INTERNATIONAL CROSS-LISTING
AND ORDER FLOW MIGRATION:
EVIDENCE FROM UKRAINE

by

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Abstract

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This paper examines the international cross-listing effect on the Ukrainian stock market based on the market information linkages. It has been found that introducing shares abroad within the sample under investigation (22.01.1997 - 01.11.2004) improves market characteristics: base-level volatility tends to decrease and market liquidity tends to increase. According to the methodology developed by Domowitz et al (1998) we can infer that Ukrainian market is integrated with abroad market.

Precise attention was paid to the analysis of the structure of Ukrainian stock market. We composed the overview of legislation acts, highlighted major market institutions, and indicated the dynamics of trading volume with respect to the Regulated and OTC market. Several reasons that explain the predominance of the OTC trading over Regulated market are presented. Peculiarities of the Depositary Receipts issues for shares of Ukrainian enterprises are also discussed in the thesis.

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GLOSSARY

ADR – American Depositary Receipt. A financial asset issued by a US Depositary Bank representing shares in a non-US (domestic) company held by a domestic custodian or a domestic depositary. These receipts are traded in the US.

Beneficial Owner – the owner of a security who is entitled to the benefits of that security. The beneficial and legal (Nominee) owner may be different.

Book Entry Securities - securities represented by electronic book entry records in either a custodian or a depository.

Clearing process – checking the amount of money and securities between counterparties that are going to perform a settlement of securities.

Custodian - legal entity that provides safekeeping service (custody) for securities on securities accounts. Other services performed by custodians include reporting on securities held on securities accounts to the owners of these accounts, participating in corporate actions.

Delivery Free of Payment – transfer of ownership of an asset (security) with no transfer of the equivalent assured counter value in funds.

Depository – legal entity established in the form of a joint stock company that performs settlement of securities through securities accounts that are opened by custodians. Depositories perform also clearing of securities.

Depository Receipt – a financial asset issued by a foreign depositary bank representing shares in a domestic company held by either a domestic custodian or a domestic depositary on the basis of an sub-custodian agreement with a foreign bank.

DVP – Delivery versus Payment. The simultaneous and irrevocable transfer of ownership of an asset (security) in exchange for the equivalent assured counter value in same day funds.

GDR – Global Depositary Receipt. A financial asset issued by a foreign depositary bank (other than in the US) representing shares in a company that is located at the market other from the depositary bank's issuing GDR location and the US, which are held domestically.

Immobilized Security – security in the book entry form that previously was in paper form, but at the moment the paper certificate is hold in the either Custodian or Depository vault and the security is kept at the record of the either Custodian or Depository.

Issuer – legal entity that offers or proposes to offer its securities for sale.

Limit Order - instruction to dealer to buy shares at the best possible price.

Market Order - instruction to dealer to buy shares at the best available price.

Nominee Owner – an organization that acts as the named holder of securities on behalf of a beneficial owner.

Organized Market (Regulated Market) – includes specially organized securities trading places (see also opposite notion – **OTC Market**).

OTC exchange – over-the-counter exchange. The term used to describe network for securities trading through the telephone- and computer-connected exchange. Only listed shares are traded at the over-the-counter exchange. One should not consider OTC exchange as a part of OTC market. OTC exchange belongs to the Regulated Market while OTC Market does not have any precise trading place.

OTC Market (Unorganized Market) – unregulated market, where brokers, dealers and investors contact each other privately, usually through the phone or computer and come to an agreement on securities trading between each other. None information on subject of agreement and securities volume is available for OTC market participants other than counter parties of an agreement.

Paper Form Securities – securities that are held in a paper (certificated) form.

Registered Share – a share in a paper form with its owner's name stated on the share certificate.

Registrar – legal entity that performs record keeping of registered shares.

SEC – Securities and Exchange Commission. The major regulatory body of the stock market in the USA.

Secondary Market – a market for trading securities that have already been issued.

