



**T.C.
YEDITEPE UNIVERSITY
INSTITUTE OF SOCIAL SCIENCES**

**Essays on Spillover Effects; Electricity Consumption, Monetary Interventions and
Financial Contagion**

by

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A thesis submitted in conformity with the requirements for the degree of

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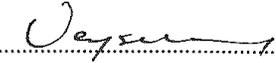
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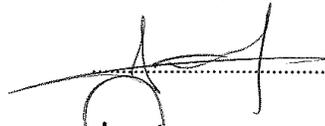
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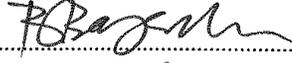
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DEDICATION

This dissertation is dedicated to my mother Selma Kılıç, who sacrificed so that I could obtain the best possible education and created an atmosphere in which hard work became easy.

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ABSTRACT

This dissertation consists of three loosely connected essays. Each paper is an econometric analysis of economic and financial spillover effects. The motivation is to relate the derived results to macroeconomic transmission mechanisms.

Chapter 1 intends to analyze economic factors that influence electricity consumption in the OECD economies. A special interest in this context is given to spillover effects of trade on electricity consumption. The obtained results suggest a positive relation between electricity consumption and trade.

In Chapter 2 central bank interventions are analyzed from an endogenous perspective in order to determine the effectiveness of monetary policy instruments for the period 1987-2009 in Turkey. A special interest in this context is given to central bank preferences, which are obtained from the underlying macroeconomic structure by utilizing a SEM framework. The SEM framework results indicate that the Central Bank of Republic of Turkey (CBRT)'s preferences changed for two subsample periods, 1987-2000 and 2001-2009.

Chapter 3 aims to analyze cross-border contagious dynamics on foreign exchange markets and on stock exchange markets. The propagation are analyzed with respect to the transmission of nonlinearities that are endogenously determined. The contagion process is discussed in the context of financial systems, FDI, and trade. Diversified trade and financial relations decrease the risk of exposure to contagion from external markets. World's largest economies however pursue a price setter role; in this case diversification is of secondary importance.

ÖZET

Bu tez, yayılma etkisini temel alan üç farklı bölümden oluşmaktadır. Her bölümde ekonomik ve finansal yayılma etkisi bir ekonometrik analiz ile ele alınmaktadır. Temel amaç, elde edilen sonuçları makroekonomik aktarım mekanizmaları ile ilişkilendirmektir.

Birinci bölüm OECD ekonomilerinin elektrik tüketimini etkileyen ekonomik faktörleri analiz etmeyi planlıyor. Bu bağlamda, elektrik tüketimi ile ilişkilendirilmiş ticaretin yayılma etkisine özel bir önem verilmiştir. Elde edilen sonuçlarda, dış ticaret bağlamında pozitif bir ilişki bulunmaktadır.

İkinci bölümde, para politikası araçlarının etkinliğini belirlemek amacı ile, Türkiye'de, 1987-2009 dönemi için Merkez Bankası müdahaleleri endojen bir perspektif ile analiz edilir. Bu kapsamda, eşanlı denklem modeli kullanarak, temel makroekonomik yapıdan elde edilen Merkez Bankası tercihlerine özel ilgi gösterilir. Bu çerçevedeki sonuçlar, Merkez Bankası tercihlerinin iki alt örnek dönem için, 1987-2000 ve 2001-2009, değiştiğini göstermektedir.

Üçüncü bölüm, döviz ve borsa piyasalarındaki sınır ötesi yabancı bulaşıcı dinamikleri incelemeyi amaçlamaktadır. Doğrusal olmayan ve içsel olarak belirlenmiş olan yayılımın iletimi analiz edilmektedir. Bulaşma süreci, finans sistemleri, doğrudan yabancı yatırımlar ve ticaret bağlamında ele alınmıştır. Farklı ticari ve finansal ilişkiler dış pazarlardan kaynaklanan bulaşıcı etkilere maruz kalma riskini azaltmaktadır. Dünyanın en büyük ekonomilerinin fiyat belirleyici bir rol üstlenmekte olduklarından, bulaşıcı dinamikler bağlamında, çeşitlendirme ikincil önem taşımaktadır.

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CHAPTER 1

ELECTRICITY CONSUMPTION AND SPILLOVER EFFECTS – A DYNAMIC PANEL DATA APPROACH

ABSTRACT

The chapter intends to analyze economic factors that influence electricity consumption in the OECD economies. A special interest in this context is given to spillover effects of trade on electricity consumption. For this purpose, a model is constructed that uses a dynamic panel study approach. The model is estimated in a GMM-framework in which a dynamic procedure is conducted along the balanced growth path for electricity consumption in each economy. In advance, the long run dynamic behavior of prices, GDP, and trade induced spillover variables is determined. In a further step, the short run dynamic mechanism is pursued by estimating the partial adjustment dynamic coefficient on the target level of electricity consumption. The analysis is conducted for industrial, as well as residential electricity consumption. Alternatively, the same procedure is estimated by the application of a fixed period model. The model provides a benchmark tool for electricity policy decisions and for electricity consumption projections.

Keywords: *Energy Economics, Spillover Effects, Electricity Consumption, Dynamic Panel Studies, Partial Adjustment*

1.1. INTRODUCTION

The deregulation and liberalization in the energy markets in a wide range of countries in the last twenty years, such as in the USA and in Europe called forth new challenges for energy companies, distributors and consumers. The price building process follows a competitive market process in contrast to the monopolistic price setting of a public regulator. Deregulated prices are indicating a new basis for cost structures: supply and demand curves of market participants determine the price equilibrium. Consequently, market participants allocate their investment or consumption decisions according to the new market equilibrium which proclaims new risk management and optimization tools. Further, global acting energy sales companies are getting involved in the previously non-contestable national energy markets inducing more market pressure. From the perspective of an energy company new methods for risk management of the above described risk became necessary. In this context the knowledge of energy market dynamics enables new market actors to profound their management decision on a robust basis.

An important strand of the energy market related literature pursues the relationship of electricity consumption and economic growth. In this context elasticities are investigated that describes the consumption behavior in different countries. A pioneering research is employed by Nordhaus (1975). He uses a pooled autoregressive distributed lag (ARDL) model to examine the relationship of electricity consumption and economic growth in the largest OECD countries. The estimation includes income and price elasticities for industrial and residential electricity demand observing the short-term, as well as the long-term. He finds lower short-term parameters. In all elasticity classifications except for short-term prices, residential elasticities are higher than the industrial counterparts. Industrial elasticities are below unity, indicating inelastic dynamics. The same scheme is valid for the residential sector, except for long term income elasticity. Liu (2004) finds results that are consistent with the previous research. In the industrial sector income elasticity is about unity. In the residential sector the demand is more elastic for prices.

Haas and Schipper (1998), Lanzi and Roson (2007) and Duerick (2009) find that income elasticities are higher than price elasticities in the residential sector. Lanzi and Roson (2007) model a fixed effect panel study including weather, price and income electricity, gas and

oil products. They find long-run price and income elasticities around unity with expected sign.

Contradicting results is given by Duerick (2009). He finds larger negative short-term income elasticity for electricity demand that is significant for a 10%-level. Long-term elasticities in sign and magnitude however, are in theoretical accordance with previous studies.

Concerning the industrial sector, Adeyemi and Hunt (2007) estimate long-run income and price elasticity about 0.8 and -0.3, respectively. Ciarreta and Zarraga (2010) are conducting a GMM estimated panel cointegration approach. Their estimated results are comparable to the previous studies; income as well as price elasticity is low with the predicted sign.

Other studies with similar methodology are focusing on a single country case, when analyzing electricity demand elasticities. All studies exhibit a higher long-run elasticity magnitude than short-run elasticities. However, Dubin and Mc Fadden (1984) and Holtedahl and Joutz (2004) supply some offensive results, such that, short-run price elasticities are larger than the long-run counterparts.

A wide range of studies observe a long-term income elasticity above unity, among them following authors can be mentioned, Holtedahl and Joutz (2004), Rapanos, and Polemis (2006), Zachariadis, Pashaourtidou (2006). Studies indicating inelastic income behavior below unity are employed by authors such as, Dubin and McFadden (1984), Halicioglu (2007), Dergiades, Tsoulfidis (2008), Narayan and Smyth, (2005). All the cointegration analyses or ECM approaches yield income elasticity values above unity in the case of residential electricity demand and indicate the same pattern for short-run and long-run price elasticities.

Other methodologies for single country studies are applied as follows: Nakajima and Hamori (2010) uses a dynamic OLS approach, Sa'ad (2009) is applying a structural time series approach, Kamerschen and Porter (2004) are utilizing a partial-adjustment approach and a simultaneous equations approach, Dubin and McFadden (1984) conduct an

instrumental variable approach by employing OLS.

In this chapter we intend to analyze the role of trade spillover effects on electricity demand in the OECD-countries. For this purpose, a model is constructed that uses a dynamic panel study approach. The model is estimated in a GMM-framework in which a dynamic procedure is conducted along the balanced growth path for electricity consumption in each economy. In advance, the long run dynamics of prices, GDP, and trade induced spillover variables are determined. In a further step, the short run dynamic mechanism is pursued by estimating the partial adjustment dynamic coefficient on the target level of electricity consumption. The analysis is conducted for industrial, as well as residential electricity consumption. The remainder of the chapter is organized as follows. Section 1.2 deals with methodological issues used in the econometric models. Section 1.3 presents the particular model specifications. Section 1.4 discusses the results. Section 1.5 gives a brief summary and concludes.

1.2. ECONOMETRIC METHODOLOGY

1.2.1. Data and Spillover Variable Creation

The data sample spans the period from 2000 to 2006 and involves all OECD countries (updated for 2009). The data for industrial and residential electricity consumption and electricity prices are taken from the International Energy Agency's (IEA) Electricity Information and Energy Prices and Taxes reports for each period. GDP values are expressed in constant 2000 US\$ and are obtained from World Bank's World Development Indicators (WDI) database.

The trade data surrounds imports and exports by commodity in value (2000 US\$) between each country and remaining other OECD countries. 2582 different products are classified according to the Standard International Trade Classification system (SITC) (Revision 2). SITC does not contain the most recent products on markets, but provides the most consistent time series over a longer period.

The industry specific spillover variable is created as follows:

$$X_{2t} = \sum_i \sum_j \frac{(x_{ij} \cdot GDP_i)}{GDP} \quad (1.1)$$

Where, i denotes the partner countries and j , each specific industry. The industry specified trade value of a country is weighted by the GDP of the partner country for the recent period. This procedure is repeated for all OECD countries successively. The same index building procedure is followed for imports of each country. (See Figure 1 for more detailed illustration of the index building.):

$$M_{2t} = \sum_i \sum_j \frac{(m_{ij} \cdot GDP_i)}{GDP} \quad (1.2)$$

1.2.2. Dynamic Panel Data Analysis

Consider an example with standard log linear autoregressive specification of the described electricity model:

$$\ln E_t^* = \alpha_0 + \mu_{t-1} \sum E_t + \alpha_1 \sum \ln P_t + \alpha_2 \sum \ln y_t + \alpha_3 \sum \ln X_{2t} + \varepsilon_t \quad (1.3)$$

Elasticities and specific regression error terms can be correlated. In this case the usage of an OLS-estimator will generate inconsistent results due to heteroskedasticity or serial correlation in the error terms. First differences are taken in order to eliminate unobserved firm-specific effects, and we use lagged instruments to correct for simultaneity. However; unsatisfactory estimation can be resulting. This problem of weak estimation is related to weak correlation between the explanatory variables and the lagged levels of these variables (assuming that explanatory variables are persistent over time). This fact induces weak instruments in the context of the first-differenced GMM estimator (Arellano and Bond, 1991). A solution is provided by including more moment conditions under stationarity restrictions on the initial condition process.

Blundell and Bond (1998) propose to use of a system estimator that exploits moments through combining a level equation, which is using lagged first differences as instruments. Their proposed framework uses lagged first-differenced endogenous variables as instruments for equations in levels, in addition to the usual lagged level variables. Thus, temporal and cross sectional variation in the data can be exploited and unobserved cross-country heterogeneity can be controlled.

1.2.2.1. GMM Estimation

The Generalized Moments Methods (GMM) is a semi-parametrically efficient estimation method. The GMM methodology starts from a set of overidentified population of moment conditions and seeks to find an estimator that minimizes a quadratic norm of the sample moment vector. The resulting estimation has been shown to be consistent and asymptotically normal under many conditions.

Main underlying GMM assumptions to be mentioned are, that variations of initial conditions from their long-run values should be uncorrelated with their long run values. Furthermore, current or lagged changes in explanatory variables should not be correlated with individual effects.

Under these considerations the first differences of Eq. (1.3) are taken, which yields:

$$\Delta \ln E_t = \beta_1 \Delta \ln P_t + \beta_2 \Delta \ln y_t + \beta_3 \Delta \ln X_{2t} + \gamma \Delta \ln E_{t-1} + \Delta u_t \quad (1.4)$$

The choice of consistent instruments set the condition of correlation with $\Delta \ln E_{t-1}$, however not with the error terms Δu_t . Appropriate candidates are lagged values of the endogenous regressors (Arellano and Bond, 1991), that satisfy the moment conditions $E\{\Delta x_{it} \Delta u_{it}\} = 0$ for each t .

The models' instrument matrix can be described as¹:

$$Z_i = \begin{pmatrix} [y_{i0}, \Delta \ln P_{i2}, \Delta \ln y_{i2}, \Delta \ln X_{2i2}] & 0 & \dots & 0 \\ 0 & [y_{i0}, y_{i1}, \Delta \ln P_{i3}, \Delta \ln y_{i3}, \Delta \ln X_{2i3}] & & 0 \\ \vdots & & \dots & 0 \\ \vdots & & & 0 \\ 0 & \dots & 0 & [y_{i0}, \dots, y_{iT-2}, \Delta \ln P_{iT}, \Delta \ln y_{iT}, \Delta \ln X_{2iT}] \end{pmatrix}$$

The most efficient estimator is determined by the optimal weighting matrix.

$$W_n^{pot} = \left(\frac{1}{N} \sum_{i=1}^N Z_i' \Delta \hat{\varepsilon}_i \Delta \hat{\varepsilon}_i' Z_i \right)^{-1} \quad (1.5)$$

Under the assumption that autocorrelation is absent, the validity of the moments conditions is guaranteed. The optimal weighting matrix can be calculated by imposing the following restrictions on the error terms:

$$E\{\Delta \varepsilon_i \Delta \varepsilon_i'\} = \sigma_\varepsilon^2 G = \sigma_\varepsilon^2 \begin{pmatrix} 2 & -1 & 0 & \dots \\ -1 & 2 & \cdot & 0 \\ 0 & \cdot & \cdot & -1 \\ \cdot & 0 & -1 & 2 \end{pmatrix} \quad (1.6)$$

The consistency of instruments depends on their relevance and their validity. The relevance is determined by the correlation with endogenous variables, whereas, the validity of instruments depends on the orthogonality to the error terms. In order to apply the GMM estimator it is essential to test the absence of serial correlation in the differenced residuals. This test is known as the Arellano-Bond m2 test for second order serial correlation of differenced residuals. We implement this test as conventional AR(2) regression on the differenced residuals, which asymptotically provides the same results:

$$u_t = \rho u_{t-1} + \rho^2 u_{t-2} + \varepsilon_t \quad (1.7)$$

The correct specification is tested by the Sargan test of overidentifying restrictions. The

¹ (Verbeek, 2004, p. 365)

obtained statistic value is named as the J -statistic, which asymptotically follows the Chi-square distribution. Under the null hypothesis of validity of instruments, we reject this hypothesis if the obtained p-value is below the chosen significance level.

1.3 EMPIRICAL SPECIFICATION

Due to frequently missing values in almost all trade data and due to the flexibility of a GMM-framework, the application of unbalanced panel data analysis has been preferred.

The partial adjustment model describes the desired level of the electricity consumption E_t^* :

$$\ln E_t^* = \alpha_0 + \alpha_1 \ln P_t + \alpha_2 \ln y_t + \alpha_3 \ln X_{2t} \quad (1.8)$$

$$\ln E_t^* = \alpha_0 + \alpha_1 \ln P_t + \alpha_2 \ln y_t + \alpha_3 \ln M_{2t} \quad (1.9)$$

Equation (1.8) contains the export induced trade spillover variable and equation (1.9) the import induced one. These equations represent the desired demand function for electricity. The desired demand function is supposed to behave in a similar way to the current demand.

The short run adjustment process of electricity consumption is generated through a partial adjustment mechanism (PAM) model. The adjustment equation is given as follows:

$$\ln E_t - \ln E_{t-1} = \lambda(\ln E_t^* - \ln E_{t-1}) \quad (1.10)$$

Where, λ describes the short-run elasticity that can be regarded as the speed of adjustment for reaching the desired level of consumption. The actual change during a time period is described by $\ln E_t - \ln E_{t-1}$, and $(\ln E_t^* - \ln E_{t-1})$ reflects the desired change. The long-run adjustment mechanism can be computed by setting equal the desired demand and the actual demand. Therefore, Eq. (1.10) is rearranged as

$$\frac{\ln E_t - \ln E_{t-1}}{\lambda} + \ln E_{t-1} = \ln E_t^*$$

Substituting Eq. (1.8) or Eq. (1.9) for $\ln E_t^*$ yields:

$$\frac{\ln E_t - \ln E_{t-1}}{\lambda} + \ln E_{t-1} = \ln E_t^* = \alpha_0 + \alpha_1 \ln P_t + \alpha_2 \ln y_t + \alpha_3 \ln X_{2t} + \varepsilon_t$$

Rearranging gives:

$$\ln E_t - \ln E_{t-1} + \lambda \ln E_{t-1} = \lambda \alpha_0 + \lambda \alpha_1 \ln P_t + \lambda \alpha_2 \ln y_t + \lambda \alpha_3 \ln X_{2t} + \lambda \varepsilon_t$$

$$\ln E_t - (1 - \lambda) \ln E_{t-1} = \lambda \alpha_0 + \lambda \alpha_1 \ln P_t + \lambda \alpha_2 \ln y_t + \lambda \alpha_3 \ln X_{2t} + \lambda \varepsilon_t$$

$$\ln E_t = \lambda \alpha_0 + \lambda \alpha_1 \ln P_t + \lambda \alpha_2 \ln y_t + \lambda \alpha_3 \ln X_{2t} + (1 - \lambda) \ln E_{t-1} + \lambda \varepsilon_t \quad (1.11)$$

The new parameters and the new error term are obtained in the following way (Liu,2004: 5): $\beta_0 = \lambda \alpha_0$, $\beta_1 = \lambda \alpha_1$, $\beta_2 = \lambda \alpha_2$, $\beta_3 = \lambda \alpha_3$, $\gamma = 1 - \lambda$ and $u_t = \lambda \varepsilon_t$.

Substituting the new parameters into Eq. (1.11) gives:

$$\ln E_t = \beta_0 + \beta_1 \ln P_t + \beta_2 \ln y_t + \beta_3 \ln X_{2t} + \gamma \ln E_{t-1} + u_t \quad (1.12)$$

Now, the short-run and interim effects of a change in the real price can be easily obtained by taking the derivations of each variable for the period of interest (Liu,2004: 6):

$$\text{for the current period, } \frac{\partial y_t}{\partial P_t} = \beta_1, \text{ for two periods later } \frac{\partial y_{t+2}}{\partial P_t} = \gamma^2 \beta_1.$$

Finally, the geometric lag order structure gives following expression for the long-run elasticities:

$$\beta_1 + \gamma \beta_1 + \gamma^2 \beta_2 = \frac{\beta_1}{(1 - \gamma)} \quad (1.13)$$

1.4 EMPIRICAL RESULTS

The estimation results of the models together with standard statistics are reported in Table 1.2 for import and in Table 1.3 for export, respectively. In the illustration of the results we focus on the results of Model I, which prevails an overall higher significance in the relevant statistics and seems to be more consistent with the previous energy literature.

In a general evaluation it can be observed that the signs of coefficients are consistent with previous research on electricity or energy demand. In the case of residential electricity demand in Table 1.2 and in Table 1.3, price has a slight negative coefficient with weak significance. The coefficient for GDP is illustrated as positive with high significance. The residential import and export coefficients are small and exhibit only weak significance.

The coefficients for the industrial import estimation in Table 1.2 are all significant with expected signs. The counterparts in Table 1.3 follow the same pattern, except for the consumption parameter which indicates only weak significance.

The computed elasticities for the estimated models are presented in the tables from Table 1.4 to Table 1.7. Initially, it should be maintained that in all cases elasticities in the long-run are larger than in the short-run. Concerning the industrial sector, import elasticity (Table 1.4) has a slightly higher positive effect on electricity consumption than industrial export (Table 1.5). Residential income elasticity is more sensitive than industrial income elasticity (Table 1.4 and 1.5). Price elasticities are negative and exceptionally low for all residential specifications; industrial price elasticities are only somewhat higher about -0.05 per cent, but still negative. For all sectorial classifications income elasticity are positive and higher than price elasticity in magnitude, but still below unity, indicating an inelastic demand function. The adjustment parameter is about unity for residential import and export specifications; about 0.70 for industrial import and 0.86 for industrial export, respectively. In this context unity indicates an adjustment process of the parameters within one single period, which means a very rapid speed of adjustment to the long-run equilibrium.

