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# Estimating the Opening-Up Shock: an Optimal Portfolio Approach to Would-be Integration of the C.I.S. Financial Markets

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# Estimating the Opening-Up Shock: an Optimal Portfolio Approach to Would-be Integration of the C.I.S. Financial Markets

Abstract

The paper presents a hierarchy of the rational investor's counterfactual portfolios that consist of treasury bills of the three largest CIS countries – Russia, Ukraine, and Kazakhstan, in case some degree of at least negative integration is achieved there. The author performs an adjustment of the measure of relative attractiveness of various counterfactual two-country and three-country portfolios for the estimated opening-up shock (that consists in a dramatic re-allocation of funds, given the optimal portfolio composition). It has been found out that there is only one counterfactual optimal portfolio that is realistically feasible. This would comprise the government-issued papers from all the three countries considered and would imply the international rational investor's following a mildly risk-averse investment strategy. Importantly, an overhaul of exchange-rate and monetary policy is unnecessary, which fact augments the incentives for the countries involved, even despite their political resentment.

In the Annex, the author undertakes an attempt to demonstrate that the recent collapse of the Russian treasury bills market can be explained in terms of the derivatives market analysis.

Keywords: optimal investment portfolio; financial integration; economy in transition; government bonds market; derivative instruments; Russian treasury bills

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## Problem setting and the technique employed

As the optimism at the inception of the Commonwealth of Independent States (CIS) has faded, the possibility of integrating CIS financial markets has come to seem increasingly remote. Putting political sentiments aside, however, it nevertheless is possible to construct a set of *ex ante* counterfactual «as if» optimal investment portfolios based entirely on the information implicit in the market performance of the assets to be included into the rational investor's portfolio. The spatial scope of the analysis below is limited to the three largest member countries of the CIS - the Russian Federation, Ukraine, and Kazakhstan. For the sake of the discussion, we assume that whenever negative integration is achieved, dramatic structural adjustments can be expected. Such readjustment, i.e., a one-time reallocation of funds, is referred to hereinafter as an opening-up shock.

This is a problem that is often overlooked in the literature, to the author's knowledge at least. The issue we are going to investigate cannot be reduced either to the balance-of-payments disequilibria or to the interest rate differences in countries involved. Studying the directions and relative strength of the flows of funds that are explainable in terms of the optimal portfolio approach, requires processing of considerably larger an amount of information than rival approaches normally do. Thus, under the portfolio-balance approach to the estimation of the flows of funds affecting the balance of payments, it is only the returns (interest rates, or yields) that are considered, whereas most of the other issues related to optimal portfolio specification, with the degree of risk in the first place, are normally left unheeded.

The threat of a brisk re-allocation of investments is especially pronounced given the market's being dominated by just a few types of assets with sharply differing characteristics. That being the case, financial integration looks extremely unlikely even if there is political will and social consensus about it in the countries involved. Anticipating the results obtained below, it may be stated here that the most interesting general finding in this paper is an explicit formulation of a powerful (and often overlooked) constraint on financial integration of economies in transition.

Perhaps the weakest methodological point in the following line of argument is the tacit assumption that it is only the exchange-rate policy conditions and investors' strategy that vary, while the market behaviour of the treasury bills yield remains invariant. This is not less realistic an assumption, however, than that implicit in the optimal control approach under which some specific conditions characteristic of the time period that is regarded as "optimal" are used to determine the model's functional relationships. Besides, formally, the return behaviour is an externality to our analysis here, so we are entitled to assume that its properties would persist for some time after the lowering of the degree of market segmentation.

The state of equilibrium the opening-up shock will tend to, is presumably determined by the composition of the investment portfolio that is optimal given the policy-related conditions. Therefore, it should be possible to estimate the effects of the opening-up shock in terms of capital flows caused by the adjustment of the existing capital allocation pattern to the rational investor's optimal portfolio composition under various sets of exchange-rate policy conditions. We can also evaluate the relative probabilities of these sets depending on the ratio of estimated gain to the cost (the latter incorporates both the portfolio risk and the dramatic structural adjustment of the financial markets).

For the sake of our discussion, we also assume that the rational investor may choose one of two strategies: a mildly risk-averse Efficient Portfolio strategy or a strongly risk-averse Least-Risk Portfolio strategy. In the first instance, to determine the optimal portfolio composition, the investor solves a set of classical equations (Fama & Miller, 1972) of the following form:

$E(r_i) - E(r_p) = (E(r_p) / \sigma_p) [(\Sigma a_j \sigma_{ij}) / \sigma_p - \sigma_p]$,

where $E(r_p) = a_1E(r_1) + ... + a_iE(r_i) + ... + a_nE(r_n)$ is the expected rate of return to the portfolio, $E(r_i) = \mu_{r,i}$ is the mean return to the $i$th asset, $\sigma_p = (\Sigma^n_{i=1}\Sigma^n_{j=1}a_ia_j\sigma_{ij})^{0,5}$ is the portfolio risk, and $\sigma_{ij}$ is the covariance of returns to the $i$th and $j$th assets, $\sigma_{ii} = \sigma_i^2$ is the $i$th asset's variance. The proportionality factor $s = E(r_p) / \sigma_p$ is the Sharpe ratio that we shall use as an unadjusted estimation of a portfolio's attractiveness.

The set of equations should be solved for the $a_i$, ..., $a_j$, ..., $a_n$, the shares of the $i$th, ..., $j$th, ..., $n$th assets in the optimal portfolio. However, when there are more than two assets in the portfolio, the investor is of course unlikely to solve cubic equations. Notably, when the minor terms (i.e., those with three or more decimal zeros) are omitted, the proportion of $a$'s is roughly equal to the proportion of the individual assets' ratios $r_i / \sigma_i^2$ (which amplify fluctuations of the assets' risk when translating them to the fluctuations of the assets' shares). This observation conforms to recent findings in the literature that the optimal portfolio composition is considerably more sensitive to risk than to return to its component assets (Muhtaseb, 1997).

Our second strategy requires cumbersome calculations, but seems to be easier to be approximated *par tatonnement*. We shall not consider the procedure in detail; it should be pointed out, however, that it requires application of Cramer's rule to the variance - covariance matrices of the return time series. Assets' shares that are obtained using this procedure provide for a portfolio whose risk is minimal for the available assets (although the portfolio return may appear lower than in the previous instance).

Under whatever strategy, it is assumed that there is no short selling.

Which assets then deserve consideration? For the purpose of this discussion, there are four compelling reasons as to why it is sufficient to confine our counterfactualisation to the markets for treasury bills.

First, the treasury bills market capitalisation is times as large as that of the stock market and has been growing steadily in all the three countries considered - the Russian Federation, Ukraine, and Kazakhstan. So, when we speak of investments in the three countries' emerging markets it is simply times more probable for the funds to be invested in treasury bills than in equities.

Second and more important, given the portfolio separation principle, the individual rational investor in the three countries' markets is much more likely to opt for investing in the state-issued papers than in any other securities, whatever his actual portfolio might be. Suffice it to say that winners in the continuous virtual competition among the would-be portfolio managers (in fact, financial analysts) organised by the «*Den'gi*» magazine in Russia in the first half of 1998 had their portfolios composed, in most cases, of either 80 to 90% Russian T-bills (GKOs) or 70 to 100% US dollar.

Third, portfolios consisting of treasury bills seem to be more liquid than any other portfolios and, therefore, may be used to make the opening-up effect salient.

Finally, accounting for the lion's share of the total amount of funds invested in the three countries' market, counterfactual portfolios that consist of the local treasury bills provide a plausible approximation to the real-world effects.

Two arguments can be used to justify the theoretical basis for considering a limited number of assets separately from the broader portfolio. First, the underlying theory suggests that portfolio components may be regarded as smaller-size portfolios (Fama, 1976) This is the usual procedure applied in constructing broad portfolios where the elements are national stock market indices. Thus, limiting the analysis here to portfolios that may be regarded as composite elements of higher-level portfolios does not affect the logical consistency of the findings. Second, a rational investor is likely to apply different strategies in the management of different «composite assets» in his broad portfolio. Tailored strategies are particularly important in the case of high-risk emerging markets (compare, e.g., Posner, 1998).

Assume that a rational international investor's broad portfolio is the vector $\boldsymbol{y}°$, such that $\boldsymbol{y}° = (a_1, a_2, ..., a_l, ..., a_n)$, where $a_1, a_2, ..., a_n$ are the individual assets. Let the investor apply the efficient portfolio strategy to $\boldsymbol{y}°$ as a whole. Then, the vector $\boldsymbol{w}°$ of the assets' weights will comprise some functions $w° (a_i)$, so that

$$\boldsymbol{w}° = [w° (a_1), w° (a_2), ..., w° (a_l), ..., w° (a_n)].$$

Now, let the investor apply the least-risk portfolio strategy to a subset vector $\boldsymbol{y} = (a_{l+1}, ..., a_n)$. The individual assets' weights in $\boldsymbol{y}$ will be determined using a new procedure, and so their weights (sub)vector will be $\boldsymbol{w} = [w (a_{l+1}), ..., w (a_n)]$. The broad portfolio is now a new vector, $\boldsymbol{y}*$, that includes one composite asset along with a number of individual assets, $\boldsymbol{y}* = (a_1, a_2, ..., a_l, \boldsymbol{y})$. The new weights vector for the broad portfolio is, then,

$$\boldsymbol{w}* = [w* (a_1), w* (a_2), ..., w* (a_l), w* (\boldsymbol{y})].$$

Decompose it to obtain

$$\boldsymbol{w}* = [w* (a_1), w* (a_2), ..., w* (a_l), w* (\boldsymbol{y}) \bullet w (a_{l+1}), ..., w* (\boldsymbol{y}) \bullet w (a_n)].$$

The relationship between $\boldsymbol{w}°$ and $\boldsymbol{w}*$ will vary depending upon the variety of strategies applied to different subsets, or composite assets, in the investor's broad portfolio, $\boldsymbol{w}$ remaining intact. Then, it is not incorrect to consider the principles of construction of $\boldsymbol{y}$ separately, i.e. irrespectively of its relationships with the rest of the broad portfolio.

Finally, a few words about time series used for the following analysis, specifically the time series of return on the countries' treasury bills and those for exchange rate of the US dollar against local currencies. The exchange rate time series were used as weights to obtain the yield time series in dollar terms and as market performance proxy when the dollar was regarded as a financial asset to be included into the investor's portfolio. When necessary, the bilateral exchange rates of the three countries' currencies were calculated as cross-rates *via* the dollar. All the data are taken from the «International Financial Statistics» (various issues). The problem with the data was that only the most recent observations may be regarded, roughly, as distributed symmetrically, and practically no time series is normally distributed. Symmetrical distribution will do, however (Fama & Miller, 1972). Thus, we have to truncate the time series and base our analysis on the time period stretching from September 1996 to April 1998. The values of skewness (fat tails) did converge to zero as we shortened the initial period.

The words «whole period» used below refer to the period starting from March 1996 through April 1998. The words «three months less» designate the period from June 1996 to April 1998. The word «unfeasible» filling in some cells in a number of tables means that either the mildly or strongly risk-averse portfolio implies irrational or negative assets' weights. (Worth pondering might be the idea of feasibility of portfolios composed of the given assets as a criterion of optimal financial area, whatever meaning the term «area» may acquire when further specified, and of optimal policy set.)