Self-Regulatory Organization – voluntary unprofitable union of professional members of the stock market registered by the SSMSC in line with the established procedure that aims at protection of its members' interests, as well as interests of securities owners and issuers.

Settlement – the process of completing a transaction whereby cash moves from the buyer to the seller and security moves the other way.

SSMSC – Securities and Stock Market State Commission. The major regulatory body of the stock market in Ukraine.

Trading Place – both Stock Exchanges and electronic trading-information systems that are licensed by SSMSC to perform the activity of organizing securities trading.

INTRODUCTION

The amount of cross-listing (simultaneous trading of shares at the domestic and foreign markets) shares increased significantly during last years. Depositary receipt is one of the cross listing instruments, it is a receipt issued by a foreign bank for domestic shares. Apart from the advantage of facility of trading, portfolio diversification etc. for foreign investors, this instrument brings benefits to its issuer. It increases the shareholder base of the company, enhances value of the company, its reputation on the foreign market. Figure 1.1 represents the trading volume of American depositary receipts (ADR) in terms of billion of shares and in terms of million of dollars.

Annual Volume of ADR Trading
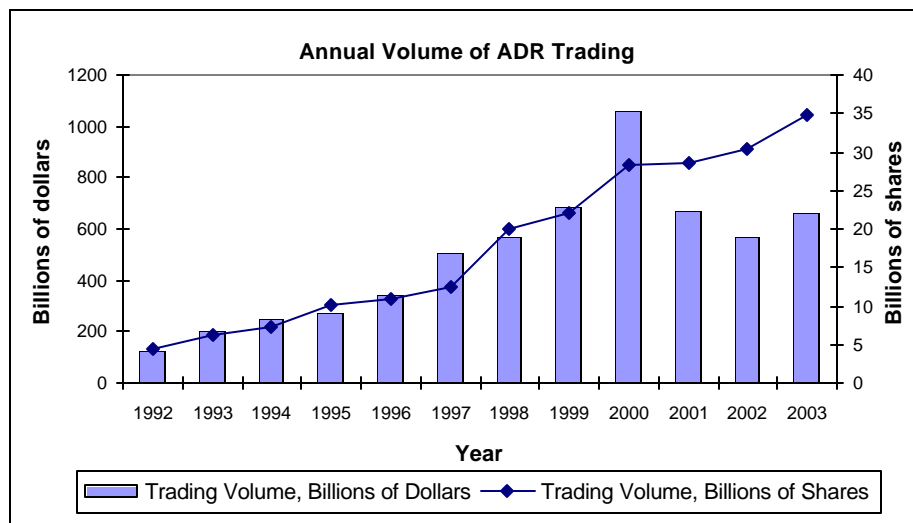
* Source: ADR Reference Guide, JPMorgan, Sep. 2004

Figure 1.1 - Annual Volume of ADR Trading, 1992-2003

However, the issuer's or investor's interest in issuing or buying the DR also affects the performance of domestic stock market. This influence can be either positive or negative. This is especially the case for emerging markets, where market structure is unstable and market members are not as qualified as the foreign ones. The model used in this thesis was introduced by Domowitz et al (1998). It allows us to measure the effect of cross-listing on market quality. This approach is based on market information linkages. We can consider perfect information linkages case, when the introduction of shares abroad reduces the spread of the underlined share and increases its trading volume and order inflow to domestic market. If the mentioned above consequences of cross-listing appears at domestic market, its quality will improve. Such markets are named integrated. However, it might be the case when cross-listing of shares leads to moving the price discovering process abroad, this will result in decrease in trading volume of shares. It means that foreign market will have a negative impact on domestic bid-ask spread that might influence negatively domestic stock market. Order outflow might be observed in this situation. Domestic market that exhibits the described pattern is named partially fragmentized market. The information linkages for such market are somewhere in the middle between perfect and extremely poor. Another case occurs when introduction of shares abroad causes decrease in intensity and volume of trading of the underlined shares together with the increase in bid-ask spread. Such domestic market is named fragmentized.

