CONTAGION OF FINANCIAL CRISES IN THE CONTEXT OF UKRAINE

by

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Abstract

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This paper will discuss financial crises contagion in Ukraine and Russia. Contagion is defined as the increase of probability of speculative attack in Ukraine, which is caused by the existence of speculative attack in Russia, rather than by domestic economic fundamentals and as an increase of degree of comovements across financial markets of the countries in a crisis period relative to tranquil period. After review of relevant literature, the author constructs exchange market speculative pressure indexes and tests the null hypothesis of no contagion using regression, correlation, Granger causality and VAR analyses tools. No evidence supporting the existence of contagion of the 1998 financial crisis from Russia to Ukraine is found.

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GLOSSARY

Balance of payments - an accounting record of all transactions made by a country with over a certain time period, which is calculated by comparing the amount of foreign currency taken in to the amount of domestic currency paid out.

Balance of trade - a country' exports minus its imports.

Contagion – 1) systematic effect on the probability of a speculative attack that stems from attacks on other currencies rather from changes in domestic fundamentals; 2) a significant increase in cross-market linkages after a shock to individual country.

Currency - any form of money that is in public circulation.

Devaluation - a decrease in the value of currency relative to other currencies.

Exchange rate - rate at which one currency may be converted into another.

Financial crises - major disruptions in financial markets that are characterized by sharp declines in asset prices and the failures of many financial and non-financial firms.

Financial markets - markets in which funds are transferred from people who have an excess of available funds to people who have a shortage. E.g. foreign exchange, bond and stock markets.

Foreign debt - the money one country owes to another country, as a result of loans and/or a negative balance of trade.

Section 1

INTRODUCTION.

The issue of international financial crises has attracted a close attention of researchers starting from 1994 Mexican crisis and 1997 Asian crisis. It was observed that shocks to financial markets may not only produce devastating effects for domestic economy, but also hurt other countries through financial and real linkages, thus, contributing to macroeconomic instability, reducing investors confidence, exacerbating the situation in financial sector and even generating financial crises in these countries.

Such transmission of shocks across financial markets of various countries is sometimes called contagion by analogy with transmission of physiological virus. Formally, contagion is defined as "systematic effect on the probability of a speculative attack that stems from attacks on other currencies rather than from changes in domestic fundamentals" (Eichengreen, Rose, Wyplosz (1996) (p.19)). It is also defined in most of works as "a significant increase in cross-market linkages after a shock to individual country" (Dornbush, Park, Claessens (2000) p.3). These two definitions are not exclusive, but rather mutually complementary. My work uses both these definitions.

This work was motivated by 1998 financial crisis in Ukraine and by commonly mentioned allegations that Ukraine's crisis was caused by Russia's crisis. It can also be considered as a part of a number of studies that seek to understand the

propagation nature deeper by exploring transmission of financial market shocks within and across regions, which differ economically and institutionally. My paper explores the problem of contagion across financial markets of transition economies with the case of Russia and Ukraine as an example, taking into account both aforementioned definitions of contagion. Foreign exchange, stock and eurobonds markets are studied. First, I use a model, which attempts to isolate the contagion effects of the Russian crisis from the influence of Ukrainian domestic fundamentals. Next, I use Granger causality, correlation and VAR analyses to explore the issue of contagion deeper.

The main questions that my work discusses are the following:

- To what extent was the crisis in Ukraine attributable to the crisis in Russia rather than to weak domestic fundamentals?

- Did the degree of comovements, or, in other words, correlation across Russia's and Ukraine's financial markets differ during crisis periods relative to tranquil periods?

To my knowledge there is only one paper (Fries, Raiser, Stern (1998)) that examines contagion effects for Ukraine. That work is mainly descriptive, it does not present rigorous econometric analysis and discusses the events that are different from those discussed in my paper.

Comparing the results for Ukraine with results of other studies exploring contagion for other countries, may help in answering the question whether financial shocks get transmitted easier across transition economies, such as Ukraine and what are the reasons of such susceptibility. The issue is especially important in the light of the intentions of Ukraine to integrate

within the European structures. The integration includes the integration of financial markets and, therefore, therefore increases the possibility of contagion in both directions: from Europe to Ukraine and from Ukraine to Europe.

Section 2.

SURVEY OF LITERATURE.

The aim of this section is to review the models of financial crisis origination, evolution and transmission. I start this section with the review of pivotal models of financial crises including Krugman's (1979) and multiple equilibria models of exchange rate collapse. Next, I summarize the theories and empirical studies on international propagation of shocks across financial markets of various countries.

According to Krugman's model (1979), an abandonment of fixed exchange rates occurs when an inconsistency in fundamentals causes a critical loss in reserves. For example, a government performs an overly expansionary policy by running a fiscal deficit and financing it by emissions of money. As a result, domestic absorption exceeds production and the central bank needs to run down its foreign exchange reserves. When the reserves reach a minimum level the fixed rate should be abandoned.

This theory of balance of payments crises has produced four implications.

1) The relevant fundamentals that should be paid particular attention by policy makers are specified.

2) The date of collapse can not be predicted using a current rate of reserves depletion. The balance of payments crises occurs earlier due to the speculative attack. The date of attack is determined such that its magnitude

is sufficient to become successful in eliminating of the central bank's reserves.

3) The currency peg can be maintained only if the central bank has adequate reserves. After the reserves have been depleted, there is no other alternative, but abandoning peg.

4) The authorities can not repel the attack. Even if it is able to borrow foreign exchange and uses these funds for sterilized intervention, money supply increases and there is no level of reserves sufficient to fend off an attack. The attack can only be repelled in case of unsterilized intervention. However, that causes shrinking of monetary base and, as a result, increasing of interest rates. If the rise of interest rates is large enough, a banking crisis can develop. To prevent the latter the government begins sterilizing its intervention and the story repeats.

Although this model has contributed a lot to understanding currency crises, it has been criticized because of its assumption of government's inertia. The model describes politicians as passive, adhering to inconsistent economic policies and abandoning the pegged exchange rate regime after the minimum level of reserves is hit. However, in many the decision on devaluation is determined by political factors. Often the government is able to defend the currency aggressively, especially when it has access to borrowed funds, but no longer finds it optimal.

