Using the Exchange Rate as Nominal Anchor:
Evidence from the 1999-2005 Ukrainian Experience

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Abstract:

Transition economies, and especially those of the former Soviet Union, have used fixed exchange-rate policy as a nominal anchor for interest rates and inflation during recent decades. In this paper I demonstrate that the rigorous application of this policy in Ukraine over the period 1999-2005 did not in fact eliminate significant deviations of Ukrainian interbank interest rates from those on the London interbank market. Estimation using weekly data over the period 1999-2005 illustrates that the government's "nominal anchor" policy *vis à vis* the US dollar was effective at eliminating the risk of currency depreciation. However, other risks related to convertibility and liquidity were either not addressed or exacerbated, and thus deviations from uncovered interest parity continued through the period. This has a clear policy implication: monetary and financial-sector policy should be coordinated to address convertibility and liquidity risk as well as the risk of currency depreciation.

JEL classifications: E43, F31, F36

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I. Introduction.

The use of the exchange rate as a nominal anchor for emerging economies has been a commonly practiced monetary policy option throughout the post-Bretton Woods years. Advantages cited for the policy have included elimination of inflation and interest rate premia as the risk of depreciation is removed.[1] Drawbacks exist as well, most notably the danger of speculative attack on the currency leading to domestic financial crisis. Whatever the theoretical merits and demerits, the policy is a popular one. International Monetary Fund (2008) classified 115 countries as practicing an exchange-rate-based nominal-anchor policy in 2008, as opposed to the 77 countries following all other types of monetary policy. Among the transition economies formerly of the Soviet Union, only Georgia and Armenia did not have a nominal-anchor exchange rate policy.[2]

The period 1999-2005 in Ukraine provides an interesting and rigorous application of the nominal anchor policy for financial-market outcomes. After a period of rapid depreciation of the Ukrainian hryvnia relative to the US dollar and the European currencies subsequent to the Russian financial crisis of August 1997, the National Bank of Ukraine maintained a stable, near-fixed, exchange rate relative to the US dollar. Despite this, interest rates on interbank credits in Ukraine, whether on hryvnia-denominated or US dollar-denominated credits, deviated substantially from those on US dollar-denominated credits in the London interbank market for extended periods. In this paper I identify the sources of these deviations and attribute them to non-monetary policy initiatives of National Bank and government of Ukraine.

Throughout this period there were three components of the observed risk premium on Ukrainian interbank credits. One of these components – the currency risk premium -- is reduced, and eventually eliminated, by the nominal-anchor regime. The other two components are the products of imbalances between demand and supply in the

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[1] Corden (1993) provides a concise explanation of the "nominal anchor" view of stabilization policy, and contrasts it with the "real targets" approach. Agenor and Montiel (1996) and Mishkin (2007) provide good summaries of the theoretical advantages and drawbacks. Edwards (1992) is an application to the experience of Chile and Mexico.

[2] Those identified as having fixed exchange rate as nominal anchor were Azerbaijan, Belarus, Estonia, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Russian Federation, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. Among the transition economies of Eastern Europe, six of 13 are identified as having a fixed exchange rate as nominal anchor: Bosnia, Bulgaria, Croatia, Macedonia, Montenegro and the Slovak Republic. Albania, Czech Republic, Moldova, Poland, Romania, Serbia and Slovenia are identified as following more flexible exchange rate regimes.

domestic credit markets. The convertibility risk premium reflects an excess supply of HRV credit matched with an excess demand for USD credit. The liquidity risk premium reflects the excess demand for longer-maturity credits matched with an excess supply of shorter-maturity credits. These premia were not eliminated, but rather enlarged, by the application of exchange-rate nominal anchor.

This persistent interest-rate premium is a violation of uncovered interest parity. Whether investigated as a forward discount bias or as a deviation of expected depreciation from ratio of interest factors, the systematic and sustained divergence of actual exchange rates and interest rates from uncovered interest parity has been demonstrated repeatedly in the past for developed countries.[3] A number of alternative hypotheses have been considered. Froot and Frankel (1989) considered non-rationality of expectations and time-varying risk premia with specialist survey results used as an instrument for expectations in US dollar exchange rates. Black and Salemi (1988) use explicit optimization in portfolio-balance asset demand to estimate time-varying risk premia in the US dollar-deutschemark exchange rate. Lewis (1991) and Bekaert, Hodrick and Marshall (1997) consider persistent interest-rate premia as evidence of a "peso problem" in expectations – or, as the latter put it, "the sample moments from the actual data do not coincide with the population moments that agents actually use in making their decisions" (Bekaert et al., 1997, p.2). A non-zero common probability of default, for instance, can lead to persistent interest-rate premia even if the default is never observed. Bekaert and Hodrick (2001) reconsider the risk-premium tests for exchange rates between the US dollar, British pound and German Deutschemark for the period 1975-1997, with special attention to the small-sample properties of the estimators. They conclude that previous tests suffered from potential bias – but they continue to reject the uncovered-interest-parity hypothesis.

Tests of uncovered interest parity for emerging markets are less often reported, in part because of the difficulty of obtaining matching financial-market data for these

[3] Hodrick (1988) has an excellent exposition and summary of results prior to that time, while Bekaert and Hodrick (2001) have a summary of more recent findings. Bansal and Dahlquist (2000) note that the forward premium puzzle is most significant in developed economies. For emerging economies, the puzzle remains but is often statistically insignificant. Bautista (2006) associates the violation of uncovered interest parity with exchange-rate regime shifts in East Asian economies during the 1990s. Ahn (2004) provides a derivation of exchange-rate risk premia for monthly observations of the US dollar and German Deutschemark credit markets for the period 1974-1988.

countries. On the theoretical side, McKinnon and Pill (2000) tie the deviations from uncovered interest parity to various sources of risk; they conclude that currency risks can lead banks to overborrowing in foreign currency. Haque and Montiel (1991) modeled the actual developing-country interest rate as an average of the rate observed under uncovered parity and the one observed in financial autarky. They then estimated a "coefficient of financial integration" as the degree to which uncovered interest parity was in fact observed. Of fifteen developing countries between 1969 and 1987, for only five could the uncovered interest parity assumption be rejected. Flood and Rose (2005) investigate the deviations from uncovered interest parity for the 1990s in 13 industrial and 10 newly developing countries. They conclude "While UIP [uncovered interest parity] still does not work well, it works better than it used to." (p. 2) It was especially effective, in fact, among those countries facing exchange-rate crises during that period. Empirical studies of financial markets for emerging economies have typically focused upon estimating the demand for money within a macroeconomic model; Starr (2005) and Oomes and Ohnsorge (2005) are examples for Russia, while Bilan (2005) considers similar issues in Ukraine. Despite the potential for uncovered interest parity, each of these studies treats the financial markets as being in financial autarky.

The substantive contribution of this paper is to identify the financial risk premia that continue or grow larger when the nominal-anchor policy is applied. This result is presaged by Krueger (1999), who interprets the exchange-rate-based nominal-anchor policy as a distortion to the financial markets – she shows that it drives a wedge between domestic and foreign social rates of time preference. To provide structure to this insight, I make precise the concept of a time-varying risk premia by specification of a model based on stochastic discount factors. Once identified, the causes of the time-varying premia are found in fundamental adjustments in the international credit market, the macroeconomic environment in Ukraine, and imbalances in denomination of credit to Ukrainian borrowers between 1999 and 2005.[4]

[4] The approach in this paper can be thought of as a two-step approximation to the asset-pricing based macro estimation of Ang and Piazzesi (2003) and subsequent authors. These authors specify a VAR macro model with nested affine asset pricing component and estimate as a simultaneous system. I divide this into two steps: the initial derivation of the risk pricing based on latent factors, and a subsequent estimation model linking latent variables to observable macro and financial variables and then these observable variables to the observed risk premia. The Ang and Piazzesi (2003) approach will be difficult to implement

There is an important policy conclusion drawn from this analysis. The National Bank of Ukraine (NBU) policy of stable exchange rate with the US dollar was successful at eliminating depreciation risk. However, the other two components of the premium persisted. The banking system's mismatch in borrowing and lending in US dollars was a continuing source of imbalance, as was the Ukrainian macro policy. The nominal anchor's interaction with these "pre-existing" distortions served to reinforce these premia.

II. The nominal-anchor experience.

The arguments for the nominal-anchor policy in Ukraine can be dated from 17 August 1998 with the onset of the Russian financial crisis. The Russian crisis caused an economic crisis for Ukraine, as well as for the other economies of the former Soviet Union.[5] While the National Bank of Ukraine (NBU) initially defended the value of its currency, it soon thereafter adopted a more passive stance – and the nominal exchange rate depreciated strongly. As Figure 1 illustrates, the nominal exchange rate of the hryvnia to the US dollar depreciated from 1.86 in September 1997 to 5.66 in December 1999.

In May 1999 the Ukrainian legislature passed the "Law on the National Bank of Ukraine", giving the NBU three main policy objectives (in decreasing order of importance): the stabilization of the Ukrainian monetary unit, the stability of the banking sector, and price stability.[6] The NBU chose to achieve its objectives through maintaining a near-fixed exchange rate with the US dollar. As Figure 1 illustrates, the period from the end of 1999 to April 2005 was one of remarkable stability in the exchange rate.[7]

This is seemingly a singularly successful application of the exchange-rate-based "nominal anchor". Ukraine enjoyed rapid export-led growth during the policy, though

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here, as the usual macro variables are not available at weekly frequency and the single-agent assumption of financial markets is potentially violated. I will investigate further steps in that direction in future work.

[5] See Conway (2001, chapter 10) for a detailed discussion of the implication of that crisis in three non-Russian countries, including Ukraine.

[6] Source: "The Law on the National Bank of Ukraine", approved in May 1999.

[7] The data illustrated here are the daily offered rate on private markets measured each Thursday: an upward movement is a depreciation. The rapid depreciation in the currency begins with the Russian financial crisis of 17 August 1998. In April 2005 the NBU undertook a five percent revaluation against the US dollar, as van Aarle et al. (2006) point out.

that growth has slowed since the October Revolution. However, the stability in currency value has not worked through commonly expected channels. Commodity prices were not brought into line with US prices, as would be suggested by the law of one price: while US inflation remained at about 3 percent per annum, Ukrainian annual inflation has ranged from over 20 percent to -6 percent during this period. Interest rates on interbank credits also had not converged with the rates observed on US-dollar credits in international markets. There was a large premium on interest rates in hryvnia-denominated (HRV) interbank credits relative to US dollar-denominated (USD) credits in Ukrainian markets. Both interest rates differed significantly from the interest rates on London interbank markets for credits of identical maturity. Figure 2 illustrates one such case: nominal annualized interest rates on 30-day interbank credits in Kyiv and London markets. Both HRV and USD interest-rate series are presented for Kyiv.[8]

Despite the stability of the exchange rate, there is a great deal of variation evident in the hryvnia interest rate. The "Orange Revolution" of end-2004 is evident in the data, but from the financial-market perspective this was only one of many causes for divergence of Kyiv-based interest rates from those available in the Euromarkets. There is also a persistent divergence in interest rates between USD interbank rates in Kyiv and in London.[9] Similar divergences exist at all maturities of interbank credit. This is an unexpected outcome if exchange-rate depreciation was the only source of risk for Ukrainian financial instruments. It is inevitable when other macroeconomic and banking-system risks are considered.

III. Theoretical derivation of the risk premia.

A simple identity illustrates the potential sources of deviation from uncovered interest parity. Define r_{t+n} as the annual nominal domestic-currency yield on a domestic asset sold in period t with maturity n, and r^*_{t+n} as the annual nominal yield on a foreign-currency-denominated asset sold in the domestic economy. R^*_{t+n} is the annual nominal yield on a foreign-currency-denominated asset available in the foreign country.