The examined results are consistent with findings in different studies: industrial income elasticity is comparable to Nordhaus (1975), industrial price elasticity is similar to Liu (2004) and residential income elasticity supports findings in Kamerschen and Porter (2004).

Similarly to Haas and Schipper (1998), Lanzi and Roson (2007) and Duerick (2009), our research results suggest that income elasticities are higher than price elasticities in the residential sector.

Table 1.4 Elasticities including import spillover index for Model I

	Residential		Industrial	
	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>
Price	-0.0013 (insignificant)	-0.0013	-0.025	-0.036
Income	0.67	0.68	0.29	0.42
Import	0.0067	0.0067	0.017	0.025
γ	0.98		0.70	

Notes: Model I, GMM-estimation with first differenced cross-sections.

Table 1.5 Elasticities including export spillover index for Model I

	Residential		Industrial	
	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>
Price	-0.0076 (sign. at 10%-level)	-0.0077	-0.045566	-0.053
Income	0.69	0.70	0.470165	0.55
Export	0.0069	0.00695	0.011	0.013
γ	0.99		0.86	

Notes: Model I, GMM-estimation with first differenced cross-sections.

1.5 CONCLUSION

This study examines electricity consumption in industrial and residential sector for thirty OECD countries from 2000 to 2006. The methodology we used in the study consists of a GMM-estimated dynamic panel data approach applied on unbalanced data. In a further step a partial adjustment model is pursued to determine the short-run elasticities. In addition to previous studies on energy demand, we contribute findings for an industry specified trade induced spillover variable to the discussion on electricity demand elasticities. The findings of the study are in general consistent in sign and magnitude with the results in the energy demand literature; except for price elasticity in the residential sector which is exceptionally low.

The trade spillover variable elasticity exhibits a slight positive effect concerning imports, as well as exports. The positive import elasticity of electricity demand indicates necessities for intermediate products during the industrial production process. An increase in exports induces enhanced further production. The trade spillover effects in the residential sector on the other hand, are quite low and partly insignificant.

For sure taking additional data on electricity market would improve the efficiency of the model, when considering that we have supply and demand conditions on the electricity markets evolving over time. In addition, some different methodologies like Simultaneous Equations Model (SEM) can be applied.

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APPENDIX

Table 1.1 Literature survey

Study	Study period	Country-Energy sector	Short run price elasticity	Long run price elasticity	Short run income elasticity	Long run income elasticity	Methodology
Nordhaus (1975)	1955-	5 OECD-	(r)-0.423	(r) -0.836	(r) 0.588	(r) 1.032	Pooled ARDL
	1972	R, I	(i)-0.485	(i)-0.612	(i) 0.487	(i) 0.625	
Dubin, McFadden (1984)	1975	USA- R	R -0.310	R -0.197	R 0.008	R 0.028	OLS, IV
Haas,Schipper (1998)	1970-	10 OECD-	-0.05	-0.16	0.26	0.26	ARDL Panel approach
	1993	R	R -0.16	R -0.2	R 1.00	R 1.00	
Holtedahl and Joutz (2004)	1955-	Taiwan-					ECM
	1995	R	-0.22	-0.16	0.23	1.04	
Kamerschen porter (2004)	1973-		(r) -0.84		(r) 0.65		PAM, SEM
	1998	USA- R,I	(i) -0.35		(i) 0.23		
Liu (2004)	1978-		(r) -0.030	(r) -0.157	(r) 0.058	(r)0.303	PAM, ARDL
	1999	OECD- R,I	(i) -0.013	(i) -0.044	(i) 0.300	(i)1.035	
Narayan,Smyth, (2005)	1969-	Australia-					ECM
	2000	R	R -0.263	R -0.541	R 0.0.121	R 0.323	
Rapanos, Polemis (2006)	1965-						ECM
	1998	Greece- R	R -0.17	R -0.69	R 0.36	R 1.38	
Zachariadis, Pashaourtidou (2006)	1960-	Cyprus-	(r) -0.103	(r) -0.43	(r) -0.019	(r) 1.175	VECM
	2004	R, C	(c) -0.086	(c) -0.30	(c) 0.063	(c) 1.119	
Aldemyar hunt (2006)	1962-	15 OECD-					ARDL
	2003	I	(0.021)	-0.3	(0.777)	0.8	

Table 1.1 Continued

Study	Study period	Country-Energy sector	Short run price elasticity	Long run price elasticity	Short run income elasticity	Long run income elasticity	Methodology
Lanzi, Roson (2007)	1978-2000	31 world-R		-1.037		1.098	Fixed effect estimator,
Halicioglu (2007)	1968-2005	Turkey-R	-0.46	-0.63	0.40	0.54	ARDL, Cointegration
Dergiades, Tsoulfidis (2008)	1965-2006	USA-South R	-0.386	-1.0652	0.101	0.2728	ARDL, ECM
Sa'ad (2009)	1973-2007	Korea-R		-0.35		1.33	Structural Time series model
Duerinck (2009)	1990-2005	13 EU-R	-0.3876	-0.19	0.558	0.83	Cointegration, OLS
Nakajima, Hamori (2010)	1993-2008	USA-R	-0.33		0.38		DLOS, Cointegration
Ciarreta, Zarraga (2010)	1970-2007	12 EU-R	-0.0695		0.0687		GMM, Cointegration

Notes: Abbreviations we used in the table are as follows: R or (r), residential energy demand, I or (i), industrial energy demand, C or (c), commercial energy demand, ECM: Error Correction Model, VECM: Vector Error Correction Model, ARDL: Autoregressive Distributed Lag, PAM: Partial adjustment model, SEM: Simultaneous Equations model, IV: Instrumental Variable approach, GMM: Generalized Moments Method.

Table 1.2 Estimation results including import spillover index

Variable	Industrial		Residential	
	Model I	Model II Dummy	Model I	Model II Dummy
Consumption (-1)	0.299 (3.64)	0.033 (0.199)	0.011 (15.77)	0.035 (2.17)
Price	-0.025794 (-7.38)	-0.016 (0.058)	-0.0013 (-0.087)	-0.196 (-3.66)
GDP	0.29 (4.04)	2.17 (0.69)	0.68 (13.93)	0.66 (4.69)
Import	0.018 (6.057)	0.096 (0.016)	0.0067 (1.43)	0.0022 (0.22)
Period 2002	Dummy -	-0.096 (0.021)	-	0.017 (1.34)
Period 2003	Dummy -	-0.14 (0.047)	-	0.061 (2.92)
Period 2004	Dummy -	-0.21 (0.068)	-	0.081 (3.063)
Period 2005	Dummy -	-0.29 (0.099)	-	0.089 (3.11)
Period 2006	Dummy -	-0.32 (0.12)	-	0.10 (3.30)
S.E. of regression	0.051	0.066	0.051	0.052
SSR	0.21	0.34	0.34	0.33
J-statistic	12.84	14.79	21.17	14.61
Instrument rank	18	19	18	27

Notes: Model I, GMM-estimation with first differenced cross-sections. Model II, GMM-estimation with first differenced cross-sections and fixed periods.

Table 1.3 Estimation results including export spillover index

Variable	Industrial		Residential	
	Model I	Model II Dummy	Model I	Model II Dummy
Consumption (-1)	0.14 (1.36)	0.29 (4.0798)	0.011 (15.96)	0.019 (1.49)
Price	-0.046 (-3.38)	-0.0083 (-0.24)	-0.0077 (-0.49)	-0.22 (-4.13)
GDP	0.47 (6.42)	1.074 (9.18)	0.69 (14.42)	0.66 (4.93)
Export	0.011 (3.298)	0.021 (2.26)	0.0069 (1.58)	-0.0074 (-0.89)
Period Dummy	-	-0.031 (-2.61)	-	0.031 (2.58)
2002				
Period Dummy	-	-0.046 (-2.34)	-	0.083 (3.797)
2003				
Period Dummy	-	-0.078 (-2.95)	-	0.11 (3.77)
2004				
Period Dummy	-	-0.10 (-3.015)	-	0.12 (3.49)
2005				
Period Dummy	-	-0.13 (-3.36)	-	0.13 (3.46)
2006				
S.E. of regression	0.050	0.053	0.0514	0.052
SSR	0.29	0.301	0.335	0.328
J-statistic	14.77	22.42	21.49	16.0014
Instrument rank	18	25	18	27

Notes: Model I, GMM-estimation with first differenced cross-sections. Model II, GMM-estimation with first differenced cross-sections and fixed periods.

Table 1.6 Elasticities including import spillover index for Model II

	Residential		Industrial	
	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>
Price	-0.196	-0.20351934	-0.016 (insignificant)	-0.017
Income	0.66	0.68601487	2.17	2.24
Import	0.0022 (insignificant)	0.002279	0.095	0.099
γ	0.965		0.967 (insignificant)	

Notes: Model II, GMM-estimation with first differenced cross-sections and fixed periods.

Table 1.7 Elasticities including export spillover index for Model II

	Residential		Industrial	
	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>	<i>Short run</i> <i>elasticity</i>	<i>Long run</i> <i>elasticity</i>
Price	-0.221	-0.226	-0.0083 (insignificant)	-0.012
Income	0.663	0.677	1.074	1.501
Export	-0.0074 (insignificant)	-0.0075	0.021	0.029
γ	0.98 (insignificant)		0.715	

Notes: Model II, GMM-estimation with first differenced cross-sections and fixed periods.

CHAPTER 2

MEASURING CENTRAL BANK INTERVENTION EFFECTIVENESS FROM ENDOGENOUS POLICY PREFERENCES

ABSTRACT

Central Bank interventions are analyzed from an endogenous perspective in order to determine the effectiveness of monetary policy instruments for the period 1987-2009 in Turkey. A special interest in this context is given to central bank preferences, which are obtained from the underlying macroeconomic structure by utilizing a SEM framework. A further step consists of a Value at Risk approach, that is used to determine excessive volatility in the relevant policy instruments, endogenously. The SEM framework results indicate that the Central Bank of Republic of Turkey (CBRT)'s preferences changed for two subsample periods, 1987-2000 and 2001-2009. The weight on interest rate smoothing becomes significantly positive in the second period, which suggests an effective role of the CBRT in monetary policy. Controlling for excessive volatility in the exchange rate and the inflation rate improves the results in size and significance. Further, a survival analysis model is examined, that identifies the most significant explanatory variables for policy effectiveness.

Keywords: *Central Bank Policy, Monetary Interventions, GARCH, Financial Crisis*

2.1 INTRODUCTION

2.1.1 Background

The Turkish economy has suffered from hyperinflation in the 80's, 90's, and in the first years after the millennium. The excessive inflation phenomenon has determined the proper working of the Turkish economy in these years (See Figure 2.1). This macroeconomic basis constituted a great challenge for the monetary policy and its smooth functioning. The start up of a newly formed open economy, after the military regime, was confronted to severe structural macroeconomic problems: exorbitant interest rates, a high debt level, and the malfunction of the financial sector were main factors that raised periodically economic crises².

After assigning the IMF stand-by agreement at the end of 1999, the Central Bank of Republic of Turkey (CBRT) has announced its monetary policy principles. A proactive role was assigned to monetary policy, based on reduced rate of exchange rate depreciation in line with the targeted inflation, providing a nominal anchor for inflationary expectations. The exchange rate commitment was supported by strong fiscal adjustment and consistent income policies in the public sector.³

Despite the IMF stand-by agreement, the great financial crisis aroused in 2001, accounting for a negative GDP growth of about -9,4% and a 28,2% decline in the volume of real credit growth. This painful experience provoked the constitution of a new structural program for the economy, especially in the financial sector. The structural reformation program compassed several issues⁴: financial sector restructuring, increasing transparency in the public sector and strengthening of the public financing, enhancing the competitiveness and efficiency of the economy, and strengthening social solidarity. The outcome comprises a lower inflation rate, stabilization in GDP growth, lowered indebtedness level, and more recently a sound level of real interest rate.

The motivation of this research chapter is to show empirically, the extent to which this macroeconomic development is reflected in the monetary preferences of the CBRT. From

² See Dervis et al. (1981) for a description of the growth strategy provided for the Turkish economy.

³ Ozutku (2004, p. 6)

⁴ See www.tcmb.gov.tr/yeni/duyuru/eko_program for a detailed description of the reformation program.

an endogenous perspective, the effectiveness of monetary policy instruments is analyzed. The analysis straightens out the effects of excessive volatility in the interest rate, in the exchange rate, and in the inflation rate on the central bank's monetary preferences. The central bank's *deep* preferences are determined from an underlying macroeconomic structure on the basis of a loss function in a Taylor rule style with flexible inflation targeting. Afterwards, the effectiveness of endogenous and historical interventions are compared through the application of various GARCH model specifications.

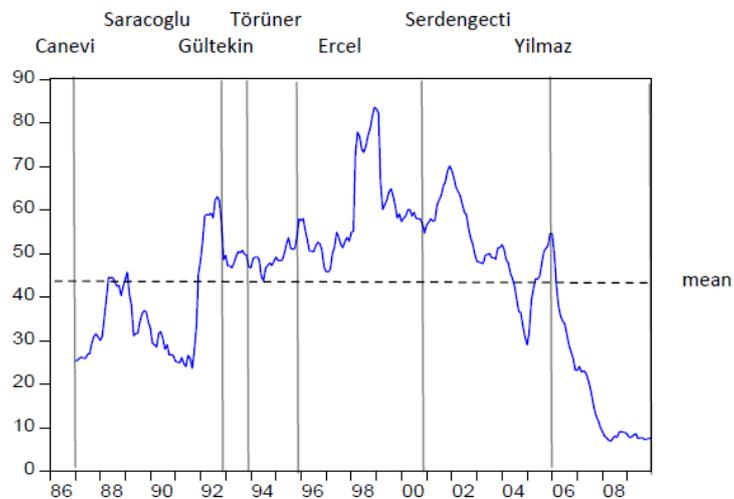


Figure 2.1. Inflation rate. The inflation rate under the incumbent central bank governors is illustrated for the period 1986-2009.

2.1.2 Literature Review

The effectiveness of central bank interventions is discussed extensively over the last 30 years.⁵ The empirical evaluation of the effectiveness of official intervention has been pursued through case study methods and number of time series models. In the related research literature, efficiency is defined in means of short-term and long-term reversal of the trend after a certain intervention episode.⁶ Concerning the time series approach, efficiency of exchange rate interventions are tested under the hypothesis that interventions generate either higher volatility or lower volatility. With this purpose, various GARCH specifications under controversially discussed error terms distributions are preferred methods to gather information about the exchange rate intervention impacts.

⁵ See Raymond et al. (2006) for detailed evaluation of the literature.

⁶ Edison et al. (2003)

A pioneering research in the times series approach for monetary intervention effectiveness is accomplished by Dominguez (1998), who investigates intervention policies for the dollar/mark and dollar/yen exchange rates over the period 1977-1994 in Germany, USA and Japan. Dominguez applies a maximum-likelihood estimated a GARCH (1,1) approach to model the change in exchange rates. She includes reported and secret exchange rate interventions, interest rate spreads as explanatory variables; and holiday, week, and exchange rate policy news as dummy variables. The findings suggest that changes in the monetary and intervention policy mostly influenced exchange rate daily and long-term volatility positively.

In addition to a GARCH model similar to Dominguez (1998), Nydahl et al. (2000) propose to model implied volatility from currency options which allows for moderate problems due to the sample size and sudden shifts in the volatility for the Swedish krona /Us-dollar and Swedish krona /German mark over the years 1993-1996.

Due to its ability to account for asymmetry in the intervention effects, EGARCH specifications are widely used in the literature. Booth et al. (2000) analyze the effects of monetary interventions in the German discount and interest rate on the Euro/German mark exchange rate during 1987- 93. Kim et al. (2000) investigate the key characteristics of foreign exchange intervention by the Australian central bank during 1983-1997. They separate the sample in five subsamples according to the size of intervention, whether the intervention is unique or part of a series, and whether they are public or secret.

Bradner et al. (2001) investigate the effects of monetary German mark exchange rate interventions in the EMS conducted by six European central banks during the period 1993-1998. The authors apply EGARCH and three Markov switching regime (MSARCH) models to show the effects on the conditional means and variances. MS-ARCH models do not enhance significance of the estimation results. In line with empirical literature about the impact of interventions, most of the estimated interventions are not significant for both methods.

Mendoza and Domac (2004) accomplish an EGARCH model to study the effects of foreign

exchange intervention under the adoption of inflation targeting in Mexico and Turkey. They utilize a double exponential distribution for the error terms. They distinguish the effects of sale and purchase operations. Sale operations indicate to appreciate the home country currency significantly, whereas purchase operations are insignificant. They contend the view that interventions render to be useful in stabilization of the volatility under the condition not to target a certain exchange rate level, within an inflation targeting framework interventions are useful to smooth the adverse effects of temporary exchange rate shocks on inflation and stability. However, the result is only significant in the case of sale operations.

Saatcioglu et al. (2007) utilize an EGARCH model for the intervention impacts in Turkey the post-crisis period from 2001 to 2006. They nest a news impact curve into the variance term which allows analyzing foreign investors' expectation concerning the exchange rate evolution. The outcome is an asymmetric behavior of the news shocks: the conditional variance of the exchange rate shows a greater sensitivity to previous positive shocks (appreciation) than to negative shocks (depreciation). Thus, they follow that an unanticipated increase in the exchange rate generates a higher level of uncertainty.

The introduced simultaneous equations model (SEM) attempts to describe the macroeconomic structural change from the perspective of endogenous policy preferences. The methodology follows the approach applied by Rudebusch and Svensson (1998). Dennis (2004) argues “..., *the key reason why optimal policies fail to adequately explain interest rate movements is that the policy objective function is invariably parameterized without reference to the data.*” Rudebusch and Svensson (1998) describe the Taylor rule as an outcome of an intertemporal optimization problem and estimate the preferences under a macroeconomic demand and a supply function. Due to the intertemporal optimization methodology, the cited criticism can be circumvented. Applying a similar intertemporal optimization approach, Cecchetti et al. (2002) examine the relative importance of output and inflation variability in the policymakers' objective functions. They evaluate the changes of the central bank's preferences under the participation to a monetary union, where the output is assumed to be an independent variable in the objective function. Favero and Rovelli (2002) apply a simpler version of the Rudebusch-Svensson approach

for the Federal Reserve. They compare the monetary policy and the central bank preferences for the Volcker and Greenspan periods. A significant change in the inflation target for the Greenspan era is being observed. Dennis (2004) utilizes a similar methodology as Rudebusch and Svensson (1998) to estimate the parameters in the Federal Reserve's policy objective function during the Volcker and Greenspan periods. Similarly to previous research, he reports significant results for inflation targeting. Another comparable research with Taylor rule optimization is pursued by Rodriguez (2008). He analyzes the monetary authorities' preferences in subsamples, distinguishing between hyperinflation period and moderate inflation periods in Peru. The results prognosticate that different regimes convey different sensitivities in monetary policy.

The chapter is organized as follows: In section 2.2 the model utilizes a GMM-estimated SEM framework to determine monetary policy preferences expressed in a Taylor rule style. A further step consists of a Value at Risk approach (VaR) that is used to endogenously determine excessive volatility in the relevant policy instruments. In Section 2.3 the obtained results are presented. Section 2.4 provides a survival analysis model that identifies the most significant explanatory variables for policy effectiveness. Section 2.5 constructs an institutional governance index on the basis of the obtained results and is introduced into the previous SEM framework. Various GARCH model specifications in Section 2.6 examine the effectiveness of central bank interventions with daily frequency of the exchange rate. Section 2.7 discusses the obtained results. The chapter ends with a conclusion in Section 2.8.

2.2 Endogenous Preferences Determination

In order to test the hypothesis of interest rate smoothing and the effect on output stabilization in our model, we choose a flexible inflation targeting. This is justified when concerning that, following a high inflation rate era since the late 80's, Turkey began to pursue an inflation targeting after 2006 under a floating exchange rate regime. As the parameters cannot be observed explicitly, the endogenous determination of the *deep* parameters requires developing an implicit estimation of the monetary variables⁷. In this

⁷ Favero (2002, p. 548)

context, the endogenous policy parameters should deliver a general macroeconomic orientation for the analysis of monetary intervention.

2.2.1. Data

The data sample spans the period from 1987 to 2009 with monthly frequency for Turkey. The time series for each variable, namely, the industrial production, the consumer price index, the buying Turkish Lira/US Dollar exchange rate, and the short term interest rate are taken from the Turkish Central Bank database⁸. The IMF commodity price index time series is obtained from the IMF Financial Statistics database. The output gap is calculated as the percentage deviation of industrial production from its trend value, which is obtained by the Hodrick–Prescott filter with a weight of 1600 for monthly data. The inflation rate is calculated as the annual logarithmic differential of the consumer price index, . Since the considered series exhibit a nonstationary pattern in general, the differential or the logarithmic differentials of the related variables are utilized in the applied models.