This shortcoming has been addressed in "New Crises Models". As Krugman now (1996) puts it (p.350): "A government - no longer a simple mechanism like that in the classical model, but rather an agent trying to minimize a loss

function - must decide whether or not to defend an exogeneously defined exchange rate parity".

Obstfeld (1986, 1995) discusses the model of multiple equilibria and self-fulfilling attacks. Multiple equilibria are possible when participants of foreign exchange market expect a successful speculative attack. What really matters here is expected future fundamentals given that the attack occurs. There exist two epuilibria: the first with no attack and infinite keeping of exchange rate peg; the second one includes speculative attack which leads to change of exchange rate regime and fundamentals. Models of self-fulfilling crises imply that maintaining "good fundamentals" is not sufficient to prevent speculative attack. The credibility of the central bank's intentions really matters. Obstfeld (1986) provides an example of averting an attack if the central bank is expected to implement measures for defense.

Theoretical framework for analyzing propagation of international financial crises is relatively underdeveloped. As Rigobon (1999) mentions (p.2): "theories concerning the propagation of shocks can be divided into two broad classes: the crisis contingent and the non-crisis contingent".

Several types of models have been considered within the crisis contingent class of theories. The first type of models (Masson (1997)) argues that the crisis in one country affects investors' expectations in another, upsetting the equilibrium of the latter economy and causing a crash.

The role information in crises contagion is discussed in the paper of Calvo (1999). He considers two types of investors: informed and uninformed. Uninformed investors use informed investors' behavior as criteria to make decisions. As a result, even if informed investors do not consider situation in

emerging markets catastrophic, but have to sell emerging markets assets to meet marginal calls, uninformed investors can misread these actions as a signal to sell.

The mechanism of political contagion is discussed in the paper of Allan Drazen (1998). The author presented the concept of membership contagion and discussed its applicability using the examples of explicit monetary unions, in particular the example of EMS crisis of 1992-1993. In his view, (p.29) "German monetary policy had moonsoonal effects, and spillovers of competitiveness clearly played a role in some of the EMS devaluation, as they have in other contagious currency crises".

The second class of transmission theories studies the propagation of shocks as independent of the existence of crises. These theories are based around the role of trade, monetary policy coordination, learning and aggregate shocks, such as international interest rates, aggregate shifts in risk aversion, random liquidity shocks, and world demand.

Gerlach and Smets (1995) presented one of the first models, developed within this class of theories, in their investigation of relationship between the falls of Finish Marka and Swedish Krona in 1992. In this model it is implied that two countries are tightly linked by trade. Depreciation in one country due to successful speculative attack improves its trade balance. This produces trade deficit in the other country. As a result, the foreign exchange reserves of the second country decline and the speculative attack eventually becomes successful.

The learning models can be divided into the following types: pure learning (Rigobon (1998)), herding (Chari & Kehoe (1999)) and information cascades (Calvo & Mendoza (1998)).

Dornbush (2000) divides contagion tests applied in the empirical works devoted to examination of shocks propagation into the following categories (p.10): ”correlation of asset prices; conditional probabilities of currency crisis, changes in volatility and other tests”.

Correlation of assets prices. This approach includes estimation of correlation coefficients of changes in asset prices of different economies (interest rates, stock prices, and sovereign spreads). The survey of such tests is presented by Forbes and Rigobon (1999). Under this approach contagion is characterized by a significant increase in correlation among different countries markets during turmoil periods relative to tranquil periods.

Conditional probability. The essence of this approach (as Dornbusch (2000) (p.12) indicates) is “estimating the probability of a crisis conditional on information of the occurrence of crisis elsewhere, taking into account fundamentals or similarities”.

The most commonly used methodology was presented in the paper of Eichengreen, Rose and Wyplosz (1996). They try to isolate contagion effect by (p.20) “taking into account the effects of current and lagged domestic macroeconomic and political influences”. They argue, however, that a strong positive correlation between exchange rate movements in two countries can be explained not only by spillovers from one country to another, but also by an unmeasured shock to economic fundamentals which strikes a number of countries simultaneously. As a result, they also consider alternative channels of

transmission of this contagion effect. In their investigation the authors use trade weighted and macro-weighted contagion measures. These indicators are constructed by averaging differentials of currencies exchange rate relative to DM, the difference of countries short-term interest rates and German short-term interest rate, and the difference between the differentials of ratio of international reserves to narrow money of each country and the same ratio for Germany. Germany is actually used as a reference country in this paper. Using data for twenty industrialized countries spanning more than three decades, a number of empirical specifications fail to reject, at high level of significance, the hypothesis of contagion. According to the authors (p.37): "Both the trade-weighted contagion proxy and macroweighted proxy outperform the naive unweighted contagion measure when they are included one at a time". The authors consider this fact to be a corroboration of the presence of pure contagion. The results of robustness tests suggest that trade contagion effect dominates macro effect.

The empirical work in this direction is continued by Glick and Rose (1998). They consider the patterns of international trade in order to understand "how currency crises spread above and beyond macroeconomic influences" (p.2). They do not reject the hypothesis that currency crises spread because of the trade linkages. Accounting for a variety of macroeconomic factors does not change this result. This finding results in very important policy implications. If a country may be affected because of actions of its neighbors, who tend to be trading partners merely because of geographic proximity, the possibility of augmented international monitoring should be seriously considered.

Sachs, Tornell and Velasko (1996) analyze the reasons of the "Tequila Effect", which was experienced by many emerging markets immediately after the

Mexican currency crisis in December 1994. The objective of the paper is to find out (p.1) "whether there are some fundamentals that help explain variation in financial crisis across countries or whether the variation must reflects contagion". They find that the countries that were susceptible to the "Tequila Effect" had experienced lending booms, over-valued exchange rate and low reserves. They also find that alternative hypotheses raised to explain this effect, such as excessive capital inflows, loose fiscal policies etc., have not been supported by data. However, there are some points to be mentioned here. The sample is not random both in terms of country and time choice. Moreover, the paper presents no distinction between attacks caused by macroeconomic similarity but unwarranted by fundamentals, and attacks that are justified by poor economic performance.