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[8] While interbank rates are available from mid-1997 in hryvnia denomination and from early 1999 in US dollar denomination, Figure 2 illustrates only the period of stable exchange rates from end 1999 to mid 2005.

[9] The series reported for USD-denominated interbank credits ends in mid-2005.

$$(1+r_{t+n}) \equiv [(1+r_{t+n})/(1+r^*_{t+n})][(1+r^*_{t+n})/(1+r^*_{t+1})][(1+r^*_{t+1})/(1+R^*_{t+1})](1+R^*_{t+1}) \qquad (1)$$

The three ratios in brackets are three potential components of the premium. The first bracket $[(1+r_{t+n})/(1+r^*_{t+n})]$ is the ratio of returns to domestic- relative to foreign-currency-denominated assets of the same maturity in the same country's market. I will call this the currency-risk premium. The second bracket $[(1+r^*_{t+n})/(1+r^*_{t+1})]$ is the ratio between returns to assets denominated in the same currency but with different maturities. I call this the liquidity premium, and I will derive this from the term structure of returns in the domestic and foreign economies. The third bracket $[(1+r^*_{t+1})/(1+R^*_{t+1})]$ is the ratio of returns on two assets, both denominated in foreign currency and of the same maturity, but offered in different countries. I call this the convertibility premium for domestic assets.[10]

Premia defined in terms of asset-pricing theory. Asset pricing theory provides a precise statement of these components based upon the concept of a stochastic discount factor.[11] In a financial market and in the absence of arbitrage opportunities, the equilibrium one-period nominal rate of return r_{t+1} on a domestic asset purchased in period t satisfies (2) below, with m_{t+1} the pricing kernel for the domestic economy in period t+1 and E_t the expectations operator based upon the information set of period t.[12] The ratio $[m_{t+1}/m_t]$ is the "stochastic discount factor"; in the consumption-based asset pricing models beginning with Breeden (1979), for example, it is the intertemporal marginal rate of substitution. This is evident in the derivation of the one-period "forecast" or base rate in domestic currency r^f_{t+1} in (3).[13] Individuals participating in an integrated set of financial markets will have the same stochastic discount factor.

Integration will be the null hypothesis of this paper, but I introduce an alternative by specifying three possibly separate groups of agents with potentially different stochastic discount factors. The first is the group of participants in international credit

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[10] Table A1 in the appendix conducts the decomposition of the data according to (1).

[11] This insight is implicit in the literature from the beginning, as noted below, and is stated explicitly in Flood and Rose (2005).

[12] Hansen and Richard (1987) provide an early explanation, and Cochrane (2001, chapter 4) a more recent and very accessible one. The pricing kernel in the representative-agent model is $m_t = \beta^t U'(C_t)$, with β the rate of time preference and $U'(C_t)$ the marginal utility of consumption.

[13] With a CRRA utility function, $[m_{t+1}/m_t] = \beta(c_{t+1}/c_t)^{-\nu}$. For c_t a random walk, $1+r^f_{t+1} \approx 1/\beta$. More generally, r_{t+1} will depend will depend upon the nature of stochastic shocks to c_{t+1}.

markets – for example, agents trading on US dollar-denominated LIBOR credit markets. The second is the group of participants able to trade freely on credit markets in Ukraine with both US dollar and Ukrainian hryvnia denominations. The third is the group of participants in Ukraine able to transact freely only in the hryvnia-denominated credit markets. Thus, there are two potential differences among market participants, designed to reflect Ukraine's role as an emerging financial market. First, the stochastic discount factors for the two Ukrainian groups will potentially differ due to differential access to US dollar-denominated Ukrainian markets. Second, Ukrainian participants are potentially unable to borrow internationally against future income, thus leading to a different stochastic discount factor from the international agents.

To illustrate this I consider a model with three financial assets. First, there is an asset issued in the domestic economy in the domestic currency in period t with return r_{t+1} in the next period. Second, there is an asset issued in the domestic economy in period t but denominated in foreign currency, with return r^*_{t+1} in the next period. Third, there is an asset issued in the foreign economy in period t denominated in foreign currency with return R^*_{t-1} in the next period.[14]

Equations (2) and (3) represent market equilibrium conditions for the first asset. For the second asset, there are analogous arbitrage relationships.

$$1 = E_t([m_{t+1}/m_t]\ (1+r_{t+1})) \tag{2}$$

$$1/E_t([m_{t+1}/m_t]) = 1+r^f_{t+1} \tag{3}$$

$$1 = E_t([m^*_{t+1}/m^*_t]\ (1+r^*_{t+1})) \tag{4}$$

$$1/\ E_t([m^*_{t+1}/m^*_t]) = 1+r^{*f}_{t+1} \tag{5}$$

The two domestic participants differ in their ability to contract for foreign-currency denominated instruments, and this is sufficient to allow for different "riskless" or forecast rates r^f_{t+1} and r^{*f}_{t+1} defined by equations (3) and (5). The difference between r_{t+1} and r^*_{t+1} will then be due to differences in the two investors' ability to insure against systemic market risks and to differences in expected intertemporal rate of substitution.

[14] Assets with multi-period maturities can also be modeled; I defer that to the term-structure discussion.

The exchange rate S_t is defined as the domestic-currency price of one unit of foreign currency. In an integrated financial market, arbitrage implies that it can be stated in terms of the stochastic discount factors as in (6). [15]

$$(S_{t+1}/S_t) = [m^*_{t+1}/m^*_t]/\ [m_{t+1}/m_t] \qquad (6)$$

In the absence of credit risks or market rigidities, the central bank's commitment to a fixed exchange rate effectively removes the difference between the agents – the left-hand side of the equation is unity, and the stochastic discount factors on the right-hand side must be identical. This implies interest rate equalization: $r_{t+1} = r^*_{t+1}$ on the domestic markets. One of the anomalies of the Ukrainian case is the violation of the condition (6), reflecting the macroeconomic rigidities and market imperfections in the credit markets.

The third asset is available on international markets. Its arbitrage-free equilibrium condition and base rate can be stated:

$$1 = E_t([M_{t+1}/M_t]\ (1+R^*_{t+1})) \qquad (7)$$

$$1/\ E_t(([M_{t+1}/M_t]) = (1+R^f_{t+1}) \qquad (8)$$

It exhibits the same properties as the other assets. The base rate for the international investor can differ from that of the Ukrainian investor due to their differing levels of wealth and expectations for the future. This defines the differential between domestic and foreign interest rates denominated in foreign currency.

$$(E_t(r^*_{t+1}) - E_t(R^*_{t+1}))/(1+R^f_{t+1}) = [(1+r^{*f}_{t+1})/(1+R^f_{t+1})-1] + Cov([M_{t+1}/M_t],(1+R^*_{t+1}))$$
$$- [(1+r^f_{t+1})/(1+R^f_{t+1})]Cov([m^*_{t+1}/m_t],(1+r^*_{t+1}))) \qquad (9)$$

The left-hand side of (9) defines the scaled deviation between the interest rates on the two foreign-currency-denominated assets. Two sources of deviation are evident on the right-hand side. First, the investors of the two countries may have differing rates of time preference (i.e., expectations of next-period stochastic discount factors) as represented by

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[15] See Backus, Foresi and Telmer (2001) for a derivation of this.

the first term in brackets. If Ukraine is less patient, and thus has higher base rate than the international investor (i.e., $r^{*f}_{t+1} > R^{f}_{t+1}$), the first term will be positive. Second, the same asset may play a different role in adjusting for risk in the two portfolios, leading to different covariation with the stochastic discount factors. Factors that intensify the liquidity constraint in Ukraine, for example, while not causing a similar response in international financial markets, will lead to a larger premium in the expected returns to foreign-currency-denominated assets in Ukraine relative to those on world markets.[16]

The term structure of returns on assets of maturity n relative to a one-period asset ($T_{n,1}$) can be defined through application of the expectations hypothesis as in (10).[17]

$$T_{n,1} = (1+r^{n}_{t+1})/(1+r_{t+1}) = \Pi_{s=2}^{n}\, E_t(1+r_{t+s})^{1/n} \qquad (10)$$

The notation r^{n}_{t+1} refers to an asset with maturity n observed in period t+1, and the absence of a superscript indicates a one-period maturity. There are then two potential sources of an upward-sloping yield curve. The first is the expectations hypothesis: the compounding of the succession of one-period base rates for the maturity of the asset. For countries with differing rates of time preference, this will lead to different slopes of the yield curve. The second is the passthrough of the increased risks of holding longer-maturity assets to the return on those assets: these will be evident in the formalization below.

Premia derived from a three-factor CIR model. Asset-pricing theory can serve as the basis for an empirical investigation once a functional form of the stochastic discount factor is chosen. I begin from a discretized and extended version of the three-factor Cox, Ingersoll and Ross (1985, hereafter CIR) model.

I model the three exogenous factors (x_t, y_t, z_t) as international credit market, Ukrainian financial-market and macroeconomic conditions, respectively.

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[16] This is also the term that encompasses "peso problem" differences between expected distribution of outcomes and observed distribution of outcomes. That hypothesis is distinguished from the market-separation hypothesis of this paper when the "peso problem" expectations are common among the three groups of agents in the financial markets.

[17] When returns and stochastic discount factors are assumed to be distributed log-normally, for example, there is also a maturity-specific constant in (10). See Bekaert and Hodrick (2001).

$$x_{t+1} = (1-v_x)\mu_x + v_x\, x_t + x_t^{1/2}\, \varepsilon_{xt+1} \tag{11x}$$

$$y_{t+1} = (1-v_y)\mu_y + v_y\, y_t + y_t^{1/2}\, \varepsilon_{yt+1} \tag{11y}$$

$$z_{t+1} = (1-v_z)\mu_z + v_z\, z_t + z_t^{1/2}\, \varepsilon_{zt+1} \tag{11z}$$

All three factors are stochastic in nature, and evolve in autoregressive fashion over time. The parameter v_i (i=x,y,z, $0<v_i<1$) indicates the strength of convergence in the series to a steady-state value, with smaller v_i associated with more rapid convergence. The parameter μ_i is an indicator of policy stance in that market, with larger μ_i supporting larger stochastic discount factors, other things equal. The three series are characterized by conditional heteroskedasticity.

Decisions of international credit-market agents do not depend on factors y_t and z_t. Their stochastic discount factor and base rate of (7) and (8) are modeled as:

$$- \ln(([M_{t+1}/M_t]) = (1 + \Lambda_x^2/2)\, x_t + \Lambda_x\, x_t^{1/2}\varepsilon_{xt+1} \tag{7'}$$

$$(1+R^f_{t+1}) = - \ln(E_t(M_{t+1}/M_t)) = x_t \tag{8'}$$

The price placed by international credit-market participants on the risk of variation in the "global" factor is Λ_x.[18]

For participants in the Ukrainian financial markets, the stochastic discount factor depends upon all three factors driving asset pricing and preferences. The price placed by a resident on risk i is given by λ_i. Those participants able to trade in foreign-currency-denominated assets have stochastic discount factor and base rate of (4) and (5) as follows.

$$\begin{aligned} - \ln([m^*_{t+1}/m^*_t]) = {} & (\gamma + \lambda_x^2/2)\, x_t + (\gamma + \lambda_y^2/2)\, y_t + (\gamma + \lambda_z^2/2)\, z_t + \\ & \lambda_x\, x_t^{1/2}\varepsilon_{xt+1} + \lambda_y\, y_t^{1/2}\varepsilon_{yt+1} + \lambda_z\, z_t^{1/2}\varepsilon_{zt+1} \qquad \gamma>1 \end{aligned} \tag{4'}$$

$$(1+r^{*f}_{t+1}) = - \ln(E_t(m^*_{t+1}/m^*_t)) = \gamma x_t + \gamma y_t + \gamma z_t \tag{5'}$$

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[18] This specification has an obvious practical deficiency when ε_{it} is large enough to cause the outcome x_t, y_t or z_t equal to zero. I will consider this in estimation, but maintain the current derivation in exposition for its simplicity.

