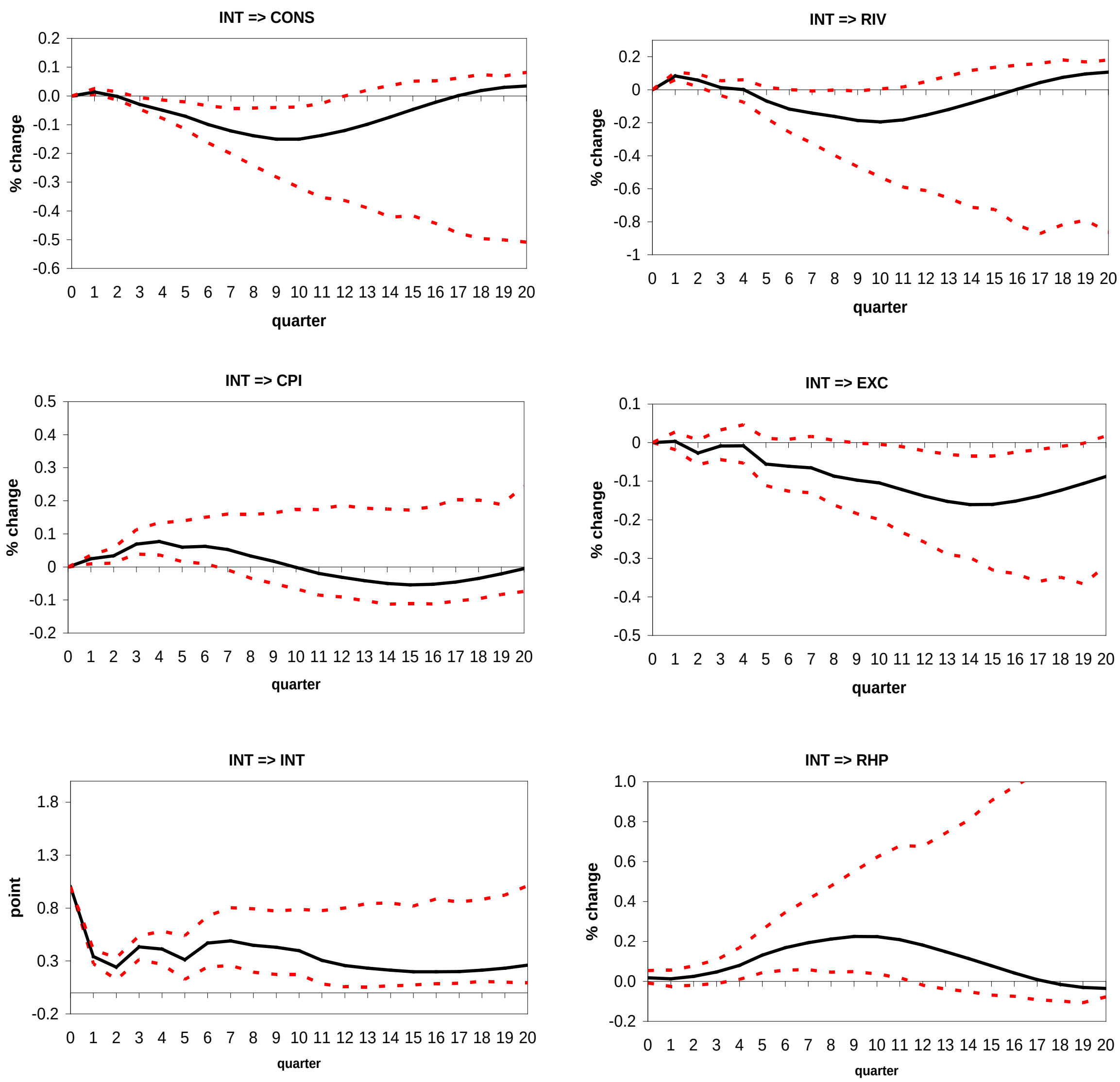
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Solid lines represent the responses of the benchmark model whereas the the lines with squares represent the simulated model responses. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, CONS, RHP, CPI, EXC, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.13: IRFs for Int. Rate Shock (Counterfactual Exp., Bench. Ord., post-2001)