Lowell, Neu and Tong (1995) consider contagion of crises for both currency and stock markets in the emerging markets countries. First, they identify and analyze using statistical methods multicountry episodes for the period January 1989 to August 1997. From the eleven episodes found the majority can be explained as purely coincidental, triggered by country specific factors rather than by contagion. Next, they performed a formal causality analysis (single country tests employing single-equation time series regression techniques and multicountry tests employing vector-autoregressions) of four of the episodes - the August 1990 Gulf crisis, a rash of crises spanning January-June 1994, the December 1994 - March 1995 Mexican peso crisis, and the July-August 1997 Thai baht crisis. In the first two episodes they find little evidence that U.S. stock prices movements were responsible for stock market collapses in the countries involved. This finding confirms the hypothesis that these two episodes were not triggered by financial market events in the United States. However, they reject the hypothesis that multicountry stock and currency

market collapses were generally independent of the events in Mexican and Thai currency markets in 1995 and 1997, respectively. To investigate how the presence of contagion affects predictability and preventiveness of crises in individual countries, four informal models

Kaminsky and Reinhart (1996) analyze the connections between speculative attacks on currency and banking crises. They consider twenty countries in Asia, Europe, Latin America and the Middle East that experienced banking difficulties in the period 1970-1995. They construct a currency crisis index as a weighted average of exchange rate changes and reserve changes. In the sample of countries they explore, crises tend to be preceded by declining of economic activity, weakening export sectors, falling stock markets, high real interest rates, accelerating money growth and rapid rate of growth of the liabilities of banking system. The authors find out that banking crises can predict currency crises pretty well, but there are few instances where currency crises predict banking crises.

Volatility spillover. This approach explores cross-market spillover of volatility, i.e. movements in the second moments of assets prices. For example, Edwards (1998) uses an augmented GARCH to find that there was a spillover of the rise in Mexican interest rates into Argentina, but not in Chile. This approach does not control for fundamentals and do thus not distinguish between pure and fundamental based contagion.

Section 3.

TIMING OF EVENTS: IS THERE ROOM FOR SUSPICION OF CONTAGION?

The aim of this section is to examine the stylized facts regarding the timing of events linked to the financial crisis in Russia to Ukraine and to find out whether there is room for suspicion of contagion. It also presents both ways of reasoning: consistent and inconsistent with the contagion view. The formal testing of this suspicion will be performed in the next sections.

Starting from 1995 the Russian Government was being able to curb inflation; prices and exchange rates were stabilized. Relative economic and social tranquility was achieved. However, internal policy was inconsistent with external objectives in the sense that fixed exchange rate regime was inconsistent with expansionary fiscal policy. Unfavorable changes of world prices of natural resources and, consequent, worsening of terms of trade by almost 18 percent in 1998 also contributed to exchange rate collapse.

In 1996-1998 the fiscal deficits of 7-8.5 percent were financed mainly by borrowing, a considerable part of which was foreign borrowing. The lasting Asian crisis, which started in July 1997, resulted in massive withdrawals by investors of funds from all emerging markets resulted in the decline of net financing of Russian federal government deficit by nonresidents in the form of Eurobonds and ruble-denominated debt by 1.8 percent of GDP during July 1997-June 1998, compared to previous 12 month period.

From late 1997 Russian domestic interest rates were raised sharply in order to maintain the ruble fixed in response to unfavorable developments in the balance of payments. Underlying reasons of imbalance were not eliminated, however. The absence of decisive fiscal adjustment and continuing withdrawals on the side of foreign creditors resulted in large losses of external reserves. When these losses became sufficiently large, restructuring of ruble denominated debts and widening exchange rate band were announced. As a result, a large number of banks that had had a large amount of treasury bills on assets side and extensive foreign currency exposure on liabilities side collapsed, the domestic payment system was temporarily impaired, access to international capital markets was severed, and trade financing was severely disrupted.

As a result, investors exposed to sovereign risk of Russia suffered major losses from both the restructuring of the Russian debt and the devaluation of the ruble. Foreign mutual funds and other institutional investors which invested heavily in Russian government securities faced liquidity problems as their clients, mainly small private agents, concerned with the general situation in emerging markets, started withdrawals of deposits.

One may argue that at this point contagion originated. In order to manage the liquidity outflow, the institutional investors were forced to liquidate their positions in other emerging markets, such as Ukraine. The situation in Ukraine was worsened by the fact that Ukraine and Russia are active trade partners and, moreover, competitors on the third markets. In 1998 Ukraine's exports to Russia was 26.9 percent of the whole amount of Ukraine's exports, Ukraine's import from Russia was 39.6 percent. If nominal hryvnya/dollar exchange rate maintained at the same level, the Ukraine's exports would have become less

competitive in both Russian and other markets. That increased the pressure on hryvnya already existing due to withdrawals of foreign investments from Ukraine. The prospects of abandoning pegged regime shifted domestic agent's expectations towards negative outcomes. A self-fulfilling panic began and, in September 1998 the National Bank of Ukraine was forced to widen the band after massive loss of international reserves. The balance of payments crises was accompanied by a sharp fall of stocks' and other assets' prices.

The alternative point of view is that the crisis in Ukraine was inevitable because of weak domestic fundamentals, such as too expansionary fiscal policy, overvalued currency etc. The crises in Ukraine and Russia could have occurred at approximately the same time because of some kind of common shock. One of the possible candidates is Asian crisis that occurred a year earlier and by the time of Russian and Ukrainian ones was still not completely over. The Asian crisis changed perceptions of international investors about the possibility of crises in the emerging markets and made investors more cautious in this respect. As a result, the non-resident financing of both Russian and Ukrainian governments deficits declined. Furthermore, by the time of the crisis both Russia and Ukraine had to disburse the portions of the domestic currency denominated debt payments. This payment obligation can also be considered as a common disturbance factor.

There is one more thing that deserves mentioning here. Ukraine and Russia had some similar economic developments prior to the crises. Both Russia and Ukraine ran large fiscal deficits and financed it by borrowing. As a result, both countries built debt pyramids, which could have been sustained only for a very limited period of time, as long as creditors were willing to provide more and more funds. The regimes of narrow exchange rate band led to overvaluation of

domestic currencies in real terms and loss of competitiveness. Pursuing similar economic policies can be to some extent explained by following common IMF recommendations or by the habit remaining from the times of Soviet Union.