The parameter γ is an indicator of the relative impatience in the emerging economy; other things equal, this alone will lead to larger base rate than is observed among international credit-market participants. The two "local" factors enter the stochastic discount factor as well, symmetrically to the role of x_t. The final group of agents is made up of those with access only to domestic-currency-denominated instruments. These will have the same response to Ukrainian-financial-market factor y_t as did the other Ukrainian group, but will have different impact of global and Ukrainian macroeconomic factors due to the inability to hedge in Ukrainian foreign-currency-denominated instruments. The parameter α is the indicator of this, and may be either greater than or less than one. This implies stochastic discount factor and base rate of (2) and (3) restated:

$$- \ln([m_{t+1}/m_t]) = \alpha (\gamma + \lambda_x^2/2)\, x_t + (\gamma + \lambda_y^2/2)\, y_t + \alpha (\gamma + \lambda_z^2/2)\, z_t + \alpha^{1/2} \lambda_x x_t^{1/2}\varepsilon_{xt+1} + \lambda_y y_t^{1/2}\varepsilon_{yt+1} + \alpha^{1/2} \lambda_z z_t^{1/2}\varepsilon_{zt+1} \qquad \alpha > 0 \tag{2'}$$

$$(1+r^f_{t+1}) = - \ln(E_t(m_{t+1}/m_t)) = \alpha\gamma x_t + \gamma y_t + \alpha\gamma z_t \tag{3'}$$

The stochastic discount factors of home agents differ from those of foreign agents in two ways: the response to an innovation in a factor is larger ($\gamma>1$) because of the greater "impatience" of the Ukrainian investors, and there is a systematic effect of factors y_t and z_t on the stochastic discount factors domestically while not abroad. The two groups of domestic agents differ in their ability to insure against the impact of factors: those of (2') have a differential effect (measured by α) on their stochastic discount factors of innovations in factors x_t and z_t.

With this parameterization, I can derive predictions from this model for the currency risk premium, the convertibility premium, and the liquidity premium in Ukraine.

- The currency risk premium ($\rho_{t+1} = \ln((1+r_{t+1})/(1+r^*_{t+1}))$) on domestic-currency assets and the currency depreciation rate are in theory determined simultaneously within the Ukrainian markets.

$$\rho_{t+1} = \ln(E_t([m^*_{t+1}/m^*_t])) - \ln(E_t([m_{t+1}/m_t])) + E_t(\ln([m_{t+1}/m_t])) - E_t(\ln([m^*_{t+1}/m^*_t])) = ½(\alpha-1)[\lambda_x^2 x_t + \lambda_z^2 z_t] \quad (12)$$

$$\ln(S_{t+1}/S_t) = \ln([m^*_{t+1}/m^*_t]) - \ln([m_{t+1}/m_t]) = (1-\alpha)[(\gamma + \lambda_x^2/2) x_t + (\gamma + \lambda_z^2/2) z_t + \lambda_x x_t^{1/2}\varepsilon_{xt+1} + \lambda_z z_t^{1/2}\varepsilon_{zt+1}] \quad (13)$$

The model's prediction of exchange-rate depreciation is based upon a flexible-rate regime. Central bank intervention in the foreign exchange market to stabilize the exchange rate will attenuate the effects, but will not eliminate the underlying factors.

- The convertibility premium ($\chi_{t+1} = \ln((1+r^*_{t+1})/(1+R^*_{t+1}))$) is the premium paid to holders of foreign-currency-denominated assets in Ukraine relative to the rate paid in international markets.

$$\chi_{t+1} = ½\{[\Lambda_x^2 - \lambda_x^2] x_t - (\lambda_y^2 y_t + \lambda_z^2 z_t)\} \quad (14)$$

The convertibility premium will in theory respond to all three sets of factors. The factors x_t that drive the international credit markets can cause movement in this premium if the Ukrainian investors price differently the volatility in these factors. If ($\lambda_x > \Lambda_x$), the convertibility premium will respond negatively to shocks to x_t. Variations in the financial-market factors y_t that reflect instability or inefficiency in the Kyiv markets will also move the convertibility premium. Finally, z_t will matter as well. Management of the exchange rate will not remove the impact of other macoreconomic interventions.

- The term structure will differ across countries with differences in underlying intertemporal rate of substitution. For the two countries, I obtain a term structure relative to the one-period credit rate and then create the term-structure ratio $\tau_{n,1} = T_{n,1}/T^*_{n,1}$. Using (10) and the CIR structure:

$$\ln(\tau_{n,1}) = n(\gamma + \delta_1 x_t + \delta_2 y_t + \delta_3 z_t) + \eta_t \quad (16)$$

The parameter n represents the maturity of the "long" credit. Comparison of the two term-structure indicators will provide a measure of the relative impatience parameter γ, so long as the derivation controls for the potential importance of x_t in both term structures and y_t and z_t in the determination of the domestic term structure. While (16) could be estimated using either Kyiv-based term structure in the numerator, I exploit the availability of USD-denominated credits in the Kyiv market and compare USD-denominated term structures in London and Kyiv.

IV. The premia of the financial markets in Kyiv – and the factors that cause them.

The currency risk premium, the convertibility premium and the term structure are derived in this study from weekly observations from the interbank credit market in Kyiv. Four separate maturities are considered: overnight, 7-day, 30-day and 90-day. The domestic-currency credits are in hryvnia (HRV) and the foreign-currency credits are in US dollars (USD). The time period considered is 21 January 1999 to 9 June 2005.[19] For comparison, interest rates at the same maturities and on the same dates were collected for the London Interbank (LIBOR) market and used as R^*_t.

Convertibility premium. The inability of Ukrainian investors to borrow without limit on international markets and the excess demand for USD-denominated credits in Kyiv led to convertibility premia χ_{t+n}. The χ_{t+n} for overnight, 7-day and 30-day USD-denominated deposits on the Kyiv interbank market are calculated relative to the equivalent-maturity LIBOR rate and are illustrated in Figure 3.[20]

It is evident from this figure that there has been substantial variation in the convertibility premium. The 30-day premium falls from 1.07 at the end of 1999 to 1.03 by the beginning of 2001. It rises above 1.08 by the end of 2001, and then falls again to 1.03 by March 2003. It then reaches its peak for this period at the end of 2003 with a ratio of 1.11. It falls throughout 2004, but then spikes again during the Orange Revolution at the end of 2004, until finally falling to less than 1.02 during the first half of 2005.[21]

Currency risk premium. The currency risk premium ρ_{t+1} is a wedge between the interest rates on USD and HRV credits of the same maturity offered in the same

[19] The interbank rates were reported in the weekly issues of the periodical "Business".

[20] The mid-point of bid and offer rates is pictured for each maturity.

[21] This may give the impression that the financial markets were more troubled by events at the end of 2003 than by the Orange Revolution. We don't have direct evidence of this, since no interbank rates are reported for a number of weeks in late 2004. The absence of rates is itself striking evidence of upheaval.

market. One potential component of this wedge is the expected depreciation of the nominal exchange rate, while a second component may be the heightened risk of transacting in hryvnia in Ukraine. If expected exchange-rate depreciation were the only factor at play (if, for example, the actors had rational expectations and risk neutrality), then expected depreciation of the exchange rate leads to $\rho_{t+1} > 1$. Figure 2 illustrates the difference in HRV and USD 30-day rates on the Kyiv interbank market. ρ_{t+1} is greatly in excess of one despite the stability of the nominal exchange rate. This could have been the effect of expected but unrealized depreciation against the US dollar, but may also reflect an excess demand for USD-denominated assets.[22]

Liquidity premium. The liquidity premium is measured through comparison of term structures $\tau_{n,1}$, $\tau^*_{n,1}$ and $T_{n,1}$. These term structures are illustrated in Figure 4 for n=30. While the international markets register almost no term structure over this maturity, there is evidence of positive premia in both Kyiv credits.[23] The term structure $\tau^*_{30,1}$ is characterized by a solid, relatively constant mark-up, while the $\tau_{30,1}$ illustrates an even larger mark-up on average and greater volatility over this period.

Latent factors in the interbank market outcomes. The theoretical model of the previous section specified the stochastic discount factor in terms of three unobserved factors: one representing external (LIBOR) credit market tendencies, one representing common elements of the Kyiv financial markets, and one representing the impact of macroeconomic policies. Factor decomposition of logarithmic returns in these markets yield three principal components that match this characterization very well.

The factor x_t can be derived as principal component from the (logarithmic) returns observed on transactions in the LIBOR market for the overnight, 7-day, 30-day and 90-day USD-denominated credits. It is illustrated in Figure 5. The factors y_t and z_t are derived as the first two principal components from the (logarithmic) returns observed on transactions in the Kyiv interbank market for the overnight, 7-day, 30-day and 90-day

[22] The expected-but-unobserved depreciation explanation would be similar to the "peso problem" exposited for Mexico by Krasker (1980) and for the US by Lewis (1991).

[23] While the London interbank market exhibits term structure, the positive slope of the term structure only becomes evident for maturities longer than 90 days.

credits, both those denominated in HRV and those denominated in USD.[24] These are also illustrated in Figure 5.

The factor x_t summarizes 93 percent of the total variation in the four London interbank credit returns. The two factors y_t and z_t together summarize 82 percent of variation in the residuals from logarithmic returns in the Kyiv market in both denominations. y_t picks up the common movements in all returns (63 percent of total variation); z_t puts positive weight on positive variation in the HRV-denominated markets and negative weight on positive variation in the USD-denominated market (19 percent of total variation).

Estimating the parameters of the stochastic discount factors. These derived values of x_t, y_t and z_t are used in estimating the parameters λ_x, λ_y, λ_z, Λ_x, α and γ from the stochastic discount factors. Equations (12), (14), and (16) of the currency premium ρ_{t+i}, convertibility premium χ_{t+i}, and term-structure ratio $\tau_{n,1}$ are estimated by GMM systems estimation. The results are reported in Table 1. Three features stand out:

- There is relatively little "cost" to risk to investors on the external markets. The estimate of Λ_x (0.025) is insignificantly different from zero.
- There is relatively large cost to risk in the Kyiv markets. The price of financial-market uncertainty/inefficiency λ_y is roughly twice as large as the substantial prices of global risk λ_x and macroeconomic risk λ_z. All are estimated very precisely.
- The magnification costs of the same risks to those unable to access the USD-denominated markets α is substantial at 6.987 and is significantly larger than the value of unity assumed for those able to trade in US dollars.
- There is a strongly significant measure of impatience γ in Kyiv markets. Its value of 0.01 on seven-day credits is magnified as the maturity lengthens, as evidenced by the values of m_{30} and m_{90} of 3.023 and 5.200 respectively, both significantly different from zero.[25] The coefficients of y_t and z_t take the expected positive sign, but are insignificantly different from zero at the 95 percent confidence level. The

[24] This derivation is accomplished in two steps. First, the log domestic returns are regressed on the external factor x_t. The residuals from that regression are then used in deriving the latent factors y_t and z_t.
[25] The coefficient m_7 is normalized to one prior to estimation.

external factor has a larger effect on the London term structure than on the Kyiv term structure as evidenced by the estimated δ_1 value (also significant) of -0.009.