As an interesting pattern in the data, it should be noted that the average inflation rate has declined from 72% in 1987-2000 to around 20% in 2000-2009. The IMF supported disinflation program and the restructuring initiative in the financial sector, after the traumatic crisis in the financial sector in 2001, has been identified as the break point, which divides the subsample periods. Further, the post crisis era represents the institutionalization of the financial sector, which has affected the macroeconomic stability after 2001.

⁸ The data is available at evds.tcmb.gov.tr

2.2.2. Model

2.2.2.1. Endogenous monetary preferences

The central bank preferences are described by an intertemporal loss function⁹ :

$$E_t \sum_{i=0}^{\infty} \delta^i L_{t+i} \quad (2.1)$$

and

$$L = \frac{1}{2} [(\pi_t - \pi^*)^2 + \lambda x_t^2 + \mu (i_t - i_{t-1})^2] \quad (2.2)$$

The equations contain following variables: δ , intertemporal discount factor, π , inflation rate, π^* , target inflation rate, λ , the weight attached to the output stabilization, and μ , the weight on interest rate smoothing.

The loss function (2.2) represents the central bank's reaction function. At the same time, it characterizes the central bank policy preferences and objectives in the context of monetary policy rules. We follow Taylor (1993) to describe the central bank's reaction function, which has been the common practice in empirical analysis¹⁰. The loss function contains an inflation targeting term, an output stabilization term, and an interest rate smoothing term; while, a special case is provided by strict inflation targeting with ($\mu = \lambda = 0$). The solution of the model is provided by an intertemporal optimization of the loss function subject to the aggregate demand (*IS curve*) and supply function (*Phillips curve*). The small macroeconomic model is constructed by determining the specific lag order, which is the result of a vector autoregressive model (VAR)¹¹. The VAR model with Cholesky decomposition is consisting of inflation rate, output gap, interest rate and the world IMF inflation rate as a super exogenous variable, which is accounting for a leading factor of inflation rate¹².

⁹ See Rudebusch and Svensson (1998)

¹⁰ One reason why the Taylor rule has been preferred is for the sake of its simplicity in formulation and accountability as Kydland and Prescott (1977, p.487) points out: *"In a democratic society, it is probably preferable that selected rules be simple and easily understood, so it is obvious when a policymaker deviates from the policy."*

¹¹ For the discussion of the VAR model we refer to Christiano et al. (1998), who give a detailed illustration and interpretation of VAR models in monetary policy.

¹² The vectorautoregressive specification is neglected in order to leave space for the presentation of the core

Once the VAR model is applied and insignificant lags for each variable are omitted, the supply and demand function is stylized by:

$$\begin{aligned}x_t &= c_1 x_{t-1} + c_2 (i_{t-1} - \pi_{t-1}) + u_t^d \\ \pi_t &= c_3 \pi_{t-1} + c_4 x_{t-1} + c_5 x_{t-2} + u_t^s\end{aligned}\quad (2.3)$$

Similar to Favero and Rovelli (2002), we apply an Euler equation to solve the (*first order*) optimization problem, by making use of its transversality property (see Eq. 2.2.4). The Euler equation captures the dynamics of intertemporal optimization under certain constraints¹³.

$$\begin{aligned}x_t &= c_1 x_{t-1} + c_2 x_{t-2} + c_3 x_{t-3} + c_4 (i_{t-2} - \bar{\pi}_{t-2}) + u_t^d \\ \pi_t &= c_5 + c_6 \pi_{t-1} + (1 - c_6) \pi_{t-2} + c_8 x_{t-3} + c_9 (i_{t-1} - \bar{\pi}_{t-1}) + c_{15} \Delta lcimf_{t-1} + u_t^s \\ 0 &= (i_t - i_{t-1}) \mu - (i_{t+1} - i_t) \delta \mu + \delta^3 c_9 c_4 E_{t-1} [(\pi_{t+3} - \pi^*) + \delta (\pi_{t+4} - \pi^*)] \\ &+ \lambda \delta^2 c_4 E_{t-1} [x_{t+2} + \delta c_1 x_{t+3} + \delta (c_1^2 + c_2 c_1) x_{t+4}] + u_t^m\end{aligned}\quad (2.4)$$

The model variables are given as follows: x_t , relative gap between actual and potential industrial output with applied Hodrick-Prescott filter in percentage points, π_t , annual inflation in the GDP chain-weighted price index (in percentage points), $i_t - \bar{\pi}_t$, short-term real interest rate, and $\Delta lcimf$, IMF commodity price index (annual growth rate in percentage points) to account for the international price level. The discount factor, which indicates the time preference, is chosen as 0,95. The third equation in equation (2.2.4) is the optimization outcome of the model. It can be considered as the monetary authorities' policy rule. Under this model construction the motivation is to estimate the structure of the economy, and simultaneously, to mimic central bank's preferences from its behavior.

model and its results.

¹³ For illustration of the Euler function, see Favero and Rovelli (2002, p.554). The utilized restrictions on the Euler function are given in the Appendix.

2.2.2.2. Endogenous determination of monetary interventions

We hypothesize that the monetary authorities are motivated use their monetary policy instruments to stimulate overall macroeconomic stability, and furthermore to cope with fluctuations, such as in the currency markets. Departing from this standpoint, each excessive fluctuation in the related policy variable has to be regarded as a circumstance, which requires potential policy action or intervention. For this purpose, the effectiveness of endogenously determined hypothetical policy interventions on endogenous macroeconomic preferences is analyzed. The endogenous determination procedure is conducted through a Value at Risk (VaR) framework that examines excessive volatility in the exchange rate, the interest rate, and the inflation rate.

$$Y_t = c_0 + c_1 Y_{t-1} + \varepsilon_t$$
$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (2.5)$$

For each excessive volatility date one dummy variable is matched, which is obtained from a GARCH-estimated Value at Risk (VaR) framework. The GARCH specification is selected as a rudimentary AR(1)-GARCH(1,1) model, which fulfills the criteria for a stationary process and accounts for heteroskedasticity¹⁴ (see Eq. 2.2.5). The results for each GARCH specification are presented in Table 1.5. Following the VaR estimation approach as described i.e. by Best (1998), we determine exception time periods, in which the VaR-predicted volatility is exceeded by the realized volatility in the following period. The estimation is conducted on the basis of a one standard deviation confidence level. Subsequently, the obtained exception periods are used to constitute a time series of dummy variables, which takes the value ‘1’ for volatility excess and ‘0’ otherwise. These dummy variable series are built for the inflation rate differential, the interest rate differential, and the exchange rate differential¹⁵. Afterwards, the dummy series are introduced into the Simultaneous Equation model (SEM) that mimics the macroeconomic dynamics of the economy. Section 2.3 presents the results for each specification of the model.

¹⁴ The procedure contains conventional tests, such as LM test, Ljung Box test, and squared residuals. The differential logarithms are taken for the dependent variables. The model for the exchange rate and the inflation rate follow a student’s t distribution, the model in the case of interest rate exhibits a generalized error distribution in order to cope with non-normality in the data.

¹⁵ The numbers of the obtained dummy variable observations are as follows: 45 negative and 30 positive excesses in the inflation rate, 21 negative and 23 positive excesses in interest rate, 23 negative and 17 positive excesses in the exchange rate.

2.3 Results

The initial model is estimated according to the model described in subsection 2.2.2.1¹⁶.

Table 2.1 SEM estimation results with subsamples

	Sample 1987-2009	P value	Subsample 1987-2000	P value	Subsample 2000-2009	P value
c_1	1.265074	0.0000	1.148196	0.0000	0.737748	0.0000
c_2	-0.084959	0.5575	-0.038006	0.5667	0.132076	0.0000
c_3	-0.347891	0.0002	-0.500199	0.0000	-0.092692	0.0000
c_4	-0.0000877	0.0022	0.0000911	0.1045	-0.001318	0.0000
c_5	0.526425	0.1427	2.908541	0.0000	0.053583	0.4651
c_6	1.453909	0.0000	1.336679	0.0000	1.685742	0.0000
c_8	-0.016545	0.0268	-0.044710	0.0000	-0.004682	0.0012
c_9	-0.066181	0.0006	0.018391	0.1100	-0.037821	0.0000
c_{15}	35.06485	0.0002	-59.64857	0.0000	-2.381816	0.0018
π^*	44.77599	0.0000	48.78558	0.0000	39.21710	0.0000
λ	0.024175	0.0269	-0.002612	0.0666	-0.013520	0.0000
μ	-0.00000324	0.0504	-0.00000129	0.0000	0.0000483	0.0000
$\sigma(u^d)$	8.978643		9.094165		6.725578	
$\sigma(u^s)$	2.661115		2.872596		1.586995	
<i>J statistic</i>	0.191487		0.238314		0.254986	

Note: The GMM-instrument list is chosen as: constant term, various lags of output gap, external inflation rate, inflation rate, interest rate, real interest rate, and exchange rate. The *J* statistic measures the validity of the model, and whether the moment conditions match the data well or not.

In Table 2.1 it can be observed that the weight on output stabilization, λ , is significantly positive about 0.0241. The target inflation is about 44.78% and positive at a 5%

¹⁶ The SEM framework is primarily solved via a three lag Newey-West estimation of the covarinace matrix.

confidence-level. The weight on interest rate smoothing, μ , is negative and significant at a 10%-level, indicating that no interest rate smoothing by the CBRT can be observed for the sample period. Further, in Table 2.1 the sample period is divided into two subsample periods 1987:09-2000:05 and 2000:6-2008:12.

The weight on output stabilization, λ , is negative in both subsample periods. The parameter on interest rate smoothing, μ , increases from $-1.29 \cdot 10^{-6}$ to $4.83 \cdot 10^{-5}$. This gives some indication that the interest rate decisions signal a lower level of discretion in the second period. Although the estimated parameters for interest rate smoothing are very small, it would not be correct to assume that they are irrelevant. In particular, if $\mu = 0$, the central bank would have used interest rates much more actively (*higher degree of discretion*), in order to reach its goals¹⁷.

A further key issue in Table 2.1 is that the implicit inflation target, decreases significantly from 48,8% to 39,2%. The same trend is evident in the interest rate, which, comparatively to the first sample period, decreases by about 32% in the latter period (See Figure 2.3).

The standard deviation of supply and demand shocks decrease both in the period from 2000 to 2009, by 45% and 26% vice versa (see Table 2.1). Beside cyclical macroeconomic effects, it can be argued that the effectiveness of monetary policy for the second period has been improved. In the next subsections, the model results are presented for the case, when endogenously determined dummy variable are included.

2.3.1 Exchange rate effects

Table 2.2 contains the results for the exchange rate excessive dummies, which are determined by the VaR estimation. The positive exchange rate dummy model has a more significant impact on μ compared to the initial solutions in Table 2.1. The negative exchange rate dummy variable induces a slight lower target inflation value; about 45% (see Table 2.2). Both excess types coincide with increased values in the relevant variables. However, the simultaneous inclusion of positive and negative dummies induces an

¹⁷ Favero and Rovelli (2002, p. 550)

insignificant value for output stabilization. The dummy variable coefficient is positive, about 1,03, at a high significance level (see Table 2.2).

Positive and negative excesses in the exchange rate mean currency depreciation and appreciation. Thus, it can be contested that exchange rate stabilization on a *sound* equilibrium level should significantly contribute to stabilization in the monetary policy variables.

2.3.2 Inflation rate effects

The model results with included excessive volatility dummies in the inflation rate are presented in the Table 2.3. In the case of negative inflation rate dummy variable, μ is insignificant, λ is increased in size, about 0,0308, compared to the initial results. The introduction of the positive inflation rate dummy makes λ lower, about 0,021 at a 5% confidence level compared to the initial model, and μ becomes slightly positive, about 0,0000121. When including positive and negative dummies simultaneously, μ turns out to be insignificant, λ is placed near the equilibrium rate at a 5% confidence level as in the initial results. By controlling for excessive inflation, the weight on output stabilization is strengthened.

2.3.3 Interest rate effects

The model results with included excessive volatility dummies in the interest rate are presented in the Table 2.4. Positive and negative excess dummy variables render all coefficients positive, where μ is insignificant at a 10% confidence level. Positive interest rate dummies make μ weak in coefficient size and significance, λ is higher than the initial results in Table 2.1, about 0,016 at a 10% confidence level. In the case of negative interest rate dummy variables, the results are significant at a 10% confidence level with slightly more weight on output stabilization than in the original solutions. The coefficients for the dummy variables deliver significant results; provided that the excess variables are introduced separately (see Table 2.4).

2.4 Measuring effectiveness of endogenous policy- Survival analysis

This section provides an estimation method that accounts for institutional determinants of a monetary intervention. For this purpose a survival analysis is conducted and estimated by a Cox regression. As estimation method an exact partial-likelihood estimator is applied.

On the basis of endogenous determined interventions in section 2.2.2.2¹⁸, we consider each intervention duration as a single identity that has to be researched. Some basic terms of survival analysis are to be adapted to our research topics¹⁹. This analogy to a biostatistical approach is constructed in terms of duration, which encompasses the interval from an intervention date until the occurrence of a new intervention. Hence, the duration of an intervention indicates how long an intervention has been effective in moderating the exchange volatility. In other terms, the hazard rate measures, when it is likely, that the central bank considers intervening due to excessive volatility or extreme trends in the exchange rate.

2.4.1 Duration model

The basic quantity in survival analysis is the hazard rate. The hazard rate is the ratio of conditional probability for the event to occur within a certain time interval, given the realization of T :

$$h(t) = \lim_{dt \rightarrow 0} \frac{\Pr\{t \leq T < t + dt \mid T \geq t\}}{dt} \quad (2.6)$$

For continuous random variables, the cumulative hazard function is expressed as the integral of the hazard rate:

$$H(t) = \int_0^t h(u) du$$

The hazard rate can also be written in terms of a survival function:

¹⁸ The endogenous interventions are estimated by a GARCH at on standard deviation confidence level.

¹⁹ For illustration of economic adaption see Lancaster (1979) .

$$h(t) = \frac{f(t)}{S(t)} = \frac{f(t)}{1 - F(t)} = -\frac{d}{dt} \{\log S(t)\} \quad (2.7)$$

The relationship between the cumulative hazard function and the survival function is as follows: $S(t) = \exp\{-H(t)\}$ or $H(t) = -\log S(t)$. The hazard rate can be perceived as speed of change, a large hazard rate value means fast change. Most commonly the hazard function is described as the cumulative hazard rate.

2.4.1.1 Construction of the spells

The spells are constructed as the period from one endogenous exception date to the next endogenous exception date. In the case of empirical variables, the summation of the variable values is built within the spell length. The variable for government style takes the value 0 in the case of a coalition government and 1 in the case of a one-party government. The explanatory variable for the central bank governor is constructed for each governor separately with value 1 for the corresponding period.

2.4.2 Descriptive Analysis

2.4.2.1. Kaplan Meier Estimation

A non parametric approach of the hazard rate provides initial results for the survival analysis and be regarded as a source of descriptive information. In Figure 2.5 the Kaplan-Meier survival estimation of the data is illustrated²⁰. The results indicate that half of the duration is still alive after 5 months; 25 per cent of interventions still continue their duration after 10 months.

2.4.2.2. Smoothed Hazard rate

Figure 2.6 illustrates the smoothed hazard rate for the data²¹. The smoothed hazard rate for 6 months is 15 per cent and 13,5 per cent for 18 months. The smoothed hazard estimate

²⁰ The y-axis is showing the cumulative hazard function and time is given on the x-axis.

²¹ Note that the smoothed hazard rate has a faster convergence than the conventional hazard rate.

indicates that the probability of a great turbulence that requires a monetary intervention on the exchange rate occurs once a year.

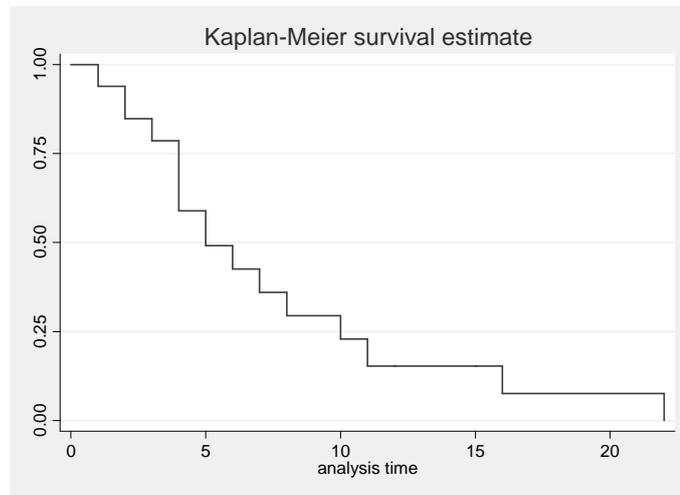


Figure 2.5 Kaplan-Meier estimation function. Y-axis is showing the cumulative hazard function and time is given on the x-axis.

The function has a two peaked shape that shows time-varying sensitivity of intervention durations. Interventions seem to exhibit a short term and a long term property²². After 5 months, half of the interventions are still to be undertaken. However, as the smoothed hazard estimates show, right after 5 month and 12 months later, the probability of occurrence is again higher. So, concerning the intervention hazard rate, an unequal distribution is given .

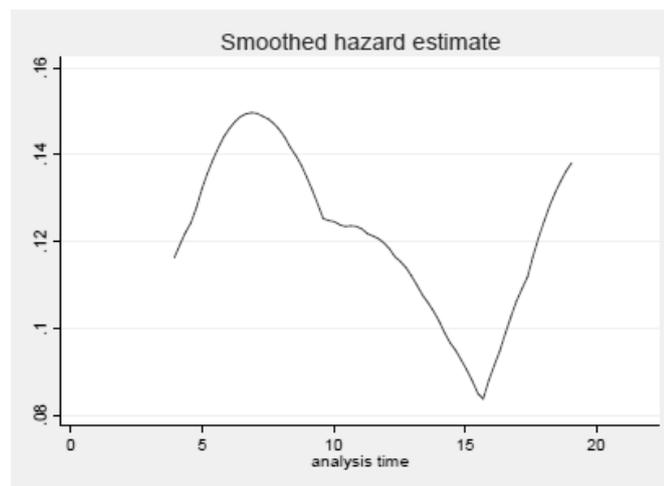


Figure 2.6. Smoothed hazard estimation function. X-axis indicates analysis time and y-axis, the conditional probability.

²² In this context, it should be kept in mind, that interventions appear to be the most rigorous measure to implement policy and the most drastic measure to avoid serious harm from the general economy.

2.4.3 Cox regression

The Cox-regression that is used in the model is estimated by the exact partial log likelihood function. The partial likelihood estimation does not depend on assumptions about the shape of the baseline hazard functions²³. Equation (2.8) describes the exact partial likelihood estimator:

$$\log L = \sum_{j=1}^D \left[\sum_{i \in D_j} x_i \beta - d_j \log \left\{ \sum_{k \in R_j} \exp(x_k \beta) \right\} \right] \quad (2.8)$$

The survivor function that is built in the case of exact partial likelihood function is given in equation (2.9):

$$\log L_{epf} = \prod_{i=1}^m \frac{e^{x^{(i)}, \beta}}{\prod_{k=1}^d \left[\sum_{j \in r(t_{(i\#)})} e^{x_i j} - \frac{k-1}{d_i} \sum_{j \in D(t_{(i)})} e^{x_i \beta} \right]} \quad (2.9)$$

Various models with combinations of the following variables are estimated: government style, central bank governors, industrial output, money supply and monetary reserves. The most significant model is chosen according to the LR-test and the p-values for the variable coefficients (See Table 2.6).

Table 2.6 Cox regression results for the period 1986-2009

	Hazard Rate	Standard Error	Probability	Log Likelihood
CANEVI	$2.13 \cdot 10^{-12}$	$7.63 \cdot 10^{-12}$	0.000	-51.9093
SARACOGLU	$3.48 \cdot 10^{-12}$	$1.28 \cdot 10^{-11}$	0.000	
TÖRÜNER	$4.55 \cdot 10^{-12}$	$1.71 \cdot 10^{-11}$	0.000	LR chi-square(7)
SERDENGECTI	$4.03 \cdot 10^{-11}$	$1.01 \cdot 10^{-10}$	0.000	14.30
YILMAZ	$5.86 \cdot 10^{-11}$	-	-	
Industrial Output	1.042	0.054	0.430	Probability > chi-square
Money Supply	1	$4.99 \cdot 10^{-9}$	0.028	0.0461
Monetary Reserves	0.999	0.0002	0.044	Observations 33

²³ See Kiefer (1988) for discussion of economic duration models.