## Assessment of market segmentation

Obviously, the opening-up shock will likely be harder in all respects, the higher the invisible barriers dismembering the would-be integrated economic space. In our three CIS «core» countries, the market inefficiency is presumably high. To measure the degree of market segmentation, we apply two techniques that differ in some essential details in spite of the apparent similarity of the ideas underlying them. First, we use the uncovered interest parity test (e.g., Montiel, 1994) to test the difference

$d_t = ln\,(1+i_t) - (s_t / s_{t-1})\, ln\,(1+i^*_{t-\tau})$,

where $d_t$ is an estimation of prediction error, $i_t$ is the rate of return in one of the two countries compared in period $t$, $i^*_{t-\tau}$ is the rate of return in the other country in period $t$ or $t-\tau$ if $\tau \neq 0$, $s_t$ is the bilateral exchange rate in period $t$ and $s_{t-1}$ - the bilateral exchange rate in the preceding period. If the mean value of $d_t$, $\mu_d \neq 0$ over the sample period and the values of $d_t$ are serially correlated, then there is market segmentation the strength of which can be measured in terms of systematic prediction error, $\mu_d$. Allowing for an adjustment period, we also estimate $\mu_d$ for $\tau \neq 0$[1]. The estimates are summarised in Table 1. We see that $\mu_d \neq 0$ in all the instances checked; moreover, in no one case it is serially uncorrelated. We have also estimated $\mu_d$ for a series of three-period moving averages with the same qualitative result.

The second test procedure was suggested within the methodological framework of the portfolio-balance approach to exchange rates determination (e.g., Isard, 1995). We use it in the following way. We must estimate the implicit premium, $\phi$, from the equation

$\phi = (r_t - r^*_t) - (s_t - s_{t-1})$,

where $r_t$ and $r^*_t$ are the rates of return, respectively, in the home country and in the foreign country in time period $t$, and $(s_t - s_{t-1})$ is the difference of logarithms of the bilateral exchange rate over the period $t$. To obtain the average evaluations of $\phi$, we estimate a regression equation for each pair of countries

$(r_t - r^*_t) = \alpha + \beta\,(s_t - s_{t-1}) + \varepsilon$

and set the variable $(s_t - s_{t-1})$ equal to zero, i.e. assume that the exchange rate remained stable during the period $t$. Then, the value of $\alpha$ serves as an estimate of $\phi$. The lowest row in Table 1 seems to contain the most reliable estimations of the systematic prediction error. The level of segmentation of the financial markets in the three-country «core» of the CIS looks high indeed, especially if one compares the systematic error values to the values of mean return to local treasury bills to find out that they are practically of the same order.

The institutional structure of market participants may account for these figures. For example, the biggest buyers of Russian T-bills were the Bank of Russia and the Russian Savings Bank (*Sberbank*). One would not expect them to change their implicit «national bias» whatever the international market transparency. Further, it is not always easy to say whether any two assets considered are imperfect substitutes “as such” or the systematic premium is a result of high but removable segmentation barriers.

The figures, nevertheless, indicate that the extent of market segmentation is sufficient to generate opening-up shocks once barriers are lowered or removed.

# Results obtained

## National capital’s perspective

The distinction between national and international capital is not self-evident. National investors can be identified neither with those investors who are residents of the country in question (say, of the Russian Federation) nor with those assuming some «patriotic» bias in making their investment decisions. Therefore, it is the most formal definition that seems to be the most reliable. Thus, we shall define national capital of each of the three countries as (*i*) that whose allocation is optimised (i.e., optimal investment portfolios constructed) with

[1] It is tacitly assumed that the accommodation delay takes place in a timeless world, which is only possible if the rate of return at a time the investment was made in one country is compared to the rate of return in another country now; or, in other words, if it is the expected yield estimated for the moment of investment, not the actual or continuously-estimated yield, that is equalised.

respect to the assets' performance expressed in terms of the local currency and (*ii*) that which regards the hard currencies, with the US dollar in the first place, as an asset to be included into the portfolio, not as just a *numeraire* and a weighting factor, since it yields a low-risk return that allows for rational expectation-based assessment owing to the steadily growing exchange rate in local currency terms.

The optimal portfolio composition - and respectively, the rational (or would-be) allocation pattern of national capital - is largely influenced across the three countries by the differences in behaviour of the local treasury bills. The GKO on one side, and the Ukrainian and Kazakh treasury bills on the other, were not assets of the similar economic nature, despite their legal equivalence[2].

Consider Figures 1 through 4. Brief visual inspection leads to at least two immediate observations. First, the upward linear regression plot in the Russian case and (more pronounced) downward plot in the case of Ukraine show that while liquidity is what was prized in Ukraine, in the Russian case it was risk. Second, the shape of the two probability curves prompts that, unlike in Ukraine's treasury bills market, in the GKO market risk was more evenly distributed, except for two maverick limiting clusters. The Ukraine curve looks more concave, while the Russia curve is biased to convexity with a plateau that may reflect some fundamental risk implicit in the GKO that was only vaguely, if at all, related to the distribution of the periods of time to maturity.

The fundamental risk underlying the market performance of the GKO resulted from the fact that the time pattern of the rate of return to the Russian treasury bills was basically a stochastic process with only a slight control on the part of the government (or the country's monetary authorities, whatever imprecise the term might be). Consider Figures 5 to 6. In Figure 5, the bold curve plots the performance of the daily GKO price index while the other curve represents the path of a non-generalised Wiener process. The former curve reflects deviations (residual values) of the price index time series from the values of their deterministic trend; the latter curve depicts the 25-day moving average of the values obtained in the following way:

$$x_t = x_{t-1} + z\,(t),$$

$$z\,(t) = k\,(\varepsilon\sqrt{\partial t}).$$

The term $\varepsilon$ is normally distributed with $\mu = 0$ and $\sigma = 1$ and the coefficient of proportionality $k$ is gauged to make the synchronised movement of the two variables salient, $k = 0{,}325$. Figure 6 demonstrates that, for the most of the sample, already the first-order differences of the values of the «gap» between the two variables (plotted in Figure 5) were steadily converging to zero.

As it is historically observable, the treasury bills price index is not a pure random walk, of course, for its autocovariance differs from zero. Even so, we can't say whether this is due to the nature of the process or to efforts undertaken by the monetary authorities in order to control it. So, it is helpful (especially in view of certain ideas elaborated in the Annex) to assume that it is a Wiener process.

As a Wiener process, the GKO market performance not unexpectedly generates periodic outbursts of accumulated uncertainty that at least partially account for the market's repeated dire straits (this issue is given a more detailed examination in the Annex). More important for our analysis, however, is that this provides an explanation of the high fundamental risk implicit in the now-defunct Russian treasury bills. Given its basically stochastic character, the GKO required a balancing asset *en masse* to hedge against the fundamental risk and, thus, make an optimal portfolio. Quite naturally, it was the US dollar that carried out this mission having become an inseparable counterpart of the GKO in rational

[2] The time series used below are borrowed from the Emerging Market Companion Database and the Bank of Russia's home page on the Internet, as well as from the *Ukrainian Economic Trends* published by the Ukrainian – European Policy and Legal Advice Centre.

investors' portfolios, the covariance of return on the two assets being strongly negative[3].

Table 2 proves that, unlike in the cases of Ukraine and Kazakhstan, in Russia weighting the time series of the rate of return to the local treasury bills by the changes in the exchange rate of the dollar reduces randomness, and thus the risk, contrary to the common assumption in the literature (holding true for the other two countries, however) that adding the exchange rate factor increases randomness.

The differences in the character of the centrepiece constituting asset of the national capital's portfolios and in its relationships with the balancing assets determine the differences in optimal capital allocation across the three countries and largely influence the selection criteria.

We turn now to Tables 3 through 5. Here the optimal portfolio composition is evaluated. Moving from the top to the bottom of each of the three tables, we can trace the gradual expansion of opportunities facing the country-specific investor. At the highest level, the investor optimises his portfolio by manoeuvring within the limits of two assets - local treasury bills and dollars. At the second tier he may include in his portfolio one of the other two countries' treasury bills, to be substituted by the treasury bills of the remaining country at the next level. Finally, at the lowest level, the investor may construct a portfolio comprising all the four assets: his national T-bills, both his neighbours' T-bills and dollars.

At every level two possible strategies have been explored - the efficient portfolio strategy and the least-risk portfolio strategy, as specified in the preceding section. In all instances, in which both strategies are feasible, the latter makes no significant amendments either to the portfolio composition or to the value of the Sharpe coefficient as compared to the composition and the Sharpe coefficient obtained under the other strategy. The only exception is the second level in Table 5. Here, the local treasury bills' share gets by 1/8 higher and that of the Russian GKO by four times lower as the national investor moves from the weakly risk-averse efficient portfolio strategy to the strongly risk-averse behaviour pattern.

The first-glance impression of the three tables' being put together is that the share of the dollar in the optimal portfolios is sharply higher in Russia than in the other two countries. Correspondingly, the share of the local treasury bills drops by 0,29 in the Russian case, while in the Kazakh case it comes down by only 0,14 and in the case of Ukraine by the slimmest 0,02 along with the national portfolios' expansion. The share of the assets other than the local treasury bills and the US dollar is, on the contrary, as large as 21% in the Russian four-asset portfolio, as compared to 15% in Kazakhstan and 2% in Ukraine. Russia seems to be (moderately) willing to expand eastward to Kazakhstan, the latter (again, moderately) ready to expand westward to Russia, in the event of *negative integration* of the core CIS countries' financial markets. Ukraine seems to be the most locked-in of the three countries.

It must be pointed out that the opportunities for Kazakh national capital to include Russian government-issued paper in its optimal portfolio is limited by a low Sharpe ratio[4]. Thus, it is effectively Russia alone in having cause to pursue negative integration[5]. However, then the considerable re-allocation of funds within the unified market would result, e.g., in an inflow to Kazakhstan of USD 10 billion or even more from Russia. Such developments would threaten financial markets stability (in particular, the ability to control the market for government papers) in Kazakhstan and in the Russian Federation as well as

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[3] Recursively estimated covariance $\sigma_{\textit{GKO yield, USD exchange rate in RUR terms}} \leq -2$ throughout the whole period, although it may drift over the sample.

[4] Later we shall suggest a composite measure of relative attractiveness of integration reflecting both the Sharpe ratio and the portfolio composition.

[5] We speak of negative integration as opposed to positive, the former implying opening-up of the markets while the latter implies also tight coordination of economic, mostly financial, policy.

sharply affect bond market equilibrium. Russia's interest in negative integration is moderated also by the fact that, like in Kazakhstan's case, integration provides no dramatic increase in incentives measured in terms of the Sharpe coefficient.

As an initial approach to the issue of *positive integration*, consider Figures from 7 to 12. Figures 7-9 describe the portfolio opportunities available to the rational investor who adopts the efficient portfolio strategy when exchange rates are fixed firmly (or removed). Figures 10-12 provide plots of portfolio opportunities curves in case of the «real-world» performance of cross-rates for the countries taken pair-wise. What is the loss the rational investor suffers from the existence of exchange rates? Or, to put it in a different way, what would be his relative gain provided that there is monetary transparency within the single area combining the two markets that presumably are on the way to unification? A tentative answer to this question is given in Table 6. It presents in a generalised form the information that can be extracted from Figures 7 through 12. We see that the portfolio opportunities improve basically only for the Ukraine-Kazakhstan pair, although the feasible yield increases in all the three instances.

In summary, the national capital's perspective lacks promise. Countries expanding their portfolios to include their neighbours' government-issued papers either lose or, at best, remain in approximately the same position as before (the reader is invited to refer again to Tables 3-5). We cannot, therefore, make any definitive conclusion as to the options the three countries' national capital would prefer. Generally speaking, however, the national capital approach seems to be less realistic than what can be termed the international capital approach.