We base our research on the Ukrainian stock market. Its structure, main peculiarities and institutions will be discussed in the thesis. We are the first who investigates the information linkages of the Ukrainian stock market. Also we managed to gather unique data set for both DR issues and PFTS prices that is not publicly available. We use the data provided by the biggest organized stock market in Ukraine - PFTS.

In this research paper we analyze the cross-listing effect on the basis of trading information on shares of Ukrainian enterprises, for which Depositary Receipts were issued in the period between 22.01.1997 and 01.11.2004. Starting from 22.01.1997 the Ukrainian OTC-exchange started to report daily prices and trading volumes. We limit the reporting period till 01.11.2004, when the first round of the presidential elections in Ukraine was over and primary election results were published. Since the political events happening afterwards (the Orange Revolution) in Ukraine could have an influence on the Ukrainian shares trading at stock exchange, we have reduced our data sample to limit possible political effects.

The thesis consists of 7 Chapters. Chapter 1 stands for Introduction. We start Chapter 2 with the general overview of the Ukrainian stock market and the biggest organized securities trading place in Ukraine – PFTS. We also describe the notion of the DR (depositary receipts) program. In Chapter 3 we provide literature review. Data description is provided in Chapter 4. In Chapter 5 we build theoretical model describing the effects of issuing the depositary receipts on the quality of domestic stock market. Chapter 6 is dedicated to empirical results of our research. In Chapter 7 we draw major conclusions and provide some guidelines for further research.

UKRAINIAN STOCK MARKET OVERVIEW

2.1 Structure of Ukraine's Stock Market

Ukraine started developing its stock market since 1991, when the Law of Ukraine on Securities and Stock Exchange was adopted (hereafter Law (1991)). It is a major regulative framework that provides comprehensive definitions of securities and major requirements and procedures for securities issues. Table 2.1. presents the full list of the types of securities stipulated in the Law (1991). In 1996 the Law on State Regulation of Securities Market was passed establishing an independent stock market regulator - the Securities and Stock Market State Commission in Ukraine (hereafter SSMSC). SSMSC had received a statutory power to perform government regulation of the stock market and control over the securities issues and transactions. In 1997 the Law of Ukraine on the National Depository System and Electronic Circulation of Securities was passed. It stipulates the creation of a two-level National Depository System in Ukraine. The upper level of the system includes the National Depository of Ukraine and other depositories; custodians and registrars represent the lover level.

According to the Law (1997), depositories in Ukraine are established in the form of a joint stock company and perform securities settlements on securities accounts that are opened by participating custodians. Only locally licensed are allowed to open such accounts with depositories. Custodians perform safekeeping and settlement of dealers'/brokers' or investors' securities on securities accounts (custody service) that are opened according to the custody agreement between custodian and an investor. Securities can be issued in Ukraine either in a paper or a book-entry form. Book-entry form securities are presented by correspondent account entries with a custodian or a depository, whereas paper

form securities are a paper certificates handled by local registrars, which are entitled to list owners of the paper form securities. Paper form securities issues in Ukraine were originally connected with the small-scale privatization process started in 1990s. The government issued numerous registered privatization certificates (vouchers), which became widely spread and required the creation of special registrars for performing ownership registration. In that way registrars in Ukraine appeared. According to the Law (1997), in order to enable trading of the paper form securities at the organized market, they have to be immobilized in the Nominee Name of the Depository that serves them. Immobilization of paper form securities implies their placement into the vault of either a custodian or a depository and a simultaneous crediting of such securities to a securities account by correspondent book entry executed by custodian or a depository. Thereby, a custodian or a depository acts as the Nominee Owner of the securities on behalf of the Beneficial Owner. Table 2.2 presents the description of other legislative acts, which relate to the development of stock market in Ukraine.