Under this explanation, even if the financial markets of both countries exhibit some degree of comovements, such correlation can rather be called spurious, because it would reflect the influence of common shock or economic similarity.

Consequently, there is some room for contagion suspicion under some of the ways of reasoning. The next sections will examine it formally.

Section 4.

THEORETICAL BACKGROUND.

This section presents the theoretical background that is essential to answer the main questions of this work about attribution of Ukrainian crisis to Russian crisis and about the change of the degree of correlation across financial markets for the crisis period. The theoretical background can be divided in two parts: theoretical justification of including domestic economic variables into the model, which tries to isolate contagion from influence of domestic fundamentals, and theoretical foundations of other econometric tests that are used to test the presence of contagion such as Granger causality test, correlation and VAR analyses.

Using economic fundamentals as indicators of financial crises in empirical works should be justified by theoretical models of financial crises described above. In this section I will present the variables, which I use in the model, and explain why I use these variables as predictors of currency crisis.

Fiscal balance. According to the first-generation models (Krugman (1979)) a speculative attack can occur in response to expansionary fiscal or monetary policy inconsistent with fixed exchange rate regime. There was a tight monetary policy in Ukraine for the last three years before the crisis. However, fiscal policy was expansionary and, consequently, I include this variable in the model. Such expansionary fiscal policy can influence the financial sector of the domestic economy in two ways: 1) the government can finance fiscal deficit

through borrowing, thus, driving up interest rates. That, in turn, may weaken banking system.

2) it leads to higher demand for traded and non-traded goods which. This higher demand can be partly satisfied by increased imports, thus, leading to higher demand for foreign currency.

Negative correlation of fiscal balance with the measure of speculative pressure is expected.

Current Account Balance. Current account deficit indicates that there is an increase in the demand for foreign currency to finance trade balance deficit or unilateral transfers, such as debt service payments. An increase in demand for foreign currency will increase the pressure on domestic currency. Negative correlation of current account balance with the measure of speculative pressure is expected.

Foreign debt. The same reasoning applies to this variable. An increase in the amount of foreign debt raises the demand for foreign currency in order to repay the debt and creates pressure on the currency. Positive correlation with the measure of speculative pressure is expected.

Real GDP growth. This indicator reflects the general health of economy and to some extent the prospects for foreign investments. Negative correlation with the measure of speculative pressure is expected.

CPI inflation. High inflation lowers attractiveness of domestic currency as a store of value and contributes to economic instability, thus, decreasing the demand for domestic currency. Moreover, it causes a real exchange rate appreciation and, consequently, deterioration of trade balance. The export

receipts of foreign currency fall, while the demand for foreign currency to purchase imports increases. Positive correlation of CPI inflation variable and measure of speculative pressure is expected.

Next, I would like to present a brief discussion of other econometric methods employed. This brief review of the empirical methods is based on Gujarati (1995).

First, we would like to discuss the Granger causality test. Let's suppose that we examine two variables X and Y. The essence of Granger test is the notion precedence. Initially, one examines how much of the current Y can be explained by past values of Y and then adds lagged values of X to see whether this procedure can increase the explanatory power. Y is caused by X in the Granger sense, if the coefficients on the lagged Xs are statistically significant. It should be emphasized that Granger causality is not the causality in the common sense, but rather precedence.

The test involves estimating the following regressions:

$$Y_t = \sum_{i=1}^{n} \alpha_i X_{t-i} + \sum_{j=1}^{n} \beta_j Y_{t-j} + u_{1t}, \qquad (1)$$

$$X_t = \sum_{i=1}^{m} \lambda_i X_{t-i} + \sum_{j=1}^{m} \delta_j Y_{t-j} + u_{2t}, \qquad (2)$$

where u_{1t} and u_{2t} are uncorrelated disturbances. Choosing lag length should be based on the predictions of theory about the longest time over which one of the variables could help predict the other.

The test includes four regressions: Y on lagged Ys, Y on lagged Ys and lagged Xs; X on lagged Xs, and X on lagged Xs and lagged Ys. The tests are whether all the coefficients of the lagged Xs in the second equation may be considered to be zero, and similarly whether the coefficients of the lagged Ys in the fourth equation are zero. Thus the null hypotheses being tested are that X does not Granger-cause Y and that Y does not Granger-cause X. Output from the test gives the relevant F-statistics for these two hypotheses.

The next empirical method used in the work is vector autoregression (VAR). A vector autoregression (VAR) is a system in which every equation has the same right hand variables, and those variables include lagged values of all of the endogenous variables. It can be presented in the following way:

$$y_t = A_1 y_{t-1} + \ ... + A_N y_{t-N} + Bx_t + \varepsilon_t \ , \qquad (3)$$

where y_t is a vector of endogenous variables, x_t is a vector of exogenous variables, $A_1 ... A_N$ and B are matrices of coefficients to be estimated, and ε_t is a vector of innovations that are correlated with each other but uncorrelated with their own lagged values and uncorrected with y_{t-1} and x_t.

In order to interpret the results of VAR economists often use the impulse response function, which traces the response of an endogenous variable to a one standard deviation change in one of the innovations.

Section 5.

EMPIRICAL PART.

5.1. Data description.

Two data sets are used in the work. The first set includes data for macroeconomic variables, such as real GDP (gross domestic product) growth, fiscal deficit as percent of GDP, CA (current account) as percent of GDP, CPI (consumer price index) inflation, for Ukraine, and ratio international reserves to monetary base, nominal UAH/USD and RUR/USD exchange rates, for Ukraine and Russia. The data is mostly available on the monthly basis, with the exception of CA, the data for which is available on the quarterly basis. Because the work uses CA as percent of GDP, assigning of the quarterly value for all three months of the quarter is used as a disaggregation method. This method produces very rough approximation, because it requires the assumption that the ratio of CA and GDP remains constant throughout the quarter. The data set spans from January, 1996 to December, 1999. The data for Ukraine is obtained from "Ukrainian Economic Trends" which is published monthly by UEPLAC (Ukrainian-European Policy and Legal Advice Center). The data for Russia is obtained from "Russian Economic Trends" which is published monthly by Russian-European Center for Economic Policy. The data was tested for multicolliniarity and autocorrelation.