In the case of Turkey the central bank governors, the monetary aggregate variable and the reserve variable are significant at a 5% level. All other variables do not deliver significant results. The LR-test shows a significant result at 5% level. This indicates that the included variables overall the model are significantly estimated. The monetary aggregate variable has a hazard rate of 1, which illustrates that a 1 percentage unit change in money supply does not enhance the risk of an exchange intervention. Although it is a significant variable in determining an exchange rate intervention, it does not contribute to an increase of risk. The industrial production variable shows a hazard rate of about 1.0422. Thus, a 1 percentage unit growth in the industrial production will increase the risk of an exchange rate intervention by 4.22 per cent. In other words, the survival time will decrease by 4.22 per cent. However, the variable is not significant. The monetary reserve variable shows a hazard rate of about 0.9995948. Thus, a 1 unit upward change in the reserves will slightly decrease the risk of a hypothetical exchange rate intervention by 0.040502 per cent in the next period (here, it is a month). So, the monetary reserves and the money supply should deliver further appropriate results, when estimating the intervention dates.

2.5 Institutional Governance Effect

2.5.1 Governance Index

This section develops an institutional governance index on the basis of the survival analysis and examines its effects on monetary policy. The exchange rate intervention is underlying a decision process in the central bank. Therefore, the analyses concerning the effectiveness of monetary interventions should be measured under a governance influence in order to gain some new information concerning the dynamics of exchange rate interventions.

The Central Bank Governance Index is described as follows:

$$\sum_{i=1}^T [m_i + n_i]^\psi \quad (2.10)$$

Where, m , denotes the central bank's reserve assets, n , money supply, ψ , governance

scala ranging between 0 and 1. The governance scala is the turnover score described by De Haan and Eijffinger (1996)²⁴.

2.5.2 Empirical results

In order to test the governance effects on the central bank policy preferences, the constructed governance index is introduced into the model in section 2.2.2.1. As it can be seen from the coefficient in the supply function the governance index contributes significantly to lower the inflation rate (Table 2.7). Another point is that the weight for interest rate smoothing becomes significant and positive around 0,0000161 compared to the original model results in Table 2.1. The results in the case when the index is included in the supply and as well as the demand function indicate that the weight on interest rate smoothing becomes larger and more significant than in the previous case (Table 2.7).

2.6 Estimating effect of intervention on exchange rate volatility

The effect of monetary interventions is analyzed under different GARCH model specifications. Daily frequent data for US Dollar/Turkish Lira exchange rate is used to enable a more focused view on intervention effects. The several specifications allow for analyzing the results from different perspective. Additional features in the GARCH model specification are assumed to deliver diverse information about the intervention effectiveness. Another motivation is to examine the outcomes on the basis of theoretical predictions of the monetary theory. The results are presented in next subsections.

2.6.1 Historical exchange rate interventions

The intervention data spans the sample period between 2002 and 2006. The intervention dates are published official dates and are taken from the CBRT's database. The dummy variables are identified as interventions, whenever a purchase or a sale of monetary reserves (in US dollars) occurred, purchases, for purchase of US Dollars, and sell, for the sale of US Dollars. For each GARCH model only the specifications with the highest values

²⁴ Turnover ratio is determined as the reciproke number of central bank governors during the period of interest, see De Haan and Eijffinger (1996).

for the decision criteria are selected.

2.6.1.1 GARCH

$$Y_t = X_t' \theta + \varepsilon_t$$

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (2.11)$$

The results based on a GARCH(1,1) specification are as follows. The AR(1)-GARCH model with intervention dummy exhibits 0.0000606 a positive sign at a 10% confidence level in the variance equation (Table 2.8, Model 1). On the mean equation basis the intervention is insignificant. The same model is applied with purchases and sells as two separate variables in the variance equation: the sell variable is insignificant; purchases give a positive result $5.38 \cdot 10^{-5}$ at a 10% significance level (Table 2.8, Model 2). The separate inclusion of purchase dummy and the intervention dummy variable does not give any significant result for the related variable in the mean equation (Table 2.8, Model 3). The inclusion of the sell dummy variable in addition to the intervention variable shows a positive result 0.0000533 at a 10% confidence level for the mean equation (Table 2.8, Model 4).

2.6.1.2 EGARCH

$$\log \sigma_t^2 = \omega + \beta \log(\sigma_{t-1}^2) + \alpha_1 \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad (2.12)$$

AR(1)-EGARCH(1,1) model prevails following results: the intervention variable in the variance equation has a relatively strong positive sign 0.632368 and is significant; the results in the level equation, however, are insignificant (Table 2.9, Model 1).

The same model is applied with purchases and sells as two separate variables (Table 2.9, Model 2): the purchase variable gives a positive result 0.564293 and the sells variable is about 0.711359 at 10% significance level in the variance equation.

The separate inclusion of the purchase dummy and the intervention dummy does not give any significant result for the purchase variable and a positive sign 0.711357 for intervention at 10% significance level (Table 2.9, Model 3).

The inclusion of the sell dummy variable in addition to the intervention variable shows a positive result 0.564294 at a 5% confidence level. Level equations give very significant negative results for the intercept about -0.000816 (Table 2.9, Model 4).

2.6.1.3 PARCH

$$\sigma_t^\delta = \omega + \beta_1(\sigma_{t-1}^\delta) + \alpha_1(|\varepsilon_{t-1}| - \gamma_1\varepsilon_{t-1})^\delta \quad (2.13)$$

, where $\delta > 0, |\gamma_1| \leq 1$.

The estimation results for specification PARCH (1,1,1) are as follows: the level intercept -0.000823 is very significant, in the variance equation the power variable delta 1.437 is significant, the intervention variable, however, is insignificant (Table 2.10, Model 1). The inclusion of sell and intervention variables shows following results: the sell variable in the mean equation is weakly significant at a 20% level and positive about 0.015628, the intervention variable is insignificant for mean and variance equation (Table 2.10, Model 2).

2.6.1.4 GARCH-M

$$Y_t = X_t'\theta + \lambda\sigma_t^2 + \varepsilon_t$$

$$\sigma_t^2 = \omega + \beta_1\sigma_{t-1}^2 + \alpha\varepsilon_{t-1}^2 + z_t'\pi \quad (2.14)$$

The GARCH in mean model, GARCH(1,1) with inclusion of the intervention dummy variable shows following results: intercept and intervention are very significant, $1.49 \cdot 10^{-6}$ and $2.09 \cdot 10^{-6}$ in the mean equation, the intervention variable is very significant about $-3.73 \cdot 10^{-12}$ in the variance equation (Table 2.11).

2.6.2 Endogenous Interventions

2.6.2.1 Determination of endogenous Interventions

$$\omega = \hat{\sigma}^2(1 - \beta_1 - \alpha_1) \quad (2.15)$$

The endogenous interventions are obtained by a GARCH-estimated VaR model as described in previous sections (2.2.2.2.). The GARCH estimation for daily frequency is conducted by an IGARCH specification at a confidence level of 0.02 (t-value 2.326). The error terms follow a t-distribution.

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (2.16)$$

2.6.2.2 Effectiveness of endogenous Interventions

Endogenous interventions increase the volatility and decrease the mean equation. An exception is given for the GARCH-M model that decreases both, the volatility as well as the mean equation. Under a distinction between positive and negative excesses, the GARCH model is indicating a decrease in the level equation for positive excess, and an increase for negative excesses. However, the results in the case of such a distinction are not significant (Tables 2.12-2.14).

2.6.3 Comparison of effects

In general, it can be observed that EGARCH model results are more significant, have stronger effects, and the volatility increase is greater. When allowing for asymmetry in the variance equation, the increasing volatility in data is more obvious: asymmetric GARCH models enhance the significance level stronger than the rudimentary GARCH model. The separate inclusion of intervention directions makes the total intervention variable more significant and stronger in sign. The intervention affects the variance for all models at a range of 0 - 0.000005.

Endogenous interventions support the results of historical intervention estimation. The variance is increased by intervention, however at a low confidence level. The results for the mean equation are mostly insignificant.

2.7 Discussion

The SEM framework results indicate that the CBRT's preferences changed for two subsample periods, 1987-2000 and 2001-2009 (see Section 2.3). When splitting the analysis in subsample periods, output stabilization plays no or a poor role in the central bank policy; monetary transmission effects are kept at a minimal level. The target inflation rate decreases from 48% to 39,2%. The weight on interest rate smoothing becomes significantly positive in the second period.²⁵ Thus, it can be followed that the CBRT has been focused on the correction of monetary phenomena, which suggests an effective role of the CBRT in monetary policy. The realized inflation rate in the period from 2000 to 2008 with an average about 36,4% is below the predicted implicit inflation rate of about 39,2%. Evidently, the CBRT has been effective in combating against the hyperinflation disease in the latter period²⁶. As shown in Table 2.3, the inclusion of the excessive inflation dummy variable accounts for highly significant coefficients in the second sample period. At the same time, μ and λ become significantly positive. The same outcome can be observed for the exchange rate; controlling for excessive exchange rate volatility makes both relevant parameters positive and significant. The simultaneous inclusion of positive and negative excess dummy variables, however, weakens the significance of the results in general. In the case of separate inclusion, the dummy variable coefficients are significant in all variables. This shows that the relevant variables are effective in influencing the macroeconomic demand and supply function, namely initiating a shift in the functions.

The standard deviation of supply and demand shocks decrease both in the period from 2000 to 2009, by 45% and 26% vice versa. Since these shocks are determined endogenously as the standard deviation of the equations, after the optimization of the

²⁵ These results are supported i.e. by Dennis (2001) and Ozlale (2003), who find that interest rate smoothing plays a more important role than output stabilization and observe a shift in the preferences in the case of the Federal Reserve, when the sample period is splitted into subsamples.

²⁶ Woodford (1999) supports the argument that the degree of commitment towards policy goals with related time-consistent central bank behavior raises the level of inertia in policy decisions. The change in interest rate decisions, however, is increased (less persistent) under the objective of inflation targeting for the second subsample period in our study (see Figure 2.4).

model, it can be concluded that the central bank's policy or preference change has shown some effectiveness in moderating volatility and in establishing macroeconomic stability. In addition to the preference changes, the real business cycle gives some further indication for the ameliorated results²⁷. Following the financial and monetary restructuring program, the macroeconomic developments have shown evident improvements in the inflation rate and a profound restructuring in the financial sector. Nonetheless, the output growth has been continuing to be disputable in the context of high real interest rates. The criticism has put the focus on (speculative) foreign capital inflows that were attracted by high interest rates. As it is argued regularly, such a growth model is not capable to create sources for new employment²⁸. We obtain results in line with the criticism, concerning the value for the output stabilization parameter, which is negative for two subsamples, nevertheless, positive for the initial sample period. This controversy reflects the structural development over the entire sample period rather than the monetary effectiveness within a monetary transmission process which is supporting the real sector. After turmoil in social and political stance under the governance of influential cumbersome bureaucratic authorities, the Turkish economy began to pass through a *metamorphose* towards an open economy with dynamic economic activities with more or less robust growth in the recent years.

Yeldan (2002) controversially regards the real motivation of the "stability" as encouraging foreign capital inflows to the national financial markets, higher supply of real return, and building an exchange rate regime which is adjusted by the risk of currency devaluation. Under this structure, the central bank "independence" is rendering no other role than the purpose of supplying price stability; the possibilities to play with interventions, however, are limited. Opposing this argument, it should be mentioned that the CBRT took some recent measures with the aim of preventing speculative short-term capital inflow, primarily through lowering the real interest rate.

The model results in section 2.6 show that VaR estimated hypothetical interventions coincide with the dates of historical exchange rate interventions. This implies that the Turkish Central Bank employed interventions in periods of excessive volatility with the

²⁷ Note, that the inclusion of the dummy variables into the model changes the supply and demand shocks (see Table 2.1 to Table 2.3). For instance, the negative exchange rate dummy variable induces the level of the demand shock to increase.

²⁸ See Ay and Karacor (2007) for an elaborate illustration for the post restructuring economic stance in Turkey.

purpose of volatility moderation. However, interventions themselves create short term volatility. Considering the effectiveness, this indicates that the central bank aims to disturb undesired trends by creating heterogeneous signals in the market as i.e. Kim et. al (2000) points out in the case of Australia. Asymmetric GARCH models give more support for increased volatility, as results are larger in sign and more significant. In general, the results for GARCH models using endogenous interventions support findings for historical estimation. The results can be discussed under the impossible trinity in monetary policy (Mundell, 1978), where preferences are mutually compatible: full capital mobility, independence of the monetary policy, and fixed exchange rate. In the case of Turkey with a floating exchange rate regime, supposed that the monetary policy is more or less independent, full capital mobility provokes more risk of excessive volatility. Thus, the CBRT has to be prepared to react efficiently with the purpose of volatility moderation. A critical dimension with regard to its reaction margin is the current deficit/central bank reserve ratio²⁹.

The survival analysis model in section 2.4 delivers significant results concerning the probability of a monetary intervention; money supply, central bank reserves, and central bank governors are significant variables in determining the duration of an intervention. With regard to central bank reserves, it can be concluded that decreasing reserves are indicating a higher risk for exchange rate interventions. Further, it can be argued that the reserves lowered afterwards, when an intervention has been conducted. Once more, this signals a weakness in the reserve position and an improvement here would enhance Turkey's monetary stabilization. A *dichotomy* in macroeconomic variables or at least a *neutrality* of monetary variables can be observed in the context of interventions. According to the duration model, output stabilization plays no or a poor role in the central bank policy, so it can be followed that monetary transmission effects are kept at a minimal level. The CBRT has been focused on the correction of monetary phenomena for the time period from 1987 to 2009. The results supports the findings of the full sample SEM framework.

²⁹ See Yeldan (2006), Yeldan regards the current deficit/central bank reserve ratio as a central fragility indication for the financial stance of the Turkish economy.

2.8 Conclusion

In this chapter we have examined the effectiveness of hypothetical central bank interventions on the endogenously determined monetary preferences for the period 1987-2009 in Turkey. The central bank's *deep* preferences are determined from an underlying macroeconomic structure on the basis of a loss function in a Taylor rule style with flexible inflation targeting.

The evolution of these *deep* monetary preferences is examined in the context of excessive volatility in the related monetary variables. In our analysis, we presume that the CBRT has the motivation to moderate excessive volatility in the respective monetary variable. Further, a GARCH-estimated VaR model identifies excessive volatility in each variable. The excessive volatility results are introduced into the analysis in form of dummy variables, while keeping in mind, that each dummy variable should be regarded as a hypothetical intervention. The coefficients for the dummy variables are all significant when they are introduced separately. So, it can be followed that the endogenously determined potential interventions significantly affect the optimized behavior of the central bank and its preferences. At the same time, the consideration of potential interventions ameliorates the weights on output stabilization and interest smoothing in their size compared to the initial results in Table 1. The improved effectiveness is especially apparent in the case of exchange rates (see Table 2.2).

On the basis of the examined results it can be concluded as a policy advice, that the CBRT should control both, excessive inflation and volatility in the exchange rate, in order to conduct effective monetary policy, which allows for monetary transmission processes beyond a pure inflation targeting. Rodrick (2009) points out that the CBRT intervenes only to smooth short-term fluctuations, without taking a stand on the medium-term level of the exchange rate. This should be replaced with a clear statement of preference in favor of preventing overvaluation in order to exploit potential growth³⁰. Further research may contain a general equilibrium model that includes more macroeconomic constraints on the

³⁰ Rodrick (2009, p.24)

monetary policy³¹. In this context, the controversial relationship between monetary policy, employment, and economic output could be analyzed. The institutional governance index is extendable by the inclusion of institutional variables such as, transparency in the decision making process of the central bank, liability in policy actions, and communication of policy decisions and related information. Modeling of heterogeneity in the expectations of market participants related to central policy decisions is another valuable research path.

³¹ For example, the model introduced by Rogoff (1985) provides initial study in the similar research area. He analyzes inflation targeting and time-consistent monetary policy versus employment stabilization within a stochastic macroeconomic model with rational expectations.

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APPENDIX

Table 2.2 Model results with excessive exchange rate dummies

	Negative excess	P value	Positive excess	P value	Negative +Positive excess	P value
c_1	1.269707	0.0000	1.192983	0.0000	1.204553	0.0000
c_2	-0.098442	0.4917	-0.015422	0.9183	-0.035928	0.8399
c_3	-0.346127	0.0002	-0.329366	0.0010	-0.310033	0.0223
c_4	0.000116	0.0019	0.000979	0.0014	0.000420	0.0357
c_5	0.674257	0.0816	0.799758	0.0703	0.873384	0.1107
c_6	1.469811	0.0000	1.310537	0.077132	1.419306	0.0000
c_8	-0.018674	0.0184	-0.016559	0.009365	-0.019352	0.0873
c_9	-0.076969	0.0003	-0.083978	0.0000	-0.121283	0.0039
<i>Neg. dummy</i>	37.13131	0.0001	37.14252	0.0774	53.25722	0.0085
<i>Pos. Dummy</i>	-0.854017	0.0553			-3.428606	0.0162
c_{15}			1.028845	0.0003	-1.571013	0.0785
π^*	45.00781	0.0000	45.31194	0.0000	46.49511	0.0000
λ	0.024601	0.0281	0.029111	0.0337	0.051507	0.3040
μ	4.53E-06	0.0471	6.94E-05	0.0061	0.000108	0.1308
$\sigma(u^d)$	9.017314		8.681843		8.745028	
$\sigma(u^s)$	2.701753		2.909206		3.115263	
<i>J statistic</i>	0.189680		0.175604		0.261115	

Note: The results are obtained through the inclusion of the excessive exchange rate volatility dummy variables that are estimated by the corresponding model in Table 2.5. The GMM-instrument list is chosen as: constant term, various lags of output gap, external inflation rate, inflation rate, interest rate, real interest rate, and exchange rate.

Table 2.3 Model results with excessive inflation rate dummies

	Negative excess	P value	Positive excess	P value	Negative +Positive excess	P value
c_1	1.237933	0.0000	1.260059	0.0000	1.246500	0.0000
c_2	0.006692	0.9663	-0.053060	0.7307	0.011828	0.9451
c_3	-0.457450	0.0001	-0.385438	0.0002	-0.482607	0.0001
c_4	0.000600	0.0076	0.000379	0.0063	0.001194	0.0042
c_5	0.587483	0.2347	0.626489	0.1325	0.647089	0.2531
c_6	1.428545	0.0000	1.453545	0.0000	1.406547	0.0000
c_8	-0.016297	0.1076	-0.016232	0.0477	-0.015394	0.1563
c_9	-0.082780	0.0037	-0.057313	0.0026	-0.076529	0.0019
c_{15}	45.82415	0.0053	34.95997	0.0002	49.34368	0.0019
<i>Neg. dummy</i>	-1.045401	0.0299			-1.112084	0.1069
<i>Pos. Dummy</i>			-1.132535	0.0565	-1.197960	0.0100
π^*	44.78885	0.0000	44.75493	0.0000	44.56699	0.0000
λ	0.030812	0.0415	0.020762	0.0435	0.027964	0.0416
μ	2.42E-05	0.1796	1.21E-05	0.0534	3.97E-05	0.2479
$\sigma(u^d)$	8.967656		9.005070		9.046474	
$\sigma(u^s)$	2.828646		2.695001		2.909313	
<i>J statistic</i>	0.217256		0.188317		0.217075	

Note: The results are obtained through the inclusion of the excessive inflation rate volatility dummy variables that are estimated by the corresponding model in Table 2.5. The GMM-instrument list is chosen as: constant term, various lags of output gap, external inflation rate, inflation rate, interest rate, real interest rate, and exchange rate.

Table 2.4 Model results with excessive interest rate dummies

	Negative excess	P value	Positive excess	P value	Negative +Positive excess	P value
c_1	1.149056	0.0000	1.269222	0.0000	1.246500	0.0000
c_2	0.117856	0.4475	-0.094679	0.4952	0.011828	0.9451
c_3	-0.420620	0.0001	-0.380937	0.0001	-0.482607	0.0001
c_4	0.001205	0.0097	0.000612	0.0435	0.001194	0.0042
c_5	1.337285	0.0253	0.522403	0.0486	0.647089	0.2531
c_6	1.328317	0.0000	1.474348	0.0000	1.406547	0.0000
c_8	-0.028294	0.0240	-0.007431	0.3933	-0.015394	0.1563
c_9	-0.088509	0.0055	-0.046813	0.0437	-0.076529	0.0019
c_{15}	49.58296	0.0062	7.177188	0.6398	49.34368	0.0019
<i>Neg. dummy</i>	-4.275710	0.0008			-1.112084	0.1069
<i>Pos. Dummy</i>			-2.742035	0.0052	-1.197960	0.0100
π^*	45.39054	0.0000	44.54641	0.0000	44.56699	0.0000
λ	0.034656	0.0602	0.015898	0.079	0.027964	0.0416
μ	7.39E-05	0.0623	1.45E-05	0.1155	3.97E-05	0.2479
$\sigma(u^d)$	8.712914		9.019795		8.900152	
$\sigma(u^s)$	3.113778		2.597231		3.044640	
<i>J statistic</i>	0.204510		0.186341		0.217075	

Note: The results are obtained through the inclusion of the excessive interest rate volatility dummy variables that are estimated by the corresponding model in Table 2.5. The GMM-instrument list is chosen as: constant term, various lags of output gap, external inflation rate, inflation rate, interest rate, real interest rate, and exchange rate.