This is thus a rejection of the single-agent model of financial integration in favor of the segmentation of the market into three groups of agents with varying exposure to risk, prices of risk and degrees of impatience.

V. Testing hypotheses on policy and private behavior.

The model of the previous section provides a compelling derivation of the three premia based upon the CIR factor parameterization. However, it remains unclear just what "causes" the three factors. In this section I introduce observable indicators of risk and inefficiency in the financial markets, will check for correlation with the underlying factors identified in the last section, and will estimate the impact of these observable indicators on the three premia of interest. Two general non-exchange-rate causes of risk and inefficiency are considered: the instability of macroeconomic policy and the instability/inefficiency of the Ukrainian financial markets.

The instability (or predictability) of macroeconomic policy. In the conduct of monetary policy, risks and market distortions can introduce a separation between Ukrainian and foreign markets that leaves scope for independent credit policy.[26] Two variables are considered to proxy for credit stance: the discount rate and the Lombard-discount channel. The discount (r^d_t) and Lombard (r^L_t) rates in Ukraine played similar roles to those in other European banks.[27] The discount rate was the lowest rate at which banks can borrow from the NBU, and was often below the market rate. Bank-level quotas for borrowing at that rate were set by the NBU. The Lombard rate was charged on emergency loans from the NBU to banks. No quota was placed on its use, and it thus should serve as an upper bound on market overnight interest rates. These two rates were set by NBU officials at periodic meetings. The Lombard/discount channel is $L_t = (r_{Lt} - r_{dt})/(1+r_{dt}/100)$ and is a measure of interest-rate volatility acceptable to the NBU.

[26] Bilan (2005) concludes just this – her "liquidity effect" is a measure of the degree to which monetary policy, ceteris paribus, can affect the interest rate. Her analysis is limited by an absence of variables indicating international parities – either exchange rate or foreign interest rate.

[27] In 2001 the Ukrainian central bank dropped the "Lombard" designation, and now calls it the overnight credit rate. I continue with the earlier name for continuity.

Country-specific market expectations can also play a role in determining the interest rates observed in the Kyiv market. Actual exchange-rate depreciation will in theory be driven by this factor, as will the currency risk premium. The learning process among market participants as to the NBU commitment to a stable exchange rate will be a component of this factor, proxied by both time-specific dummy variables and the observed standard deviation in exchange-rate depreciation over the preceding 30 days denoted σ_{30t}.

Financial market-level instability and imbalance. Commercial banks act as intermediaries on the financial markets: they accept deposits and extend credits. In Ukraine, both depositors and creditors had a choice of denomination in their transactions. Table 3 illustrates the magnitude and denomination of both "credits to the economy" and "deposits of enterprises, institutions and households" in the commercial banking system.[28] The first set of columns describes credits granted by commercial banks. The share of HRV credits was declining over time, from 74 percent in 1995 down to 48 percent at the end of 1999 and rising slightly to 58 percent at end-June 2005.[29] The second set of columns presents the liabilities of the commercial banks; there, the share of HRV liabilities remains fairly steady throughout, ending in 2005 at 66 percent.

Two features stand out in this table. First, there was remarkable growth in the financial intermediation of the economy, with both credits and liabilities of commercial banks growing rapidly. Second, the deposits denominated in foreign currency did not keep up with the credits extended in foreign currency. If the commercial banks were unable to meet their excess demands on the international markets, the relative shortage of USD funds could generate a premium.

Figure 6 illustrates the excess supplies (deposits minus credits) to commercial banks for HRV and USD instruments at a monthly frequency. There was a sustained excess demand for USD credits in the commercial banking system – more USD credits were issued than USD deposits were received. There was also a sustained excess supply of HRV credits, with deposits in general exceeding demands for HRV credits. The net

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[28] These credits exclude "net credit to the government" from commercial banks. This was a relatively small amount throughout the period studied.

[29] Decomposition of credits into short-term (less than or equal to one year maturity) and long-term (greater than one-year maturity) illustrates that short-term credits remain predominantly HRV while long-term credits are nearly 50 percent USD.

effect of the two was that of excess demand for credits. While there was an excess supply of credits overall prior to September 2000; only in October 2004 and March-April 2005 was the excess supply of credit observed again. For econometric application, I define xc_t as the excess demand for total credit in period t.[30] The variable $xc^{\$}_t$ is the excess demand for USD credits in period t, and xc^h_t is the excess demand for HRV credits in period t. The data are measured monthly, and are interpolated to weekly data through use of a spline fit to the data.

For a measure of the fundamental risk and inefficiency of the financial markets, I examine the bid-ask spreads observed in each market.[31] Figure 7 illustrates three credit-market spreads: the spread on overnight HRV-denominated credits in Kyiv, the spread on overnight USD-denominated credits in Kyiv, and the spread on overnight LIBOR credits. There was a decline over time in the Kyiv spreads from 4 percent to about 1 percent, consistent with a deepening of the Kyiv foreign-exchange and interbank markets. There was still room for further reductions, as is evident from the spread reported for the London overnight credits; that spread differs only marginally from zero.[32] The Kyiv market also exhibited a great deal more volatility in spreads, with the HRV-denominated credits more volatile than the USD-denominated credits. The extreme volatility of the spread on HRV overnight credits disguises the fact that this series began and ends just as did the USD-credit spread: beginning at about 4 percent at end-1999, and ending at about 1 percent in mid-2005. In between, though, its volatility is more striking than that in the other two series.

To summarize the information available in these spreads, I derived four principal components. The first ($\hat{s}_{et}$) is the principal component derived from the logarithmic returns (overnight, 7-day, 30-day and 90-day) observed on the LIBOR markets. The second ($\hat{s}_{ft}$) is the Kyiv financial-market factor defined as the principal component of the spreads observed in six Kyiv credit-market assets: the overnight, 7-day and 30-day

[30] This is measured as a percentage of deposits. If total credits of commercial banks are denoted cr_t and total deposits are dep_t, then $xc_t = (cr_t - dep_t)/dep_t$. The HRV and USD components are defined analogously. These variables are observed monthly, and a spline is created to interpolate the weekly values.

[31] The spreads reported here for all interbank credit markets are defined ("offer" rate – "bid" rate)/(1+ "bid" rate/100).

[32] The bid-ask spread in the London overnight markets is generally less than 0.1 percent. Its sole spike in the weekly series examined came on 9/13/2001, when the spread rose to 0.25 percent.

maturities for both HRV- and USD-denominated credits.[33] An upward movement indicates an increase in banking-system specific distortions of transactions in Ukraine: capital controls, opacity of commercial bank performance, and other features that increase the risk of non-repayment.[34] I also create two currency-specific factors: $\hat{s}_{\$t}$ for the USD-denominated credits and $\hat{s}_{ht}$ for the HRV-denominated credits. These are principal components for the parts of the spreads in each market orthogonal to $\hat{s}_{ft}$. An upward movement in these reflects the currency-specific instability of these markets.[35]

Simple correlations with the latent factors. These observable variables demonstrate the expected correlation with the latent factors derived in the previous section. Table 3 reports simple contemporaneous correlations with observable variables. The external factor x_t is, not surprisingly, almost perfectly correlated with the overnight LIBOR rate on USD-denominated credits. It is also highly correlated with two indicators of Ukrainian monetary policy – the discount rate (r^d_t) and the Lombard-discount channel (L_t) – as a consequence of the NBU management of the exchange rate. It is strongly negatively correlated with excess demand for USD-denominated credits in Ukraine ($xc^\$_t$). Smaller, but still substantial, correlation exists with the standard deviation in exchange rate over the previous 30 days (σ_{30t}) and the annual equivalent of the weekly realized inflation (π_t).

The domestic factors y_t and z_t are less correlated with these observed variables. y_t does have a significant positive correlation with σ_{30t} , with the NBU discount rate and with the excess demand for hryvnia-denominated credits. z_t also is significantly and positive correlated with σ_{30t}, but is significantly negatively correlated both with the overnight LIBOR rate and the NBU discount rate.

In Table 4, I examine the correlations of the spread-derived variables with these latent factors. For the external factor x_t, the correlations are significant but not especially

[33] I've excluded the 90-day-maturity credits from this calculation because of missing values that would limit the range of the derived factor. This does not make a large difference in the values derived for the principal component.

[34] There is a significant positive correlation between the overnight rate on LIBOR credits and $\hat{s}_{ft}$, but that rate explains only 5 percent of the variation in $\hat{s}_{ft}$.

[35] I create these in three steps for each denomination. First, I regress the spread for each maturity on $\hat{s}_{ft}$. I use the residual from this regression as the orthogonal measure of the spread. I then derive the principal component from the spreads on transactions in overnight, 7-day and 30-day markets in the same currency.

large.[36] The principal component derived from spreads for the entire Kyiv financial market ($\hat{s}_{ft}$) has a strong positive correlation with y_t: it represents well the distortions and location-specific risks for Kyiv financial markets. The denomination-specific indicators $\hat{s}_{\$t}$ and $\hat{s}_{ht}$ are strongly correlated with z_t. They are also strongly negatively correlated with each other, and so only one will be used at any time.

There are three premia of interest: the currency risk premium, the convertibility premium, and the liquidity premium (as evident in the term structure). Under the null joint hypothesis of (a) complete integration of the Ukrainian markets with international credit markets and (b) no significant difference (i.e., identical pricing kernels) for agents within Ukraine, the factors y_t and z_t will have no significant effect on the markets observed here: convertibility and liquidity premia will be zero on average and the currency risk premium will be equal to expected depreciation plus a random zero-mean error. The model identifies alternative hypotheses associated with the factors x_t , y_t and z_t. Specifically, the premia will depend upon:

- Learning the reliability of the NBU's stable exchange-rate regime. This leads to gradual adjustment in interbank rates toward parity.
- Market-specific risks associated with the interbank markets in Kyiv.
- Shifts in monetary policy.
- Excess USD-denominated credit demands in the Kyiv markets leading to interest rate premia.

What determined the currency risk premium? The asset-pricing theory predicts in a flexible-exchange-rate regime (equations (12) and (13)) that the currency risk premium and nominal exchange-rate depreciation will be jointly determined by the factors x_t and z_t. In Table 5 I report the results of regression analysis linking the rate of depreciation (first column) and the currency risk premium in various maturities (last four columns) to the observed indicators of policy instability and market risk/inefficiency.[37]

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[36] A principal component derived from spreads on the LIBOR markets ($\hat{s}_{et}$) was not strongly correlated with x_t in large part because of the dominant role played by 11 September 2001 in the observed spreads.

[37] In appendix Table A2 I report the results of similar regressions linking the latent factors to the currency premium and exchange-rate depreciation.

The first column of Table 5 reports results of a regression of 30-day forward depreciation of the nominal exchange rate on the factors identified above.[38] International interest rates and NBU discount rates contribute insignificantly, as does the volatility of the exchange rate over the preceding 30 days (σ_{30t}).[39] The fundamental drivers of depreciation are apparently expectations-rated, with a significant pattern of rapid depreciation on average in the first year (1999) followed by a declining average rate through the sample until reaching the 2005 average of 0.91.

The persistent currency risk premium $\rho_{m,t+1}$ for maturities m (of overnight, 7-day, 30-day and 90-day) seems an anomaly, as this is a period of exchange-rate stability. The premium could nevertheless be due to inflation in hryvnia prices, but instead increased inflation in this sample is associated with a significantly lower currency risk premium.[40] The factors identified above, however, provide a persuasive explanation of this persistent premium. First, distortion or instability in the Kyiv financial markets ($\hat{s}_{ft}$) is priced into an increase in the currency risk premium. An increase in the observed standard deviation of the exchange rate over the previous 30 days leads to a significant increase in the currency risk premium. This coefficient, ranging from 0.77 for the overnight premium to 0.41 for the 90-day premium, is an estimate of the pricing of exchange-rate volatility risk. The negative impact of contractionary monetary policy on the risk premium is significant and large for overnight credits, but declines with increased maturity and switches to a positive effect for the 30-day and 90-day credits.