The second data set includes Ukraine's and Russia's stock market price indices, measured in dollars, and sovereign spreads of Russia's and Ukraine's eurobonds, measured in basis points. Sovereign spread is defined as the

difference between yield to maturity of a risky Eurobond (such as Ukraine's or Russia's Eurobond) and yield of a risk-free Eurobond of the same type (such as Eurobond issued by US government). The data set spans the whole of 1998, the year of crisis. The data is weekly for stock market price indices and daily for sovereign spreads.

The values of sovereign spreads are obtained from Deutsche Bank researcher and information agencies Reuters and Bloomberg. As stock market price indices, PFTS (Ukraine's electronic shares trading system) stock price index for Ukraine and RTS (Russia's trading system) stock price index for Russia are used.

5.2.Methodology.

In this section the mechanisms of the testing for contagion are discussed. Two types of tests are employed. The first type is based on the model proposed by Eichengreen, Rose and Wyplosz (1996) and it explores contagion across foreign exchange markets. After modifying the model to make it compatible to economic conditions in Ukraine and data availability, I apply it in the context of the Ukraine and Russia. The second type is based on the methodology used by Goldfajn and Baig (2000) and Gelos and Sahay (1999) and includes Granger causality, correlation and VAR analyses. This methodology can be used to study transmission of shocks over all types of financial markets, including stock, bonds and foreign exchange markets.

First of all, let me clarify what is implied by contagion. I use two definitions. The first one is provided by Eichengreen, Rose and Wyplosz (1996) (p.19): "The contagion effect is an increase in the probability of a speculative attack on the domestic currency which stems not from the domestic "fundamentals" such as money and output but from the existence of a (not necessarily successful) speculative attack elsewhere in the world". The second one describes contagion as "a significant increase in cross-market linkages after a shock to individual country" (Dornbush, Park, Claessens (2000) (p.3)). The aim of the paper is to check whether there is a contagion across financial markets of Ukraine and Russia. The null hypothesis is that there is no contagion of financial shocks from Russia to Ukraine.

Let me start with the first methodology. The first important issue is determination of the moment of time when a speculative attack against

domestic currency occurs. Using exchange rate movements exclusively is not appropriate. Speculative attacks can be unsuccessful due to some external reasons or aggressive defense of central bank. The bank can defend the exchange rate via interventions or increases of interest rates. In Ukraine and other transition economies of the Former Soviet Union the latter instrument is far from effective due to the low levels of savings. Moreover, the data for interest rates of commercial banks in Russia is not available for the period before 1997. Therefore, on the currency I use a weighted average of exchange rate changes and reserves changes as a measure of speculative pressure.

The index of exchange market pressure is constructed as following:

$$EMP_{i,t} = \alpha \%\Delta e_{i,t} - \beta (\%\Delta r_{i,t} - \overline{\%\Delta r_i}), \qquad (4)$$

where $e_{i,t}$ -the price of US dollar in i's country currency (nominal exchange rate, r - ratio of international reserves to monetary base, $\%\Delta$ - percentage change over time. Changes of the aforementioned variables are measured with the respect to the mean of that series for each country. The variable "international reserves" is divided by monetary base for the following reasons. We can not compare the levels, and even changes, of international reserves of two different economies. Russia's economy is larger than Ukraine's one. Therefore, some kind of normalization is needed. Moreover, when a central bank performs open market interventions to fend off speculative attacks, it converts domestic currency into foreign one. As a result, international reserves and monetary base change. Of course, the changes of monetary base can be mitigated by sterilization: selling or buying of government securities to the public. Anyway, it is the international reserves to monetary base ratio, which indicates how successfully the central bank can repel speculative attacks.

The crucial issue concerns the method of weighting of the components of the index. One can be tempted to use unweighted average, which has an advantage of simplicity. However, I can not use that method because the volatility of reserves and exchange rates is very different. Therefore, I weight the components in such a way that the volatilities of two components are equalized. Therefore, the weights attached to the components of the index, α and β, are the inverse of standard deviation for each series.

The index takes too high values when either the currency devalues or depreciates, or the international reserves are heavily depleted. The crisis episode can be defined as $Crisis_{i,t} = 1$ if $EMP_{i,t} > 1.645\ \sigma_{EMP} + \mu_{EMP}$, (5)

$= 0$ otherwise,

where μ_{EMP}, σ_{EMP} are the sample mean and standard deviation of PER respectively. Under normally distributed errors this procedure is equivalent to defining one-side confidence level of 5 percent. Of course, this threshold is somewhat arbitrary, as all other choices presented in the literature.

The procedure described above allows me to investigate the patterns of speculative pressure and identify the episodes of strong exchange market pressure.

To test the presence of contagion Eichengreen, Rose and Wyplosz estimated a binary probit model, namely, they used a dummy variable reflecting the crisis for one country as a dependent variable and analogous dummy variables for other countries from the sample plus domestic economic fundamentals of the country in question as independent variables.

I am unable to use binary probit model, because of too low variability of crisis variables (only two months can be characterized as the periods of crisis). However, we can include into specification the indices of speculative pressure instead of binary crisis variables. Although this regression per se does not allow us to evaluate the systematic effect on the probability of a speculative attack, it provides an opportunity to judge about interdependence foreign exchange markets in Ukraine and Russia over the whole period explored (1996-1999) and allows to find out to what extent the movements of speculative pressure index for Ukraine are caused by movements of speculative pressure index in Russia, rather than by changes of domestic economic fundamentals. Stability tests of the model can be used to find out whether interdependence of foreign exchange markets increase during crisis. The specification takes form:

$$EMP_{U,t} = \gamma EMP_{R,t} + \chi I(L)_{U,t} + \varepsilon_{i,t} \qquad (6)$$

Where $I(L)_{U,t}$ presents a set of contemporaneous and/or lagged control regressors, which represent the following Ukraine's domestic fundamentals:

- real GDP growth rate;
- inflation;
- current account balance as a percentage of GDP,
- budget balance as a percentage of GDP;
- $\varepsilon_{i,t}$ is a normally distributed disturbance representing effect of omitted variables on the index of speculative pressure in Ukraine

The least-squared regression is used for estimation.