According to the SSMSC information, as of January 1, 2005 the Ukrainian stock market included 780 securities brokers/dealers, 140 custodians, 371 registrars, 10 organized trading places and 1 depository – the Interregional Securities Union. The Interregional Securities Union is the only Depository that services shares and corporate bonds by providing both settlement and clearing. It also acts as the Nominee Owner for the immobilized securities. However, it does not have a guarantee fund while some custodians do, that's why investors often prefer to immobilize securities into custodians Nominee Names. The two other depositories, the National Bank of Ukraine and the National Depository of Ukraine, are not directly reported to SSMSC. The National Bank of Ukraine services government bonds, whereas the National Depository of Ukraine performs mainly a representative function and assigns international codes to issued securities.

In 2004 stock market of Ukraine serviced UAH 321.3 bn of securities trading. Figure 2.1 shows the dynamics of trading volumes in the 1998 – 2004 period.

Stock Market Trading Volume, UAH billion
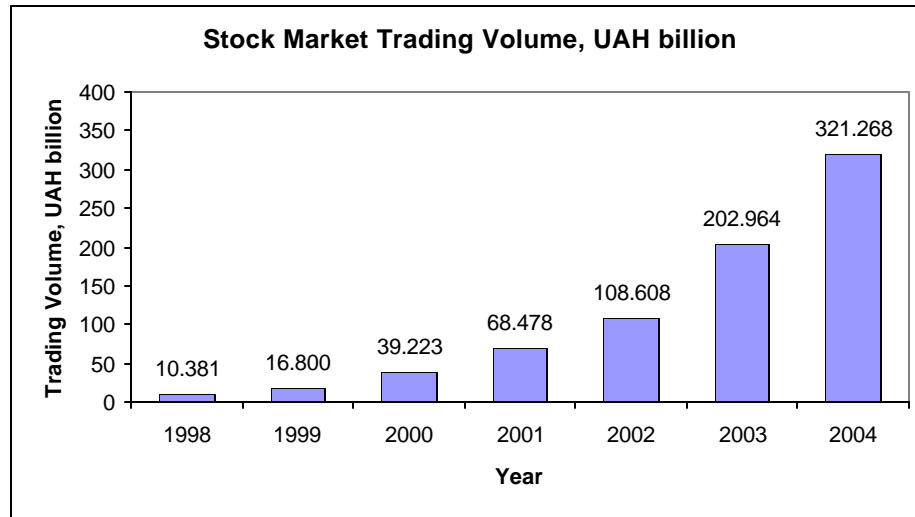
* Source: SSMSC annual reports

Figure 2.1 – Stock Market Trading Volume, UAH billion, 1998-2004

The volume of securities traded at the stock market has clearly exhibited a permanent growth since 1998. The largest rise in YoY terms took place in 2000, when trading volume at least doubled in comparison with the previous year.

Securities in Ukraine can be traded either at regulated market or over-the-counter (OTC). The regulated market consists of a several organized trading places, where dealers and brokers meet to conduct trade on behalf of securities investors. At the OTC market securities trade is usually conducted over the phone or computer making it impossible to be regulated. In Ukraine trading of securities at the OTC market prevails by several times trading volume at regulated places (see Figure 2.2).