Table 2.5 GARCH estimation results from VaR Model

	Exchange rate		Inflation rate		Interest rate	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
<i>Mean Equation</i>						
C					0.00000000	
AR(1)	0.002104	0.1659	0.018969	0.0000	0866	0.9954
	0.255821	0.0000	0.739089	0.0000	0.021653	0.0000
<i>Variance Equation</i>						
ω			0.00000055			
α	0.000115	0.0847	3	0.2639	0.000005.61	0.0499
β	0.353602	0.0603	0.080817	0.0229	0.215048	0.0007
	0.657412	0.0000	0.905034	0.0000	0.773135	0.0000
<i>Decision Criteria</i>						
AIC	-4.430447		-5.259063		-2.604360	
SIC	-4.353748		-5.182558		-2.527660	
Q (20)	18.212	0.508	53.902	0.000	0.2697	1.000
Q^2 (20)	8.9707	0.97	1.0218	1.000	0.0897	1.000
ARCH-LM		0.9495		0.7457		0.9495
Log likelihood	639.5540		760.6755		378.4234	

Note: The GARCH estimation results and decision criteria are illustrated for the Value at Risk model in section 2.2.2.2.

Table 2.7 SEM results - Governance index

	Governance Index supply	P value	Governance Index supply+demand	P value
c_1	0.710453	0.0000	0.698523	0.0000
c_2	0.160869	0.0000	0.154820	0.0000
c_3	-0.125341	0.0000	-0.111561	0.0000
c_4	-0.001130	0.0000	-0.014490	0.0000
c_5	6.452178	0.0000	-4.103855	0.0000
c_6	1.745469	0.0000	1.836555	0.0000
c_8	-0.048475	0.0000	0.023902	0.0000
c_9	-0.023854	0.0000	-0.036406	0.0000
<i>Governance Index</i>	-0.009077	0.0000	0.005964	0.0000
c_{15}	0.174736	0.8529	-1.937266	0.0141
π^*	1.61E-05	0.0180	0.000302	0.0009
λ	35.67071	0.0000	35.64226	0.0000
μ	-0.011491	0.0000	-0.017360	0.0000
$\sigma(u^d)$	6.6099		6.6182	
$\sigma(u^s)$	1.5418		1.6859	
<i>J statistic</i>	0.250981		0.252757	

Note: The GMM-instrument list is chosen as: constant term, various lags of output gap, external inflation rate, inflation rate, interest rate, real interest rate, and exchange rate.

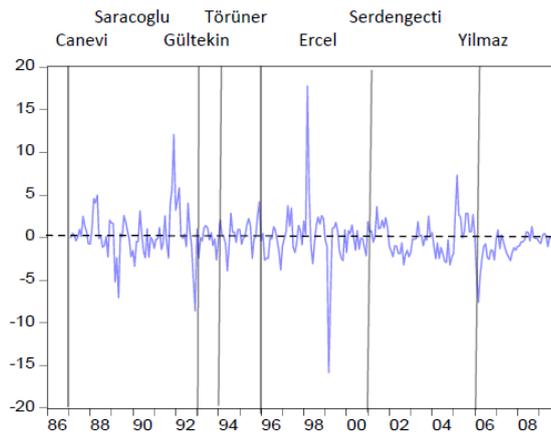


Figure 2.2. Change in inflation rate under the incumbent central bank governors (1986-2009)

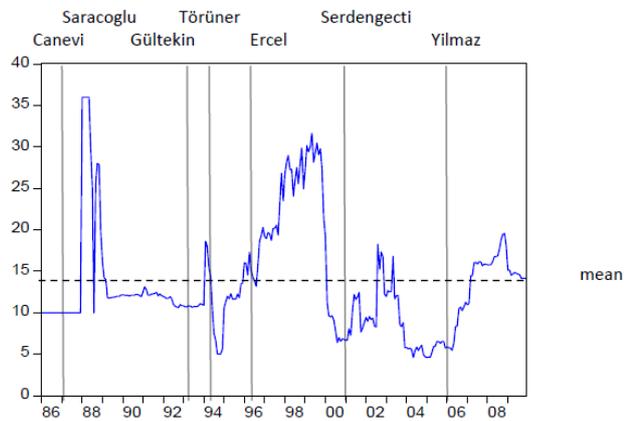


Figure 2.3. Interest rate under the incumbent central bank governors (1986-2009)

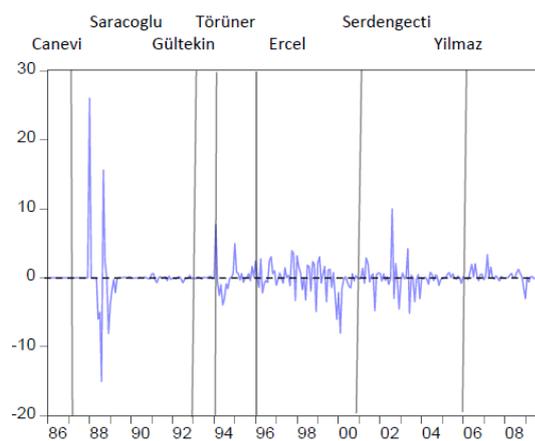


Figure 2.4. Change in interest rate under the incumbent central bank governors (1986-2009)

Lemma 2.1 Restrictions on Euler equation for model solution of Equation (2.4.)

The structural parameters of interest are obtained by imposing the following cross-equation restrictions on the Euler equation:

$$\begin{aligned} & \lambda \delta^2 E_t x_{t+3} \frac{\partial x_{t+3}}{\partial i_{t+1}} + \delta^3 \lambda E_t x_{t+4} \left(\frac{\partial x_{t+4}}{\partial i_{t+1}} \right) + \delta^4 \lambda E_t x_{t+5} \left(\frac{\partial x_{t+5}}{\partial i_{t+1}} \right) + \delta^3 \lambda E_t (\pi_{t+4} - \pi^*) \left(\frac{\partial \pi_{t+4}}{\partial i_{t+1}} \right) \\ & + \delta^4 E_t (\pi_{t+5} - \pi^*) \left(\frac{\partial \pi_{t+5}}{\partial i_{t+1}} \right) + \mu E_t (i_{t+1} - i_t) - \mu \delta E_t (i_{t+2} - i_{t+1}) = 0 \end{aligned}$$

A detailed representation of the Euler function application to solve the model is provided by Favero and Rovelli (2002, p.554) and Rudebusch and Svensson (1998).

Table 2.8 GARCH Models

<i>Parameters</i>	Model 1	P-value	Model 2	P-value	Model 3	P-value	Model 4	P-value
Intercept	-0.000999	0.0000	-0.001001	0.0000	-0.001002	0.0000	-0.001002	0.0000
AR	0.022752	0.4420	0.015701	0.5985				
Purchase			-0.00226	0.3892	-0.018034	0.1575		
Sell			0.015165	0.2213			0.018028	0.1577
Intervention	-0.00111	0.6670			0.015731	0.2079	-0.002302	0.3808
Variance Parameters								
GARCH Intercept	0.000004	0.0020	0.000004	0.0016	4.72E-06	0.0016	0.000004	0.0016
ARCH term	0.226281	0.0000	0.229526	0.0000	0.230059	0.0000	0.230060	0.0000
GARCH term	0.762461	0.0000	0.752491	0.0000	0.752370	0.0000	0.752370	0.0000
Purchase			0.000053	0.0953	-0.00028	0.3359		
Sell			0.000335	0.2588			0.000284	0.3360
Intervention	0.000065	0.0675			0.000338	0.2524	0.000053	0.0968
Test summary								
Log Likelihood	4264.563		4266.970		4269.919		4269.919	
Schwarz Criterion	-6.322032		-6.314878		-6.319931		-6.319931	
Akaike Criterion	-6.35308		-6.35368		-6.35483		-6.35483	
Durbin-Watson statistic	1.944720		1.969497		1.941318		1.941305	

Note: The GARCH estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.1.1. Model1 specification: c ar(1), Model2: ar(1) purchase sell, Model3: purchase, intervention, Model4: sell, intervention. The error terms follow a *t*-distribution.

Table 2.9 EGARCH Models

<i>Parameters</i>	Model 1	P-value	Model 2	P-value	Model 3	P-value	Model 4	P-value
Intercept	-0.000795	0.0006	-0.000817	0.0003	-0.000817	0.0003	-0.000817	0.0003
AR term	0.028136	0.3358						
Purchase			-0.002226	0.3356	-0.015072	0.1740		
Sell			0.012847	0.2364			0.015073	0.1740
Intervention	-0.00136	0.5616			0.012847	0.2364	-0.002226	0.3356
Variance Parameters								
GARCH Intercept	-0.871236	0.0000	-0.883051	0.0000	-0.883050	0.0000	-0.883050	0.0000
ARCH term	0.085861	0.0023	0.080926	0.0036	0.080926	0.0036	0.080927	0.0036
GARCH term	0.357555	0.0000	0.362114	0.0000	0.362114	0.0000	0.362114	0.0000
GARCH asymmetry	0.935873	0.0000	0.934838	0.0000	0.934838	0.0000	0.934838	0.0000
Power GARCH term								
Purchase			0.564293	0.0437	-0.147064	0.7637		
Sell			0.711359	0.0824			0.147063	0.7637
Intervention	0.632368	0.0070			0.711357	0.0824	0.564294	0.0437
Test summary								
Log Likelihood	4268.727		4272.922		4272.922		4272.922	
Schwarz Criterion	-6.32287		-6.319040		-6.319040		-6.319040	
Akaike Criterion	-6.35780		-6.35782		-6.35782		-6.35782	
Durbin-Watson statistic	1.959004		1.938873		1.938872		1.938873	

Note: The EGARCH estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.1.2. Model1 specification: c ar(1), Model2 specification: purchase, sell, Model3 specification: purchase, intervention, Model4 specification: sell, intervention. The error terms follow a *t*-distribution.

Table 2.10 PARCH Models

<i>Parameters</i>	Model 1	P-value	Model 2	P-value
Intercept	-0.000823	0.0003	-0.000829	0.0003
Sell			0.015628	0.1957
Intervention	-0.001251	0.6230	-0.002360	0.3540
Variance Parameters				
GARCH Intercept	0.000075	0.5368	0.000076	0.5560
ARCH term	0.209028	0.0000	0.211967	0.0000
GARCH term	0.774109	0.0000	0.767363	0.0000
GARCH asymmetry	-0.234720	0.0061	-0.222087	0.0088
Power GARCH				
term	1.437721	0.0000	1.450480	0.0000
Sell			0.001390	0.5413
Intervention				
	0.000613	0.4892	0.000509	0.5091
Test summary				
Log Likelihood	4272.311		4274.321	
Schwarz Criterion	-6.32349		-6.315756	
Akaike Criterion	-6.35840		-6.35842	
Durbin-Watson statistic	1.905183		1.939688	

Note: The PARCH estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.1.3. Model1 specifications: c, ar(1), Model2: ar(1), purchase and sell variables. The error terms follow a *t*-distribution.

Table 2.11 Garch-M Models

<i>Parameters</i>	Model 1	P-value
Intercept	$1.49 \cdot 10^{-6}$	0.0000
Mean	-0.02442	0.6811
Intervention	$2.09 \cdot 10^{-6}$	0.0000
Variance Parameters		
GARCH Intercept	$1.23 \cdot 10^{-12}$	0.0000
ARCH term	0.282046	0.0000
GARCH term	0.676670	0.0000
Intervention	$-3.73 \cdot 10^{-12}$	0.0000
Test summary		
Log Likelihood	14568.75	
Schwarz Criterion	-21.6852	
Akaike Criterion	-21.7162	
Durbin-Watson statistic	2.085172	

Note: The GARCH-M estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.1.4. Model1 specifications: c, ar(1). The error terms follow a *t*-distribution.

Table 2.12 Endogenous intervention - GARCH Models

<i>Parameters</i>	Model 1	P-value	Model 2	P-value	Model 3	P-value
Intercept	-0.000664	0.0044	-0.000986	0.0000	-0.000973	0.0000
AR(1)			0.020515	0.4904		
Neg. excess					0.000478	0.8234
Pos. excess					-0.000141	0.8904
Intervention	-0.000362	0.8268	-0.000101	0.7863		
<i>Variance</i>						
<i>Parameters</i>						
GARCH Intercept	0.000005	0.0000	0.000004	0.0014	0.000003	0.0045
ARCH term	0.224037	0.0000	0.230250	0.0000	0.219191	0.0000
GARCH term	0.756718	0.0000	0.761239	0.0000	0.772727	0.0000
Neg. excess					0.000024	0.3674
Pos. excess					0.000004	0.6165
Intervention	0.00002	0.1317	0.000002	0.7863		
<i>Test summary</i>						
Log Likelihood	4224.205		4261.034		4264.440	
Schwaz Criterion	-6.26786		-6.31676		-6.311760	
Akaike Criterion	-6.291133		-6.34781		-6.34666	
Durbin-Watson statistic	1.909109		1.942377		1.903954	

Note: The GARCH estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.2.1. Model 1 specifications: c, Model 2 specifications: c, ar(1), Model 3 specifications: neg. and pos.excesses. The error terms follow a *t*-distribution.

Table 2.13 Endogenous intervention - GARCH-M Models

<i>Parameters</i>	Model 1	P-value
Intercept	$1.42 \cdot 10^{-6}$	0.0000
AR	0.070844	0.0243
Mean effect	-0.001140	0.9846
Intervention	$-3.21 \cdot 10^{-7}$	0.5451
<i>Variance</i>		
<i>Parameters</i>		
GARCH Intercept	$7.43 \cdot 10^{-13}$	0.0000
ARCH term	0.307370	0.0000
GARCH term	0.710500	0.0000
Intervention	$-1.38 \cdot 10^{-12}$	0.4712
<i>Test summary</i>		
Log Likelihood	14561.95	
Schwaz Criterion	-21.6858	
Akaike Criterion	-21.7208	
Durbin-Watson statistic	2.2087	

Note: The GARCH-M estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.2.2. Model 1 specification: c, ar(1). The error terms follow a *t*-distribution.

Table 2.14 Endogenous intervention - EGARCH Models

<i>Parameters</i>	Model 1	P-value
Intercept	-0.00079	0.0008
AR	0.028583	0.3301
Intervention	-0.000411	0.7693
Variance		
Parameters		
GARCH Intercept	-0.833568	0.0000
ARCH term	0.082466	0.0033
GARCH term	0.358653	0.0489
GARCH asymmetry	0.939474	0.0000
Intervention	0.219087	0.2270
Test summary		
Log Likelihood	4265.220	
Schwaz Criterion	-6.31763	
Akaike Criterion	-6.352567	
Durbin-Watson statistic	1.961030	

Note: The EGARCH estimation results and decision criteria are illustrated for the Value at Risk model in section 2.6.2.2. Model1 specification: c, ar(1). The error terms follow a *t*-distribution.

CHAPTER 3

CONTAGION IN ENDOGENOUS VOLATILE PERIODS: AN INTERNATIONAL PERSPECTIVE

ABSTRACT

This chapter aims to analyze cross-border contagious dynamics on foreign exchange markets and on stock exchange markets. The propagation is analyzed with respect to the transmission of nonlinearities that are endogenously determined. The contagion process is discussed in the context of financial systems, foreign direct investments and trade. Diversified trade and financial relations decrease the risk of exposure to contagion from external markets. World's largest economies, however, pursue a price setter role; in this case diversification is of secondary importance.

Keywords: *VAR, GARCH, Contagion, Financial Markets*

3.1 Introduction

Financial crises have been extensively discussed in the financial economics literature over the last twenty years. The contagious effects of financial crises contain several aspects, such as, why some crises spread quickly and widely, while others are constrained to narrow group of countries, how financial distress is transmitted across countries, whether these spillover channels are changing through time, whether crises spread purely to countries with existing vulnerabilities or whether crises open up new fault lines, and further aspects concerning the managing of these crises³².

The research literature proposes a wide range of models to address these questions concerning the harm of financial contagious crises on the economic stance of countries: information asymmetry (Calvo and Mendoza, 2000), business cycle approaches (Allen and Gale, 2000) incompleteness of payment systems (McAndrews and Roberts, 1995) and interbank markets (van Rijckeghem and Weder, 2000).

A first empirically founded analysis of financial contagion is developed by Grubel and Fadner (1971) who analyze the interdependence of international equity markets. They identify the reduction in the variance of expected returns of portfolios due to returns on foreign assets and capital value changes of assets as benefits of international diversification. Their model contain the determination of variance-covariance matrices and correlation coefficients of foreign and domestic equities. The recent empirical research begins with King and Wadhvani (1990). They incorporate an information based model within a simultaneous equations model (SEM). Idiosyncratic country risk is modeled together with expectations of systematic information, concerning local stock markets. Contagion occurs when a turbulent event in one market is transmitted to other markets. Eichengreen et al. (1995) develop a probability test based framework that tests for contagion as a non-zero probability of associating foreign crises with a domestic crisis within a latent factor model with alternate conditioning information. Baig and Goldjain (1999) investigate contagious effects for the case of the Asian financial crisis during 1997-1998 within the use of VAR methodology. They put through cross-country correlation analysis among currencies, stock market, interest rates, and sovereign spreads. They find evidence for contagion in the

³² Chui and Taylor (2000, p.566)

foreign exchange market and tentative evidence on the stock market. Forbes and Rigobon (2002) pursue the empirical research investigating the conditions for a rejection of parameter stability. The rejection due to parameter instability and the diffusion of heteroskedasticity among different types of shocks or due to both conditions is generating a bias in the rejection process. Forbes and Rigobon argue that an unadjusted correlation coefficient is not appropriate to measure contagious effects. Volatility in crises periods increases, causing the calculated correlation coefficient of the crises period to expand. Therefore, the correlation coefficient of crises period is biased compared to tranquil periods. Corsetti, Pericoli, Sbercia (2002) state that the research so far made arbitrary assumptions about the variance of country-specific shocks within the originating country for the Forbes-Rigobon (2002) model. Dungey and Zhumbekova (2001) see some problems in identifying the correct observation windows. They notice that long windows include different regimes. This induces the circumstance that the autocorrelation coefficient is only a linear combination of the short crises windows, conjures up an increased volatility compared to the small sample. Favero and Giavazzi (2002) test for the presence of nonlinearities in the propagation of devaluation expectations for ERM members during the early 1990's. Applying a full-information technique, they inquire, whether transmission processes across markets, to a greater extent, are nonlinearly evolving during periods of extreme returns than during 'normal' times. A VAR model is established to control for interdependence between asset returns. Bae et al. (2003) provide a refinement of the Eichengreen (1995) latent factor model, where coincidence of extreme return shocks across emerging markets during the 1990's are tested by using daily returns. Determinants are investigated through a multinomial logistic regression. They suggest that contagion is predictable conditionally on prior information and can be explained by the regional interest rate level, exchange rate changes, and conditional stock return volatility.

The central objective for empirical research of contagion is, whether the strength of the transmission mechanism remains stable over time. Our research uses the same definition of contagion that achieved consensus in the recent empirical research on contagion (Rigobon (1999), Dungey (2002), Favero and Giavazzi (2002))³³.

³³ See (Giancarlo Corsetti Marcello Pericoli, 2005) and Billio, Caporin (2009) for an illustration of the conception of contagion. For a comprehensive literature survey on testing for empirical measurement of financial contagion, see Pericoli and Sbercia (2003).

Contagion is mainly considered as a significant change in the way that country-specific shocks are transmitted internationally. The null hypothesis of the stability of transmission mechanism is tested across tranquil and turbulent periods against the alternative hypothesis of structural breaks in the parameters of the transmission mechanism. In the international macroeconomic theory it is presumed that economic disturbances will be transmitted internationally across countries.

Our research study aims to make a contribution to the approach of the contagion test introduced by Favero and Giavazzi (2002). The contribution consists of introducing a Value at Risk (VaR) analysis, when identifying the dummy variables accounting for common or local financial shocks. The arbitrary assumption of allocating a dummy variable, in the case when the residuals exceed the standard deviation of the reduced VAR model by three times, is substituted by a Generalized Autoregressive Conditional Heteroskedastic (GARCH) estimated VaR-analysis. The core hypothesis is to be analyzed within a theoretical modeling that treats financial shocks as endogenous. Furthermore, as explanatory variables in testing for contagion, two different markets are utilized for each country, exchange rates and stock market returns. It is aimed to gain new insight information about the propagation of spillover effects in international financial markets.

3.2 Considerations for Contagion reasons: Financial systems, interdependence and capital flows

Although the trade liberalization and financial deregulation have provided benefits to some developing economies, the current financial systems have difficulties to cope with cross-border financial shocks. Financial liberalization not only allowed the financial system to fulfill its role in allocating resources. It also led to the return of banking crises, of which there have been many in the last decades³⁴.