## International capital's perspective

We shall define international capital as that whose rational allocation is determined by the market performance of the underlying assets expressed in terms of a hard currency (here US dollars) taken as a common denominator, irrespective of the origin («provenance») of the funds invested. We adopt, thus, a generalised version of the portfolio separation principle, whereby the rational investor's decisions are not influenced by his past decisions and are shaped using only the information embodied in the sample-period market performance of the assets. Hard currency is not included in the international investor's portfolio. Here, the matrix of possible outcomes is more sophisticated. These are summarised in Tables 7 to 13.

We begin with counterfactual two-country portfolios, for it is more realistic to assume that integration, if any, is considerably more likely to evolve at the two-country level.

Tables 7 to 9 present the Sharpe ratio values of counterfactual portfolios under a variety of conditions. The meaning of the row and column headings is the following.

«Fixed exchange rate» implies counterfactualisation under the assumption that the exchange rate of the country's currency against the dollar remained fixed firmly throughout the sample period. «Real-world performance» means that the nominal returns to the local treasury bills are weighted by the observed changes in the exchange rate. «Real-world imitation with narrower band» implies counterfactualisation under the assumption that the exchange rate fluctuation band was twice as narrow as observable[6]. Finally, the two lowest rows contain values obtained under the assumption of a shift of the «type of investors' rationality». This implies that the rational investor was assumed to overlook values of return as such and instead considered their deviations from the deterministic trend. This serves as a proxy for the usual assumption that investors consider differences between the rates of return in the emerging markets and

[6] The imitation procedure consisted in weighting the observable exchange rate fluctuations by random weights evenly (not normally) distributed within the range from zero to 0,5. This weighting adds uncertainty to the process, of course, which can be regarded, however, as a proxy for insufficiency of information under an unknown policy pattern.

some respectable international rate like minimal-risk world portfolio yield or LIBOR when making rational decisions with regard to the optimal portfolio composition. «Deviations, nominal» implies a fixed-rate regime. «Deviations, weighted» means that the deterministic trend was estimated for the real-world performance of returns in US dollar terms. Empty cells are shaded.

In order to enrich the spectrum of counterfactual portfolio opportunities, we allow for asymmetry of exchange rate policy patterns across the countries. Examination of Tables 7-9 shows that the relative attractiveness of the portfolio measured in terms of the Sharpe ratio changes drastically as the investor moves from one combination of policy patterns to another and from one strategy (implying mild risk-aversion) to the other (that implies strong risk-aversion). Cells containing the highest feasible values of the Sharpe coefficient are double-rimmed. They may be regarded as roughly equal for all the three pairs of countries. That is to say, the best portfolio is equally prised relative to risk in whatever combination the countries are assumed to integrate; so we cannot point out the «most likely» integration axis.

For the Russian Federation and Ukraine (Table 7), the best feasible counterfactual portfolio is obtained when Russia follows the exchange rate policy observable over the sample period and Ukraine sticks to a fixed-rate regime; the strategy adopted by the rational investor is mildly risk-averse. For Russia and Kazakhstan (Table 8), the exchange rate policy outlay is the same as in the previous case, but the international investor's strategy is now strongly risk-averse. For the pair of countries consisting of Ukraine and Kazakhstan (Table 9), it is Ukraine that follows a fixed-rate regime while Kazakhstan continues with its sample-period policy. Here, the investor's strategy is strongly risk-averse. (By the same token, the worst feasible portfolios are obtained for Russia and Ukraine under the real-world policy pattern for Russia and the real-world imitation with narrower band for Ukraine. For the pair Russia-Kazakhstan, a real-world imitation with narrower band for Russia and the real-world policy pattern for Kazakhstan. For Ukraine-Kazakhstan, a continued real-world exchange rate policy pattern for the both countries.)

To extend our analysis to the three-country case, we assume (somewhat simplistically) that the countries are synchronised in the implementation of exchange rate policies. Then, it is only under either the fixed-rate regime or the continued sample-period regime that feasible portfolios are to be found (Table 13). Moreover, only in the latter instance both strategies - that implying weak risk aversion and that which implies strong risk aversion - are feasible, while under the fixed-rate regime only the strategy that implies mild risk-aversion obtains a feasible portfolio. The best choice in the three-country case seems to be obtainable *via* a combination of the continued real-world exchange rate regime with the strongly risk-averse investor's strategy.

Even when optimal counterfactual portfolios can be determined, it does not mean that they are necessarily the easiest (or most likely) to obtain in the real world. It is so only under negative integration and given a completely unrealistic *ceteris paribus* condition. In all three pair-wise instances, to obtain the optimal portfolio would imply that one of the two countries should flinch from its sample-period exchange rate policy pattern. If it decides to adopt the appropriate policy pattern outside the framework of international policy co-ordination, then this may have a feedback in the sense that it may facilitate negative integration resulting in (a certain degree of) market openness. It is extremely unlikely, meanwhile, that an asymmetric policy decision be imposed upon the country as a result of deliberate international policy co-ordination. Generally, positive integration seems to be feasible mostly on a symmetric basis, especially given the unequal distribution of gain (portfolio return) from integration because of disproportionate market capitalisation.

Tables 10-12 summarise the capital allocation patterns among the countries determined by the composition of various counterfactual portfolios. These data allow us to estimate the opening-up shocks for the economies involved in case of financial markets integration. We see immediately (Table 10) that for Russia and Ukraine to obtain the optimal portfolio would be tantamount to a substantial reallocation of funds in favour of Ukraine and to the detriment of Russia. This reduces dramatically the likelihood that the Russian government will favour negative integration. For Ukraine, in turn, a sizeable inflow of funds would mean that the country's monetary authorities could lose control over their weak financial market. In the three-country case, the optimal portfolio that is the «best» in terms of its yield relative to risk would incur drastic reallocation of funds. That is not to say, of course, that the capitalisation proportion would be literally inverted. Nevertheless, it will cause a heavy demand pressure on the Ukrainian state-issued papers at the cost of damaging the market conditions for their Russian counterparts.

In the short run, opening-up of the three countries' financial markets in the absence of a tight and rigorous policy co-ordination would throw the Russian market into a tailspin comparable to, if not exceeding, the one we have just lived through.

Opening-up shocks can in theory work for the better, not necessarily for the worse, although calamitous developments are far more likely to happen. Of critical importance is the principle of selecting the benchmark pattern of funds allocation. We compare the funds allocation pattern that emerges under the optimal portfolio, not to the actual capitalisation pattern but to some «optimal» vector of countries' weights under the would-be pattern of allocation of the funds available. We shall henceforth speak of opening-up shocks relative to that optimal vector. It is reasonable to make its elements, i.e. the countries' optimal weights, proportionate to the dollar values of their budget deficits. Here we use the1997 figures for Russia and Ukraine and 1996 figures for Kazakhstan (the most recent reliable estimation available) provided in *International Financial Statistics*.

The concept of an optimal weights vector makes it possible to suggest a composite measure of attractiveness of various counterfactual portfolios, relating the value of the Sharpe ratio to some estimate of the corresponding structural adjustment. Implementing the composite measure, we are likely to find that the counterfactual portfolios that are the most attractive when measured in terms of the Sharpe coefficient alone turn out to be much less attractive and therefore less probable as integration guides.

For a quantitative estimate of structural adjustments resulting from opening-up shocks, we take the Euclides distance, $d$, between the optimal weights vector, $\boldsymbol{y^*}$, and the vector of individual countries' weights determined by the counterfactual portfolio composition, $\boldsymbol{y}$,

$$d = [\Sigma(y_i - y^*_i)^2]^{0,5},$$

where $y_i$'s are elements of the vector $\boldsymbol{y}$ and $y^*_i$'s elements of the vector $\boldsymbol{y^*}$. Thus, the composite measure, let it be $\eta$, is calculated as

$$\eta = s/d = (\mu_{r,p}/\sigma_p)\,[\Sigma(y_i - y^*_i)^2]^{-0,5},$$

where $s = \mu_{r,p}/\sigma_p = E(r_p)/\sigma_p$ is the Sharpe ratio.

For each $\eta_j$, $j = 1, ..., m$, where $m$ is the number of feasible portfolios, we shall calculate its relative probability. Since the sum of all the $\eta$'s may be said to represent the cumulative utility of the feasible portfolios for the given set of countries, the relative utility, and hence relative probability, of the $j$th value is simply its «frequency», so that

$$p_j = \eta_j / \Sigma\eta.$$

For the given set of countries, the frequencies add up to unity, so it is interesting to evaluate their entropy, $h$, or the probabilistic structural characteristic of uncertainty implicit in the choice of a path to follow,

$$h = - m^{-1}\, \Sigma\, p_j\,(log\, p_j).$$

Descriptions of the most probable combinations of policy patterns and investment strategies for each set of countries, their relative probabilities, and the values of entropy are reported in Table 14.

Not unexpectedly, the list of «winners» and «losers» is now different than it was before the adjustment for estimated opening-up shocks. For the pair Russia-Ukraine, the combination of the fixed-rate regime for Russia with the continued sample-period regime for Ukraine and the strongly risk-averse strategy appears to be the most likely outcome. It yields the highest portfolio return relative to portfolio risk and structural opening-up shock. For the pair comprising Russia and Kazakhstan, it is the combination of the continued sample-period policy for Russia with the fixed-rate regime for Kazakhstan and a strongly risk-averse strategy. For Ukraine-Kazakhstan, it is the fixed-rate regime for the both countries combined with a mildly risk-averse strategy. For the three-country case, it is the continued real-world regime together with a mildly risk-averse strategy that gains the upper hand. Here, however, the level of uncertainty is relatively very high. The most certain choice faces the pair Russia-Kazakhstan. Russia-Ukraine and Ukraine-Kazakhstan have to make their choices under equal uncertainty, roughly.

One should remember, however, that these relative probabilities are conditional on the assumption that the portfolio gain, on the one hand, and the (negative) loss resulting from the opening-up shock, on the other, are perfect substitutes. In the real world they are not, of course. In other words, the loss from the opening-up shock being considerable, the option is off side whatever its «frequency». Therefore, not all the winners from Table 14 are worth considering – only those options that imply comparatively soft adjustment count.

The intuition behind the idea of relative probability of integration outcomes calls for further specification here. Probability $p_j$ of an outcome $\eta_j$ is not, in fact, a direct probability but a conditional Bayesian-type probability that is to be estimated recursively as

$$p\ (e_1 \parallel e_2) = p\ (e_1) \bullet [p\ (e_2 \parallel e_1) \,/\, p\ (e_2)],$$

where $p\ (e_1 \parallel e_2)$ is conditional probability of event $e_1$ provided that $e_2$, $p\ (e_1)$ is direct probability of event $e_1$ (that is, of an optimal portfolio of the given configuration), $p\ (e_2 \parallel e_1)$ is conditional probability of event $e_2$ provided that $e_1$, and $p\ (e_2)$ is direct probability of event $e_2$ (that is, of a set of policy conditions leading to the given optimal portfolio).

Then, $p_j$ is a measure of direct probability of outcome $e_1$, other things being equal. This would be correct in case the governments were absolutely elastic in the sense that they were pursuing the unique objective of raising the demand in the government bonds market and were absolutely co-operative with each other and with the market. In reality, however, the government's utility function being specified in a more complex and often hardly known way, $p\ (e_1)$ must be weighted by the term in brackets, $[p\ (e_2 \parallel e_1) \,/\, p\ (e_2)]$, in which the numerator, $p\ (e_2 \parallel e_1)$, incorporates the government's perception of disutility of the policy conditions that result in an optimal portfolio implying a drastic re-allocation of funds, and the denominator, $p\ (e_2)$, is loaded with information concerning the government's preferences with regard to various sets of policy conditions.