Division Between OTC and Regulated Market

Trading Volume, UAH billion

350
300
250
200
150
100
50
0

1998 1999 2000 2001 2002 2003 2004

Year

☐ OTC Market Trading Volume, UAH billion ☐ Regulated Market Trading Volume, UAH billion
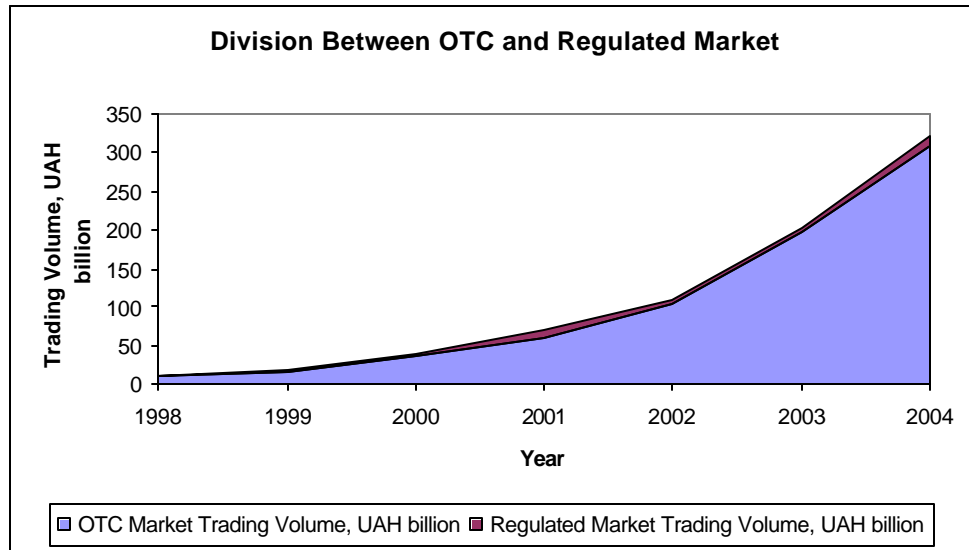
* Source: SSMSC annual reports

Figure 2.2 – Division between OTC and Regulated Market, UAH billion, 1998-
2004

Several reasons justify the predominance of the OTC over the organized market
in Ukraine. Firstly, investors usually do not will to disclose their names to public
or regulators. Since general trading rules at organized trading places usually
require from brokers to report the names of investors, they prefer to trade
securities over-the-counter and report to the SSMSC directly only the volumes of
securities traded. Secondly, according to the effective Ukrainian legislation, any
financial transaction in Ukraine should be performed in national currency. That is
why, organized trading places put quotes on traded securities in hryvnia and
register agreements in hryvnia terms. Foreign investors are usually reluctant to
make investments in hryvnia because of the liquidity risk. They prefer to conclude
agreements at the OTC market with the monetary transactions itself made in
foreign currency outside Ukraine. Since 1998 volumes of securities traded OTC
usually exceeded 85% of total securities trading in the country. Currently,
information on volume of OTC trading is the only existing statistics related to the

OTC market. Organized trading places, in contrast, usually provide more detailed information on securities trading, i.e. bid and ask quotes, daily closing prices, shares rating, etc., however, the role of this market is very limited. The lack of information on the OTC trading complicates much a research on Ukraine's stock market.

2.2 PFTS

As of January 1, 2005 10 organized securities trading places were registered in Ukraine. Table 2.3 presents complete list of them. The First Stock Trading System (hereafter PFTS) is the leading organized trading place in Ukraine with respect to volumes of securities traded in it. PFTS was created as a self-regulatory organization with its own electronic trading-information system (NASDAQ – like OTC exchange).

Several features distinguish the PFTS on the Ukrainian stock market. First of all, it has the biggest trading volume in comparison with other trading places. Since 1998 its share in total securities trading at the organized market never fell below 52% (see Figure 2.3). It has the biggest quotation list of securities traded (around 350[1]) and the biggest list of its members from all over Ukraine (around 160). Also, the IMF mentions the Ukrainian stock market by referring to PFTS (Kruvovyazuk, 2002). The Standard & Poor's Rating Agency uses PFTS data for computation of Ukraine's country index.

Trading of shares and corporate bonds at PFTS is accomplished mostly on the basis of *a dealer-driven principle*. This principle implies that the PFTS members present their quotes for particular securities and are obliged to trade securities at these declared quoted prices, also known as firm prices. Besides, under this

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[1] All the statistics about Ukrainian Stock market hereinafter refers to January 1, 2005, unless otherwise is specified.

principle they are free to choose the way an agreement is realized – either a 'delivery versus payment' or a 'delivery free of payment' method of settlement. Trading of government bonds is usually based on *an order-driven principle*. According to it, trading of securities is executed automatically if orders for sale and purchase match. Sometimes *a single-price auction principle* is utilized, when a seller is seeking for the highest price, and a buyer - for the lowest. After call orders are collected at the market, trade agreements are arranged. No matter which principle is used in arranging agreements, the PFTS members execute all trading settlements through securities accounts opened in custodians.