Emerging economies had difficulties to deal with the appropriate macroeconomic design in order to manage the effects of intensified capital flows in the new financial surrounding of

³⁴ Allen and Carletti (2008, p.2)

globalization after the cold war era³⁵. In this context, the fragility of the banking and financial system could amplify the adverse effects of speculative attacks on i.e. a currency peg or other cross-border related financial claims. Market failure in such incomplete markets with a weak domestic financial system can lead to contagion.

Allen and Carletti (2008) note that through financial fragility small shocks can again lead to larger changes in asset prices. This volatility, in turn, can lead to significant disruption and crises. With contagion there is again amplification: a shock in one region can spill over to others and have a much larger effect than the original one.

Regarding for a more general responsibility, Roubini and Frenkel (2001) blame industrialized countries for the weakness of financial systems in emerging markets. They identify short-term impacts on developing countries by three major macroeconomic variables in the industrialized countries: growth rates, real interest rates and exchange rates. Furthermore, they mention that these macroeconomic variables are in close interaction with the pursued trade policy of the emerging markets. Trade is a fundamental source of international capital inflows and foreign currency, which is utilized in serving for foreign debt payments. Hence, the pursued trade policy is directly affecting the sound working of the financial system.

Conventionally, foreign direct investments (FDI) are observed as a further engine of arising globalization³⁶. In our study we focus on trade and FDI linkages as indicators for globalization, that could provide explanation of contagion within the illustrated discussion about financial systems and market failure or fragility.

3.2.1 FDI and trade linkages

In brief we give an illustration of the FDI and trade linkages for the country in our data sample. The FDI and trade linkages follow a similar pattern. Diversification in trade partners and investor relationship is a central item in the context of globalization discourse.

³⁵ The Mexico Peso crisis (1994), Asian financial crisis (1997), currency crisis in Turkey (2001) are illustrative examples.

³⁶ See i.e. Krugman and Venables (1995), Rodrick (1997), Poon et. al (2000) for description of trade, FDI and globalization discourses.

Trade partners are in general more diversified than FDI partner countries (See Figures 3.1 and 3.2 in Appendix III). Exceptions are Japan and Mexico, which are intensively interconnected with the USA in trade and FDI relations. In almost all countries the share of FDI and trade follow the same pattern. The most important trade partners constitute the most important FDI partners at the same time.

Strong relationships beyond pure financial and economic themes have to be considered when analyzing interdependence among financial markets. Germany builds the leadership in the European Union, hence it is involved in the robust European economic block. Among other important aspects, the UK has a traditional and cultural interdependence with the USA and Europe. Investment linkages between Japan and the USA are very deepened. Further, they build a leadership role as two economic world centers beside the emerging dominant competitor China. China, itself is traditionally interconnected to Hong Kong and other Asian markets. Turkey is closely attached to the European trade zone and is targeting a potential entry to the European Union. As one would expect, Mexico's geographical situation is leading to a heavily close partnership with the USA.

3.3 Methodology

3.3.1 Data

We use daily data spanning from 05:1993 to 05:2011. The official exchange rate and the most important stock exchange market for the each of the seven countries are selected. Exchange rates include the US Dollar, British Pound Sterling, Japanese Yen, the Euro or the German mark³⁷ until year 2000, the Yuan, the Mexican Peso, and the Turkish Lira. Stock exchange market variables are identified as: the Dow Jones Index, the Nikkei index, the FTSE 100 Index, the DAX, the Hang Seng Index, the Mexican Stock Exchange (Bolsa Mexicana de Valores) Index, and the Istanbul Stock Exchange Index (IMKB).

We take the logarithmic return for each variable in order to achieve stationarity in the analysis. The data for the stock exchange variables and the exchange rates was obtained

³⁷ The conversion after year 2000 is conducted according to the official rates of the ECB.

from the Yahoo finance database and each corresponding central bank.

3.3.2 Transmission of nonlinearities - Contagion

Our methodology provides a refinement for the Favero and Giavazzi (2002) contagion model approach. Favero and Giavazzi model contagion through a range of asymmetric adjustments within a full-information VAR approach. They define contagion as a significant increase in the cross-market correlation (structural break in the parameters) during periods of extreme movements (high volatile periods). In comparison, interdependence is prevailing if the observed comovement is in line with the historically measured simultaneous feedback between the two markets. Transmission processes across markets may be nonlinear during periods of extreme returns in contrast to “normal” times. Therefore, the objective is to create a VAR analysis to control for the interdependence between asset returns. With this purpose, identification of unexpected shocks that may be transmitted across countries (contagion) is made by using heteroskedasticity and non-normalities of residuals.

We apply the following procedure to measure contagion: At the beginning we identify the channels through which shocks are normally propagated across markets. We estimate a reduced VAR model of financial interdependence and identify the reduced VAR residuals. The conditional distributions of the stock exchange or exchange rate returns, $s_{1,t} = \ln(s_{1,t}) - \ln(s_{1,t-1})$ and $s_{2,t} = \ln(s_{2,t}) - \ln(s_{2,t-1})$, generate the following joint process:

$$\begin{pmatrix} s_{1,t} \\ s_{2,t} \end{pmatrix} = \begin{pmatrix} \pi_{11} & \pi_{12} \\ \pi_{21} & \pi_{22} \end{pmatrix} \begin{pmatrix} s_{1,t-1} \\ s_{2,t-1} \end{pmatrix} + \begin{pmatrix} u_{1,t} \\ u_{2,t} \end{pmatrix} \quad (3.1)$$

With the following properties for the mean and variances/covariances:

$$\begin{pmatrix} u_{1,t} \\ u_{2,t} \end{pmatrix} \Big| I_{t-1} \sim \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{1,t}^2 & \sigma_{12,t} \\ \sigma_{21,t} & \sigma_{2,t}^2 \end{pmatrix} \right]$$

Equation (3.1) produces residuals, which are considered to exhibit heteroskedasticity/non-normality. In the second step, we estimate a Value at Risk approach to determine excessive volatility in the relevant variable. At the same time, this makes the outliers endogenously determinable and is corresponding to a local endogenous shock in the relevant market. The Value at Risk approach is implemented by using a GARCH approach. The changes in the time series are adjusted to one standard deviation. Afterwards, the obtained data is estimated through a GARCH application. The resulting parameters are integrated according to the following equation; values for each observation are inserted in this equation and calculated numerically.

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (3.2)$$

The acquired results are the Value at Risk benchmark values. They are compared to the change of the interest rate spreads in each period. In each case, in which an excess occurs, the dummy variable adopts the value 1 to this period. Successively, this procedure is conducted for all periods. At the end, a series is generated which consists of values 1 and 0 . The newly generated series is included to the VAR-system³⁸. Subsequently, we estimate a structural VAR model of interdependence by including the dummy variables. The motivation is to identify periods of financial turbulence. Equation (3.1) is rearranged to develop a test for non-normality:

$$\begin{pmatrix} s_{1,t} \\ s_{2,t} \end{pmatrix} = \begin{pmatrix} \pi_{11} & \pi_{12} \\ \pi_{21} & \pi_{22} \end{pmatrix} \begin{pmatrix} s_{1,t-1} \\ s_{2,t-1} \end{pmatrix} + B^{-1} \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{pmatrix} \quad (3.3)$$

Where, \mathbf{B} is the matrix defining the contemporaneous feedbacks between the spreads and thus their interdependence. The residuals are structured by the following dynamics:

$$\begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{pmatrix} = \left(I + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \right) \begin{pmatrix} d_{1,t} & 0 \\ 0 & d_{2,t} \end{pmatrix} \begin{pmatrix} \varepsilon_{1,t}^l \\ \varepsilon_{2,t}^l \end{pmatrix}$$

³⁸ We refer here to the subsection 2.2.2.2 in chapter 2, that follows a similar methodology in estimating excessive volatility.

These residuals exhibit heteroskedasticity and non-normality. The coefficients in the \mathbf{A} matrix allow for nonlinearities in the transmission process (contagion); their objective is to indicate how the propagation of financial shocks across countries is modified during periods of turmoil. Large residuals (local shocks in the economic sense) are defined by the VaR benchmark approach and are identified by the dummy vector $\mathbf{d} = \begin{pmatrix} d_{1,t} \\ d_{2,t} \end{pmatrix}$ with the objective to filter heteroskedasticity and non-normality out of the residuals by describing periods of market turbulence. Diagonal blocks of matrix \mathbf{A} show the extent, to which the normal –time structural shocks get amplified within countries. Diagonal blocks (of \mathbf{D} matrix) allow for non-linearities in the propagation of such shocks across countries. So, we can test the hypothesis, that during crises the normal channels of interdependence are modified with structural VAR:

$H_0 : a_{ij} = 0$, for each $i \neq j$, absence of non-linearity (no contagion) ($a_{12}, a_{21} = 0$)

$H_1 : a_{ij} > 0$, for each $i \neq j$, occurrence of non-linearity (contagion) ($a_{12}, a_{21} > 0$)

The structural model is identified by the restriction that in each equation the own lagged dependent variable is sufficient to capture the structural dynamics.

$$\begin{pmatrix} 1 & -\beta_{12} \\ -\beta_{21} & 1 \end{pmatrix} \begin{pmatrix} s_{1,t} \\ s_{2,t} \end{pmatrix} = \begin{pmatrix} \gamma_{11} & 0 \\ 0 & \gamma_{22} \end{pmatrix} \begin{pmatrix} s_{1,t-1} \\ s_{2,t-1} \end{pmatrix} + \left(I + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} d_{1,t} & 0 \\ 0 & d_{2,t} \end{pmatrix} \right) \begin{pmatrix} \varepsilon_{1,t}^l \\ \varepsilon_{2,t}^l \end{pmatrix} \quad (3.4)$$

Where, β_{12}, β_{21} determine interdependence, a_{12}, a_{21} allow for nonlinearities, $\gamma_{12}, \gamma_{21} = 0$ gives identification for the equation. Parameters of the structural residual shocks follow the distribution:

$$\begin{pmatrix} \varepsilon_{1,t}^l \\ \varepsilon_{2,t}^l \end{pmatrix} \Big| I_{t,1} \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{\varepsilon 1}^2 & 0 \\ 0 & \sigma_{\varepsilon 2}^2 \end{pmatrix} \right]$$

The advantage of our approach lies in the circumstance that it estimates interdependence and contagion simultaneously at once. Our model is solid against the argument, stated by Forbes and Rigobon (2002), that the volatility-amplification increases in crises periods causes the calculated correlation coefficients of the crises periods to increase. Hence, in high volatility periods the transmission process is modified and increases the probability of

a bias in the estimation results. Yet, the followed approach of our model utilizes a full sample approach which circumvents this criticism. High volatile periods or 'nonlinearities' are endogenously determined and explicitly introduced into the full sample model. Therefore, the applied model gives a control over the turbulent periods. In other terms, it can be argued that the model knows the source of potential bias explicitly.

3.3.3 Estimation procedure

The seemingly unrelated regression (SUR) estimation proposed by Zellner (1962) accounts for heteroskedasticity and serial correlation in the residuals across the equations³⁹. It is assumed that the equation system has m equations:

$$y_{it} = x_{it}'\beta_i + \varepsilon_{it}, \quad i=1, \dots, m$$

The vector form expression can be written as:

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_m \end{pmatrix} = \begin{pmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & X_m \end{pmatrix} \begin{pmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_m \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_m \end{pmatrix} = X\beta + \varepsilon \quad (3.5)$$

Further, it is assumed that the error terms across time are independent:

$$E[\varepsilon | X_1, X_2, \dots, X_M] = 0$$

The covariance matrix is described as:

$$E[\varepsilon\varepsilon' | X_1, X_2, \dots, X_M] = \Omega$$

We allow for contemporaneous correlation across equations:

$$E[\varepsilon\varepsilon' | X_1, X_2, \dots, X_M] = \sigma_{ij}I_T$$

³⁹ The illustration of the SUR estimation procedure is closely related to Greene (2008, p. 234)

The $M \times M$ covariance matrix of the disturbances is :

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1M} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2M} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{M1} & \sigma_{M2} & \cdots & \sigma_{MM} \end{bmatrix}$$

Consequently, the covariance matrix of the stacked error terms will be equal to:

$$\Omega = \Sigma \otimes I \quad \text{or} \quad \Omega^{-1} = \Sigma^{-1} \otimes I$$

Expanding the Kronecker products gives:

$$\hat{\beta} = \begin{bmatrix} \sigma^{11} X_1' X_1 & \sigma^{12} X_1' X_2 & \cdots & \sigma^{1M} X_1' X_M \\ \sigma^{11} X_2' X_1 & \sigma^{22} X_2' X_2 & \cdots & \sigma^{2M} X_2' X_M \\ \vdots & \vdots & \ddots & \vdots \\ \sigma^{M1} X_M' X_1 & \sigma^{M2} X_M' X_2 & \cdots & \sigma^{MM} X_M' X_M \end{bmatrix}^{-1} \begin{bmatrix} \sum_{j=1}^M \sigma^{1j} X_1' y_j \\ \sum_{j=1}^M \sigma^{2j} X_2' y_j \\ \vdots \\ \sum_{j=1}^M \sigma^{Mj} X_M' y_j \end{bmatrix} \quad (3.6)$$

Asymptotic covariance matrix for the GLS estimator is the first expression in the equation. The term Σ is unknown, so first we have to estimate this term. A consistent estimation for the elements of Σ is given by:

$$\hat{\sigma}_{ij} = s_{ij} = \frac{e_i' e_j}{T} \quad (3.7)$$

The estimation of the regression by GLS is accomplished then to compute the weights of second expression. This is achieved by utilizing the covariance matrix $\hat{\Omega} = \hat{\Sigma} \otimes I$:

$$\hat{\beta} = [X' \Omega^{-1} X]^{-1} X' \Omega^{-1} y = [X' (\hat{\Sigma}^{-1} \otimes I) X]^{-1} X' (\hat{\Sigma}^{-1} \otimes I) y \quad (3.8)$$

According to this procedure a consistent estimator is applicable to deal with correlations and heteroskedasticity among the equations, which are extremely relevant in the case of internationally interconnected financial markets.

3.3.4 Model specifications

A simultaneous equations model (SEM) with m equations is specified according to the methodology in section 3.3.2 to capture all stock exchange markets and foreign exchange markets, vice versa. Eq. (3.9) illustrates the specification with stock exchange returns⁴⁰.

$$\begin{pmatrix} 1 & -\beta_{12} & \dots & -\beta_{1m} \\ -\beta_{21} & 1 & \dots & -\beta_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ -\beta_{m1} & -\beta_{m2} & \dots & 1 \end{pmatrix} \begin{pmatrix} stock^1 \\ stock^2 \\ \vdots \\ stock^m \end{pmatrix} = \begin{pmatrix} \gamma_{11} & 0 & \dots & 0 \\ 0 & \gamma_{22} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \gamma_{mm} \end{pmatrix} \begin{pmatrix} stock_{t-1}^1 \\ stock_{t-1}^2 \\ \vdots \\ stock_{t-1}^m \end{pmatrix} \quad (3.9)$$

$$+ \left(I + \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1m} \\ a_{21} & a_{22} & \dots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mm} \end{pmatrix} \begin{pmatrix} d_{1,t} & 0 & \dots & 0 \\ 0 & d_{2,t} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & d_{m,t} \end{pmatrix} \right) \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \vdots \\ \varepsilon_{m,t} \end{pmatrix}$$

A more focused view on interdependence and contagion relations is provided by micro level models that are extracted from the macro level models. For each country the foreign exchange market, as well as, the stock exchange market are introduced into a three equations SEM, that models the propagation of external, endogenously determined, shocks. The dummy variable in the **D** matrix block determines from which market the contagious effect originates. The micro level models contain two external markets, each of different market type, and one domestic market, for which the external contagion effect is tested. For instance, if the contagion, originating from the DAX on US markets, is analyzed, the model will contain following model variables: DAX, German Mark, US dollar and alternatively the Dow Jones index⁴¹. The variables are iterated for all markets, in each model the last equation contains the target markets (foreign exchange rate or stock exchange rate market) (See Eq. 3.10). For a comprehensive illustration of the results, we utilize different clustering schemes: isolation of origin markets or target markets (See Appendix II).

⁴⁰ Stationarity of the series are test by conventional tests, such as serial correlograms and augmented Dickey-Fuller unit root tests. The number of equations, m , corresponds to seven in the macro level models.

⁴¹ Applying this procedure we estimate about 168 simultaneous equations models in total.

$$\begin{pmatrix} 1 & -\beta_{12} & -\beta_{13} \\ -\beta_{21} & 1 & -\beta_{23} \\ -\beta_{31} & -\beta_{32} & 1 \end{pmatrix} \begin{pmatrix} stock^{ex} \\ exch^{ex} \\ variable^{en} \end{pmatrix} = \begin{pmatrix} \gamma_{11} & 0 & 0 \\ 0 & \gamma_{22} & 0 \\ 0 & 0 & \gamma_{33} \end{pmatrix} \begin{pmatrix} stock_{t-1}^{ex} \\ exch_{t-1}^{ex} \\ variable_{t-1}^{en} \end{pmatrix} \\
+ \left(I + \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} d_{1,t} & 0 & 0 \\ 0 & d_{2,t} & 0 \\ 0 & 0 & d_{3,t} \end{pmatrix} \right) \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{pmatrix} \quad (3.10)$$

Each exogenous shock is determined according to the residual of the related variable that is determined through a Vectorautoregressive model (VAR), consisting of the relevant variables as described in Eq. (3.10)⁴². Hereby, we follow a Cholesky decomposition in order to account for the impulse responses of the endogenous variables. We apply Sims' (1980) structural VAR approach; a recursive economic structure with the most endogenous variable ordered last is applied⁴³. In our specifications of VAR models we select the greatest markets in size as most exogenous and the smallest markets as the most endogenous variable.

3.4 Propagation of excessive volatility

3.4.1 Macro level models

The results for the macro level models are presented in the Tables 3.6 in Appendix II. The contagious effects on each country are more widely originated in the currency markets than in the stock exchange markets, except for Germany. Germany has a nominated representative role in the models. The reason why Germany is less subjected to contagious effects can be explained through the dynamics in the European currency union. The volatility of currency flows, with respect to the Euro, is absorbed within the robust block of a currency with a common central bank. In general, if financial contagion occurs from one country to another country in the stock markets, contagion is carried out in the currency markets for the same countries in same way. For instance, if the DAX is transmitting

⁴² The normality and heteroskedasticity in the VAR models are tested by conventional tests such as serial correlation LM tests, Jarque-Bera normality tests, White heteroskedasticity tests, and stability test of the coefficients. We do not display the tests results due to space limitation and focus on the results of the models. However, they are available upon request.

⁴³ Favero (2001, p.165)

contagion to the Dow Jones, the German Mark or EURO⁴⁴ is similarly transmitting contagion on the US Dollar.

The results show a close relationship between contagion and interdependence. If there is interdependence between two markets, the contagious effects are more apparent. Nonetheless, interdependence and contagion are more loosely connected in the stock exchange markets.

Special cases are provided when there is no interdependence, however, contagion is apparent. This case is given once in both market types: for foreign exchanges, UK originated contagion in Turkey; for stock exchanges, Dow Jones originated contagion in Mexico. A probable explanation is delivered by the propagation of a continental shock. Although, on the global macro level, the interdependence is not significantly high, intra-continental relations in commodity and capital inflows are obviously linked together. An excessive turbulence in a country within the same continent (global micro level) generates substantial spillover effects that is observable on the macro level.

The number of interdependence cases without contagion is more frequent in the stock exchange markets. The high rate of global institutional investments with similar origin stimulate a wide share of correlated movements in the global stock exchange markets. The interdependence is more intensified than in the foreign exchange markets, so that the modified nonlinear behaviour is less *pressing* in times of turbulence (non-normality).

3.4.2 Extracted micro level models

Macro level models show the most dominant interdependence and contagion cases. However, multicollinearity in the estimated coefficients could be a potential drawback in such large models. We therefore construct extracted micro level models with the purpose of achieving more accurate results for the composition of interdependence and contagion. Nonetheless, these models will surely suffer from information loss. According to our model specification the interaction throughout both market types can be investigated (See

⁴⁴ Note, that after the introduction of the Euro, the contagion discourse for Germany has to be considered in the context of the European currency union, at least for the foreign exchange market.

Eq. 3.10). The results for the micro level models are presented in the Tables 3.7 and the clustering schemes are illustrated in Tables 3.2 and Tables 3.3 in Appendix II.

For leading financial centers contagion cases in the foreign exchange markets are higher than in stock exchange markets. A potential reason is that leading currencies serve as main transaction units. They fulfill the function of intermediation of international transactions. Due to this function the currencies are always subject to speculative intentions, and thus accommodating a risk of extreme fluctuations.

In the case of emerging markets and China, stock exchanges are more affected from contagion cases. Some explanation is given by investment portfolios in emerging markets. Investment portfolios typically are originated from leading global institutions and therefore a channel of potential turbulence propagation.