It is reasonable to assume that, in case the opening-up shock is unacceptable, the weighting term will tend to zero whatever the government preference with respect to the underlying set of policy conditions. Analogously, when the cost of the opening-up shock remains within the acceptable range, the conditional probability of the set of policy conditions will tend to its direct probability. We may roughly propose, thus,

$$p\ (e_1 \parallel e_2) \quad 0 \text{ if } d > d_c \text{ and}$$
$$p\ (e_1 \parallel e_2) \quad p_j\ (e_1) = \eta_j \text{ if } d < d_c,$$

where $d_c$ is some critical value of $d$.

A decomposition of relative probability roughly proves, therefore, that we may infer a map of possible outcomes from the distribution of $p_j$'s. Indeed, we are left with only two plausible available outcomes.

The first case involves the Russia-Kazakhstan pairing in the set of two-country options, i.e., continued real-world performance for Russia, a fixed-rate regime for Kazakhstan and a strongly risk-averse strategy. The other case from the set of three-country options involves a continued real-world regime for all three countries in combination with the mildly risk-averse strategy, in the set of three-country options[7]. The first case is relatively vague for it implies an asymmetric policy pattern which, as stated above, would likely emerge only spontaneously. It would not be the result of purposeful tight policy co-ordination.

Thus, in effect, only one compromise option remains - that of the continued sample-period exchange rate regime for all the three countries combined with weak risk aversion. This implies a minimum of positive integration and, within the feasible opportunity range, the highest portfolio return relative to the portfolio risk and to the loss inflicted by the opening-up shock, or short-term structural adjustment of the markets involved. All other options are essentially out of question, at least in the near future. While the Sharpe ratio that corresponds to this option is fairly low for an emerging market (3,72)[8]; we still compare it with the feasible portfolio values of the Sharpe coefficient obtainable in the other emerging markets. It allows us to evaluate the prospects for a capital inflow from the global market, provided that the CIS markets have recovered after the current financial turmoil and - perhaps more important - the degree of segmentation is sharply reduced.

## Concluding remarks

In the above, we have constructed an hierarchy of the rational investor's counterfactual behaviour patterns in the treasury bills market of the «core» CIS countries, in case some degree of at least negative integration is achieved there. We have performed an adjustment of the measure of relative attractiveness of various counterfactual two-country and three-country portfolios for the estimated opening-up shock (that consists in a dramatic re-allocation of funds, given the optimal portfolio composition).

At the end of the day, only one counterfactual optimal portfolio was found to be realistically feasible. This option would comprise government-issued papers from all the three countries and would imply the international rational investor's following a mildly risk-averse investment strategy. Importantly, an overhaul of exchange-rate and monetary policy is seen as unnecessary, which augments the incentives for the countries involved, even despite their political resentment that is quite probable.

The notion of «probability» used in the above with regard to various outcomes evidently was highly abstract for it implied that political decision-makers would deliberately select the optimal feasible option based on a compromise between the highest relative capital gain and the underlying complex cost. In reality, however, political decisions are more likely to be exogenous. It is the political decision-making after all that determines, to a substantial extent at least, the market performance of the assets in question. So the notion of probability may be used also in its weak form. That is to say, the hierarchy of outcomes sim-

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[7] The idea of «continued real-world regime» becomes ambiguous given the recent currency crisis in Russia. The findings true of the sample period cannot be applied straightforwardly to the forthcoming period of the same length, as it might be otherwise. However invalidated, the results still can be regarded as a case study and an insight into some regularities of systemic transformation.

[8] The values of the Sharpe ratio estimated for annualised nominal returns to the major EU member countries' treasury bills using yearly observations over the period 1961 through 1998 are in most cases within the range from 1,9 to 2,8 (the author's own estimations based on the data published in *The European Economy*). It must be noted, however, that the Sharpe coefficient values for least-risk portfolios composed of those treasury bills may be higher by many times (the author's estimations).

ply tells the political decision-makers that, given the set of monetary, exchange-rate, and broader financial decisions, they shall expect a certain response on the part of the rational international investor. Integration itself is, therefore, a hostage of primary financial policy options, for, as it has been shown, in many cases the cost would be merely unacceptable. By and large, this study provides just a rough map for the process of shaping the demand in the three countries' government bonds market.

One issue barely touched upon in this paper may well be worth further elaboration in a later paper. The phenomenon could be termed «inside-out segmentation». The idea is as follows. When monetary integration is under way, it is believed to be desirable and even urgent to enforce strict rules that should make the member states' financial policy patterns converge, for otherwise those governments that are less disciplined would build up pressure upon the common bank system and push up the price of money throughout the monetary union (De Grauwe, 1997). The problem has another facet, however.

Assume that the monetary policy parameters converged effectively; then so did the market performance characteristics of the government-issued papers in the countries involved. Since the financial markets have been effectively unified and there is no segmentation, the demand in the financial market would, in the limiting case, become equal for *all* the government bonds tradable (assume, for the sake of simplicity, that each state issues only one type of asset). More precisely, it can be shown that, as the T-bills rates of return and standard deviations converge, the efficient portfolio composition will become either completely indeterminate or it will depend solely upon the covariance of returns to the assets involved. In the latter case, a dramatically more complex international mechanism would be needed, for to manage covariance, the monetary union's member countries' commitment to any set of financial policy standards, whatever severe they might be, is not sufficient.

Whereas it is possible to manage the rates of return or even the values of uncertainty (variance) just by imposing some deliberate policy rules, managing the behaviour of return covariance requires a continuous monitoring of the financial markets plus an extremely tight co-ordination of implementation of the national monetary policy *reaction functions*. The adequate degree of policy co-ordination is unlikely under whatever advanced monetary union, to say nothing about the fact that co-ordinated reaction functions imply that the underlying macro-economic reality be «prearranged».

Then, those governments whose budget deficits are relatively larger in absolute terms because of different size of the economies, will have to introduce the inside-out segmentation measures, i.e. to implement a tighter monetary policy relative to the rest of the union, or try to reduce the risk (which means, to limit the band of fluctuations) implicit in the assets they issue, or allow for undesirable changes in the term structure of their treasury bills.

This effect is much more pronounced for the economies in transition, since the number of assets tradable in the market here is considerably smaller and the share of the market dominated by the government-issued paper considerably larger then in the countries of the European Union. The uniform financial policy rules seem to be hardly feasible in principle, unless softened by some additional provisions or - more likely - some indirect policy measures undertaken at the national-government level. Thus, once there is effective financial integration achieved in the CIS, Russia will have to follow much stricter a policy then her neighbours will, in order to cushion permanent disequilibrium shock in the bonds market. This, in turn, will make the national economic policy patterns diverge and, therefore, will undermine the basis of integration itself.

# Annex

Unlike for Ukraine and Kazakhstan, the dynamics of the treasury bills price index in Russia was pronouncedly positively correlated with the US dollar exchange rate in local currency terms over the period from mid-1995 to mid-1998. This cannot be explained by the foreign capital's playing an allegedly important part in the GKO market since, first, the role of foreign speculators is often exaggerated, and second and much more important, foreign investors' demand for GKO could, at best, push up the forward exchange rate of the dollar. This would only form self-fulfilling predictions with regard to the spot rate, while its direct influence on the spot rate was bearish, rather.

The idea that it may be a lagged influence, i.e. the "self-fulfilling prophecy in action", that should be accounted for the phenomenon, doesn't work either, for no peak-and-trough time pattern is revealed by lagging, the response simply fading out with the lag increasing. The researcher must, therefore, look for another plausible explanation to be suggested. In what follows we shall try one based on the derivatives pricing theory.

The Black – Scholes analysis tells us that the rationally behaved market, being risk-averse, tends to a state of short-run equilibrium, or an optimal portfolio, such that, for any infinitely small stretch of time, it is call-derivatives short and underlying-assets long. The proportion of derivatives sold and underlying assets held is continuously (or recursively) adjusted and depends upon the changing prices of the two types of assets. The Black – Scholes analysis is concentrated on prices and marginal propensities, not on the stock (volume of purchases) of assets.

An important characteristic of the market's optimal portfolio is the sign of its rate of growth. Negativity means that the "twin" markets – that for GKO and that for hard currency – are no longer in equilibrium, which incurs dramatic outbursts of uncertainty.

Consider an intermediate-stage equation obtained in the course of deriving the basic Black – Scholes equation (see, e.g., Hull, 1997, notation ours)

$$\Delta \Pi = [-(\delta \pi / \delta t) - ½ (\delta^2 \pi / \delta s^2) \sigma^2 s^2] \Delta t,$$

where $\Pi$ is the value of portfolio consisting of a call derivative contract (a futures contract) and an asset on which the derivative contract is contingent, $\pi$ is the price of the call derivative contract, $s$ the price of the underlying asset, and $t$ is the term. It can be also shown, in the course of deriving the basic equation, that

$$[(\delta \pi / \delta t) + ½ (\delta^2 \pi / \delta s^2)] \Delta t =$$
$$r [\pi - (\delta \pi / \delta s) s] \Delta t,$$

where $r$ is the rate of return to risk-free asset (in whatever way the latter might be specified). Substitute the right-hand wing of this equation to the basic equation to obtain (sign changes)

$$- \Delta \Pi = r [\pi - (\delta \pi / \delta s) s] \Delta t,$$

or

$$\Delta \Pi = r [(\delta \pi / \delta s) s - \pi] \Delta t.$$

We may either gauge $\Delta t$ so that it were set equal to unity or simply assume that it is positive. It is reasonable to assume that $r$ be positive, too. Then, we obtain the non-negative portfolio growth condition,

$$(\delta \pi / \delta s) s \geq \pi,$$

or

$$(\delta \pi / \delta s) \geq (\pi / s).$$

Now, we assume that GKO is a call derivative contract (its price being $\pi$) contingent on some security (whose price is $s$); it is further assumed that the underlying security is a certain amount of hard currency (presumably the US dollar). We obtain, thus, a formal description of a highly dollarised bonds market in which securities have their implicit "shadow" collaterals. This means that, when purchasing a government-issued bond, the rational market player has in mind that he actually buys an amount of dollars (an equivalent of the GKO face value on the date when the GKO is purchased) with a delayed shipment at some kind of a futures price.

In practice, Russian commercial banks widely used the GKO as term contracts enabling them to purchase specified amounts of hard currency (USD) at particular points in time. The GKO market and the foreign exchange market were tightly interconnected «twin» markets. We assume that these two markets are in global equilibrium if the financial system's short position in treasury bills matches its long position in hard currency. The government which performed an important technical function as the T-bills issuer is assumed to have been acting as an agent on behalf of the country's financial system (in whatever broad sense the latter notion might be taken).

Creating the financial system's short position with regard to some period of time in the future was accompanied by simultaneous current-period crediting of the government by the financial system. It is suggested here to consider these two operations as different, i.e. irreducible to mere purchasing of GKO, though inseparably paired.

To check whether there is something real behind our intuition at all, we shall begin with formulating the following hypothesis. The GKO price index followed a time pattern that would have been followed by a derivative call contract contingent on USD.