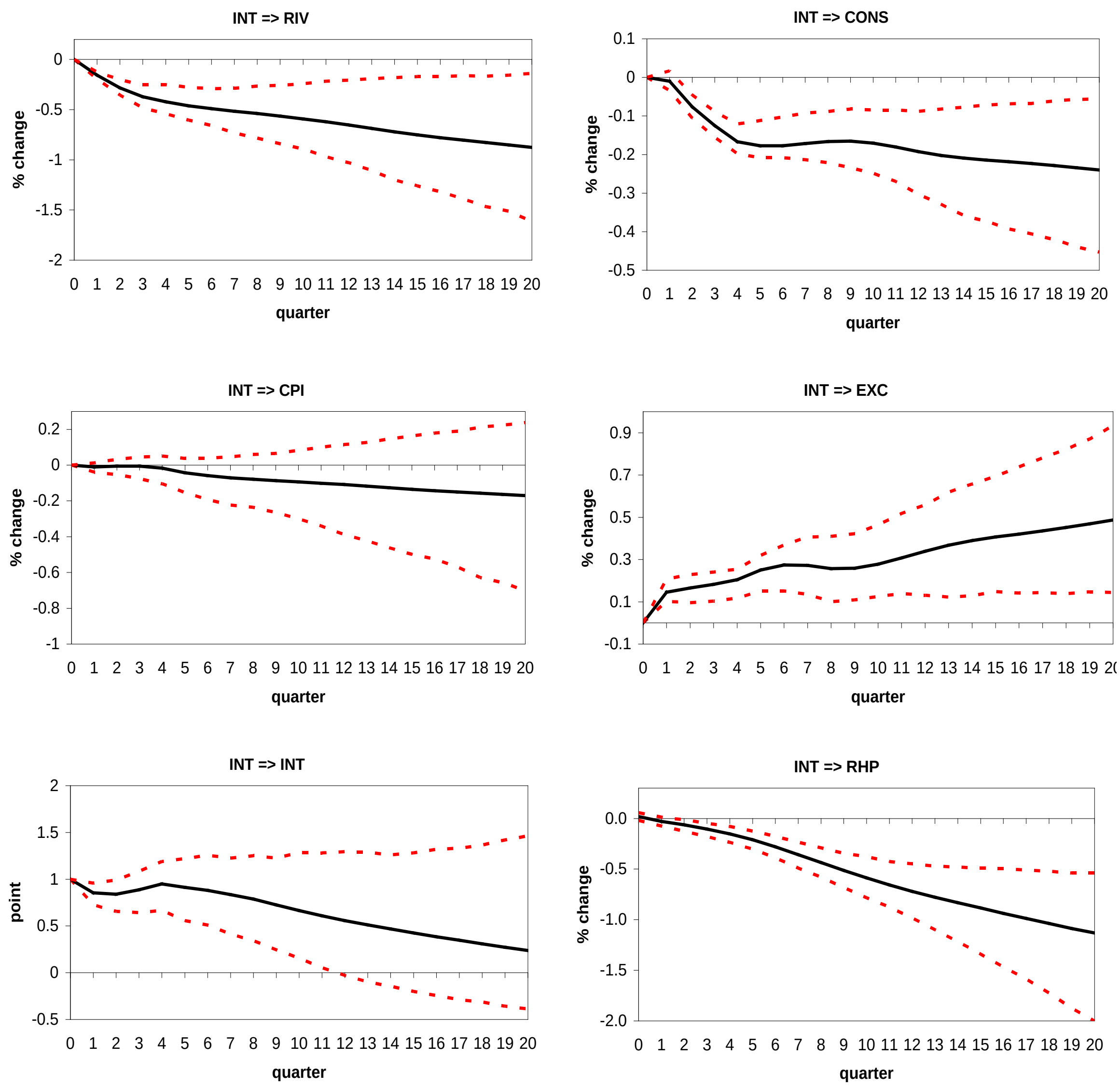
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Solid lines represent the responses of the benchmark model whereas the the lines with squares represent the simulated model responses. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, CONS, RHP, CPI, EXC, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.14: IRFs for Int. Rate Shock (Alternative Ordering 1, pre-2001)



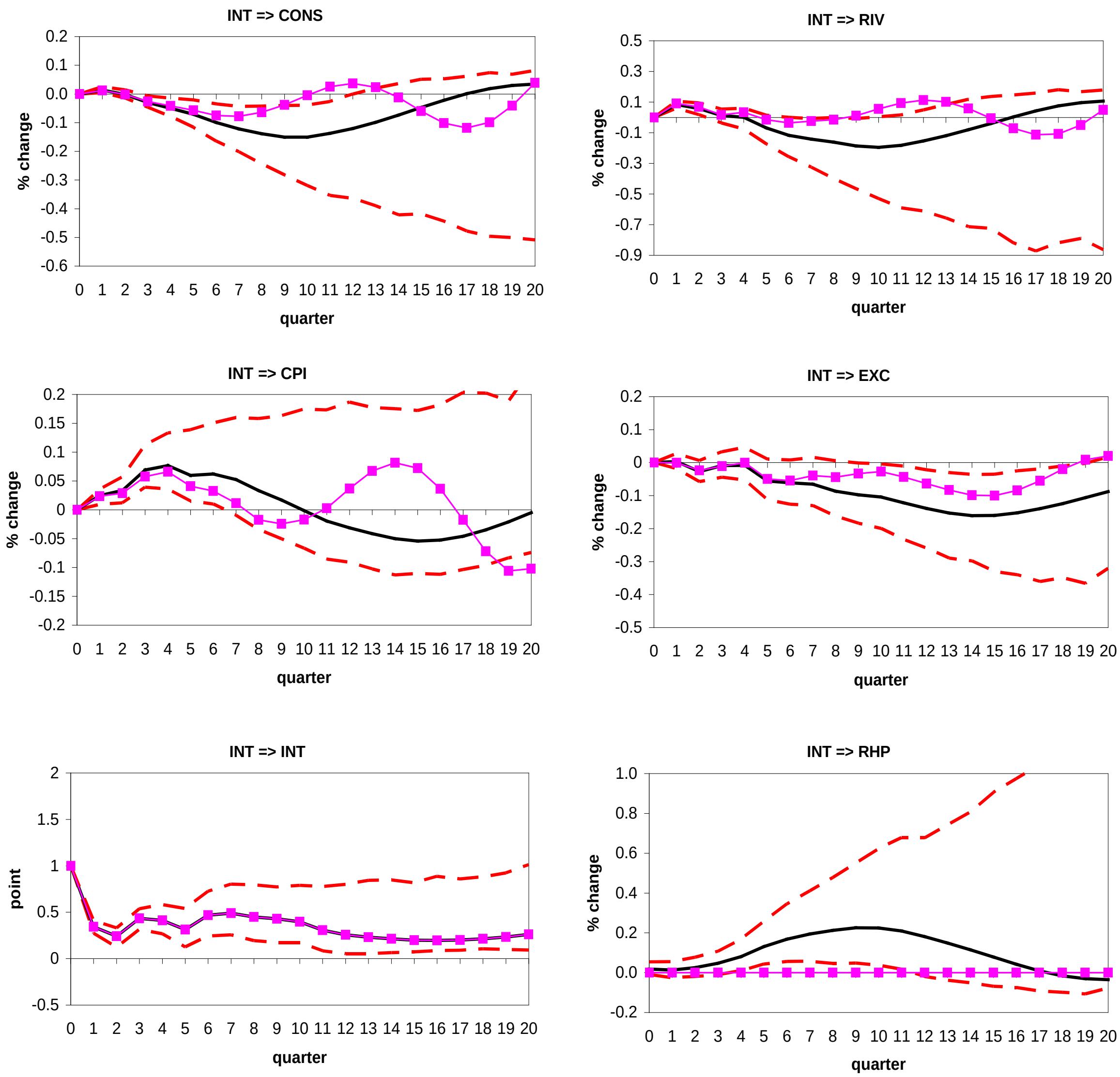
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the pre-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [CONS, RIV, CPI, EXC, INT, RHP] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.15: IRFs for Int. Rate Shock (Alternative Ordering 1, post-2001)