Further considerations show that trade partners are obviously originators of contagion, especially in emerging markets. Stock exchange markets as contagion sources follow the analogy of corresponding FDI partners: Close FDI relations expose the risk of contagion for stock exchange markets.

In general, it can be observed that foreign exchange markets are more exposed to contagion. Germany and UK follow an exceptional pattern. Although the share of Turkey is subordinated in trade and FDIs, Turkey does create contagion in both market types for the macro level as well as in the micro level models.

More detailed financial relationships are illustrated in such micro level models⁴⁵. Compared to the macro level models number of contagion occurrence is more frequently originated from foreign exchange markets. Contagion originating from stock exchanges are about equal to the cases in macro models. Interdependence originating from stock markets are higher detailed than macro level models. The results for foreign exchange market are divergent, yet, resembling the macro model results; USA and Turkey have detailed results as in the contagion case.

⁴⁵ For example, the pure contagion case for Dow Jones on the Mexican stock exchange in the macro model, exhibits now interdependence for both markets in the micro model.

3.5 Discussion

As mentioned in the previous sections the phenomena of interdependence and contagion relationships should be analyzed under various real economic or financial linkages such as (commodity) trade, FDI, and speculative cash flows.

It is apparent that the markets with high a contagion-interdependence ratio have undiversified FDI partnership relations and very dominant trade partners. The ability of markets to take *global financial sidestep* are restricted by the lack of diversification of interdependencies and incompleteness of the markets in the sense of Allen and Gale (2000). Analogously to the Kenen's argument, that diversified industrial structure in each country reduces the size of aggregate country-specific shocks in the context of optimal currency areas, diversified trade and capital inflow structure reduces the amount of exposure to contagion. In other terms, the reaction flexibility to evade the shocks increases by the degree of diversification in trade and capital flows.

The results for Germany has to be examined with respect to the common dynamics of the common currency area. The wide range of commodity trade, industrial and financial linkages within the Euro area creates a buffer zone, concerning cross-border contagion, despite the huge variety of international capital flows from outside of the monetary area⁴⁶.

One of the most exposed markets to contagion is the United Kingdom. Close relationships to the USA and the Euro Area open substantial channels of contragion transmission. Deep connectedness of economic markets in financial issues, as well as in commodity trade, appears to open new transmission channels of external shocks.

In the case of China two aspects reflect the low contagion rate. The Yuan has synthetically been suppressed in its value in order the gain competitiveness of the Chinese economy in international trade markets. Due to the fixed value, the Yuan does not response to external

⁴⁶ This is one of the main motivations to establish a monetary union as in the case of the Euro. Concerning this function of a buffer zone, that is softening the 'nonlinear' or speculative behavior of the capital flows. In the case of Germany, this goal seems to be achieved, while keeping in mind the position of i.e. UK with a higher rate of contagious effects.

spillover effects. Beside contagion some sort of insensitiveness in the case of interdependence is observable. Surely, keeping China's leadership in mind, the inclusion of the Asian markets would give here more accurate explanations. Another aspect is the powerful stance of the Chinese economy as one of the largest world economies in industrial production and GDP. The huge diversification in the industrial production delivers a further explanation for the robust position against contagion exposure.

Japanese markets reflect the robust stance of the economy. Despite the high order of interdependence, the contagion ratio is low. The second largest economy pursues the role as a kind of price setter in the global markets. Furthermore, apart from being subject to contagion, Japan is one of the major contagion creators. Turbulences in the Japanese markets spill over to other globally linked markets. This circumstance is reflected in the high significance of the results.

The results for the Turkish markets reflect the narrow relationships of the economy, especially concerning the trade partners in the EU. European countries as the dominant trade partners can be regarded as a weakness toward contagion exposure. Similarly, the dominant interdependence with the USA and Europe, concerning the FDIs, generates a further risky position in exposure to contagion. Simultaneously, this means that Turkey is linked between two powerful economic blocks, which open two substantial channels of financial shock transmission and are reducing the flexibility of evading from potential shocks.

The US markets exhibit a high order of interdependence (including weak interdependence), however a relative low contagion ratio. As in the case of Japan, the US economy is dominating the international capital markets. Thus, the opposite direction of contagion is prevailing: Us markets are one of the main sources of contagious effects.

The high order of contagion in Mexican markets reflects the exposure to the financial markets. The dominant role of the USA as the fundamental trade and FDI partner can be mentioned as the most illustrative case for the contagion exposure with insufficient diversification in commodity and capital flows. The high significance level in results

indicate the strong linkage to the US markets.

Despite the loss of information in the micro models, the differentiation between interdependence and contagion effects are more visible. In the case of contagion without any observable financial interdependence, speculative capital flows, beside FDI and trade are to be considered as an explanatory factor in contagion.

The higher order of interdependence originating from stock markets for micro level models indicates that *deep* linkages among stock markets are prevailing on further consideration. A significant turmoil in a cross-border stock exchange market will be anticipated to have transmission effects on the domestic market, due to the tied interdependent relations.: The coincidence of contagion and interdependence cases in macro and micro level models, which are originating from stock markets, can be interpreted as a case of *structurally* anticipated shock transmission.

Interdependence in foreign exchange markets are globally constructed. Contagion, yet, in this constellation is more apparent in micro level models. Turbulences or *nonlinearities* in the exchange rates spill over more widely as a global phenomenon, sometimes without any obviously reasoned economic explanation. An important consideration is given by the fact that, according to our model, turbulences occur endogenously in the domestic markets. Instantaneously, these domestic *nonlinear* behaviour is transmitted internationally. The risk that the foreign market has not anticipated the domestic turbulence should not be neglected. Preparedness of the foreign markets against a domestic shock is a central aspect of contagion. The circumstances, under which the shock occurs, define the extent to which the shocks can be absorbed: the financial system and the economic stance are important indicators under this consideration.

3.6 Conclusion

In this chapter we analyze the transmission mechanisms of endogenous excessive volatility to another international financial market. Central patterns in the obtained results can be observed, when considering the transmission of contagion effects.

Interdependence between two centers is a central phenomenon. If a country has strong relations with two dominating central financial markets, its markets severely suffer from contagion. In this stance the foreign economic surroundings (foreign linkages) do not build a buffer zone, the lack of own real economic activities/production is more apparent. In the contagion related discourse these kind of markets are, roughly speaking, *tight on edge*; fundamental propagation channels of turbulences are opened consequently.

Diversification in financial and real economic linkages is another further key aspect of the results. FDI and trade diversification loosens the tension of direct interdependence, and somewhat unilateral dependence for emerging markets. Consequently, exposure to contagion is higher without diversification in partner markets. Another interesting pattern is that contagious effects in the foreign exchange markets are higher than in stock exchange markets. Indisputably, the role of speculative flows and the intensity of market transactions are to be addressed as explanatory reasons.

Central financial markets with high production level exhibit a *price setter* behaviour. They propagate a source of contagion with global impact, rather than being subjected to contagion. In this case diversification is not as important as in the case of small adjunct market places.

Conclusively, it can be followed that contagion can be perceived as a phenomenon of international capital flow dynamics, acceleration of capital and intensity of capital markets. However, real economic output and a robust financial system stem the effect of contagion. Financial architecture of control and monitoring systems, concerning capital flows, regulation of international financial markets or at least basic rules in coherence with domestic financial systems should be considered for structural absorption of unanticipated turbulences in international markets.

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APPENDIX I

Note: The following abbreviations are used throughout the Appendix:

US, Us Dollar,	DW, Dow Jones Index,
GER, German Mark or Euro (since 2000),	DAX, Stock exchange Index – Frankfurt,
UK, Pound Sterling,	FTSE, Stock exchange Index – London,
JP, Japanese YEN,	NIKKEI, Stock Exchange- Tokyo,
CN, Chinese Yuan,	HNG, Hang Seng Index,
TR, Turkish Lira,	Stock Exchange- Istanbul, IMKB,
MEX, Mexican Peso	MEXB, Stock Exchange Mexico

Tables 3.1 VaR models, GARCH estimation

Table 3.1a VaR models - foreign exchange markets, GARCH estimation

	US		GER		UK	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
<i>Mean Equation</i>						
C	$-3.26 \cdot 10^{-5}$	0.5203	0.0001	0.1562	0.0001	0.0274
AR(1)			-0.0188	0.1811		
<i>Variance Equation</i>						
ω	$8.11 \cdot 10^{-8}$	0.0057	$2.92 \cdot 10^{-7}$	0.0013	$2.10 \cdot 10^{-7}$	0.0016
α	0.0394	0.0000	0.0373	0.0000	0.0444	0.0000
β	0.9572	0.0000	0.9567	0.0000	0.9506	0.0000
<i>Decision Criteria</i>						
AIC	-8.1631		-7.2940		-7.5672	
SIC	-8.1570		-7.2866		-7.5611	
Q (20)	21.823	0.350	17.562	0.616	17.164	0.642
Q^2 (20)	13.258	0.866	20.81	0.347	9.7450	0.973
ARCH-LM		0.8452		0.3823		0.9692
Log likelihood	21919		19568		20319	

Note: The following abbreviations are used: US, Us Dollar, GER, German Mark or Euro (since 2000), UK, Pound Sterling.

Table 3.1b VaR models - foreign exchange markets, GARCH estimation

	JP		CN		TR	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
<i>Mean Equation</i>						
C	$6.82 \cdot 10^{-5}$	0.3967	$2.63 \cdot 10^{-6}$	0.0255	0.001223	0.0000
AR(1)			-0.004164	0.8166		
<i>Variance Equation</i>						
ω	$5.14 \cdot 10^{-7}$	0.0002	$2.69 \cdot 10^{-12}$	--	$1.68 \cdot 10^{-5}$	--
α	0.033649	0.0000	0.004031	0.0000	0.758596	0.0000
β	0.956236	0.0000	0.995969	0.0000	0.240951	0.0000
<i>Decision Criteria</i>						
AIC	-7.248469		-11.13590		-7.070696	
SIC	-7.242333		-11.12971		-7.065787	
Q (20)	22.401	0.319	0.0147	1.000	5.8684	0.999
Q^2 (20)	12.660	0.891	0.0147			
				1.000	0.6477	1.000
ARCH-LM	0.7614			1.000		1.000
Log likelihood	19463.51		29559.68		18985.28	

Note: The following abbreviations are used: JP, Japanese YEN, CN, Chinese Yuan, TR, Turkish Lira.

Table 3.1c VaR models - foreign exchange markets, GARCH estimation

	MEX	
	Coefficient	p-value
<i>Mean Equation</i>		
C	-0.000142	0.0156
AR(1)		
<i>Variance Equation</i>		
ω	$1.06 \cdot 10^{-6}$	0.0000
α	0.213569	0.0000
β	0.781465	0.0000
<i>Decision Criteria</i>		
AIC	-7.739377	
SIC	-7.732110	
Q (20)	25.911	0.169
Q^2 (20)	0.1281	1.000
ARCH-LM		1.0000
Log likelihood	17012.28	

Note: The following abbreviations are used: Mex, Mexican Peso.

Table 3.1d VaR models - stock exchange markets, GARCH estimation

	DW		DAX		FTSE	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
<i>Mean Equation</i>						
C	0.000658	0.0000	0.000810	0.0000	0.000508	0.0000
AR(1)					-0.005949	0.6963
<i>Variance Equation</i>						
ω	$7.61 \cdot 10^{-7}$	0.0001	$1.37 \cdot 10^{-6}$	0.0001	$1.01 \cdot 10^{-6}$	0.0000
α	0.070771	0.0000	0.080243	0.0000	0.081202	0.0000
β	0.924139	0.0000	0.914586	0.0000	0.911557	0.0000
<i>Decision Criteria</i>						
AIC	-6.570721		-6.009133		-6.466716	
SIC	-6.564059		-6.002471		-6.458721	
Q (20)	29.562	0.077	32.579	0.038	23.227	0.228
Q^2 (20)	16.013	0.716	1.7191	1.000	26.681	0.112
ARCH-LM		0.7107		1.000		0.1534
Log likelihood	16011.28		14643.25		15755.69	

Note: The following abbreviations are used: DW, Dow Jones Index, DAX, Stock exchange Index - Frankfurt, FTSE, Stock exchange Index - London.

Table 3.1e VaR models - stock exchange markets, GARCH estimation

	NIKKEI		HNG		IMKB	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
<i>Mean Equation</i>						
C	0.000218	0.2140	0.000754	0.0000	0.001840	0.0000
AR(1)						
<i>Variance Equation</i>						
ω	$2.84 \cdot 10^{-6}$	0.0000	$1.59 \cdot 10^{-6}$	0.0002	$1.00 \cdot 10^{-5}$	0.0000
α	0.080340	0.0000	0.065121	0.0000	0.102139	0.0000
β	0.909882	0.0000	0.930379	0.0000	0.887625	0.0000
<i>Decision Criteria</i>						
AIC	-5.737049		-5.694835		-4.661476	
SIC	-5.730289		-5.688143		-4.654769	
Q (20)	5.6865	0.999	52.662	0.0000	24.099	0.238
Q^2 (20)	0.017	1.000	17.367	0.629	8.0502	0.992
ARCH-LM		1.000		0.6631		0.9991
Log likelihood	13739.50		13803.59		11271.79	

Note: The following abbreviations are used: NIKKEI, Stock Exchange- Tokyo , HNG, Hang Seng Index, Stock Exchange- Istanbul, IMKB.

Table 3.1f VaR models - stock exchange markets, GARCH estimation

MEXB		
	Coefficient	p-value
<i>Mean Equation</i>		
C	0.001095	0.0000
AR(1)	0.125819	0.0000
<i>Variance Equation</i>		
ω	$4.10 \cdot 10^{-6}$	0.0000
α	0.101210	0.0000
β	0.885920	0.0000
<i>Decision Criteria</i>		
AIC	-5.719721	
SIC	-5.711726	
Q (20)	29.047	0.065
Q^2 (20)	34.137	0.018
ARCH-LM		0.029
Log likelihood	13936.38	

Note: The following abbreviations are used: MEXB, Stock Exchange Mexico.

APPENDIX II

Tables 3.2 Micro level models - Contagion, Clustering scheme

Weak relations in interdependence or contagion are given in brackets

Table 3.2a Stock exchange markets as originating markets

Origin Market	Target Market	Origin Market	Target Market
DW	➤ HNG	DAX	➤ HNG
	➤ UK		➤ (JP)
	➤ DAX		➤ (UK)
	➤ MEXB		

Table 3.2b Stock exchange markets as originating markets

Origin Market	Target Market	Origin Market	Target Market
FTSE	➤ IMKB	NIKKEI	➤ DW
	➤ GER		➤ GER
			➤ MEX

Table 3.2c Stock exchange markets as originating markets

Origin Market	Target Market	Origin Market	Target Market
HNG	➤ US	IMKB	➤ US
	➤ MEXB		➤ JP
			➤ FTSE
			➤ UK
			➤ MEXB

Table 3.2d Stock exchange markets as originating markets

Origin Market	Target Market
MEX	➤ CN

Table 3.2e Forex markets as originating market

Origin Market	Target Market
US	➤ IMKB
	➤ JP
	➤ UK
	➤ FTSE
	➤ MEXB

Origin Market	Target Market
GER	➤ TR
	➤ FTSE
	➤ MEXB

Table 3.2f Forex markets as originating market

Origin Market	Target Market
UK	➤ TR
	➤ US
	➤ JP
	➤ MEXB

Origin Market	Target Market
JP	➤ TR
	➤ US
	➤ DW
	➤ UK
	➤ DAX
	➤ (FTSE)

Table 3.2g Forex markets as originating market

Origin Market	Target Market
TR	❖ DW
	❖ HNG
	❖ JP
	❖ FTSE
	❖ GER
	❖ DAX
	❖ MEXB

Origin Market	Target Market
CN	❖ DW
	❖ JP
	❖ NIKKEI
	❖ MEXB

Table 3.2h Forex markets as originating market

Origin Market	Target Market
MEX	➤ IMKB
	➤ US
	➤ (JP)

Tables 3.3 Micro level models - Interdependence, Clustering scheme
Weak relations in interdependence or contagion are given in brackets

Table 3.3a Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
DW	❖ IMKB	DAX	❖ DW
	❖ TR		❖ IMKB
	❖ DAX		❖ (TR)
	❖ FTSE		❖ FTSE
	❖ (NIKKEI)		❖ MEXB
	❖ CN		
	❖ HNG		
	❖ MEXB		

Table 3.3b Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
FTSE	❖ DW	NIKKEI	❖ US
	❖ US		❖ IMKB
	❖ IMKB		❖ (FTSE)
	❖ TR		❖ CN
	❖ JP		❖ HNG
	❖ NIKKEI		❖ MEXB
	❖ MEXB		❖ MEX
	❖ (MEX)		

Table 3.3c Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
HNG	❖ DW	IMKB	❖ DW
	❖ US		❖ (US)
	❖ DAX		❖ DAX
	❖ UK		❖ FTSE
	❖ NIKKEI		❖ NIKKEI
	❖ MEXB		❖ (CN)
	❖ TR		

Table 3.3d Stock exchange markets as target markets

Target Market	Origin Market
MEXB	❖ DW
	❖ US
	❖ TR
	❖ DAX
	❖ GER
	❖ FTSE
	❖ UK
	❖ NIKKEI
	❖ HNG

Table 3.3e Stock exchange markets as origin markets

Origin Market	Target Market
DW	➤ IMKB
	➤ FTSE
	➤ HNG
	➤ GER
	➤ DAX
	➤ MEXB

Origin Market	Target Market
DAX	➤ IMKB
	➤ US
	➤ DW
	➤ JP
	➤ UK
	➤ MEX
	➤ MEXB

Table 3.3f Stock exchange markets as origin markets

Origin Market	Target Market
FTSE	➤ TR
	➤ IMKB
	➤ US
	➤ DW
	➤ JP
	➤ (NIKKEI)
	➤ GER
	➤ DAX
	➤ MEXB

Origin Market	Target Market
NIKKEI	➤ IMKB
	➤ US
	➤ (DW)
	➤ HNG
	➤ FTSE
	➤ GER
	➤ MEX

Table 3.3g Stock exchange markets as origin markets

Origin Market	Target Market	Origin Market	Target Market
HNG	➤ DW	IMKB	➤ (US)
	➤ MEX		➤ DW
	➤ MEXB		➤ (JP)
			➤ NIKKEI
			➤ UK
			➤ FTSE
			➤ GER
			➤ DAX

Table 3.3h Stock exchange markets as origin markets

Origin Market	Target Market
MEXB	➤ DW
	➤ CN
	➤ HNG
	➤ NIKKEI
	➤ FTSE
	➤ GER
	➤ DAX

Table 3.3i Foreign exchange markets as origin markets

Origin Market	Target Market	Origin Market	Target Market
US	➤ TR	GER	➤ TR
	➤ (CN)		➤ JP
	➤ HNG		➤ MEXB
	➤ JP		
	➤ NIKKEI		
	➤ UK		
	➤ FTSE		
	➤ GER		
	➤ MEX		
	➤ MEXB		

Table 3.3j Foreign exchange markets as origin markets

Origin Market	Target Market	Origin Market	Target Market
JP	➤ TR	UK	➤ US
	➤ US		➤ HNG
	➤ CN		➤ JP
	➤ UK		➤ MEXB
	➤ FTSE		

Table 3.3k Foreign exchange markets as origin markets

Origin Market	Target Market	Origin Market	Target Market
CN	➤ (IMKB)	TR	➤ DW
	➤ (US)		➤ HNG
	➤ DW		➤ JP
	➤ JP		➤ FTSE
	➤ NIKKEI		➤ (DAX)
	➤ MEXB		➤ MEXB

Table 3.3l Foreign exchange markets as origin markets

Origin Market	Target Market
MEX	➤ JP
	➤ NIKKEI
	➤ (FTSE)

Tables 3.4 Macro level models - Contagion, Clustering scheme

Weak relations in interdependence or contagion are given in brackets

Table 3.4a Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
	❖ DW		❖ DW
DW	❖ DAX	DAX	❖ IMKB
	❖ IMKB		❖ NIKKEI
	❖ NIKKEI		❖ DAX

Table 3.4b Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
	❖ FTSE	NIKKEI	❖ NIKKEI
FTSE	❖ IMKB		
	❖ (NIKKEI)		

Table 3.4c Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
	❖ DW		❖ DW
HNG	❖ (DAX)	IMKB	❖ (FTSE)
	❖ HNG		❖ IMKB

Table 3.4d Stock exchange markets as target markets

Target Market	Origin Market
MEXB	❖ DW
	❖ MEXB

Table 3.4e Foreign exchange markets as target markets

Target Market	Origin Market
US	❖ CN
	❖ JP
	❖ GER
	❖ MEX
	❖ UK

Target Market	Origin Market
GER	❖ TR

Table 3.4f Foreign exchange markets as target markets

Target Market	Origin Market
UK	❖ JP
	❖ TR
	❖ UK
	❖ US

Target Market	Origin Market
JP	❖ CN
	❖ GER
	❖ MEX
	❖ US

Table 3.4g Foreign exchange markets as target markets

Target Market	Origin Market
CN	❖ CN

Target Market	Origin Market
TR	❖ GER
	❖ TR
	❖ (UK)

Table 3.4h Foreign exchange markets as target markets

Target Market	Origin Market
MEX	❖ US
	❖ (MEX)

Tables 3.5 Macro level models - Interdependence, Clustering scheme

Weak relations in interdependence or contagion are given in brackets

Table 3.5a Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
DW	❖ DAX	DAX	❖ DW
	❖ FTSE		❖ HNG
	❖ HNG		❖ IMKB
	❖ IMKB		❖ NIKKEI
	❖ NIKKEI		

Table 3.5b Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
FTSE	❖ DW	NIKKEI	❖ (DW)
	❖ HNG		❖ DAX
	❖ IMKB		❖ HNG
	❖ MEXB		❖ IMKB
	❖ NIKKEI		

Table 3.5c Stock exchange markets as target markets

Target Market	Origin Market	Target Market	Origin Market
HNG	❖ DW	IMKB	❖ DW
	❖ DAX		❖ DAX
	❖ MEXB		❖ (FTSE)

Table 3.5d Stock exchange markets as target markets

Target Market	Origin Market
MEXB	❖ FTSE
	❖ HNG

Table 3.5e Foreign exchange markets as target markets

Target Market	Origin Market
US	❖ JP
	❖ (GER)
	❖ MEX
	❖ UK
	❖ CN

Target Market	Origin Market
GER	❖ JP
	❖ TR

Table 3.5f Foreign exchange markets as target markets

Target Market	Origin Market
UK	❖ JP
	❖ MEX
	❖ TR
	❖ US

Target Market	Origin Market
JP	❖ CN
	❖ GER
	❖ MEX
	❖ US
	❖ UK

Table 3.5g Foreign exchange markets as target markets

Target Market	Origin Market
CN	- no market

Target Market	Origin Market
TR	❖ (JP)
	❖ GER

Table 3.5h Foreign exchange markets as target markets

Target Market	Origin Market
MEX	❖ (JP)
	❖ US

Tables 3.6 Macro level model results

Note: Weak interdependence and contagion are defined as a P value above 10% significance level. Weak interdependence is noted in round brackets, weak contagion is noted in square brackets.