First, we estimate the deterministic trend of the smoothed GKO price index (monthly averages of the daily observations, 21,5 working days in one month) for the period from March 1996 through March 1998. Second, we calculate the Black – Scholes three-month call option prices contingent on the RUR/USD exchange rate (monthly data) for the same period. We estimated the option prices under the assumption that the market expected the strike price to tend to the spot price, i.e. the market was «myopic»[9]. (We also estimated, for the sake of comparison, the call option prices under the assumption that the market expected the exercise price to tend to the mean value of the lognormal band as of the one-quarter-later period, but the explanatory power of the two-argument equation we have obtained is much weaker than in the case of the «myopic» market. Computational details are available from the author.[10])

Then, we multiply the values obtained by 100 so that they could fit with the same scale as the GKO index and estimate the deterministic trend of the «gauged» price series.

Finally, we estimate the linear regression of the GKO price index deviations from the deterministic trend (*TBPID*) on the «gauged», or «scaled», call option prices' deviations from their deterministic trend (*COUSD*). The equation looks as follows:

$TBPID = 3{,}499\ COUSD + \varepsilon;$
$R$^2 = 0,81 (9,57)

*t*-statistic in parentheses (99,5% confidence level), constant term close to zero. We see that our hypothesis cannot be rejected as completely inconsistent with reality.

As a call contract, the GKO must have been positively correlated, in price terms, with their underlying asset, the dollar, which fact explains the GKO market's performance.

The rate of return to GKO can be regarded as a premium implicit in the call contract's price relative to the underlying asset's price, $\rho$. Thence,

$$\pi = s - \rho s$$

(where $\pi$ is the GKO price, and $s$ is the price, in terms of the rouble, of one dollar on spot

[9] Under this assumption, the equilibrium hedging ratio of the GKO to the USD holdings of the country's financial system was as high as 1,95.

[10] Under this assumption, the equilibrium hedging ratio of the GKO to the USD holdings of the country's financial system was as high as 2,75.

and, therefore, of one-dollar GKO face value) and

$\pi / s = 1 - \rho.$

We may rewrite, then, the condition of non-negativity of the market portfolio growth rate as

$(\delta \pi / \delta s) \geq (1 - \rho).$

Indeed, during the period from April 1996 through April 1998, as Figure A1 reveals, the marginal response of the (logged) GKO price index to changes in the (logged) US dollar exchange rate against the rouble, estimated recursively over the 12-month moving period and then regressed to the deterministic time factor to obtain an instructive graphic representation, steadily decreased, while the right-wing term of the inequality, $(1 - \rho)$, kept growing due to the diminishing yield, $\rho$. One may expect the two curves to intersect, at some positive value of $\pi$ response to $s$. Then, the value of $\Delta \Pi$ becomes negative and the country's treasury bills-based financial market faces collapse.

Graphically, this would take the shape of an unexpected ”outburst of uncertainty” as indicated in the paper. Analytically, negativity of the rate of portfolio growth, $\Delta \Pi < 0$, can be shown to imply $r < 0$, i.e. negativity of the rate of return to riskless portfolio composed of a long position in hard currency and a short position in GKO. In other words, $\Delta \Pi < 0$ would mean global uncertainty on the financial market and would, therefore, incur a change of strategy of the market agents' behaviour. No risk-free optimal portfolio can be constructed any longer, whatever the values of its constituting positions.

The financial system, as a collective rational investor (including the country's monetary authorities, who are in principal charge of forming the short position, and the market agents)[11], starts searching not just for a new rational decision, but for a different decision-generating procedure, or a strategy to follow. Dumping T-bills is not the cause, but a consequence of rationality shift[12].

This must have been what happened to the Russian market in August 1998.

In a dollarised transition economy periodic crises on the treasury bills market may be caused by the mere fact that state-issued paper is perceived by most financial market players as a derivative instrument contingent on a default-free asset (i.e., a hard currency such as the US dollar). We may, therefore, define a highly dollarised economy as that in which hard currency substitutes for treasury bills as a risk-free asset. Ironocally, such crises appear to result from relatively successful policies geared towards financial stabilisation.

It is also interesting to look at the behaviour of derivatives contingent on the GKO as their underlying asset. Consider, e.g., Figure A2. Here we have plotted our Black – Scholes estimates of 3-month call options contingent on the GKO daily price index. The following two assumptions were made: first, there is no risk-free asset yielding positive return, so $r_f = 0$; second, the market was assumed to be myopic, i.e., the strike price, $X$, was assumed to be equal to the price on the date of writing the option, $S$. Thus, the pricing formula is reduced to

$$c = S\,[N_z(d_1) - N_z(d_2)],$$

where $c$ is the price for a call option, $S$ is the underlying asset's price on the date of writing the option, and $N$ is the cumulative probability of the normally distributed standardised variable, $z$, whose values, $d_1$ and $d_2$, depend, in particular, upon the option's time to maturity and the underlying asset's standard deviation.

We see that the implicit risk reflected by the price for options rises dramatically in the

[11] Of special interest is the problem of procedure of appropriating the proceeds.

[12] This model requires a detailed further specification, of course, especially concerning the concrete nature of T-bills as derivative (call) contracts and the nature of short – or *quasi*-short – position.

period preceding the GKO market collapse. However promising the analysis reported in Figure A2 might seem to be, any detailed elaboration of the related ideas would go far beyond the limits of the present paper, anyway.

To conclude with, we shall demonstrate once again that the GKO price index fits in with the 95% confidence band predicted under the assumption that it follows a geometric Brownian motion (see Figure A3). The band limits for 1047 price estimates were evaluated as:

$$e^{\tau(\mu - \sigma^2/2) - 1{,}96\,\sigma\,\tau^{½}} < S_\tau < e^{\tau(\mu - \sigma^2/2) + 1{,}96\,\sigma\,\tau^{½}};$$

$S_0$=1,

where $S$ is the "price" (index value) to be estimated, $\tau$ is the period of time (in days expressed in year terms) from the day $\tau = 0$, $\sigma$ is the price index volatility estimated from historical data, and $\mu$ is the expected rate of return also estimated from historical data.

It is seen in the Figure that the process we have analysed obeyed a Brownian motion (it kept to the mean curve for the most of the sample period), so the source of uncertainty may lie here and the Black – Scholes technique may be regarded as appropriate to apply. It can be also shown that the exchange rate kept to the upper band or was slightly above it during the period from April 1996 to April 1998.

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Figure A **Growing Uncertainty of the GKO Market, GKO Regarded as Derivatives**

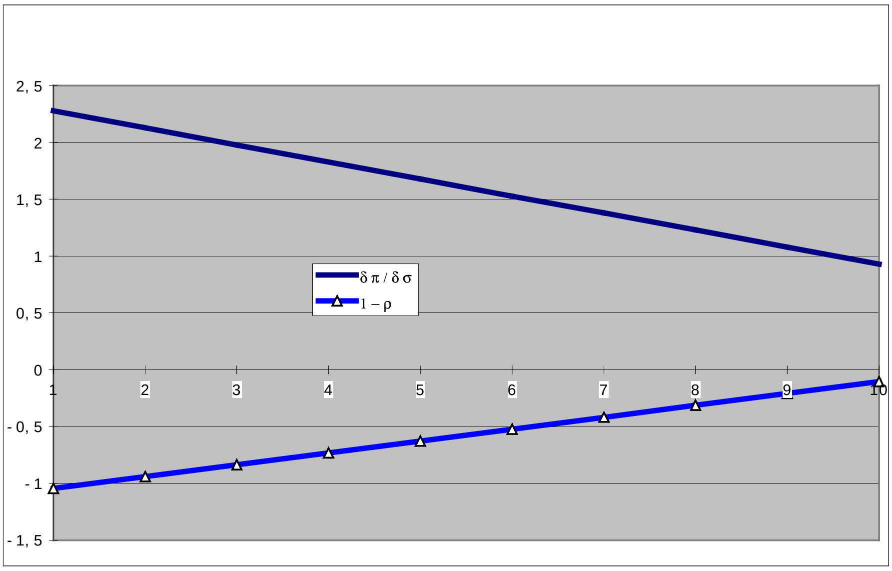



Figure A2 **Estimated Black – Scholes Three-Month Call Option Prices Contingent on the GKO Price Index**

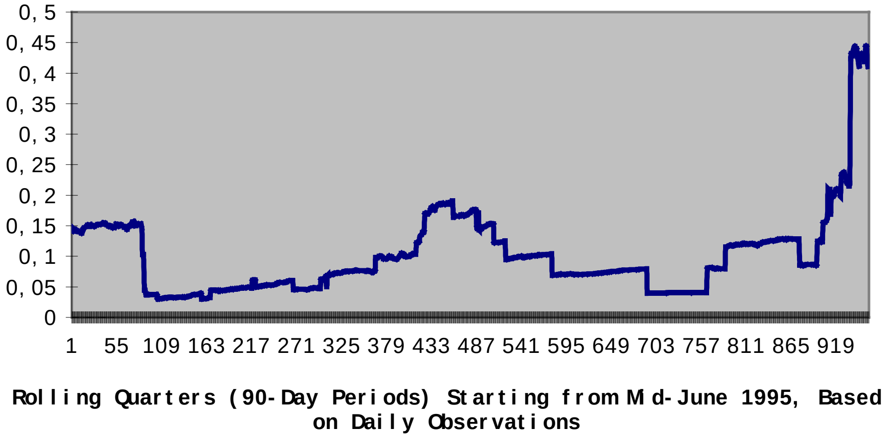


Figure A3 **GKO Price Index and the Geometric Brownian Band**

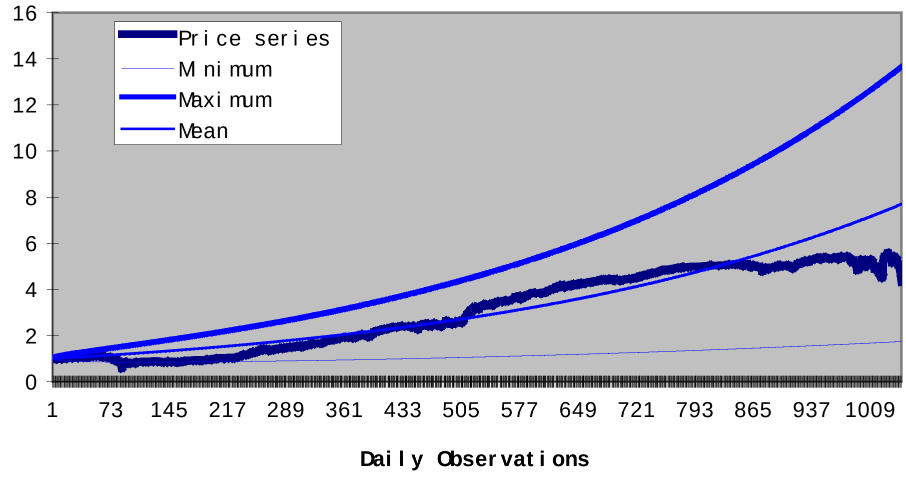


Table 1 **Pairwise Estimates of Treasury Bills Market Segmentation**

| **Pair of countries compared *** | ***Russia – Ukraine*** | ***Russia – Kazakhstan*** | ***Ukraine - Kazakhstan*** |
|---|---|---|---|
| *Systematic error in uncovered parity test (zero lag)* | 0,307 | 0,182 | 0,142 |
| # (lag $\tau$ =1) | 0,291 | 0,158 | 0,128 |
| # (lag $\tau$ =2) | 0,248 | 0,123 | 0,114 |
| # (lag $\tau$ =3) | 0,204 | 0,085 | 0,100 |
| # (lag $\tau$ =4) | 0,177 | 0,068 | 0,086 |
| # (lag $\tau$ =5) | 0,156 | 0,057 | 0,074 |
| *Systematic error in uncovered parity test, moving averages (zero lag)* | 0,314 | 0,171 | 0,140 |
| *Portfolio-balance test (regression alphas), standardized values* | 0,0772 | 0,0117 | 2,57E10-16 |
| *Portfolio-balance test (regression alphas), non-standardized values* | 0,3654 | 0,2543 | 0,16104 |

* Whole period

Table 2 **Country-Specific Effects of Weighting Local Treasury Bills' Nominal Yield Time Series by Fluctuations of the National Currencies' Exchange Rates Against the US Dollar**

| ***Country*** | ***Variance *, nominal values of the annualized monthly rates of return to local treasury bills*** | ***Kurtosis *, nominal values of the annualized monthly rates of return to local treasury bills*** | ***Variance *, USD-weighted values of the annualized monthly rates of return to local treasury bills*** | ***Kurtosis *, USD-weighted values of the annualized monthly rates of return to local treasury bills*** |
|---|---|---|---|---|
| ***Russia*** | **0,175** | *4,985* | **0,097** _ | *6,018* |
| ***Ukraine*** | 0,001 | *2,204* | 0,042 _ | *0,207* |
| ***Kazakhstan*** | 0,006 | *-0,625* | 0,015 _ | *1,751* |

* Whole period.