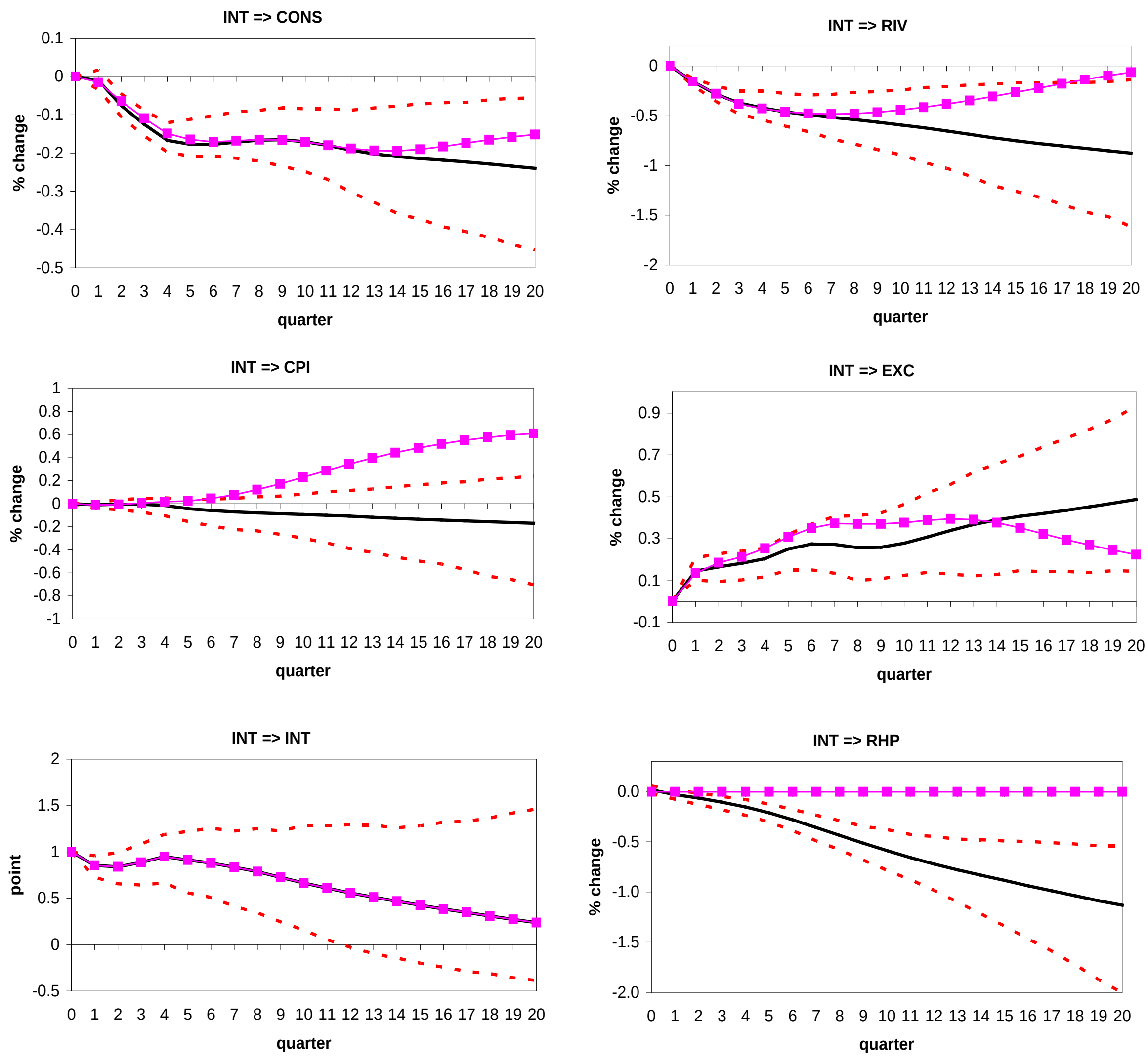
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [CONS, RIV, CPI, EXC, INT, RHP] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.16: IRFs for Int. Rate Shock (Counterfactual Exp., Alt. Ord. 1, pre-2001)