Just as for exchange-rate depreciation, the time-specific effects are positive, significant and declining over time. These are perhaps an indication of a gradually eroding "peso problem" in the HRV-denominated credit markets.

What caused the convertibility premium? In Table 6 I investigate the sources of the convertibility premium. The convertibility premium χ_{mt} is regressed on a similar

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[38] In creating the relevant depreciation rate S_{t+m}/S_t, it is necessary to adjust for the fact that the interest rates quoted by the market are annualized. To do so I first calculate the actual depreciation over the maturity of the credit. For S_{t+30}/S_t, I scale the actual depreciation rate up by 12 to represent the annualized equivalent of the actual depreciation observed over this maturity.

[39] In an augmented regression the immediate past inflation rate π_t has the expected positive coefficient, but also contributes insignificantly. This result is not reported, but will be made available on demand.

[40] These results are not reported here, but are available from the author.

set of factors. The regressions explain between 77 and 86 percent of the variation in this convertibility premium.[41]

Increases in the external factor, as proxied by the foreign overnight LIBOR return, caused a significant reduction in the convertibility premium. Increased distortions or instability in the Kyiv financial markets as measured by $\hat{s}_{ft}$ leads to an increase in the convertibility premium. The indicators of distortions and instability in the USD-denominated financial markets ($\hat{s}_{\$t}$) also has a positive and significant effect on the premium. Past variability in the exchange rate (σ_{30t}) contributes insignificantly.

The asset-pricing theory predicts that the factors of macroeconomic policy and balance will be significant drivers of the convertibility premium. Measures of monetary policy do not have significant effects, with the exception of the Lombard channel for the 90-day maturity. Most striking, however, is the estimated contribution of excess demand for USD-denominated credits ($xc^{\$}_{t}$). This has a large and significant positive effect on the convertibility premium at all maturities. A one percent increase in excess demand leads to estimates of between 0.047 to 0.083 increases in the premium. There is finally a positive and significant time-specific effect that is declining over time. For the overnight maturity this premium becomes insignificant by 2005, as is evident in the intercept. For the longer maturities the 2005 premium remains large (0.04, 0.08) and significant.

What caused the liquidity premium in the term structure in Ukraine? Table 7 reports the determinants of the term-structure ratio.[42] Just as in the other calculations, distortions or instability in either the international credit markets or in the Kyiv financial markets ($\hat{s}_{ft}$) will lead to an increase in the relative slope of the Ukrainian term structure. Greater instability in HRV-denominated markets leads to a significant decline in the term structure in Ukraine relative to international markets: I interpret that as a preference for shorter-maturity credits in more unstable times. The pattern of year-specific dummy variables indicates that the term structure in Ukraine relative to the international credit markets was steepest in 1999 and 2004, and with significantly steeper term structure persisting in 2005. Excess demand for HRV credit causes an insignificant reduction in the premium at the shorter maturities. Increases in the discount rate, the Lombard-

[41] In Appendix Table A3 I report the results of a similar regression directly on the latent factors.
[42] In Appendix Table A4, I report the results of similar regressions using the latent factors.

discount channel, past volatility in the exchange rate, and past inflation have insignificant effects on the term structure and so are excluded.

V. Conclusions and extensions.

The nominal anchor for the Ukrainian currency introduced in 1999 was quite successful in reducing exchange-rate variability *vis à vis* the US dollar. It also coincided with a pronounced reduction in interest rates on HRV interbank credits of all maturities between overnight and 90-day. To the extent that this reduction represents the removal of a risk premium in that market, credit allocations will be more efficient and the nominal anchor has fulfilled one of its roles.

The nominal-anchor policy did not, however, lead to the equalization of interest rates on similar assets in the two currencies. USD and HRV interbank credits in Ukraine, for example, remained above rates on comparable USD LIBOR credits. The degree of divergence was larger, the longer the maturity of the interbank credit. The evidence of this paper indicates that these deviations from uncovered interest parity can be decomposed into three parts: the currency-risk premium on HRV interbank credits relative to USD credits in Kyiv, the convertibility premium on USD interbank credits relative to Libor credits, and the deviation in equilibrium term structure between the Kyiv and London markets. While the nominal-anchor policy led to a substantial reduction in the currency risk premium over time, the convertibility premium and liquidity premium remained large. The empirical hypothesis testing reported here identifies the dominant factors supporting those continued deviations.

The testing also distinguishes this reason for deviations from uncovered interest parity from the rationale based on the "peso problem". The estimation of CIR parameters for the three groups of agents in the financial markets distinguishes three groups acting under three significantly different constraints. The "peso problem" rationale is typically based upon a common belief in a distribution of future payoffs that differs significantly from the observed historical payoffs (e.g., a shared non-zero probability assigned to the default of the banks on their loans). This explanation would not support the significant differences among agents confirmed in estimation in section IV.[43]

The fundamental policy message is this: Kyiv interbank credit markets were not completely integrated with international markets during this period. Persistent deviations continued in interest rates between the two. Factors associated with distortions and instability in the Kyiv markets certainly contributed to the persistent premia; encouraging a deeper and more stable domestic financial market will reduce these. Excess demands for USD-denominated credits during this period translated into a persistent convertibility premium. Last, it was also the case that the premia were increased by instability in the London markets – even though the instability occurred in those markets, it was associated with an increase in both convertibility and currency-risk premia on Kyiv credits. This is a phenomenon we should anticipate observing in larger magnitude during the shakeout of the world financial crisis of 2008-2009.

The Ukrainian situation in 2005 shared some characteristics with the "moral hazard" outcome described by McKinnon and Pill (2000). While the currency premium had been eliminated, the risk premium (what the authors call the "super premium") remained in the form of liquidity and convertibility premia. These are positively related to the excess demand for USD credits as defined in this paper. McKinnon and Pill (2000) recognize the excess demand for USD credits by its flip side: the "overborrowing" of the banking system from international lenders. Duenwald et al. (2005) raises this red flag as well in speaking of the "credit boom" in Ukraine. In Conway (2007) I point out that the credit boom was in fact fueled by a larger "saving boom" during this period, but that there is a mismatch in currencies between saving and investment. In this study, the mismatch is evidenced by the excess demand for USD credits.

The time period considered in this paper was chosen to focus upon the nominal-anchor period of Ukrainian monetary policy. The NBU decision in mid-2005 to change its target exchange rate with the US dollar suggested a change in this policy. In practice, however, the policy continued through 2008 at the appreciated exchange rate. It will be

[43] A "peso problem" rationale based upon distributions of expected payoffs significantly different for each of the three agents will be observationally equivalent to the market-segmentation hypothesis put forward in this paper, and the utility coefficients estimated in section IV will then be reinterpreted as characteristics of the distribution of expected payoffs. This struck me as a less plausible interpretation of the data, but obtaining data to separate the two hypotheses is an important area for future research.

interesting to consider the credit-market developments of the years 2005-2009 as an extension of this analysis.

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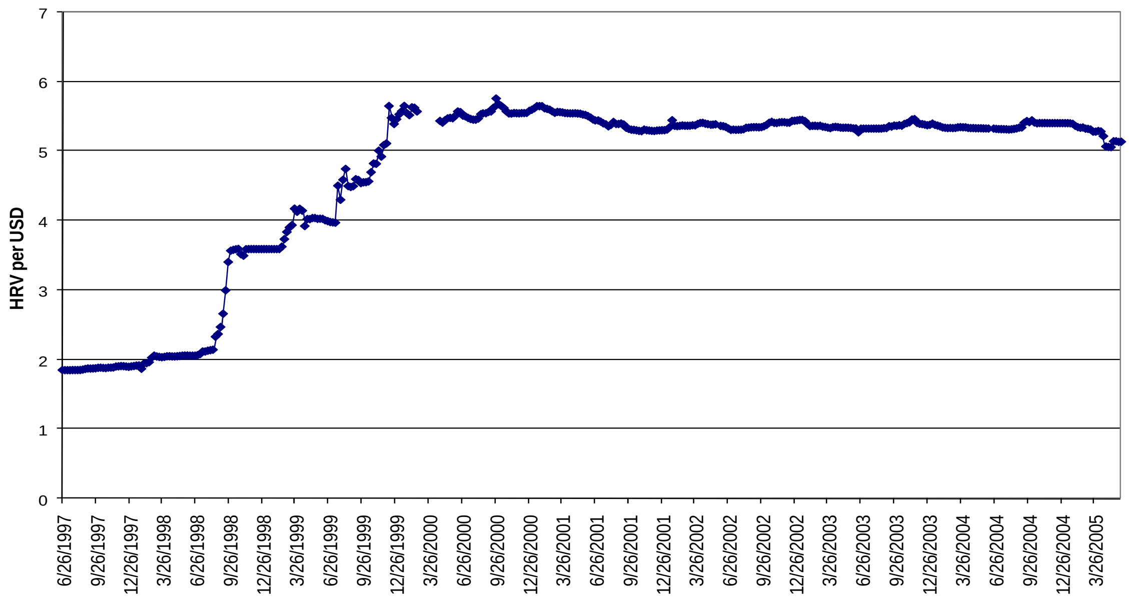
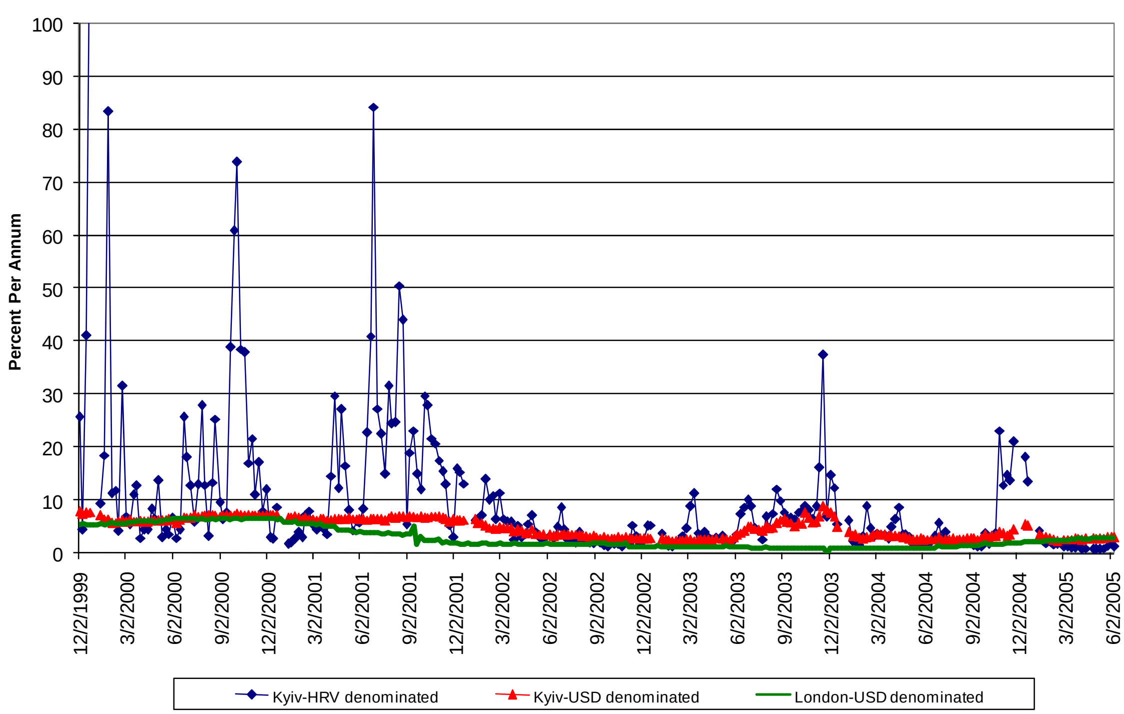
Figure 1: Hryvnia Exchange Rate