Table 3 **National Capital Approach. Russia's Policy Patterns**

| Strategy options | Assets' shares | | | | Sharpe ratio |
|---|---|---|---|---|---|
| | *Two-asset case* | | | | |
| | Local treasury bills | | US dollars | | |
| **Efficient portfolio** | 48% | | 52% | | 2,38 |
| **Least-risk portfolio** | Unfeasible | | | | |
| | *Three-asset cases* | | | | |
| | Local treasury bills | US dollars | Ukraine treasury bills | | |
| **Efficient portfolio** | 41% | 54% | 5% | | 2,36 |
| **Least-risk portfolio** | Unfeasible | | | | |
| | Local treasury bills | US dollars | Kazakhstan treasury bills | | |
| **Efficient portfolio** | 36% | 46% | 18% | | **2,50** |
| **Least-risk portfolio** | Unfeasible | | | | |
| | *Four-asset case* | | | | |
| | Local treasury bills | US dollars | Ukraine treasury bills | Kazakhstan treasury bills | |
| **Efficient portfolio** | 34% | 45% | 4% | 17% | 2,48 |
| **Least-risk portfolio** | Unfeasible | | | | |

Table 4 **National Capital Approach. Ukraine’s Policy Patterns**

| Strategies options | Assets' shares | | | | Sharpe ratio |
|---|---|---|---|---|---|
| | *Two-asset case* | | | | |
| | Local treasury bills | US dollars | | | |
| **Efficient portfolio** | 99 % | 1 % | | | 2,77 |
| **Least-risk portfolio** | 99 % | 1 % | | | 2,70* |
| | *Three-asset cases* | | | | |
| | Local treasury bills | US dollars | Russia treasury bills | | |
| **Efficient portfolio** | 97 % | 1 % | 2 % | | 2,50 |
| **Least-risk portfolio** | 99 % | 1 % | 0 % | | **2,78** |
| | Local treasury bills | US dollars | Kazakhstan treasury bills | | |
| **Efficient portfolio** | 98 % | 1 % | 1 % | | 2,53 |
| **Least-risk portfolio** | 99 % | 0 % | 1 % | | **2,78** |
| | *Four-asset case* | | | | |
| | Local treasury bills | US dollars | Russia treasury bills | Kazakhstan treas-ury bills | |
| **Efficient portfolio** | 97 % | 1 % | 2 % | 0 % | 2,37 |
| **Least-risk portfolio** | Unfeasible | | | | |

Table 5 **National Capital Approach. Kazakhstan's Policy Patterns**

| **Strategies options** | **Assets' shares** | | | | **Sharpe ratio** |
|---|---|---|---|---|---|
| | *Two-asset case* | | | | |
| | Local treasury bills | US dollars | | | |
| **Efficient portfolio** | Unfeasible | | | | |
| **Least-risk portfolio** | 90 % | 10 % | | | **3,20** |
| | *Three-asset cases* | | | | |
| | Local treasury bills | US dollars | Russia treasury bills | | |
| **Efficient portfolio** | 80 % | 8 % | 12 % | | 2,38 |
| **Least-risk portfolio** | 90 % | 7 % | 3 % | | 2,64 |
| | Local treasury bills | US dollars | Ukraine treasury bills | | |
| **Efficient portfolio** | 87 % | 8 % | 5 % | | 2,57 |
| **Least-risk portfolio** | 85 % | 8 % | 7 % | | 2,53 |
| | *Four-asset case* | | | | |
| | Local treasury bills | US dollars | Russia treasury bills | Ukraine treasury bills | |
| **Efficient portfolio** | 77 % | 8 % | 11 % | 4 % | 2,31 |
| **Least-risk portfolio** | Unfeasible | | | | |

Table 6 **Changes in Two-Country Portfolio Opportunities in Case of a Tighter Integration**

| **Countries** | **Changes in feasible portfolio characteristics in case of exchange rate transparency** | | **Prospects for a tight bilateral exchange rate policy coordination** |
|---|---|---|---|
| | *Yield change* | *Risk change* | |
| *Russia / Ukraine* | Higher | Wider | Poor or neutral |
| *Russia / Kazakhstan* | Higher | Wider | Poor or neutral |
| *Ukraine / Kazakhstan* | Higher | Narrower | Neutral or moderately optimistic |

Table 7 **International Capital Approach. Sharpe Ratios under Russia's (Vertical Axis) and Ukraine's (Horizontal Axis) Policy Patterns**

| ***Policy options / implied types of rationality*** | ***Strategies*** | ***Fixed ex-change rate*** | ***Real-world performance*** | ***Real-world imitation with narrower band*** | ***Deviations, nominal*** | ***Deviations, weighted*** |
|---|---|---|---|---|---|---|
| ***Fixed ex-change rate*** | *Efficient* | 2,61 | 1,66* | 0,98 | | |
| | *Least-risk* | Unfeasible | 2,88 | 0,94 | | |
| ***Real-world performance*** | *Efficient* | **3,76** | 0,50** | 0,89** | | |
| | *Least-risk* | Unfeasible | 0,39** | 0,95 | | |
| ***Real-world imitation with narrower band*** | *Efficient* | 1,87* | 1,04 | 1,92 | | |
| | *Least-risk* | Unfeasible | 0,96 | Unfeasible | | |
| ***Deviations, nominal*** | *Efficient* | | | | Unfeasible | |
| | *Least-risk* | | | | Unfeasible | |
| ***Deviations, weighted*** | *Efficient* | | | | | Unfeasible |
| | *Least-risk* | | | | | Unfeasible |

* Three months less.

** Whole period.

Table 8 **International Capital Approach. Sharpe Ratios under Russia's (Vertical Axis) and Kazakhstan's (Horizontal Axis) Policy Patterns**

| ***Policy options / implied types of rationality*** | ***Strategies*** | ***Fixed exchange rate*** | ***Real-world performance*** | ***Real-world imitation with narrower band*** | ***Deviations, nominal*** | ***Deviations, weighted*** |
|---|---|---|---|---|---|---|
| ***Fixed exchange rate*** | *Efficient* | 3,15 | 1,58 | 1,69 | | |
| | *Least-risk* | Unfeasible | 2,63 | Unfeasible | | |
| ***Real-world performance*** | *Efficient* | 3,71 | 1,33 | 1,77** | | |
| | *Least-risk* | **3,84** | 3,51 | 1,61 | | |
| ***Real-world imitation with narrower band*** | *Efficient* | 2,76 | 0,75 | **5,18** | | |
| | *Least-risk* | Unfeasible | 0,24 | Unfeasible | | |
| ***Deviations, nominal*** | *Efficient* | | | | Unfeasible | |
| | *Least-risk* | | | | Unfeasible | |
| ***Deviations, weighted*** | *Efficient* | | | | | Unfeasible |
| | *Least-risk* | | | | | Unfeasible |

* Whole period.

Table 9 **International Capital Approach. Sharpe Ratios under Ukraine's (Vertical Axis) and Kazakhstan's (Horizontal Axis) Policy Patterns**

| ***Policy options / implied types of rationality*** | ***Strategies*** | ***Fixed exchange rate*** | ***Real-world performance*** | ***Real-world imitation with narrower band*** | ***Deviations, nominal*** | ***Deviations, weighted*** |
|---|---|---|---|---|---|---|
| ***Fixed exchange rate*** | *Efficient* | 3,30 | 1,02 | 2,52 | | |
| | *Least-risk* | Unfeasible | **3,48** | Unfeasible | | |
| ***Real-world performance*** | *Efficient* | Unfeasible | Unfeasible | 0,91 | | |
| | *Least-risk* | 2,80 | 0,63 | 2,61 | | |
| ***Real-world imitation with narrower band*** | *Efficient* | 1,12 | 1,94 | **3,57** | | |
| | *Least-risk* | 1,31 | 2,27 | 3,01 | | |
| ***Deviations, nominal*** | *Efficient* | | | | Unfeasible | |
| | *Least-risk* | | | | Unfeasible | |
| ***Deviations, weighted*** | *Efficient* | | | | | Unfeasible |
| | *Least-risk* | | | | | Unfeasible |

Table 10 **International Capital Approach. Individual Countries' Shares under Russia's (Vertical Axis) and Ukraine's (Horizontal Axis) Policy Patterns**

| ***Policy options / implied types of rationality*** | ***Strategies*** | ***Fixed exchange rate*** | | ***Real-world performance*** | | ***Real-world imitation with narrower band*** | | ***Deviations, nominal*** | ***Deviations, weighted*** |
|---|---|---|---|---|---|---|---|---|---|
| | | *Rus.* | *Ukr.* | *Rus.* | *Ukr.* | *Rus.* | *Ukr.* | | |
| ***Fixed exchange rate*** | *Efficient* | 57% | 43% | 52% | 48% | 43% | 57% | | |
| | *Least-risk* | Unfeasible | | 70% | 30% | 38% | 62% | | |
| ***Real-world performance*** | *Efficient* | **54%** | **46%** | 36% | 64% | 55% | 45% | | |
| | *Least-risk* | Unfeasible | | 32% | 68% | 70% | 30% | | |
| ***Real-world imitation with narrower band*** | *Efficient* | 21% | 79% | 39% | 61% | 55% | 45% | | |
| | *Least-risk* | Unfeasible | | 35% | 65% | Unfeasible | | | |
| ***Deviations, nominal*** | *Efficient* | | | | | | | Unfeasible | |
| | *Least-risk* | | | | | | | Unfeasible | |
| ***Deviations, weighted*** | *Efficient* | | | | | | | | Unfeasible |
| | *Least-risk* | | | | | | | | Unfeasible |