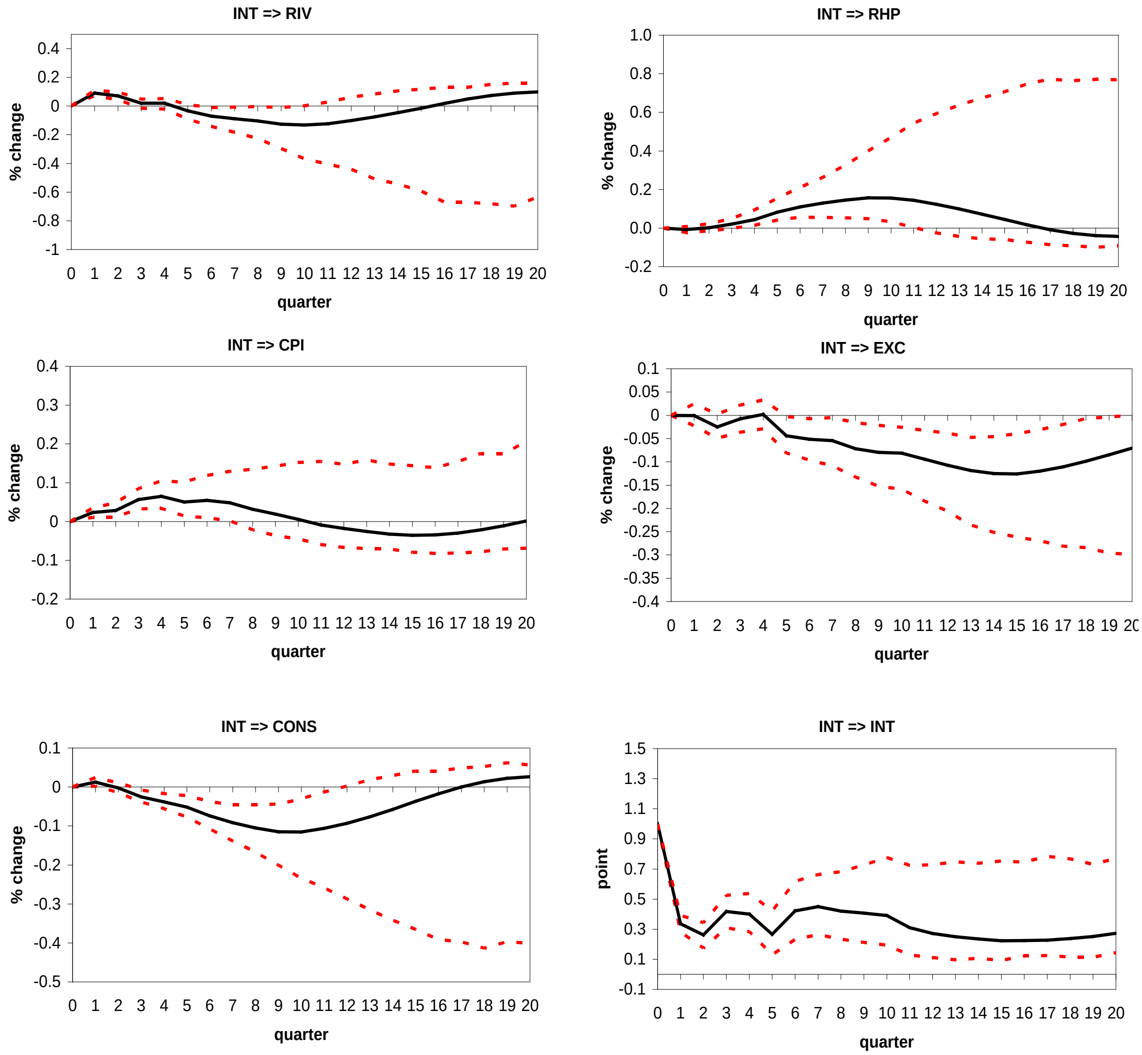
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the pre-2001 period. Solid lines represent the responses of the benchmark model whereas the the lines with squares represent the simulated model responses. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [CONS, RIV, CPI, EXC, INT, RHP] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.17: IRFs for Int. Rate Shock (Counterfactual Exp., Alt. Ord. 1, post-2001)