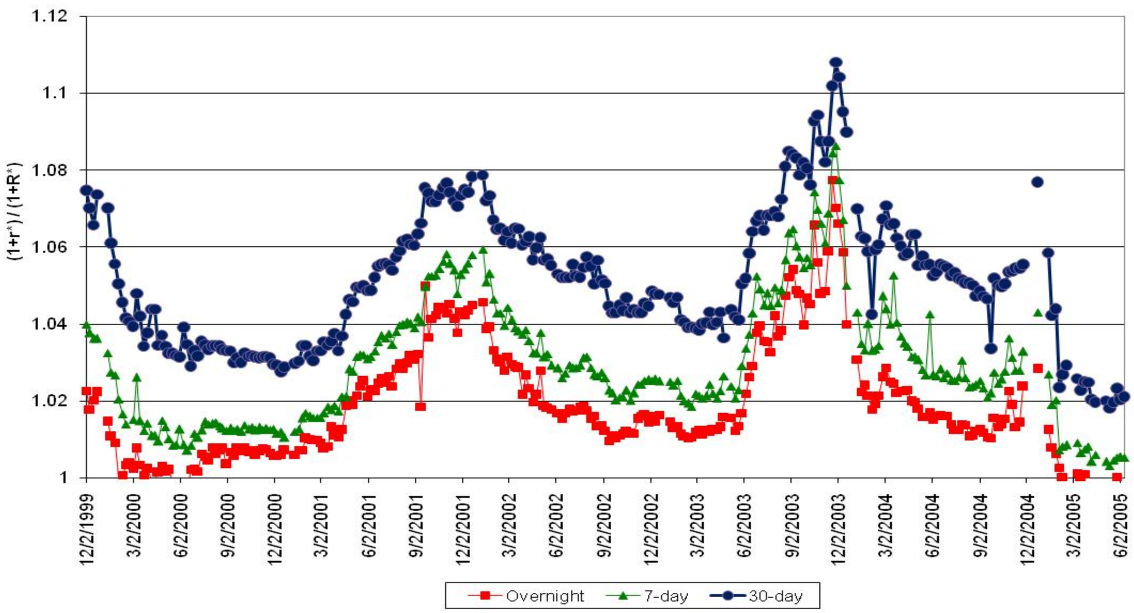
Source: National Bank of Ukraine

Figure 2: Interest Rates on Overnight Interbank Credit



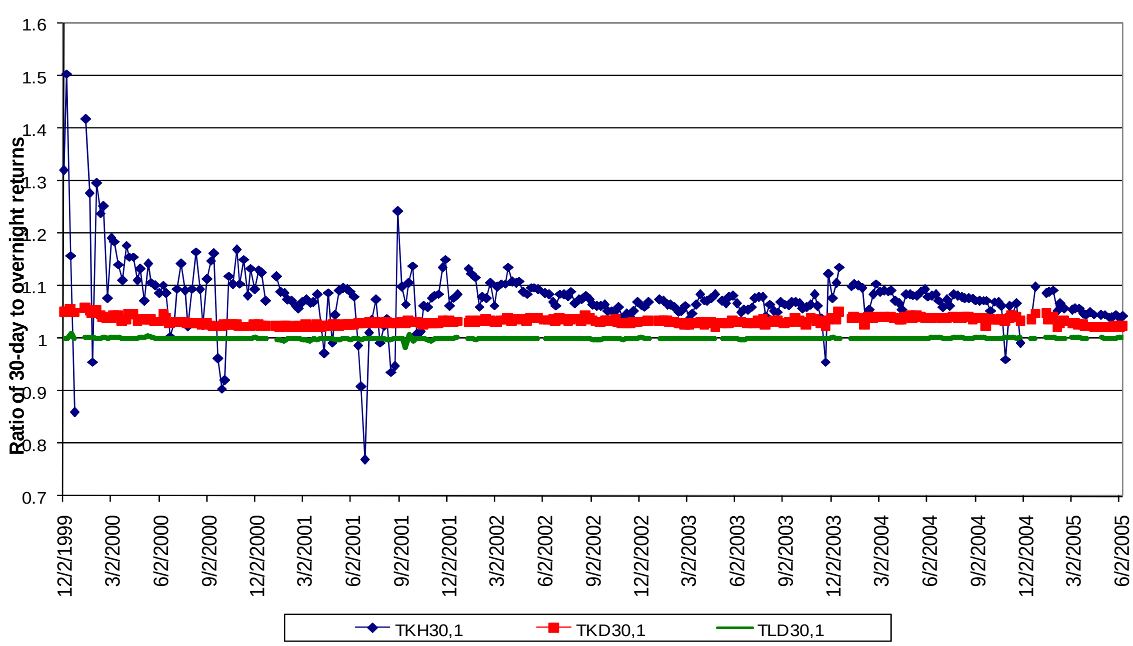
Source: author's calculation

Figure 3: Convertibility Premia in Ukraine



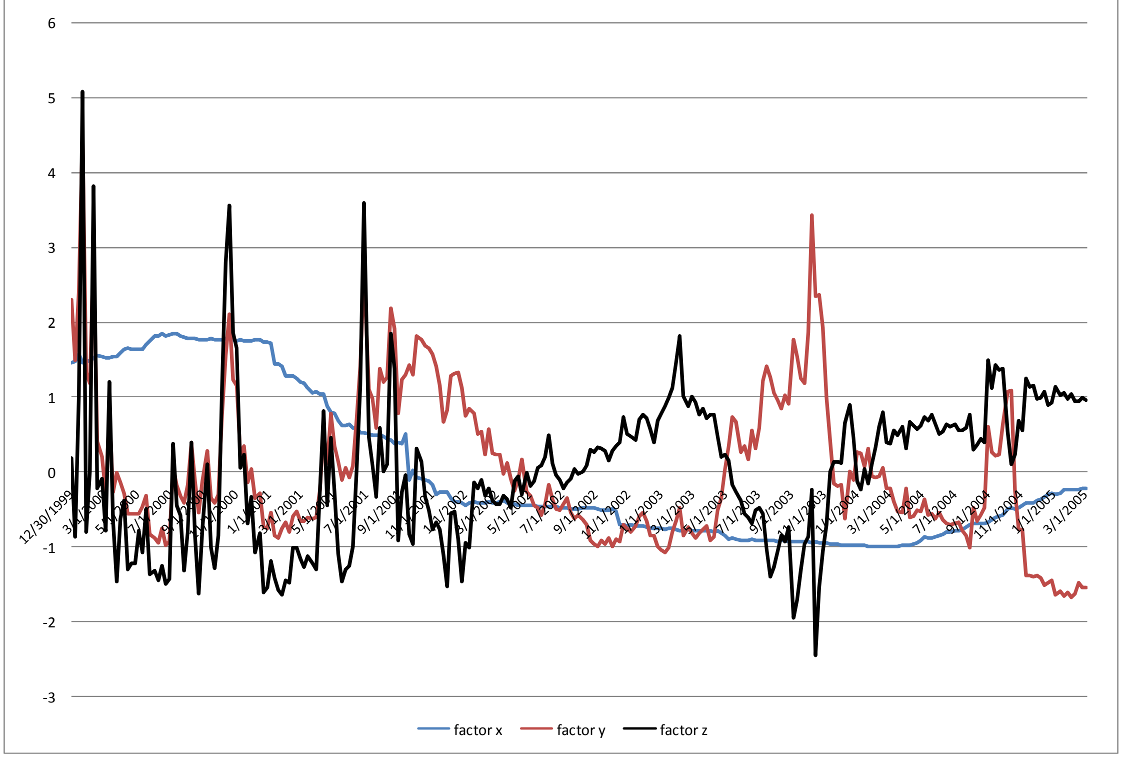
Source: author's calculation

Figure 4: Term Structures in 30-day relative to Overnight Interbank Credits



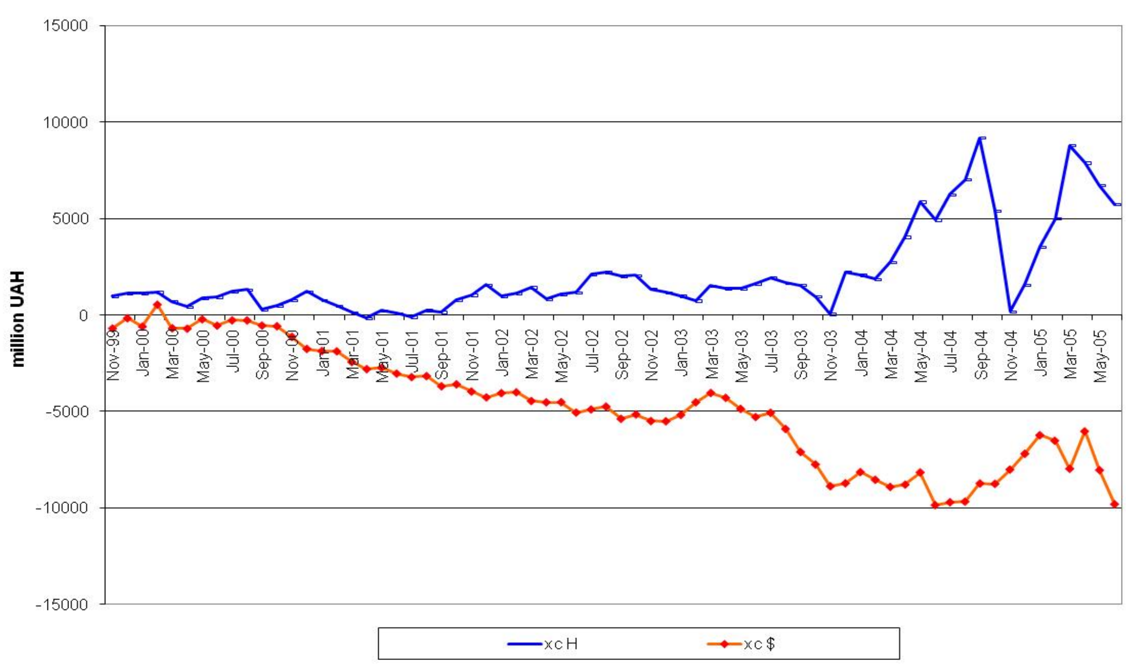
Source: author's calculation

Figure 5: **Latent factors defining Interbank Interest Rates in Ukraine**



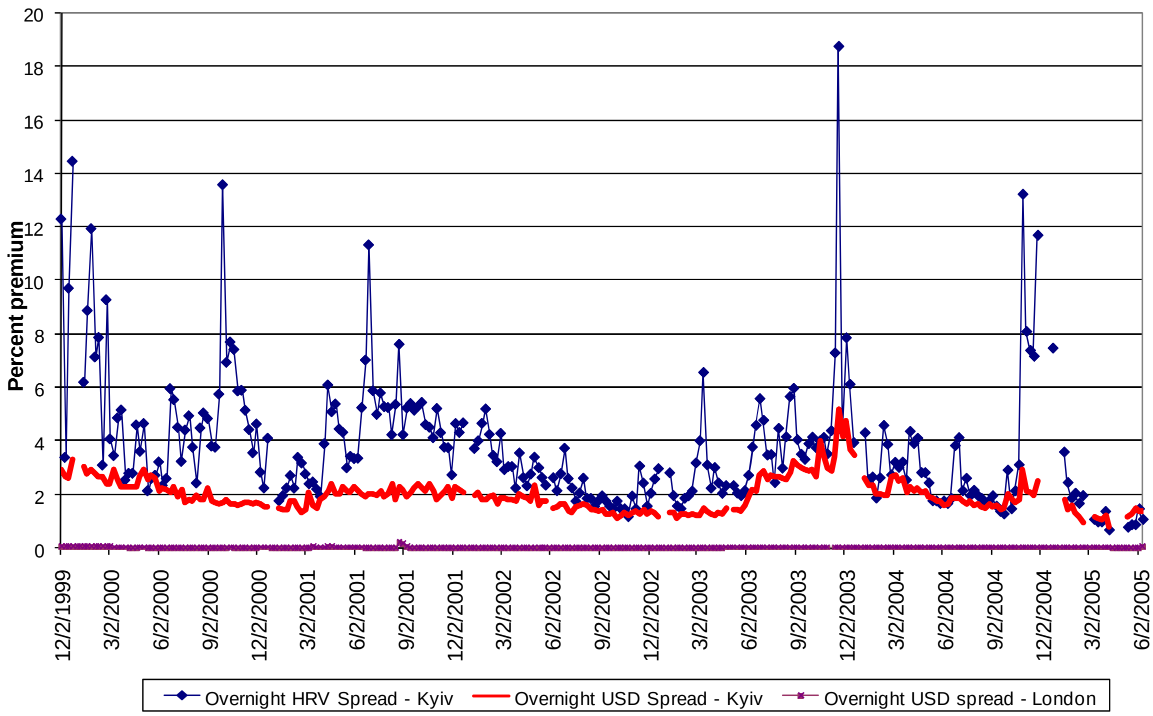
Source: author's calculation

Figure 6: Excess Supply of Funds to Commercial Banks



Source: author's calculation

Figure 7: Bid-ask Spreads in Overnight Markets



Source: author's calculation

Table 1: **Estimating the prices of financial "risks"**

	Coefficient	Standard Error	R^2 (for associated equation)
a_1	**0.044**	0.003	0.46
a_7	**0.057**	0.003	0.46
a_{30}	**0.085**	0.003	0.40
b_1	**0.019**	0.0002	0.85
b_7	**0.029**	0.0002	0.89
b_{30}	**0.123**	0.0006	0.78
m_7	1		0.07
m_{30}	**3.023**	0.051	0.08
m_{90}	**5.200**	0.109	0.37
α	**6.987**	0.296	
λ_x	**1.543**	0.092	
λ_y	**3.076**	0.014	
λ_z	**1.570**	0.013	
Λ_x	0.025	0.090	
γ	**0.010**	0.001	
δ_1	**-0.009**	0.001	
δ_2	0.001	0.001	
δ_3	0.002	0.001	

$$\rho_{t+i} = (1+r_{t+1})/(1+r^*_{t+1}) = a_i + ½(\alpha-1)[\lambda_x^2 x_t + \lambda_z^2 z_t] + \eta_{\rho t} \qquad i=1,7,30 \qquad (12')$$

$$\chi_{t+i} = (1+r^*_{t+i})/(1+R^*_{t+i}) =$$

$$b_i + ½\{[\Lambda_x^2 - \lambda_x^2] x_t - (\lambda_y^2 y_t + \lambda_z^2 z_t)\} + \eta_{\chi t} \qquad i=1,7,30 \qquad (14')$$

$$\ln(\tau_{n,1}) = n(\gamma^* m_n + \delta_1 x_t + \delta_2 y_t + \delta_3 z_t) + \eta_{\tau t} \qquad n=7,30,90 \qquad (16)$$

(12') and (14') are estimated as a system of 6 equations, by GMM. Equality of parameters across equations imposed. (16) is estimated as a separate system of 3 equations in GMM since there are no parameter restrictions across the two.

Coefficients in bold are significant at 95 percent level of confidence.

Table 2: Total Credits and Deposits of the Commercial Banks

	Credits			Deposits		
	Value	HRV share	Foreign share	Value	HRV share	Foreign share
1995	4078	0.74	0.26	4287	0.63	0.39
1996	5452	0.75	0.25	5145	0.69	0.31
1997	7295	0.71	0.29	6357	0.74	0.26
1998	8873	0.58	0.42	8278	0.60	0.40
1999	11787	0.48	0.52	12156	0.56	0.44
2000	19574	0.54	0.46	18739	0.62	0.38
2001	28373	0.56	0.44	25674	0.68	0.32
2002	42035	0.58	0.42	37715	0.62	0.38
2003	67835	0.58	0.42	61617	0.68	0.32
2004	91769	0.59	0.41	82959	0.64	0.36
2005 *	108742	0.58	0.42	104674	0.66	0.34

* end June

Source: National Bank of Ukraine

Table 3: **Simple correlations between latent factors and observed variables**

	x_t	y_t	z_t
$\ln(1+R^*_{1t})$	**0.99**	0.04	**-0.20**
σ_{30t}	**0.42**	**0.31**	**0.27**
$\ln(1+r^d_t)$	**0.95**	**0.23**	**-0.22**
L_t	**0.60**	0.02	0.03
$xc^{\$}_t$	**-0.72**	0.10	-0.06
xc^h_t	**-0.14**	**0.28**	-0.11
π_t	**0.32**	0.07	0.03

271 observations. Correlations in bold are significantly different from zero at 95 percent level of confidence.

Table 4: **Simple correlations between latent factors and spread-created factors**

	x_t	y_t	z_t
$\hat{s}_{et}$	**0.22**	**0.21**	-0.08
$\hat{s}_{ft}$	**0.12**	**0.67**	0.12
$\hat{s}_{\$t}$	**-0.31**	-0.05	**0.52**
$\hat{s}_{ht}$	**0.34**	**0.15**	**-0.54**

271 observations. Correlations in bold are significantly different from zero at 95 percent level of confidence.

Table 5: Sources of Nominal Depreciation and the Currency Risk Premium