Table 11 **International Capital Approach. Individual Countries' Shares under Russia's (Vertical Axis) and Kazakhstan's (Horizontal Axis) Policy Patterns**

| ***Policy options / implied types of rationality*** | ***Strategies*** | ***Fixed exchange rate*** | | ***Real-world performance*** | | ***Real-world imitation with narrower band*** | | ***Deviations, nominal*** | ***Deviations, weighted*** |
|---|---|---|---|---|---|---|---|---|---|
| | | *Rus.* | *Kaz.* | *Rus.* | *Kaz.* | *Rus.* | *Kaz.* | | |
| ***Fixed exchange rate*** | *Efficient* | 21% | 79% | 24% | 76% | 38% | 62% | | |
| | *Least-risk* | Unfeasible | | 50% | 50% | Unfeasible | | | |
| ***Real-world performance*** | *Efficient* | 2% | 98% | 25% | 75% | 35% | 65% | | |
| | *Least-risk* | **97%** | **3%** | 82% | 18% | 43% | 57% | | |
| ***Real-world imitation with narrower band*** | *Efficient* | 29% | 71% | 23% | 77% | **20%** | **80%** | | |
| | *Least-risk* | Unfeasible | | 42% | 58% | Unfeasible | | | |
| ***Deviations, nominal*** | *Efficient* | | | | | | | Unfeasible | |
| | *Least-risk* | | | | | | | Unfeasible | |
| ***Deviations, weighted*** | *Efficient* | | | | | | | | Unfeasible |
| | *Least-risk* | | | | | | | | Unfeasible |

Table 12 **International Capital Approach. Individual Countries' Shares under Ukraine's (Vertical Axis) and Kazakhstan's (Horizontal Axis) Policy Patterns**

| ***Policy options / implied types of rationality*** | ***Strategies*** | ***Fixed exchange rate*** | | ***Real-world performance*** | | ***Real-world imitation with narrower band*** | | ***Deviations, nominal*** | ***Deviations, weighted*** |
|---|---|---|---|---|---|---|---|---|---|
| | | *Ukr.* | *Kaz.* | *Ukr.* | *Kaz.* | *Ukr.* | *Kaz.* | | |
| ***Fixed exchange rate*** | *Efficient* | 45% | 55% | 50% | 50% | 67% | 33% | | |
| | *Least-risk* | Unfeasible | | **92%** | **8%** | Unfeasible | | | |
| ***Real-world performance*** | *Efficient* | Unfeasible | | Unfeasible | | 68% | 32% | | |
| | *Least-risk* | 18% | 82% | 36% | 64% | 15% | 85% | | |
| ***Real-world imitation with narrower band*** | *Efficient* | 59% | 41% | 44% | 56% | **79%** | **21%** | | |
| | *Least-risk* | 53% | 47% | 89% | 11% | 60% | 40% | | |
| ***Deviations, nominal*** | *Efficient* | | | | | | | Unfeasible | |
| | *Least-risk* | | | | | | | Unfeasible | |
| ***Deviations, weighted*** | *Efficient* | | | | | | | | Unfeasible |
| | *Least-risk* | | | | | | | | Unfeasible |

Table 13 **International Capital Approach. Three-Country Portfolios**

| ***Coordinated policy options*** | ***Strategy options*** | *Countries' shares* | | | ***Sharpe ratio*** |
|---|---|---|---|---|---|
| | | *Russia* | *Ukraine* | *Kazakhstan* | |
| ***Fixed exhange rates*** | ***Efficient portfolio*** | 15 % | 66 % | 19 % | 2,88 |
| | *Least-risk portfolio* | Unfeasible | | | |
| ***Real-world performance*** | *Efficient portfolio* | 92 % | 0 % | 8 % | 3,72 |
| | *Least-risk portfolio* | 16 % | 77,60 % | 6,40 % | **4,36** |
| ***Real-world imitation with narrowed bands*** | *Efficient portfolio* | Unfeasible | | | |
| | *Least-risk portfolio* | Unfeasible | | | |
| ***Deviations, nominal*** | Efficient portfolio | Unfeasible | | | |
| | *Least-risk portfolio* | Unfeasible | | | |
| ***Deviations, weighted*** | *Efficient portfolio* | Unfeasible | | | |
| | *Least-risk portfolio* | Unfeasible | | | |

Table 14 **Case-Specific Most Probable Integration Outcomes**

| *Bilateral case* | *1st rank policy pattern and investment strategy* | *Frequency (relative probability) weight* | *2nd rank policy pattern and investment strategy* | *Frequency (relative probability) weight* | *3rd rank policy pattern and investment strategy* | *Frequency (relative probability) weight* | *All-weights entropy* |
|---|---|---|---|---|---|---|---|
| *Russia – Ukraine* | Russia: fixed exchange rate regime; Ukraine: real-world performance. Least-risk-portfolio strategy | 0,238 | Russia: real-world performance; Ukraine: fixed exchange rate regime. Efficient-portfolio strategy | 0,168 | Russia: fixed exchange rate regime; Ukraine: fixed exchange rate regime. Efficient-portfolio strategy | 0,127 | 0,16454 |
| *Russia – Kazakhstan* | Russia: real-world performance; Kazakhstan: fixed exchange rate regime. Least-risk-portfolio strategy, first all-over winner | 0,954 | Russia: real-world performance; Kazakhstan: real-world performance. Least-risk-portfolio strategy | 0,017 | Russia: real-world performance; Kazakhstan: real-world performance. Efficient-portfolio strategy | 0,005 | 0,02021 |
| *Ukraine – Kazakhstan* | Ukraine: fixed exchange rate regime; Kazakhstan: fixed exchange rate regime. Efficient-portfolio strategy | 0,120 | Ukraine: real-world performance with narrower band; Kazakhstan: real-world performance with narrower band. Efficient-portfolio strategy | 0,112 | Ukraine: real-world performance with narrower band; Kazakhstan: real-world performance with narrower band. Least-risk-portfolio strategy | 0,107 | 0,18141 |
| *Three-country case* | Real-world performance. Efficient-portfolio strategy, second allover winner | 0,784 | Real-world performance. Least-risk-portfolio strategy | 0,127 | Fixed exchange rates regime. Efficient-portfolio strategy | 0,089 | 0,22298 |

Figure 1 **Normal Probability Plot (treasury bills, Russia)**

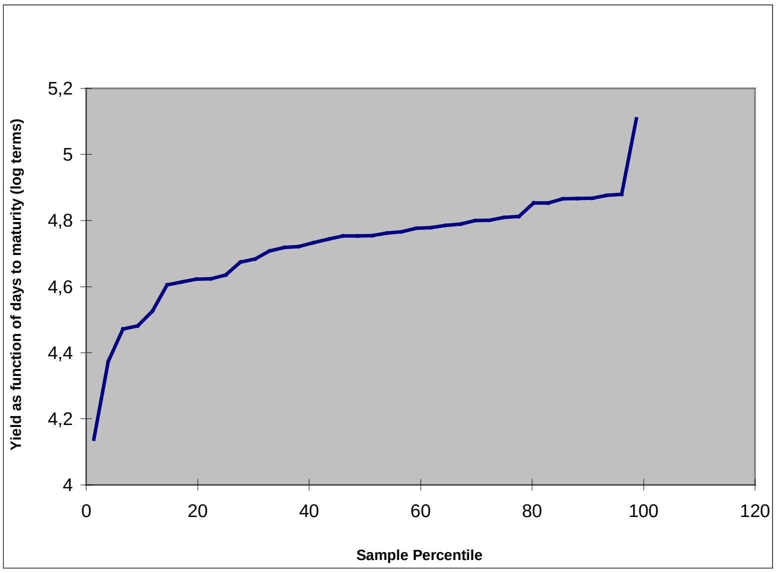



Figure 2 **Yield as Function of Days to Maturity (treasury bills term structure, Russia)**

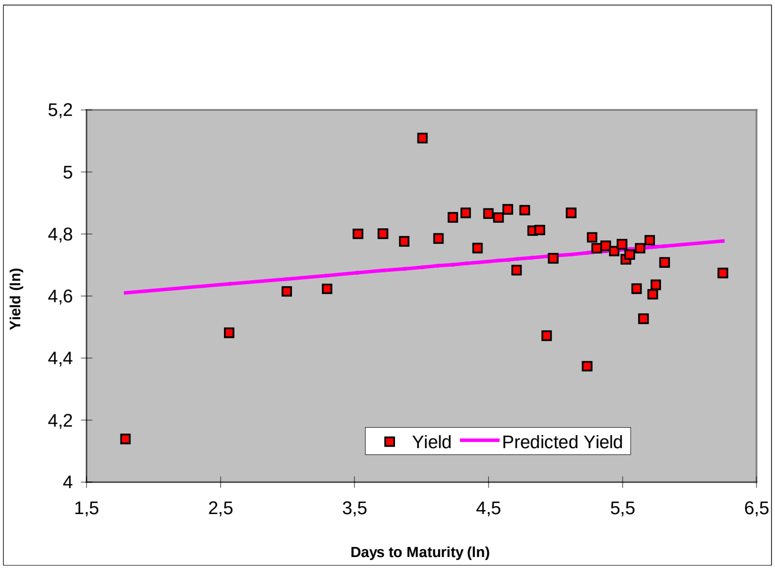


Figure 3 **Normal Probability Plot (treasury bills, Ukraine)**

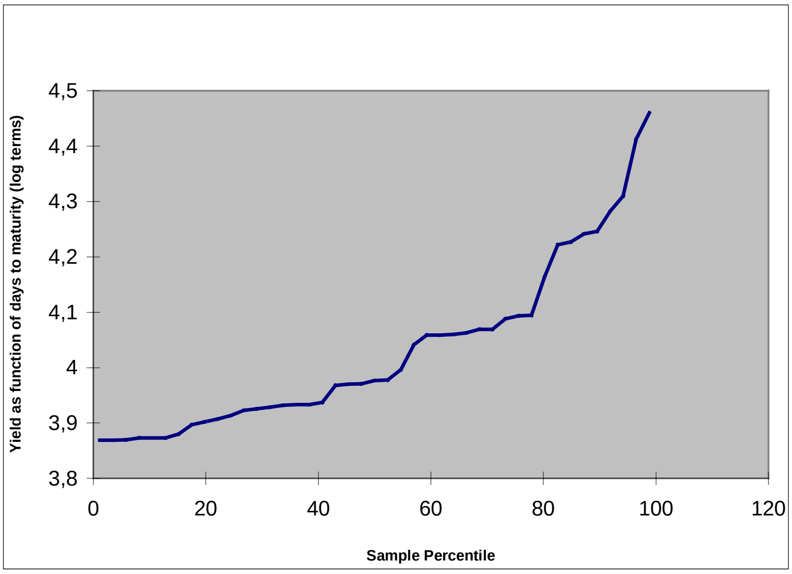



Figure 4 **Yield as Function of Days to Maturity (treasury bills term structure, Ukraine)**

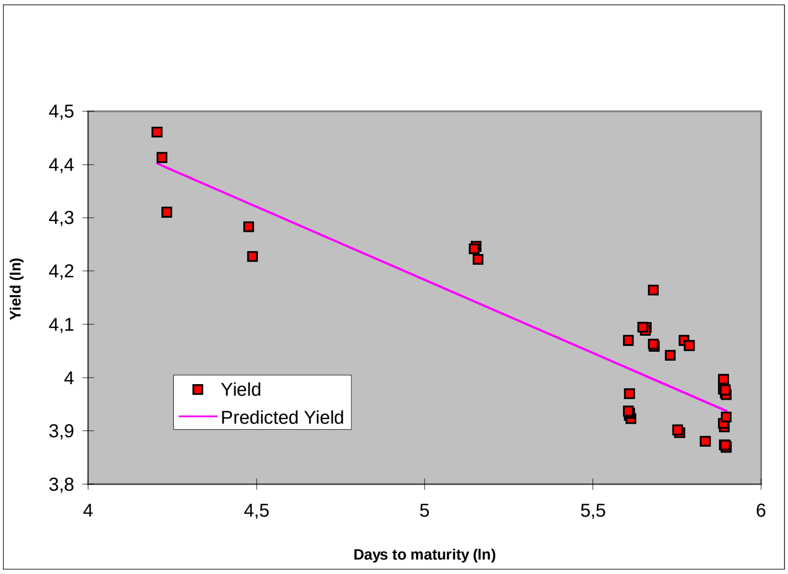


Figure 5 **Deviations of the GKO Price Series Index from the Linear Trend Values (solid line) and a Smoothed Non-Generalized Wiener Process**