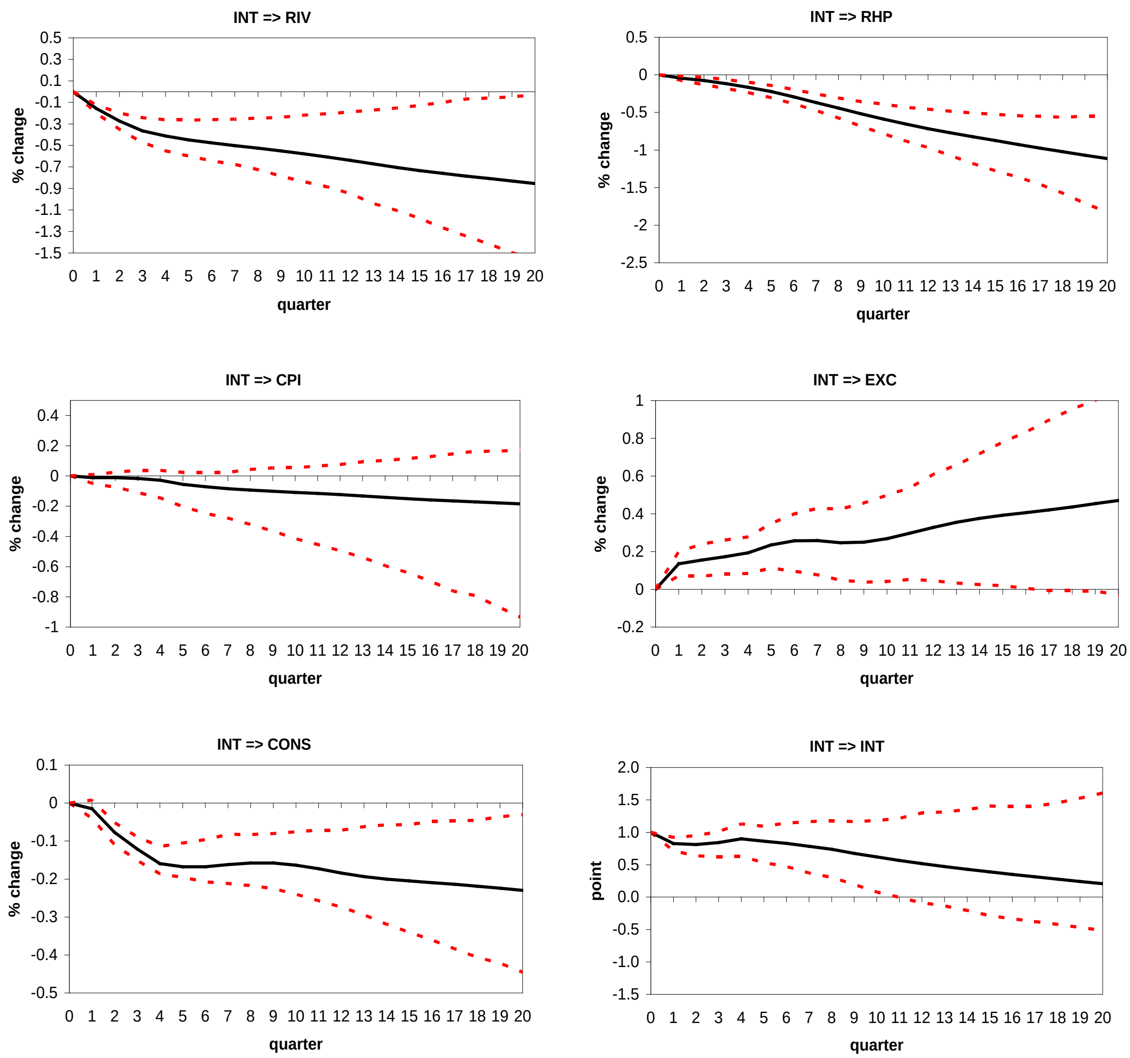
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Solid lines represent the responses of the benchmark model whereas the the lines with squares represent the simulated model responses. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [CONS, RIV, CPI, EXC, INT, RHP] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.18: IRFs for Int. Rate Shock (Alternative Ordering 2, pre-2001)



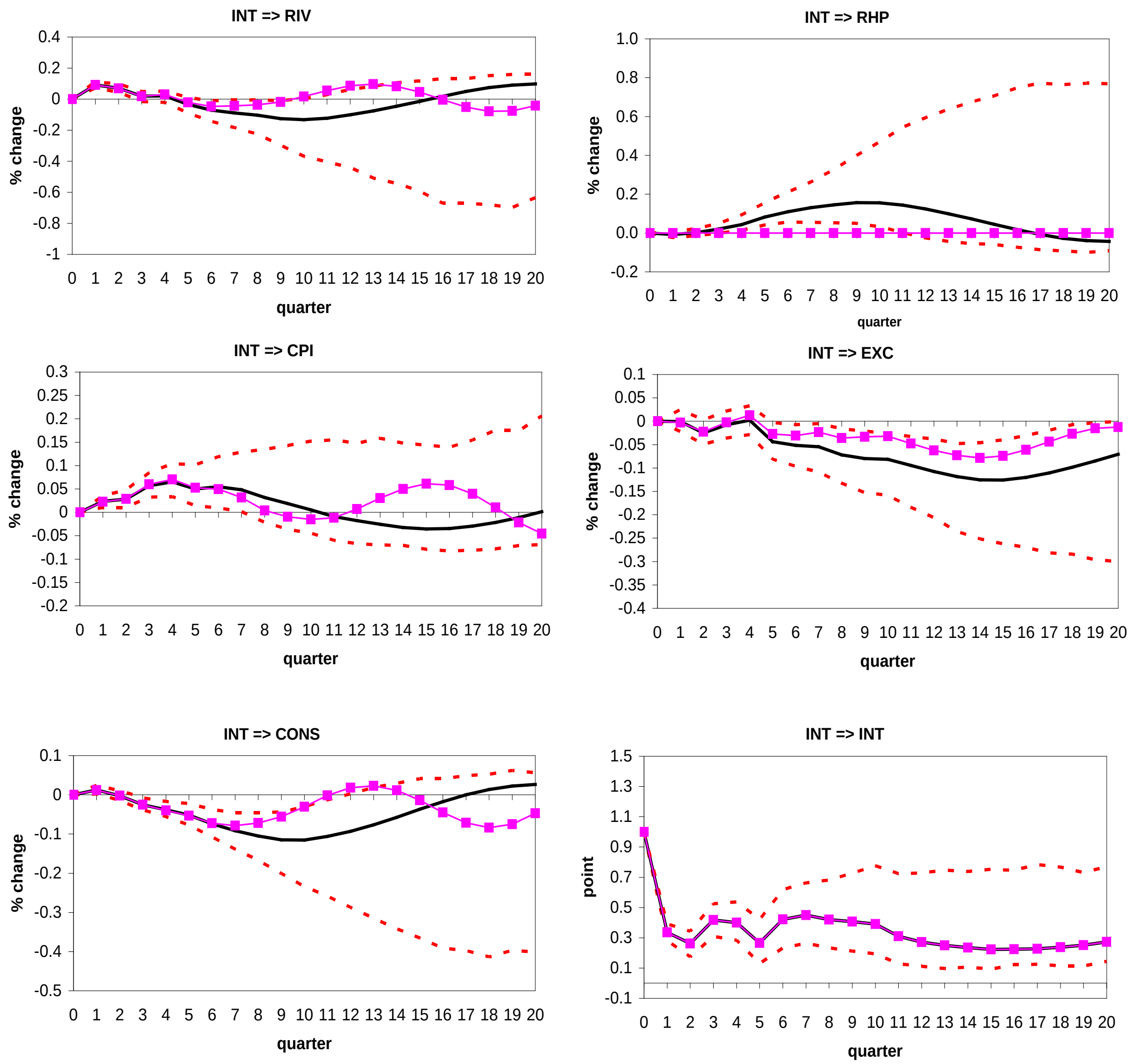
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the pre-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, RHP, CPI, EXC, CONS, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.19: IRFs for Int. Rate Shock (Alternative Ordering 2, post-2001)