The null hypothesis for this part of the work is that $\gamma = 0$, namely, that there is no interdependence between speculative pressure indices in Ukraine and Russia.

Next, I study the behavior of Ukraine's and Russia's stock markets and eurobonds and try to find out whether there are any systematic patterns in transmission of shocks and whether the correlation across these financial markets increased in the crisis period relative to tranquil periods. This methodology is based on the papers of Gelos and Sahay (1999) and Goldfajn and Baig (2000), who use Granger causality, VAR and correlation analyses. However, the samples of countries examined by those authors are different from that studied in this paper.

The null hypothesis is that there is no increase in correlation across financial markets during crisis period relative to tranquil period.

As the indicators of financial market behavior, Russia's and Ukraine's stock market returns and sovereign spreads of Ukraine's and Russia's eurobonds. Stock market return is defined as $(I_t - I_{t-1})/I_{t-1}$, where I_t and I_{t-1} are stock market price indexes in current and previous periods, respectively. I use returns for stock markets and first differences for sovereign spreads instead of level values, because changes in price determine capital gain for investor and, consequently, investors care about changes, not levels. The considerations are the same for sovereign spreads. However, I use first difference for sovereign spreads, because sovereign spread is already expressed as a percentage (more precisely in basic points).

Then, I perform Granger causality and VAR to examine the direction and patterns of shock transmission between financial markets of Ukraine and Russia. I also verify whether the correlation across Russia's and Ukraine's stock markets and eurobonds spreads increased during the crisis period relative to tranquil period. In this part of the work I do not examine foreign exchange markets, because I do not have high frequency data for these markets and because these markets were most heavily regulated after the crises and, therefore, revealed the lowest response to market forces. As crisis period, the second half of 1998, starting from August. This choice is supported by pattern of speculative pressure index, by sharp fall of stock market prices and dramatic increase in sovereign spreads in that period. The number of lags chosen for Granger causality test is 2 stock returns and 3 for sovereign spreads. Financial markets are very volatile and adjust to any news very rapidly. Therefore, it seems reasonable to include no more than two lags for data available on weekly basis (such as stock returns) and three lags for data available on daily basis (such as sovereign spreads). The choice of number of lags for sovereign spreads is confirmed by the results of VAR analyses presented in the next subsection. This analysis is not performed for stock market returns because of the lower frequency of the data available.

5.3. Results.

The patterns of speculative pressure index behavior for Ukraine and Russia are presented in the fig.1 of appendix. The procedure of defining crisis period, described in the previous section, produces two months of crisis for Ukraine, August and September 1998. This period can also be characterized as beginning of lasting fall of stock prices and increase of sovereign spreads.

The results of the attempt to isolate the influence of Russia's speculative pressure index on Ukraine's speculative pressure index, using specification (6) are presented in table 1. The signs of coefficients in principal coincide with those expected (with the exception of budget balance). However, practically all coefficients are statistically insignificant at 10 % confidence level (with the exception of current account balance, which is statistically insignificant at 5% confidence level) and explanatory power of the model is rather low. The low explanation power of the model is insensitive to modifications of specification by including the lags of the independent variables. The failure of the model to provide statistically significant results can be attributed to several kinds of problems, except of no economic interdependence:

- measurement errors and distortions that stemmed from disaggregation of current account balance data.

- inability to estimate to binary probit model, used by Eichengreen, Rose and Wyplosz (1996) also contributed to insignificant results.

- the problem of the specification bias in the sense that some variables that may explain the behavior of speculative pressure index were not included in the model. Among such variables there can be capital account balance, short-

term capital flows, the differential between domestic and foreign interest rates, the terms of trade, credit growth, employment/unemployment (Kaminsky, Lizondo, Reinhart (1998). However, the number of degrees of freedom in the estimation process is not large and, therefore, I do not include additional variables in the specification.

An alternative explanation is based on the idea that index of exchange market speculative pressure does not respond to changes in domestic fundamentals, because the National Bank of Ukraine defended the exchange rate regime not only with open market operations using its international reserves or by increasing interest rates, but also with administrative measures. These administrative measures impeded the interaction of market forces, and, consequently, made responsiveness of speculative pressure index lower than it was expected.

Next, the results of examining of behavior of stock market returns and eurobond sovereign spreads are discussed.

The results of the Granger causality test of stock returns for 1998 are presented in table 2. It can be observed that the null hypothesis that movements of Russia's stock returns does not Granger cause movements of Ukraine's stock returns would result in our sample with the probability 0.00012 (p-value - 0.012 %). Therefore, this hypothesis can be rejected with very high level of precision. On the other hand, the null hypothesis that movements of Ukraine's stock returns Granger cause movements of Russia's stock returns can be rejected at the confidence level of 9 %, which is also not very high value. Thus, this test suggests that there is no specific direction of Granger causality in stock markets, it can rather be observed in both directions. The results of Granger causality test for the first differences of

sovereign spreads of eurobonds are presented in the table 3. They can be interpreted in the same way as the results for stock returns. It is not the case that movements of Russia's sovereign spreads Granger cause the movements of Ukraine's sovereign spreads exclusively, there is Granger causality in both directions.

Fig. 3. presents the results of VAR analysis for first differences of sovereign spreads of Ukraine's and Russia's eurobonds in both directions. The maximum response is observed in the third period. That confirms the correctness of lag choice for Granger causality test. The shape of impulse response functions is practically the same in both directions. Each variable responds similarly to one standard deviation shock in one of the innovations in VAR system. These results suggest that there is no specific direction of shock transmission. The similar form of impulse response functions may be attributed to the influence of common shock, such as Asian crisis or the call of investors and creditors to repay Russian and Ukrainian governments' liabilities. This conclusion is also consistent with the results of Granger causality test. One can observe the Granger causality in both directions when both markets are subject to common shock.