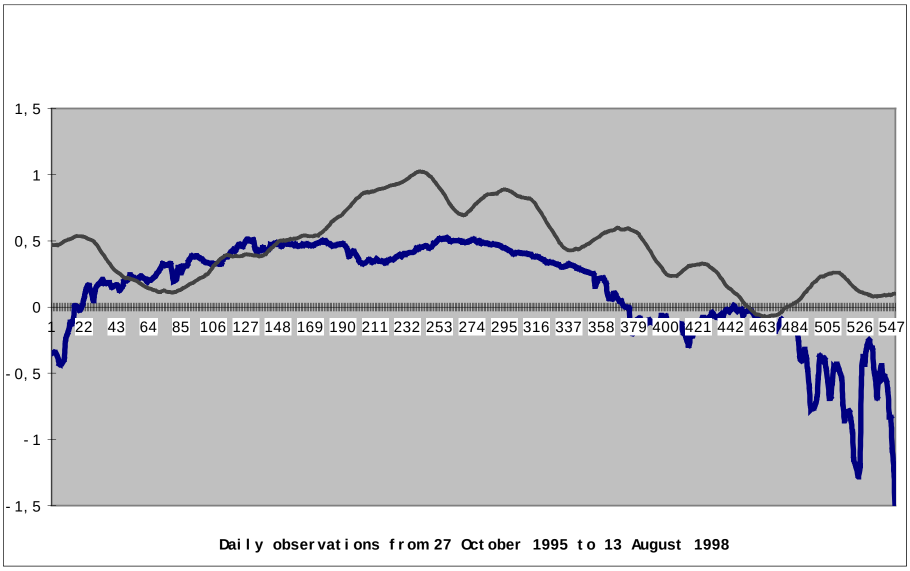



Figure 6 **First-Order Differences of the Gap between the Deviations and the Wiener Process**

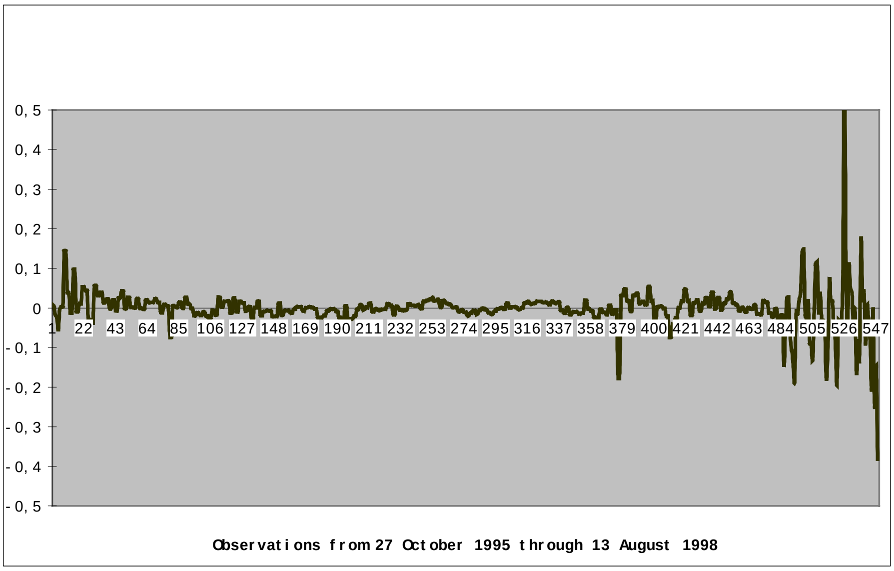


Figure 7 **Expected portfolio return as function of portfolio variance, Russia and Ukraine treasury bills (nominal terms)**

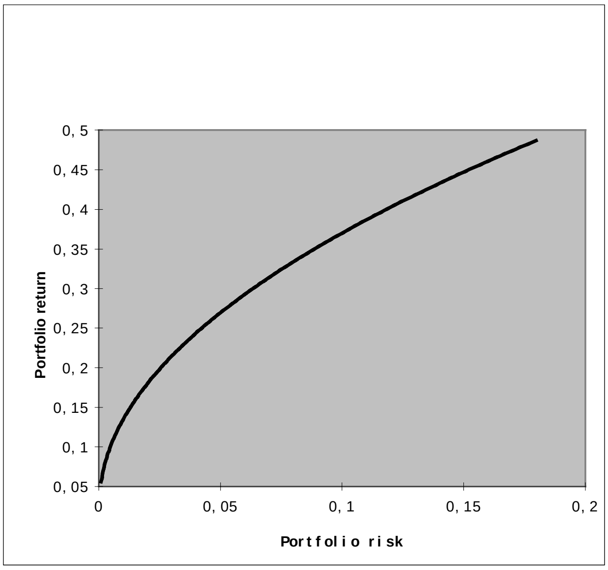



Figure 8 **Expected portfolio return as function of portfolio variance, Russia and Kazakhstan treasury bills (nominal terms)**

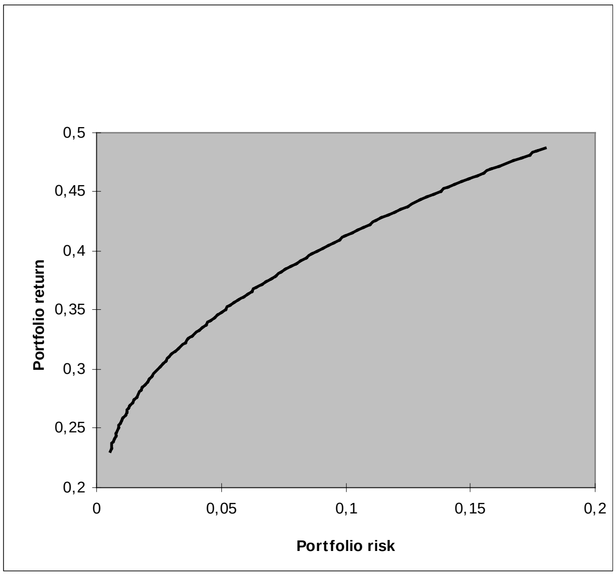


Figure 9 **Expected portfolio return as function of portfolio variance Ukraine and Kazakhstan treasury bills (nominal terms)**

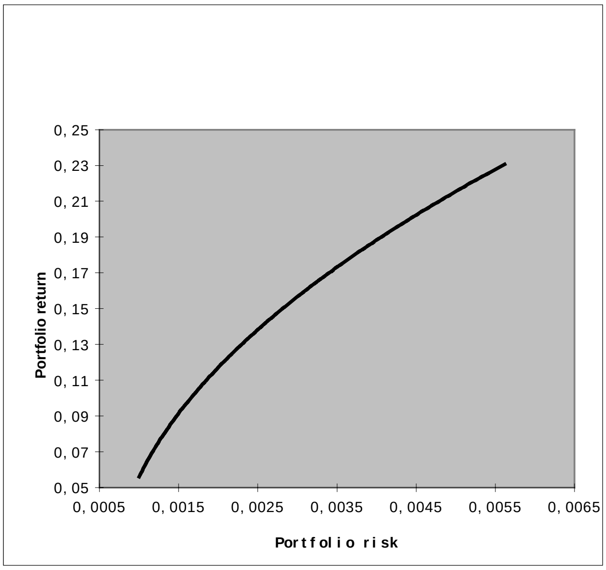



Figure 10 **Expected portfolio return as function of portfolio variance, Russia and Ukraine treasury bills (USD-weighted values)**

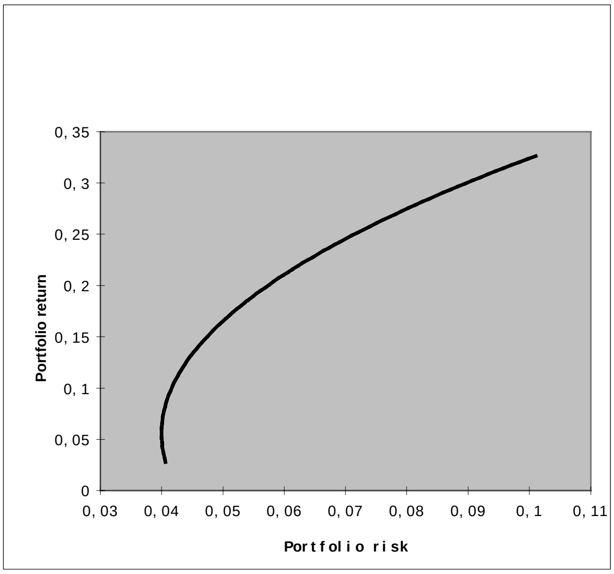


Figure 11 **Expected portfolio return as function of portfolio variance, Russia and Kazakhstan treasury bills (USD-weighted values)**

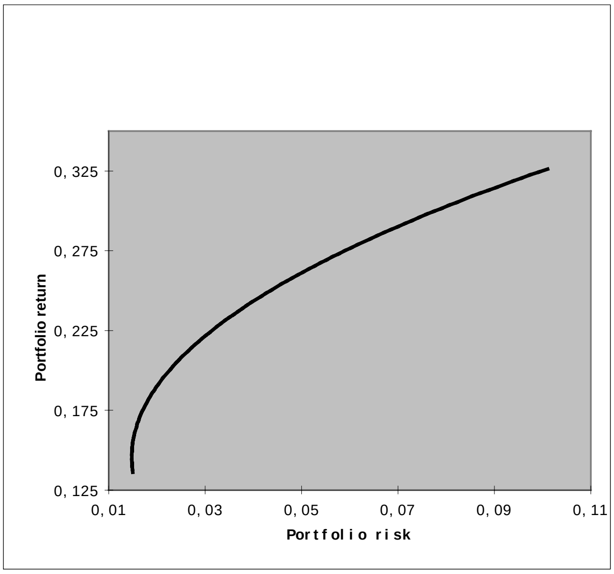
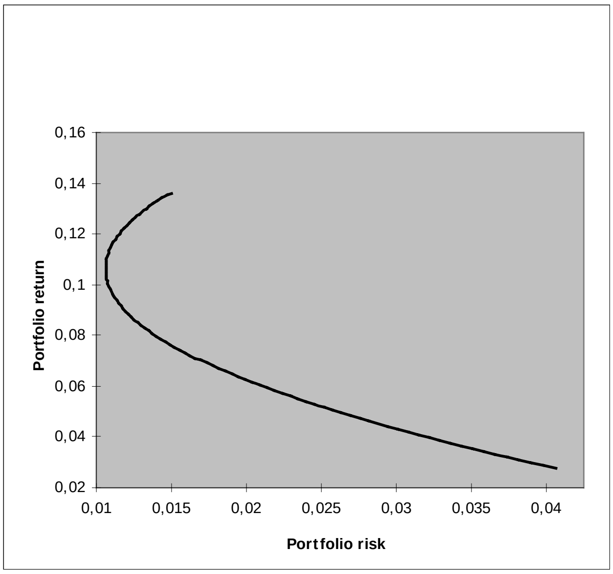



Figure 12 **Expected portfolio return as function of portfolio variance, Ukraine and Kazakhstan treasury bills (USD-weighted values)**



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