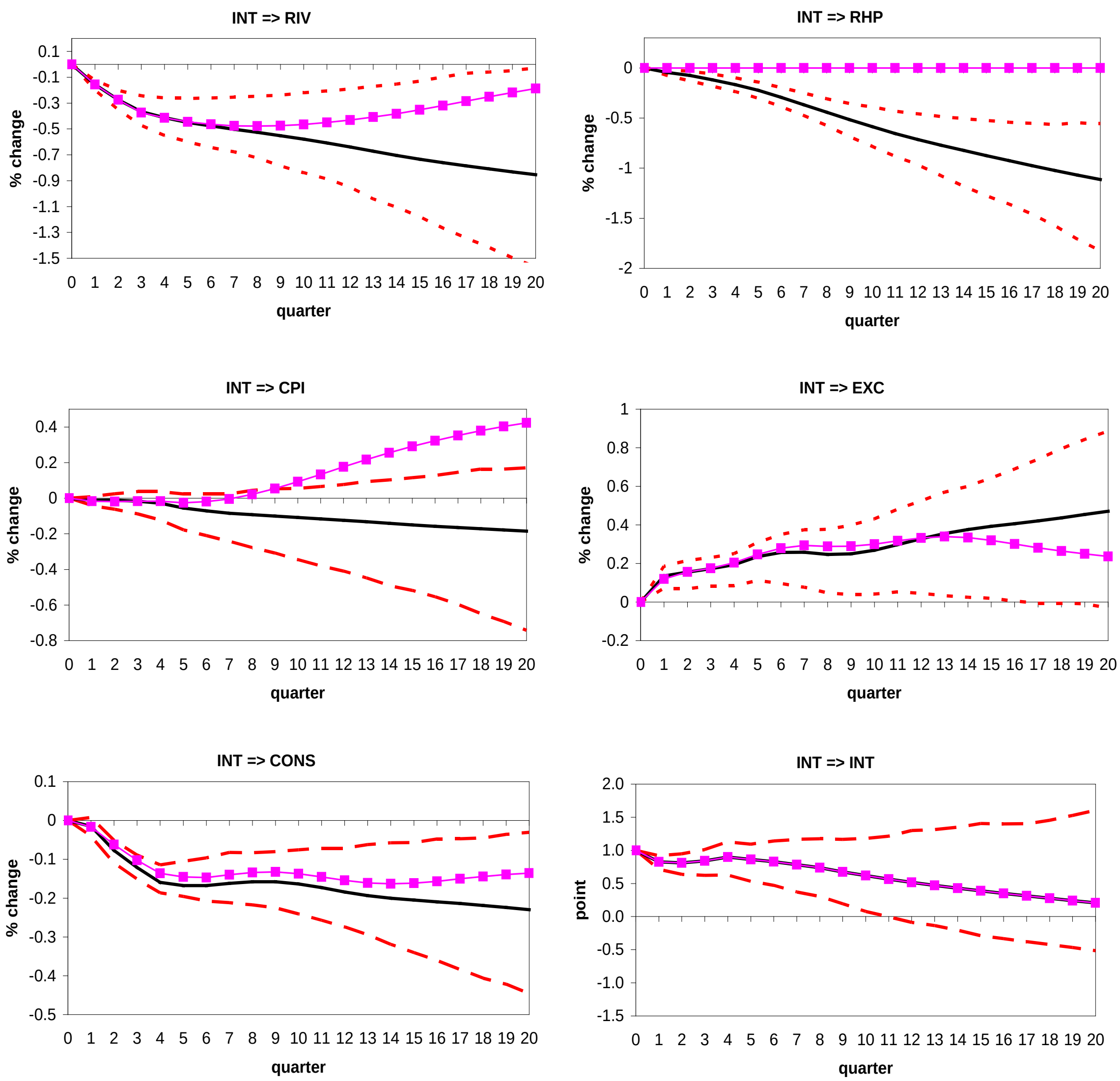
Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, RHP, CPI, EXC, CONS, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.20: IRFs for Int. Rate Shock (Counterfactual Exp., Alt. Ord. 2, pre-2001)



Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the pre-2001 period. Solid lines represent the responses of the benchmark model whereas the the lines with squares represent the simulated model responses. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, RHP, CPI, EXC, CONS, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Figure B.21: IRFs for Int. Rate Shock (Counterfactual Exp., Alt. Ord. 2, post-2001)



Note: These graphs show the impulse responses to a one unit contractionary monetary policy for the post-2001 period. Solid lines represent the responses of the benchmark model whereas the the lines with squares represent the simulated model responses. Dashed lines represent 90% percent coinfidence intervals of the responses. The ordering of the identification scheme is [RIV, RHP, CPI, EXC, CONS, INT] where RIV, CONS, CPI, EXC, INT and RHP represent residential investment, consumption, inflation, exchange rates, interest rate and house price index respectively.