	S_{t+30}/S_t	ρ_{1t+1}	ρ_{7t+1}	ρ_{30t+1}	ρ_{90t+1}
Intercept	**0.91**	**0.11**	0.02	**0.08**	**0.09**
	(0.05)	(0.03)	(0.02)	(0.01)	(0.02)
$\ln(1+R^*_{1t})$	-0.74	**1.84**	-0.21	**-3.19**	**-2.65**
	(1.65)	(0.83)	(0.71)	(0.50)	(0.48)
$\hat{s}_{ft}$	-0.004	**0.06**	**0.04**	**0.03**	**0.02**
	(0.01)	(0.005)	(0.004)	(0.002)	(0.002)
$\hat{s}_{ht}$	**-0.04**	**-0.04**	**0.02**	**0.02**	**0.01**
	(0.01)	(0.01)	(0.006)	(0.003)	(0.003)
σ_{30t}	0.23	**0.77**	**0.68**	**0.34**	**0.41**
	(0.27)	(0.15)	(0.12)	(0.09)	(0.10)
$\ln(1+r_{dt})$	-0.43	**-1.40**	**-0.65**	**0.26**	**0.37**
	(0.43)	(0.22)	(0.19)	(0.13)	(0.12)
d99	**0.74**	0.06	**0.33**	**0.13**	**0.14**
	(0.13)	(0.08)	(0.06)	(0.04)	(0.04)
d00	**0.29**	**0.12**	**0.23**	**0.17**	**0.14**
	(0.07)	(0.04)	(0.03)	(0.02)	(0.03)
d01	**0.15**	**0.13**	**0.20**	**0.10**	0.04
	(0.04)	(0.03)	(0.02)	(0.02)	(0.022)
d02	**0.16**	0.005	**0.06**	0.005	-0.03
	(0.04)	(0.02)	(0.02)	(0.01)	(0.02)
d03	**0.09**	-0.03	0.03	-0.005	-0.04
	(0.04)	(0.02)	(0.02)	(0.01)	(0.022)
d04	**0.13**	0.01	0.03	0.00	-0.04
	(0.04)	(0.02)	(0.02)	(0.01)	(0.022)
R^2	0.28	0.58	0.65	0.78	0.85
N	250	264	264	264	234

Standard errors in parentheses.
Figures in bold are significantly different from zero at the 95 percent confidence level.

Table 6: Sources of the Convertibility Premium

	$\chi_{1,t+1}$	$\chi_{7,t+1}$	$\chi_{30,t+1}$	$\chi_{90,t+1}$
Intercept	0.010	**0.016**	**0.082**	**0.040**
	(0.005)	(0.005)	(0.01)	(0.01)
$\ln(1+R^*_{1t})$	**-0.326**	**-0.66**	**-0.57**	**-0.53**
	(0.106)	(0.10)	(0.18)	(0.13)
$\hat{s}_{ft}$	**0.006**	**0.005**	**0.012**	**0.008**
	(0.001)	(0.0006)	(0.001)	(0.001)
$\hat{s}_{\$t}$	**0.003**	**0.006**	**0.009**	**0.006**
	(0.0007)	(0.001)	(0.001)	(0.001)
σ_{30t}	-0.017	-0.015	-0.010	0.023
	(0.017)	(0.017	(0.03)	(0.028)
$\ln(1+r_{dt})$	-0.050	0.033	0.063	0.018
	(0.027)	(0.026)	(0.05)	(0.36)
L_t	-0.001	-0.0009	-0.001	**-0.002**
	(0.001)	(0.0005)	(0.001)	(0.0006)
$xc^{\$}_t$	**0.052**	**0.047**	**0.083**	**0.052**
	(0.01)	(0.01)	(0.018)	(0.012)
d99	**0.058**	**0.070**	**0.084**	**0.058**
	(0.009)	(0.010)	(0.014)	(0.012)
d00	**0.028**	**0.033**	**0.055**	**0.035**
	(0.005)	(0.005)	(0.008)	(0.007)
d01	**0.024**	**0.028**	**0.040**	**0.038**
	(0.004)	(0.004)	(0.007)	(0.007)
d02	-0.000	0.004	0.008	**0.026**
	(0.003)	(0.003)	(0.006)	(0.006)
d03	**0.008**	**0.008**	**0.010**	**0.027**
	(0.003)	(0.003)	(0.001)	(0.006)
d04	-0.002	0.002	0.008	**0.051**
	(0.002)	(0.002)	(0.005)	(0.006)
R^2	0.77	0.80	0.76	0.86
N	259	259	259	229

Standard errors in parentheses.
Figures in bold are significantly different from zero at the 95 percent confidence level.

Table 7: Sources of Term-structure Ratio			
	$\ln(\tau_{7,1}/T_{7,1})$	**$\ln(\tau_{30,1}/T_{30,1})$**	**$\ln(\tau_{90,1}/T_{90,1})$**
Intercept	**0.011**	**0.029**	**0.036**
	(0.001)	(0.002)	(0.006)
$\ln(1+R^*_{1t})$	**-0.121**	**-0.183**	**-0.256**
	(0.030)	(0.049)	(0.103)
$\hat{s}_{ft}$	**0.0005**	**0.001**	**0.0015**
	(0.0002)	(0.0003)	(0.0006)
$\hat{s}_{ht}$	**-0.001**	**-0.002**	**-0.002**
	(0.0003)	(0.0004)	(0.0007)
xc^h_t	-0.008	-0.012	0.016
	(0.005)	(0.009)	(0.018)
d99	**0.006**	**0.037**	**0.049**
	(0.003)	(0.004)	(0.009)
d00	**0.003**	**0.012**	**0.021**
	(0.001)	(0.002)	(0.006)
d01	0.0017	**0.006**	**0.020**
	(0.0011)	(0.001)	(0.005)
d02	0.0016	**0.007**	**0.027**
	(0.001)	(0.001)	(0.005)
d03	0.000	0.000	**0.020**
	(0.001)	(0.002)	(0.006)
d04	**0.003**	**0.008**	**0.051**
	(0.001)	(0.001)	(0.005)
R^2	0.34	0.51	0.75
N	270	270	239

Standard errors in parentheses.
Figures in bold are significantly different from zero at the 95 percent confidence level.