Trading volume of PFTS in the total trading volume of the Trading Places expressed at the Figure 2.3:
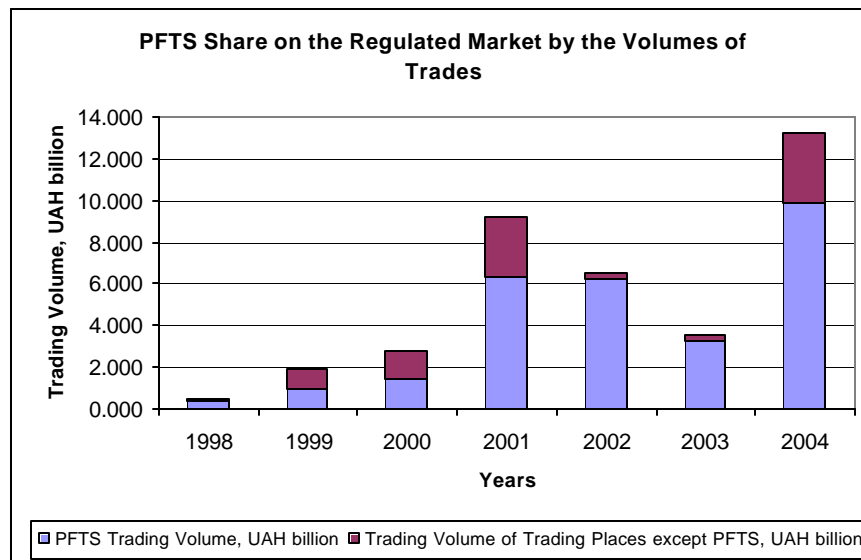
* Source: SSMSC annual reports, PFTS annual reports

Figure 2.3 – PFTS Share on the Regulated Market by the Volumes of Trades, 1998-2004

Between 2000 and 2001, the PFTS experienced the largest increase in its trading volume, by almost 330%. This was mainly attributable to the introduction of government bonds trading. However, a decrease in trading of government bonds in 2003 led to a correspondent decrease in the total trading volume by about 48% as compared with 2002.

2.3 Depositary Receipts

Depositary Receipt (DR) is a receipt issued by a foreign bank (foreign depository or global custodian) for domestic shares that are held by either a domestic custodian or a domestic depository according to the sub-custodian agreement with the foreign bank. Actually the DRs are the oversea shares that are backed by existing domestic securities. As the DR program is established, the new shares start its turnover at foreign capital market, while correspondent domestic securities are safe kept. Depending on where the major issue offer is made, depositary receipts are distinguished between the American Depositary Receipts (ADRs are placed mostly at the American market) and the Global Depositary Receipts (GDRs are placed at any other market) (Velli, 1994). The first ADR was issued by JPMorgan in 1927 for the British retailer Selfridges, and was listed at the New York Curb Exchange (JPMorgan, "75th Anniversary of the ADR"). The major reason behind the ADRs invention was a need to facilitate purchases of non-American shares by the American companies and provide the non-American companies with a possibility to trade its shares in the USA. ADRs are the US securities, denominated in US dollars, which pay their owners dividend payments in US dollars as well. The US Securities and Exchange Commission (hereafter SEC) registers all the issues of the ADRs, with the fulfillment of the stated disclosure requirements. DR also keeps valid the voting right of a correspondent domestic share. DRs provide benefits both to investors and companies issuing them. Investors usually gain from a relatively easy way to purchase foreign shares

and diversify their portfolios. Issuers of DRs usually benefit from wider access by investors to their securities and increasing company's profile at foreign markets.