Appendix C

Data Sources

Data	Definition	Source
Consumption (CON)	Logarithm of the real total private consumption expenditure derived from real GDP series which is divided by population.	Central Bank of Republic of Turkey
Disposable Income (DPI)	Logarithm of the nominal DPI is divided by population and deflated by private consumption expenditure deflator derived from the GDP series. Since there is no DPI series for Turkey, it is derived from the following calculation;	
	DPI=C+I+NG+NX+NFI-D	
	where	
	C: total private consumption	Central Bank of Republic of Turkey
	I: Gross fixed capital formation	Central Bank of Republic of Turkey
	NG: Net government expenditure (government expenditure-government revenue)	Republic of Turkey Ministry of Finance
	NX: Net exports of gooods and services	Central Bank of Republic of Turkey
	NFI: Net factor incomes	Central Bank of Republic of Turkey
	D: Depreciation (consumption of fixed capital used as a proxy)	Turkish Statistical Institute
Housing Wealth (HW)	Logarithm of the nominal HW is divided by population and deflated by private consumption expenditure deflator derived from the GDP series. Nominal HW is derived from the following calculation;	
	HW=HP*NDS-HC	
	HP: House price that is derived from rent price index.	Central Bank of Republic of Turkey
	NDS: Net dwelling stock (0.0025 is used for amortization)	Central Bank of Republic of Turkey, Turkish Statistical Institute
	HC: Housing Credits	Central Bank of Republic of Turkey
Financial Wealth (FW)	Logarithm of the net nominal FW is divided by population and deflated by private consumption expenditure deflator derived from the GDP series. Net nominal FW is derived from the following calculation;	
	FW=M2Y+S-CC	
	M2Y: Currency in circulation+deposits in both Lira and other currencies	Central Bank of Republic of Turkey
	S: Istanbul Stock Exchange Market Capitalization	Istanbul Stock Exchange
	CC: Consumer Credits (except mortgage credits)	Central Bank of Republic of Turkey
Price Level (CPI)	Consumer Price Index	Central Bank of Republic of Turkey
Residential Investment	logarithm of residential construction (m2)	Central Bank of Republic of Turkey
Exchange Rate (EXC)	logarithm of US Dollar/Turkish Lira	Central Bank of Republic of Turkey
Interest Rate (INT)	Avarage of O/N Interest rates	Central Bank of Republic of Turkey
Population	Quarterly figures interpolated from yearly data assuming intra year linearity.	WDI

References

Akin, C., 2008. "Stock Market Fluctuations, Housing Wealth and Consumption Behaviour in Turkey," Job Market Paper, George Washington University.

Akkoyunlu, S., 2002. "Modeling Consumers' Expenditure in Turkey, 1962-1994," OxMetrics User Conference at Cass Business School, September 2003.

Ando, A. and Moigliani, F., 1963. "The 'Life Cycle' Hypothesis of Saving: Aggregate Implications and Tests," *American Economic Review*, 53(1), 55-84.

Andrade, P., Bruneau, C. and Gregoir, S., 2005. "Testing for Cointegration Rank When Some Cointegrating Directions Are Changing," *Journal of Econometrics*, 124, 269--310.

Aoki, K., Proudman, J. and Vlieghe, G., 2002. "Houses as Collateral: Has the Link Between House Prices and Consumption in the UK Changed," *Policy Review: Financial Innovation and Monetary Transmission*, 8, 163-178.

Aoki, K., Proudman, J. and Vlieghe, G., 2004. "House Prices, Consumption, and Monetary Policy: A Financial Accelerator Approach," *Journal of Financial Intermediation*, 13(4), 414--35.

Aydede, Y., 2008. "Aggregate Consumption Function and Public Social Security: The First Time Series Study for a Developing Country, Turkey," *Applied Economics*, 40, 1807-1826.

Bernanke, B. and Blinder, A., 1988. "Credit, money, and aggregate demand," *American Economic Review*, 78, 435--439.

Bernanke, B., Gertler, M. and Watson M. W., 1997. "Systematic Monetary Policy and the Effects of Oil Price Shocks," *Brookings Papers on Economic Activity*, 1,91--142.

Binay, S. and Salman, F., 2008. "A Critique of Turkish Real Estate Market," Turkish Economic Association Discussion Paper, 2008/8.

Campbell, J. Y. and Mankiw, N. G., 1989. "Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence," in Oliver J. Blanchard and Stanley Fischer, editors, *NBER Macroeconomics Annual*, MIT Press, Cambridge, 185-216.

Carroll, C., 2004. "Housing Wealth and Consumption Expenditure," Paper Prepared for Academic Consultants Meeting of Federal Reserve Board, available at http://econ.jhu.edu/people/ccarroll/papers/FedHouseWealthv2.pdf.

Elbourne, A., 2008. "The UK Housing Market and the Monetary Policy Transmission Mechanism: An SVAR Approach," *Journal of Housing Economics*, 17(1), 65-87.