Table A1: Decomposition of the HRV-denominated Interbank Rate

mean annual values

	2000	2001	2002	2003	2004	2005
30-day credits						
$\log(1+r_{30t})$	**0.25**	**0.20**	**0.12**	**0.13**	**0.12**	**0.07**
$\log(\rho_{30t})$	0.15	0.11	0.05	0.05	0.05	0.01
$\log(\tau^*_{301t})$	0.03	0.03	0.03	0.03	0.04	0.03
$\log(\chi_{1t})$	0.00	0.02	0.02	0.03	0.02	0.00
$\log(1+R^*_{1t})$	0.06	0.04	0.02	0.02	0.01	0.03
90-day credits						
$\log(1+r_{90t})$	**0.29**	**0.22**	**0.15**	**0.15**	**0.16**	n.a.
$\log(\rho_{90t})$	0.19	0.10	0.06	0.05	0.04	n.a.
$\log(\tau^*_{901t})$	0.04	0.04	0.06	0.05	0.08	n.a.
$\log(\chi_{1t})$	0.00	0.02	0.02	0.03	0.02	n.a.
$\log(1+R^*_{1t})$	0.06	0.04	0.02	0.02	0.01	n.a.
7-day credits						
$\log(1+r_{7t})$	**0.17**	**0.17**	**0.06**	**0.09**	**0.07**	**0.03**
$\log(\rho_{7t})$	0.10	0.09	0.01	0.03	0.03	0.00
$\log(\tau^*_{71t})$	0.01	0.01	0.01	0.01	0.01	0.01
$\log(\chi_{1t})$	0.00	0.02	0.02	0.03	0.02	0.00
$\log(1+R^*_{1t})$	0.06	0.04	0.02	0.02	0.01	0.03
Overnight credits						
$\log(1+r_{1t})$	**0.14**	**0.15**	**0.04**	**0.07**	**0.05**	**0.02**
$\log(\rho_{1t})$	0.08	0.08	0.00	0.02	0.02	-0.01
$\log(\chi_{1t})$	0.00	0.02	0.02	0.03	0.02	0.00
$\log(1+R^*_{1t})$	0.06	0.04	0.02	0.02	0.01	0.03

Source: author's calculations. There is no term structure to overnight credits, so τ^*_{11t} is undefined.
n.a.: only 3 observations are available for the 90-day credits in 2005.
Shares calculated using the identity in (1) of the text.

Table A2: Sources of Nominal Depreciation and the Currency Risk Premium					
	$\mathbf{S_{t+30}/S_t}$	$\boldsymbol{\rho_{1t+1}}$	$\boldsymbol{\rho_{7t+1}}$	$\boldsymbol{\rho_{30t+1}}$	$\boldsymbol{\rho_{90t+1}}$
Intercept	**0.84**	**0.036**	**0.04**	**0.06**	**0.09**
	(0.04)	(0.005)	(0.002)	(0.01)	(0.02)
x_t	**-0.07**	**0.056**	**0.040**	0.01	0.01
	(0.03)	(0.004)	(0.002)	(0.006)	(0.01)
y_t	-0.01	**0.067**	**0.063**	**0.05**	**0.03**
	(0.01)	(0.001)	(0.001)	(0.002)	(0.002)
z_t	**-0.024**	**0.068**	**0.054**	**0.03**	**0.02**
	(0.008)	(0.001)	(0.0004)	(0.001)	(0.00)
d99	**0.78**	**-0.10**	**0.013**	**0.17**	**0.22**
	(0.13)	(0.02)	(0.006)	(0.02)	(0.03)
d00	**0.30**	**-0.03**	0.006	**0.09**	**0.09**
	(0.07)	(0.01)	(0.004)	(0.01)	(0.02)
d01	**0.17**	0.01	**0.015**	**0.04**	0.01
	(0.05)	(0.01)	(0.002)	(0.01)	(0.02)
d02	**0.18**	**0.02**	**0.013**	**0.013**	-0.02
	(0.04)	(0.005)	(0.002)	(0.006)	(0.02)
d03	**0.11**	**0.02**	**0.014**	-0.003	-0.04
	(0.04)	(0.006)	(0.002)	(0.006)	(0.02)
d04	**0.14**	**0.01**	**0.006**	-0.002	-0.03
	(0.04)	(0.005)	(0.002)	(0.006)	(0.02)
R^2	0.28	0.97	0.995	0.93	0.89
N	252	271	271	271	240

Standard errors in parentheses.
Figures in bold are significantly different from zero at the 95 percent confidence level.

Table A3: Sources of the Convertibility Premium				
	$\chi_{1,t+1}$	$\chi_{7,t+1}$	$\chi_{30,t+1}$	$\chi_{90,t+1}$
Intercept	**0.020**	**0.027**	**0.12**	**0.045**
	(0.001)	(0.001)	(0.002)	(0.005)
x_t	**-0.008**	**-0.011**	**-0.006**	**-0.014**
	(0.001)	(0.0003)	(0.001)	(0.002)
y_t	**0.011**	**0.012**	**0.023**	**0.012**
	(0.0002)	(0.0001)	(0.0004)	(0.001)
z_t	**-0.006**	**-0.006**	**-0.012**	**-0.006**
	(0.0002)	(0.0001)	(0.0004)	(0.001)
d99	**-0.009**	**0.004**	**0.022**	**0.031**
	(0.002)	(0.001)	(0.004)	(0.009)
d00	**-0.003**	**0.004**	**0.011**	**0.020**
	(0.001)	(0.001)	(0.003)	(0.008)
d01	0.000	**0.003**	-0.001	**0.022**
	(0.001)	(0.001)	(0.002)	(0.006)
d02	-0.000	**0.002**	**0.004**	**0.028**
	(0.001)	(0.0004)	(0.001)	(0.005)
d03	0.001	**0.002**	-0.002	**0.024**
	(0.001)	(0.0005)	(0.002)	(0.005)
d04	**-0.003**	0.001	**0.007**	**0.049**
	(0.001)	(0.001)	(0.002)	(0.005)
R^2	0.98	0.99	0.96	0.88
N	271	271	271	240

Standard errors in parentheses.
Figures in bold are significantly different from zero at the 95 percent confidence level.

Table A4: Sources of Term-structure Ratio

	$\ln(\tau_{7,1}/T_{7,1})$	$\ln(\tau_{30,1}/T_{30,1})$	$\ln(\tau_{90,1}/T_{90,1})$
Intercept	**0.008**	**0.026**	**0.025**
	(0.001)	(0.001)	(0.006)
x_t	**-0.003**	**-0.004**	**-0.006**
	(0.001)	(0.001)	(0.002)
y_t	**0.001**	**0.001**	0.000
	(0.0002)	(0.0004)	(0.001)
z_t	**-0.0005**	**-0.001**	-0.001
	(0.0002)	(0.0003)	(0.001)
d99	**0.012**	**0.027**	**0.042**
	(0.002)	(0.004)	(0.006)
d00	**0.006**	**0.013**	**0.024**
	(0.002)	(0.003)	(0.008)
d01	0.002	0.002	**0.022**
	(0.0011)	(0.002)	(0.006)
d02	**0.002**	**0.006**	**0.029**
	(0.0008)	(0.001)	(0.006)
d03	-0.000	-0.000	**0.024**
	(0.001)	(0.001)	(0.006)
d04	**0.003**	**0.007**	**0.052**
	(0.001)	(0.001)	(0.006)
R^2	0.35	0.46	0.73
N	271	271	240

Standard errors in parentheses.
Figures in bold are significantly different from zero at the 95 percent confidence level.

Appendix B: **Statistical Properties of the Latent Factors.**

The three factors derived in the text can be analyzed for their time-series properties. Table B1 reports the results of GARCH estimation of an augmented VAR system of the three variables.

Table B1: **Garch Estimation of Factor Equations**

Dependent variable: x_t			Dependent variable: y_t			Dependent variable: z_t		
constant	**-0.007**	0.003	constant	**-0.044**	0.021	constant	**-0.071**	0.020
x_{t-1}	**0.810**	0.060	x_{t-1}	-0.025	0.020	x_{t-1}	**-0.111**	0.020
x_{t-2}	**0.184**	0.060	y_{t-1}	**0.870**	0.021	y_{t-1}		
			y_{t-2}	**-0.066**	0.021	y_{t-2}		
			z_{t-1}			z_{t-1}	**-0.151**	0.024
			z_{t-2}			z_{t-2}	**0.772**	0.023
			g_{yy}	**0.352**	0.046	g_{yz}	0.003	0.022
						g_{zz}	**0.290**	0.067
			h_{yy}	**0.500**	0.229	h_{zy}	**0.472**	0.178
			h_{yz}	**0.483**	0.073	h_{zz}	**1.150**	0.135

The external factor x_t had no significant conditional heteroskedasticity; the data could not reject a simple AR(2) process that explained 99.7 percent of variation in the four log LIBOR returns. The domestic factors y_t and z_t, by contrast, exhibited a significant conditional heteroskedasticity. The specification fit was that the (2x1) domestic error vector ε_t is distributed $N(0,H_t)$ with H_t defined

$$H_t = G'G + h' \varepsilon_{t-1} \varepsilon_{t-1}' h$$

With $G = \begin{matrix} g_{yy} & g_{yz} \\ 0 & g_{zz} \end{matrix}$ and $h = \begin{matrix} h_{yy} & h_{yz} \\ h_{zy} & h_{zz} \end{matrix}$

There is a homoskedastic component to the errors, with insignificant cross-equation correlation. There is also a significant conditional heteroskedasticity to the errors. The significant and large cross-effects lead to substantial co-movement in the heteroskedasticity over time.

The autoregressive properties of the two domestic factors differed as well. The external factor was a significant factor in determining z_t but not y_t. The AR process for y_t is the typical time-series property, with great positive weight on the AR(1) term. For z_t, the AR(1) term is negative while the AR(2) has the strong positive weight.

To create the factors y_t and z_t, I began by regressing the log returns on Kyiv credits on the external factor. The results of this series of OLS regressions are reported in Table B2. The residuals of these regressions were the input variables for the factor decomposition that yielded the two domestic factors y_t and z_t.

Table B2: **Association of Observed Returns on Kyiv market to External factor x_t**					
	Constant		x_t		R^2
$\ln(r^*_{t+90})$	**0.103**	0.001	**0.002**	0.001	0.01
$\ln(r^*_{t+30})$	**0.079**	0.0008	**0.011**	0.0008	0.45
$\ln(r^*_{t+7})$	**0.058**	0.0008	**0.011**	0.0007	0.48
$\ln(r^*_{t+1})$	**0.047**	0.0008	**0.012**	0.0007	0.53
$\ln(r_{t+90})$	**0.196**	0.004	**0.056**	0.004	0.44
$\ln(r_{t+30})$	**0.163**	0.005	**0.051**	0.005	0.34
$\ln(r_{t+7})$	**0.112**	0.006	**0.042**	0.005	0.20
$\ln(r_{t+1})$	**0.087**	0.006	**0.040**	0.006	0.16