Table 4 presents the test for correlation increase for both stock returns and first differences of sovereign spreads in 1998 with the break point at July 1st, 1998, when the first signs of turmoil in Russian financial markets became perceptible. The correlation coefficient for stock market returns decreases in the second half of 1998 from 0.35 to 0.22. The correlation coefficient for the first differences of sovereign spreads remains negative in the crisis period, although it increased from -0.15 to -0.08. These results do not allow to reject the null hypothesis of no contagion of financial crisis from Russia to

Ukraine, if contagion is defined as an increase in correlation across the financial markets during the crisis relative to tranquil period.

In conclusion of this section we would like to summarize the main technical results.

- The binary probit model used by Eichengreen, Rose, Wyplosz (1996) proved to be inapplicable for studying the case of Russia and Ukraine, because of too low variability of the crisis indicator.

- The Ukraine's speculative pressure index does not reveal statistically significant responsiveness to changes of Russia's speculative pressure index and domestic economic fundamentals.

- The Granger causality and VAR analyses results do not reveal any specific direction of shock transmission. They also can be interpreted as the effect of common shock.

- Examination of correlation across financial markets of two countries in question does not allow to reject the null hypothesis of no contagion, if contagion is defined as an increase in correlation during crisis period.

Section 6.

CONCLUSIONS.

This work is aimed to respond to the allegations that the contagion of Russia's financial crisis was the reason of Ukraine's 1998 financial crisis.

Two different approaches are used to test the null hypothesis of no contagion. The first approach is based on the paper of Eichengreen, Rose and Wyplosz (1996). The second is based on the papers of Gelos and Sahay (1999) and Goldfajn and Baig (2000).

Both approaches provide the results that do not allow to reject the null hypothesis of no contagion.

Thus, Russia's crisis can not be blamed as the only and the main reason of Ukraine's foreign exchange and stock market collapse. Ukraine's crisis was inevitable because of inconsistent domestic external and internal policies. Ukraine's exchange rate was overvalued, fixed exchange rate regime was unsustainable and inconsistent with internal policies, structural reforms were not carried out in the necessary amount to improve the reputation of Ukraine among investors and so on. The crisis outburst could have been accelerated by some events, but according to the received results this accelerator was not the Russia's crisis. It rather was some shock that was common for both countries. As it is discussed in the "Section 3" of this work, the Asian crisis and need to make debt

service payments are among the possible candidates of such common shock. Similarity of the economic policies also contributed to the fact that these two crises occurred almost simultaneously. Hence, although these two events occurred together, this does not imply the contagion from Russia to Ukraine.

With respect to policy implications the following recommendations can be made. As long as the crisis can be partly attributable to inconsistent internal and external economic policies, the government can eliminate the part of potential crisis risk. Fiscal policy should be tightened; fixed exchange rate regime and, consequent, real exchange rate overvaluation should be avoided, to name just the main measures. Little can be done with the respect to external shocks, except, perhaps, that accumulation of short-term foreign debt should be avoided.

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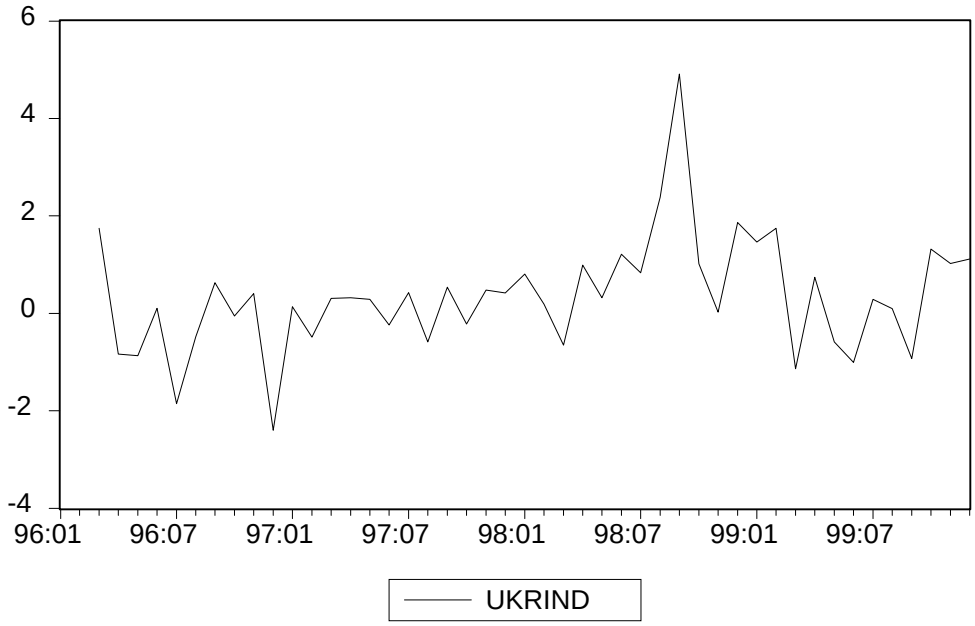
Appendix.

Fig. 1. Behavior of Ukraine's and Russia's indices of speculative pressure over time.