Franses, H. and Hobijn, B., 1997. "Critical Values for Unit Root Test in Seasonal Time Series," *Journal of Applied Statistics*, 24(1), 25-47.

Friedman, M., 1957. *A Theory of the Consumption Function*, Princeton University Press, Princeton.

G-20 Progress Report, 2009. *The Actions of the London and Washington G20 Summits*, 5 September.

Hall, R. E., 1978. "Stochastic Implications of the Life Cycle Permanent Income Hypothesis," *Journal of Political Economy*, 86(6), 971-987.

Hylleberg, S., Engle, R. F, Granger, C. W. J. and Yoo S. B., 1990. "Seasonal Integration and Cointegration," *Journal of Econometrics*, 44, 215-238.

Iacoviello, M., 2000. "House Prices and the Macroeconomy in Europe: Results from a Structural VAR Analysis," ECB Working Paper, 18.

Iacoviello, M., 2002. "House Prices and Business Cycles in Europe: A VAR Analysis," Boston College Working Paper, 540.

Iacoviello, M., 2004. "Consumption, House Prices, and Collateral Constraints: A Structural Econometric Analysis," *Journal of Housing Economics*, 13, 304-320.

Iacoviello, M. and Minetti, R., 2008. "The Credit Channel of Monetary Policy: Evidence from the Housing Market," *Journal of Macroeconomics*, 30(1), 69-96.

Jarocinski, M. and Sets, F. R., 2008. "House Prices and the Stance of Monetary Policy," Federal Reserve Bank of St. Louis Review, 90(4), 339-66.

Johansen, S., 1988. "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics*, 12, 231-254.

Johansen, S., 1991. "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models," *Econometrica*, 56, 1151-80.

Johansen, S., Mosconi, R. and Nielsen, B., 2000. "Cointegration Analysis in the Presence of Structural Breaks in the Deterministic Trend," *Econometrics Journal*, 3, 216-250.

Kim, S. and Roubini, N., 2000. "Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR," *Journal of Monetary Economics*, 45(3), 561-586.

Lanne, M., Lutkepohl, H. and Saikkonen, P., 2002. "Comparison of Unit Root Tests for Time Series with Level Shift," *Journal of Time Series Analysis*, 23, 667-685.

Lettau, M. and Ludvingson, S., 2001. "Consumption, Aggregate Wealth and Stock Returns," *Journal of Finance*, 56, 815-849.

Lettau, M. and Ludvingson, S., 2004. "Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect on Consumption," *American Economic Review*, 94, 276-299.

Ludvingson, S. and Steindel, C. L., 2002. "Monetary Policy Transmission through the Consumption-Wealth Channel," *Federal Reserve Bank of New York Economic Policy Review*, 8(1), 117-33.

Malpezzi, S. and Maclennan, D., 2001. "The long-run price elasticity of supply of new residential construction in the United States and the United Kingdom," *Journal of Housing Economics*, 10 (3), 278-306.

McCarthy, J. and Peach, R. W., 2002. "Monetary Policy Transmission to Residential Investment," *Federal Reserve Bank of New York Economic Policy Review*, 8(1), 139-58.

Meltzer, H. A., 1995. "Monetary Credit and (Other) Transmission Processes: A Monetarist Perspective," *Journal of Economic Perspectives*, Vol. 9, No. 4, pp. 49-72.

Milcheva, S. and Sebastian, S., 2010. "Housing Channels of Monetary Policy Transmission in European Industrial and Transition Countries," 17 th Annual ERES Conference.

Mishkin, F. S., 1996. "The Channels of Monetary Policy Transmission: Lessons for the Monetary Policy," NBER Working Paper, 5464.

Mishkin, F. S., 2007. "Housing and Monetary Policy Transmission," Federal Reserve Bank of Kansas City 31st Economic Policy Symposium, August 31-September 1.

Moigliani, F. and Ando, A., 1960. "The Permanent Income and Life Cycle Hypothesis of Saving Behavior: Comparisons and Tests," In I. Friend and R. Jones (eds), *Proceedings of the Conference on Consumption and Savings*, 2, 49-174.

Musso, A., Neri, S. and Stracca, L., 2010. "Housing, Consumption and Monetary Policy: How Different are the US and the Euro Area?," European Central Bank Working Paper Series, 1161.

Ozer, Y. B. and Tang, K., 2009. "An Emprical Analysis of Financial and Housing Wealth Effects on Consumption in Turkey," MRG Discussion Paper Series, 2809.

Randall, J. Pozdena, 1990. "Do Interest Rates Still Affect Housing?," *Federal Reserve Bank of San Francisco Economic Review*, 3, 3-14.

Ryding, John. 1990. "Housing Finance and the Transmission of Monetary Policy," *Federal Reserve Bank of New York Quarterly Review*, summer: 42-55.

Saikkonen, P. and Lutkepohl, H., 2000. "Testing for the Cointegrating Rank of a VAR Process with Structural Shifts," *Journal of Business and Economic Statistics*, 18, 451-464.

Sims, C., 1980. "Macroeconomics and Reality," *Econometrica*, 48 (1), 1-48.

Sims, C. and Zha, T., 2006. "Does monetary policy generate recessions?," *Macroeconomic Dynamics*, 10 (2), 231--272.

Slacalek, J., 2009. "What Drives Personal Consumption? The Role of Housing and Financial Wealth," Europian Central Bank Working Paper Series, 1117.

Sommer, M., 2002. "Habits, Sentiment and Predictable Income in the Dynamics of Aggregate Consumption," Johns Hopkins University, working paper no: 458.