Table 3.6a Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
DW	➤ DW			0.3372	0.0000
	➤ DAX	1.3587	0.0000	-0.3617	0.0000
	➤ (NIKKEI)	0.0772	0.1188		
	➤ FTSE	0.0649	0.0045		
	➤ HNG	0.1494	0.0000	-0.2037	0.0253
	➤ IMKB	-0.2620	0.0000	0.2834	0.0474
	➤ MEXB			0.1622	0.0567

Table 3.6b Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
DAX	➤ DW	0.6706	0.0000	0.2367	0.001
	➤ DAX			-0.2219	0.0084
	➤ NIKKEI	-0.0658	0.0567		
	➤ IMKB	0.2722	0.0000		
	➤ [HNG]	0.0966	0.0000	-0.2070	0.1296

Table 3.6c Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
FTSE	➤ DW	0.0229	0.0205		
	➤ FTSE			0.9926	0.0000
	➤ HNG	-0.0508	0.0241		
	➤ [IMKB]	0.1113	0.0016	-0.2155	0.1345
	➤ MEXB	0.0981	0.0000		

Table 3.6d Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
NIKKEI	➤ [DW]	0.6751	0.0000	-0.0131	0.1561
	➤ NIKKEI			1.0004	0.000
	➤ DAX	1.3414	0.0000	0.0235	0.0726
	➤ [FTSE]	0.0218	0.0573	-0.0214	0.1315

Table 3.6e Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
HNG	➤ HNG			1.0043	0.0000
	➤ DW	-0.0343	0.0000		
	➤ JP	-0.0443	0.0391		
	➤ DAX	0.0383	0.0000		
	➤ FTSE	-0.022	0.026		
	➤ MEXB	0.098608	0.0000		

Table 3.6f Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
IMKB	➤ DW	-0.02149	0.0000	0.0257	0.07
	➤ DAX	0.0461	0.0000	-0.0471	0.0186
	➤ NIKKEI	0.025417	0.0758		
	➤ FTSE	0.026	0.0001	-0.0624	0.0041
	➤ IMKB			1.0043	0.0000

Table 3.6g Stock exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
MEXB	➤ MEXB			0.99086	0.0000
	➤ HNG	0.0976	0.0000		
	➤ FTSE	0.0451	0.0000		

Table 3.6h Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
US	➤ US			0.0798	0.0115
	➤ JP	1.7252	0.0000	0.1163	0.0816
	➤ UK	-1.5131	0.0000	0.1034	0.0554
	➤ [MEX]	0.1784	0.0010	-0.1747	0.1323

Table 3.6i Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
GER	➤ [(US)]	0.0098	0.1217	-0.0306	0.1374
	➤ JP	-0.0370	0.005	0.0738	0.0828
	➤ GER			0.9956	0.0000
	➤ TR	-0.7699	0.0436	-3.8576	0.0017

Table 3.6j Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
JP	➤ US	0.4175	0.0000	-0.1455	0.0000
	➤ JP			0.5737	0.0000
	➤ GER	-0.04	0.0415		
	➤ UK	0.4814	0.0000	-0.0906	0.0002
	➤ (TR)	-0.7711	0.1027		
	➤ (MEX)	-0.0436	0.1184		

Table 3.6k Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
UK	➤ US	-0.5450	0.0000	0.1217	0.0000
	➤ JP	0.7469	0.0000		
	➤ UK			0.3736	0.0000
	➤ [TR]			2.0872	0.1132

Table 3.6l Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
CN	➤ US	-0.1424	0.0002	0.1426	0.0002
	➤ JP	0.7138	0.0000	-0.714	0.0000
	➤ CN			1.0013	0.0000

Table 3.6m Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
TR	➤ GER	-0.005	0.0078	0.0042	0.0571
	➤ UK	-0.0023	0.065	0.0028	0.0055
	➤ TR			1.1043	0.0000

Table 3.6n Foreign exchange markets as origin markets

Origin Market	Target Market	Interdependence	P value	Contagion	P value
MEX	➤ US	0.0177	0.0003	-0.021	0.0493
	➤ JP	-0.0369	0.0002	0.0493	0.0218
	➤ UK	0.017	0.035		
	➤ MEX			1.026	0.0000

Tables 3.7 Micro level model results

Note: Weak interdependence and weak contagion are defined as a P value above 10% significance level. Weak interdependence is noted in round brackets, weak contagion is noted in square brackets.

Table 3.7a Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
DW	❖ IMKB	0.0241	0.0001		
	❖ TR	0.0055	0.0572	-0.0065	0.0579
	❖ DAX	0.6853	0.0000		
	❖ (JP)	-0.0339	0.1300	-0.1449	0.0091
	❖ FTSE	0.1238	0.0000		
	❖ (NIKKEI)	-0.0339	0.1300	0.9961	0.0000
	❖ CN	-0.3135	0.0353	0.3157	0.0342
	❖ HNG	-0.04	0.0000		
	❖ MEXB	-0.0199	0.0788		

Table 3.7b Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
DAX	❖ DW	1.3612	0.0000	-0.3608	0.0000
	❖ [JP]			-0.1215	0.1174
	❖ IMKB	0.0723	0.0000		
	❖ [(TR)]	0.0066	0.1061	-0.0075	0.1249
	❖ FTSE	0.1574	0.0000		
	❖ MEXB	1.0068	-0.0367		

Table 3.7c Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
FTSE	❖ DW	0.1402	0.0000	-0.1274	0.0451
	❖ US	-0.3155	0.0000	0.4603	0.001
	❖ IMKB	0.0303	0.0000	-0.0628	0.0038
	❖ [TR]	0.0071	0.0981	-0.0080	0.1164
	❖ DAX	0.088	0.0000		
	❖ GER			0.9683	0.0000
	❖ [JP]	-0.0638	0.0165	0.0930	0.1059
	❖ NIKKEI	0.0204	0.0703		
	❖ MEXB	0.0401	0.0006		
	❖ (MEX)	0.0332	0.1129		

Table 3.7d Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
NIKKEI	❖ US	-0.5791	0.0000		
	❖ IMKB	0.0246	0.0832		
	❖ (FTSE)	0.0468	0.1371		
	❖ CN	1.6596	0.0000	-1.6589	0.0000
	❖ HNG	-0.0469	0.0240		
	❖ MEXB	0.1056	0.0074		
	❖ MEX	0.0924	0.0393		

Table 3.7e Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
HNG	❖ DW	-0.0656	0.0038	-0.1768	0.049
	❖ US	-0.1078	0.0678		
	❖ DAX			-0.2834	0.0365
	❖ UK	0.0889	0.0266		
	❖ NIKKEI	-0.0239	0.0221		
	❖ MEXB	0.105	0.0000		
	❖ TR	0.009425	0.0411	-0.0124	0.0233

Table 3.7f Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
IMKB	❖ DW	0.1336	0.0003		
	❖ (US)			0.6289	0.0353
	❖ DAX	0.1104	0.0000		
	❖ [FTSE]	0.1283	0.0003	-0.2001	0.1569
	❖ JP	-0.7381	0.0391	0.2304	0.0919
	❖ NIKKEI	0.0461	0.0857		
	❖ [(MEX)]	0.2506	0.1215	-0.1526	0.1243
	❖ (CN)	0.1058	0.1151		

Table 3.7g Stock exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
MEXB	❖ DW	-0.0602	0.0046	0.1504	0.0734
	❖ US	0.1315	0.0171	-0.5649	0.0014
	❖ [IMKB]			-0.0485	0.1034
	❖ TR	-0.0121	0.0042	0.0166	0.0009
	❖ DAX	-0.030	0.0428		
	❖ (GER)	-0.0983	0.0309	0.2404	0.0309
	❖ FTSE	0.0824	0.0001		
	❖ UK	-0.1311	0.0005	0.3926	0.0006
	❖ CN	0.6668	0.0029	-0.6614	0.0032
	❖ [HNG]	0.0977	0.0000	-0.1717	0.1519

Table 3.7h Foreign exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
US	❖ (IMKB)	0.0036	0.1411	-0.0155	0.0598
	❖ DAX	-0.0168	0.0020		
	❖ FTSE	-0.0258	0.0000		
	❖ UK	-0.6874	0.0000	0.2297	0.0000
	❖ JP	0.5501	0.0000	-0.2327	0.0000
	❖ NIKKEI	0.5233	0.0000		
	❖ (CN)	0.0026	0.1257		
	❖ HNG			-0.0641	0.050
	❖ (MEXB)	-0.0058	0.1698	0.0315	0.0259
	❖ MEX	0.0150	0.0510		

Table 3.7i Foreign exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
GER	❖ DW	-0.0333	0.0003		
	❖ US	0.0417	0.0750	-0.2338	0.067
	❖ IMKB	0.0723	0.0000		
	❖ TR			0.99267	0.0000
	❖ FTSE	0.0160	0.0741	-0.069	0.0584
	❖ NIKKEI	-0.0248	0.0830	0.0235	0.0059
	❖ MEXB	-0.0114	0.0880		

Table 3.7j Foreign exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
UK	❖ DW			-0.0670	0.0098
	❖ US	-1.2988	0.0000	0.3181	0.0001
	❖ IMKB	0.0307	0.0000	-0.0653	0.0026
	❖ (DAX)	-0.0294	0.0263	-0.0803	0.1156
	❖ JP	-0.3424	0.0000	0.2487	0.0000
	❖ TR	-0.0034	0.059		
	❖ (MEX)	0.0332	0.1129		

Table 3.7k Foreign exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
JP	❖ US	1.4302	0.0000	-0.4276	0.0001
	❖ IMKB	0.0227	0.0916	0.9936	0.0000
	❖ TR	-0.9170	0.0000	0.0048	0.0000
	❖ [DAX]	-0.0160	0.0139	0.0856	0.1244
	❖ GER	-0.0266	0.0981		
	❖ FTSE	-0.0251	0.0045		
	❖ UK	-0.3569	0.0000	0.1444	0.0036
	❖ CN	0.8361	0.0000	-0.8338	0.0000
❖ [(MEX)]	-0.0201	0.1059	0.0409	0.1270	

Table 3.7l Foreign exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
CN	❖ (US)	0.1903	0.1316		
	❖ JP	0.1991	0.0190		
	❖ MEXB	0.0017	0.0313	-0.0975	0.0005

Table 3.7m Foreign exchange markets as target markets

Target Market	Origin Market	Interdependence	P value	Contagion	P Value
TR	❖ US	-0.9181	0.0883		
	❖ GER	-0.6802	0.0436	-3.2560	0.0025
	❖ FTSE	0.6697	0.0008		
	❖ [UK]			1.6652	0.1377
	❖ [JP]	-0.7381	0.0391	-2.7638	0.1435
	❖ TR				
	❖ (MEX)	0.2506	0.1215		

Table 3.7n Foreign exchange markets as target markets

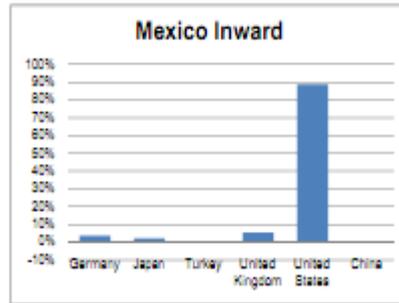
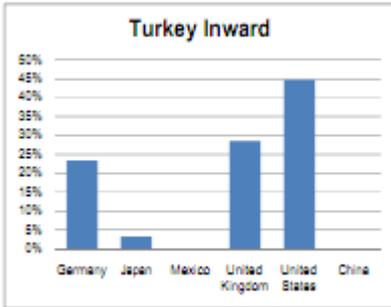
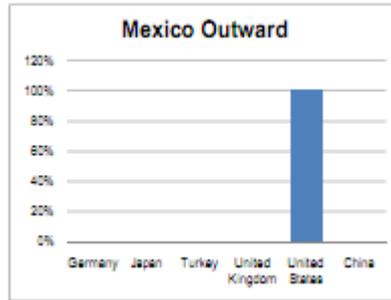
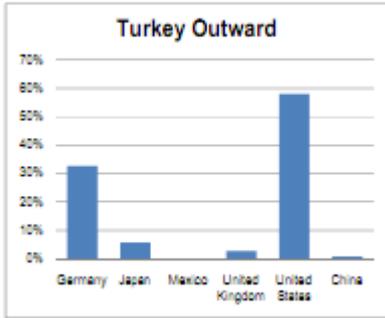
Target Market	Origin Market	Interdependence	P value	Contagion	P Value
MEX	❖ US	0.1018	0.0041	-0.2271	0.0496
	❖ (DAX)	0.0146	0.1073		
	❖ NIKKEI	0.0389	0.0001	-0.0375	0.0023
	❖ HNG	-0.0167	0.0490		
	❖ TR	-0.0121	0.0042		

APPENDIX III

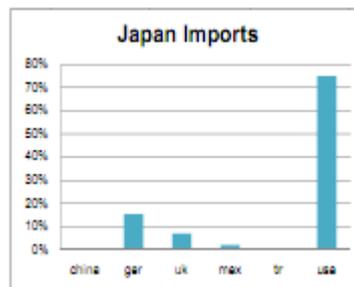
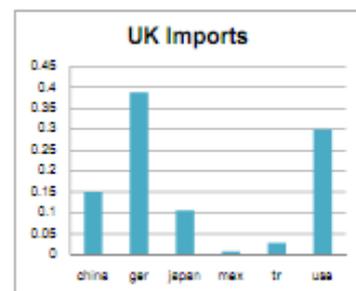
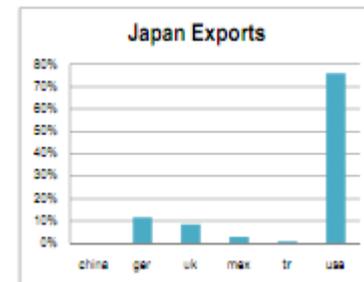
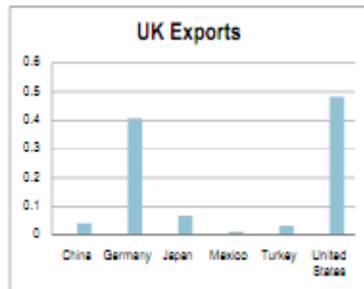
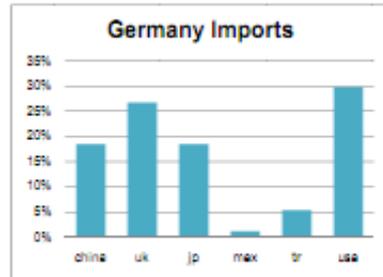
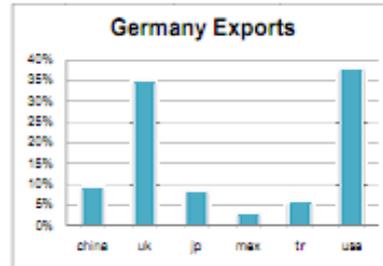
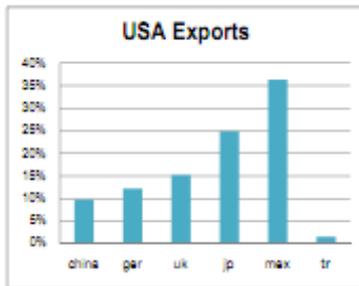
3.1 Figures - FDI and Trade distributions for sample countries with exclusion of China as exporting country of commodity and FDIs. All data (annual frequency) is obtained from OECD database (1993-2009).

3.1a FDI distributions in percentage points





3.1b Trade distributions in percentage points



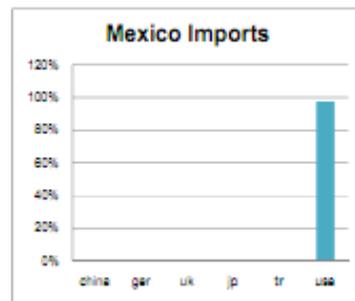
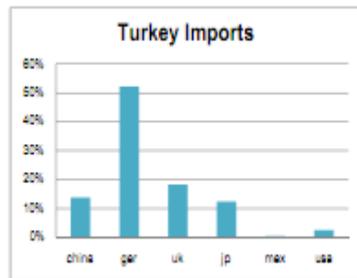
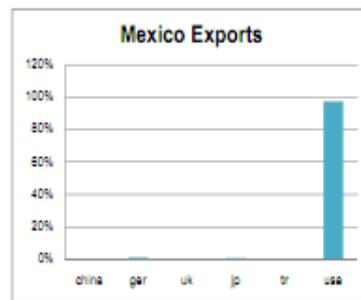
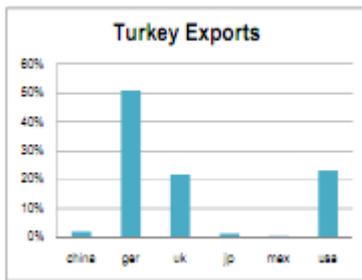
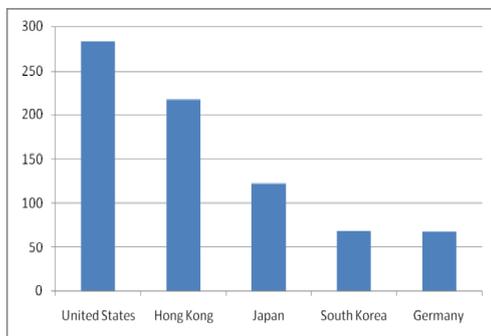
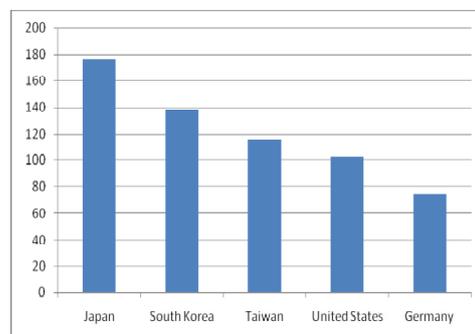


Table 3.2a China's Export 2010 (in \$ billion)



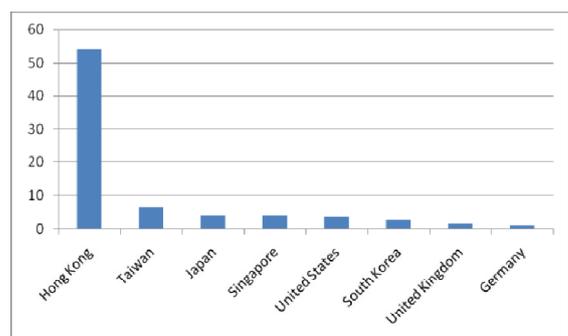
Source: PBC General Administration of Customs, China's Customs Statistics

Table 3.2b China's Import 2010 (in \$ billion)



Source: PBC General Administration of Customs, China's Customs Statistics

Table 3.2c FDI Inward 2009 (in \$ billion)



Source: Ministry of Commerce, PRC

PERSONAL

Date of Birth : 07 June 1979
Date of Place : Frankfurt/Main
Marital Status : Single

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