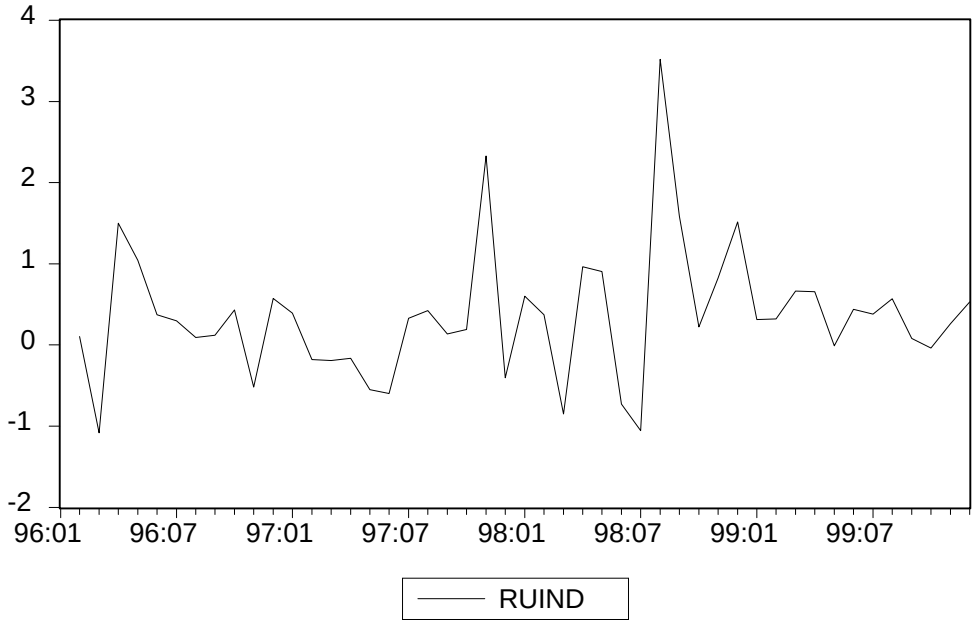


Table 1. **Results of regression.**

LS // Dependent Variable is UKRIND
Sample(adjusted): 1996:03 1999:09
Included observations: 43 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.35	1.2119	-0.289	0.7744
RUIND	0.2969	0.2207	1.3451	0.187
BUDGET	0.0534	0.0561	0.9527	0.3471
CA	-0.096	0.0553	-1.745	0.0895
CPIINFL	0.1596	0.1324	1.2058	0.2358
FORDEBT	0.0172	0.0411	0.4197	0.6772
GRRGDP	-0.281	1.6885	-0.166	0.8688

R-squared	0.226109	Mean dependent var	0.287038
Adjusted R-squared	0.097127	S.D. dependent var	1.203358
S.E. of regression	1.143426	Akaike info criterion	0.415958
Sum squared resid	47.06724	Schwarz criterion	0.702665
Log likelihood	-62.9575	F-statistic	1.753029
Durbin-Watson stat	1.746179	Prob(F-statistic)	0.136932

Where UKRIND, RUIND – indices of speculative pressure for Ukraine and Russia respectively,
BUDGET – fiscal balance of Ukraine as per cent of GDP,
GRRGDP – growth rate of real GDP in Ukraine,
CPIINFL – CPI inflation in Ukraine,
CA – current account as percent of GDP in Ukraine.

Table 2. **Results of Pairwise Granger Causality test of Ukraine's and Russia's Stock Market Returns.**

Sample: 1/02/1998 1/15/1999

Lags: 2

Null Hypothesis:	Obs.	F-Statistic	Probability
RETURN_UKR does not Granger Cause RETURN_RUS	**53**	**2.60530**	**0.08430**
RETURN_RUS does not Granger Cause RETURN_UKR		**10.9435**	**0.00012**

Table 3. **Pairwise Granger Causality Tests of First Differences of Sovereign Spreads for Ukraine's and Russia's eurobonds.**

Sample: 7/02/1998 10/30/1998

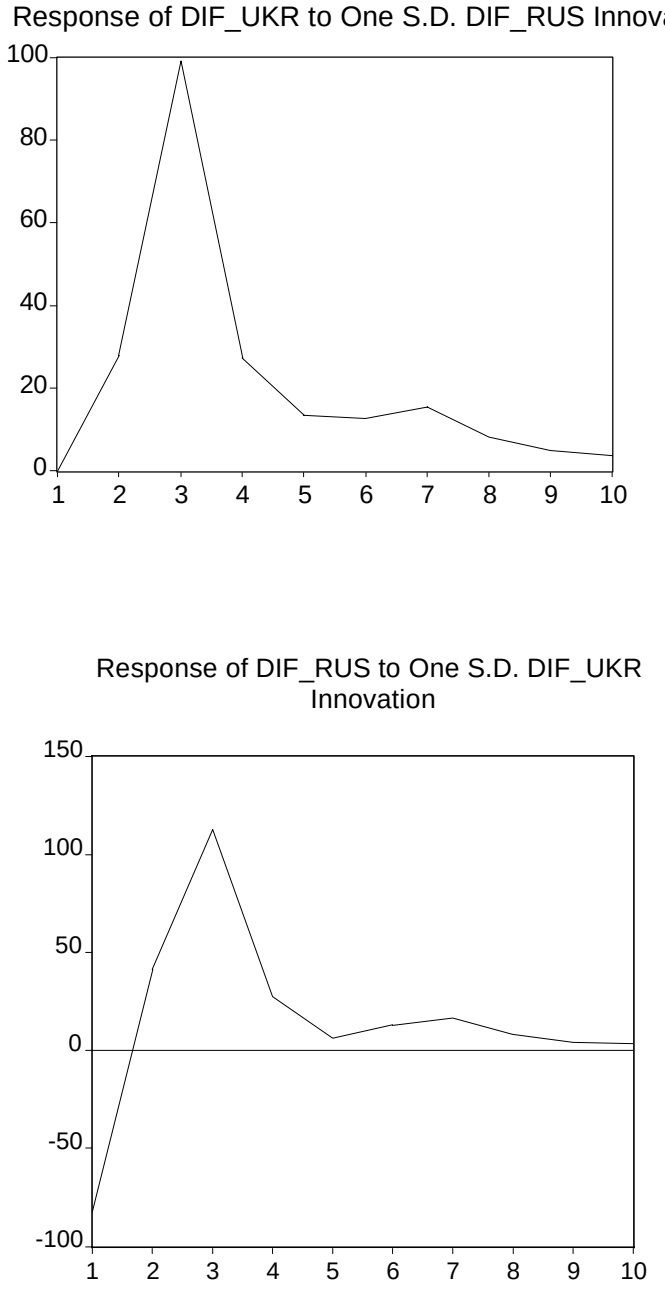
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
DIF_UKR does not Granger Cause DIF_RUS	**84**	**4.80287**	**0.00405**
DIF_RUS does not Granger Cause DIF_UKR		**4.01743**	**0.01036**

Table 4. **Test for increase in stock returns and sovereign spreads correlation.**

Correlations	Tranquil	Crisis
Stock returns	0.35	0.22
Sovereign spreads (first differences)	-0.15	-0.08

Fig.2. **Eurobonds market VAR analysis.**



DIF_UKR and DIF_RUS are the first differences of sovereign spreads of Ukraine's and Russia's eurobonds respectively.