JPMorgan ADR Reference Guide distinguishes several benefits of the launch of the DR programs. They are presented in Table 2.1

An issuer seeking to launch the DR program contracts a foreign depository or its local sub-custodian to perform jointly the DR issue. This approach is called *sponsored DR program* Otherwise, if a foreign investor is interested in purchasing foreign shares and appoints a foreign depository to carry out the purchase (usually with no notification of the local issuer of shares), the DR program is called *unsponsored* (Citibank, N.A. "Depositary Receipt, An Information Guide"). Overall, there are five major types of DR programs: ADR Rule 144A, GDR Reg S and ADR Level I, II, III.

ADR Rule 144A is a private placement of DRs among the qualified institutional investors. This kind of DRs is traded through the PORTAL electronic system, specially designed for this rule issues. ADR Rule 144A program does not require SEC review or GAAP reconciliation. The second type of DR program, GDR Reg S, foresees that the issuer of DRs raises capital outside the USA. That's why, these securities issues do not require the fulfillment of any SEC requirements. Level I ADR traded at the OTC market (through the Pink sheet information service) is subject to only minimum registration requirements set by the US Securities and Exchange Commission, i.e. provision of domestic financial statement or under special circumstances its summary in English. Level II ADR can be listed either at Stock Exchange or OTC-stock exchange. The issuer of this DR program must meet both the Trading Place's and the SEC requirements on financial statements disclosure. Level III ADR program on raising capital is subject to special information disclosure requirements. Particularly, it requires

GAAP reconciliation and annual submission of special forms to SEC. Table2.2 contains a comprehensive summary of the above-described DR programs.

On the side of launching the DR program for Ukrainian shares, it should be mentioned that the only custodian that acts as a sub-custodian in DR programs is the ING Bank Ukraine. Since 1997 there exist a sub-custodian agreement between the Bank of New York and the ING Bank Ukraine on accomplishment of DR programs. According to it, shares traded within the DR programs should be registered into the ING Bank Ukraine Nominee Name, while Nominee Names of other custodians or depositories are inappropriate. This agreement implies that any Ukrainian legal entity willing to launch the DR program should open a securities account in the ING Bank Ukraine and immobilize its shares into Nominee Name of the ING Bank Ukraine. Therefore, only paper form shares of Ukrainian companies eligible for further immobilization into the ING Bank Ukraine Nominee Name can be traded within the DR programs. Book-entry shares are not used in the DR programs in Ukraine with a few exemptions. On the one hand, an existing monopoly limits the development of the Ukrainian stock market; on the other hand, due to the fact that ING Bank Ukraine – present in the Ukrainian market – meets technical requirements of US Security and Exchange Commission as a market participant in contrast to most other components of the local market infrastructure, it allowed to introduce a new instrument for Ukraine which is Depositary Receipts.

The scheme for the DR issue and program cancellation is presented at Figure 2.4

LITERATURE REVIEW

We have divided the literature review part into 3 sections. In the first section we analyzed the papers that deal with DR. We will review the theoretical findings in the field of introducing the DR. Second part is devoted to the influence of the cross-listing on the return of shares. In the third part we will overview the models that described the multiple trading at the stock market.

Following papers highlight the benefits for the investor from the introduction of a DR program.

Foester et al. (1999) examined 153 ADR Level II and Level III and explained the reduction of the risk premium during the year following listing in accordance with segmentation theory. However, the lager number of shareholders can contribute to the decrease together with higher liquidity inherited in US market. Investors are interested in putting their financial resources into DR also because of diversification. Alaganar (2001) investigated 24 Australian ADRs for more then 10 years of daily and monthly returns in order to check the hypothesis about low correlation between Australian ADRs and American stocks. Author determined that there is an opportunity for diversification because the correlation between Australian ADRs and American stocks was low. Arnold (2004) analyzed sample of 85 securities and also derived that there is an incentive to combine US shares with ADRs because of diversification opportunity. Choi (2000) analyzed 2 samples of ADRs from 1990 to 1993 and from 1994 to 1996. The reason for dividing one period into two was caused by the European exchange rate shock in 1993. Author found the determinants of ADR: firm-specific factor, world market factor, country factor, industry factor and exchange rate factor, that approval the segmentation theory.

This group of papers measured the effect of cross-listing on the return on the shares.

There is an opinion that international cross-listing leads to the excess returns. Alexander et al. (1988) analyzed those shares of the firms that were listed at NYSE, AMEX and NASDAQ within the period from 1969 to 1982. 34 firms were included into the sample. They found the evidence of decline in excess returns of the shares after the cross-listing in the case of segmented capital markets. Callaghan et al. (1999) found that ADRs that are already traded at the NYSE for a year yield exhibited higher excess return then those traded at AMEX or NASDAQ. Evidence that ADR causes abnormal returns on the listing day was showed by Jayaraman et al. (1993).

Multi-market trading models:

Pagano (1989) examined the relationship between trading volume and liquidity. He built the model based on the mean variance utility with respect to wealth. He imposed restriction in terms of individual conjecture about market equilibrium. Then he derived the stock demand function and found Nash equilibrium conditions. After that he found conditions based on which traders are concentrated in one market and choose to trade centralized instead of searching.

Chowdhry et al. (1991) considered inform and liquidity traders in the market. The liquidity traders are risk neutral market makers that traded because of exogenous reasons. Informed traders maximized their profit from the private information they obtained. Trading of the same securities in the different markets does not exhibit information lags, however the trading of "nonidentical securities that are affected by common factors such as stock and their derivative securities" exhibits short term information lags.

In the thesis we will use frequently the research on international cross-listing of Domowitz, Glen and Madhavan (1998). This paper provides us with a basic model for the investigation of the information linkages between domestic and foreign markets. Authors developed the mean-variance investor's utility function from which they derived basic trading conditions. Based on the previous research of Glosten et al. (1985) the trading process with respect to private and public information is built. Observable market price is divided into processing cost element, asymmetry information cost and expected value of an asset. Further the key relationship between variance of close-to-close price change, trading volume, variance of innovation and bid-ask bounce variance established. This equation stands as a basic equation in the field of estimation the information linkages between markets. The level of information linkages between two markets based on the volatility-volume pattern with respect to the dummy variable which exhibits the information after the issue of DR.

Glosten et al. (1985) examined properties of transaction prices and bid-ask spread with respect to the private information. Besides the assumption of zero transaction costs authors determined that the bid-ask spread might be caused by the adverse selection. Among other things, bid-ask spread depends on the elasticity of demand and supply among liquidity traders, arrival of the informed investors (insiders) and the information they are holding.

DATA DESCRIPTION

We analyze the effect of DR issue on price and volume of shares traded for the Ukrainian company, for which the DR was issued (cross-listing effect). Our data sample relates to the period between 22.01.1997 and 01.11.2004. The period's starting date coincides with the day of the first official report on daily prices and trading volumes provided by the PFTS. We limit our sample till 01.11.2004, when the first round of the presidential elections was over in Ukraine. For research purposes we use only information on the issues of shares of the Ukrainian entities, for which DR programs were launched. The data on DR programs are provided by the Bank of New York (www.adrbny.com). Table 3.1 provides the list of DR programs launched during the period under consideration. The first Ukrainian DR program was launched in May 1998 for the shares of the Ukrainian Energy Company "Centrenergo". It was an Unsponsored GDR Reg S-type program. In April 1999 three ADR Level I programs were introduced for the shares of the metallurgical enterprise "Azovstal", energy company "Dniproenergo" and oil and gas producer "Ukrnafta". The first sponsored GDR Reg S-type program was launched in December 2002 for shares of ore mining and processing enterprise "Sukha Balka". Total number of DR programs started during the period under the analysis is 34.

Division into different types of DR programs with respect to the launching year presented at the following Figure 3.1

Types of the DR program per year for the period from 22.01.1997 to 01.11.2004

Chart y-axis: DR program (0–12); x-axis: Year (1998, 1999, 2000, 2001, 2002, 2003, 2004)

Legend: ☐ Sponsored - Level 1 ☐ Sponsored - REG S ☐ Unsponsored - REG S
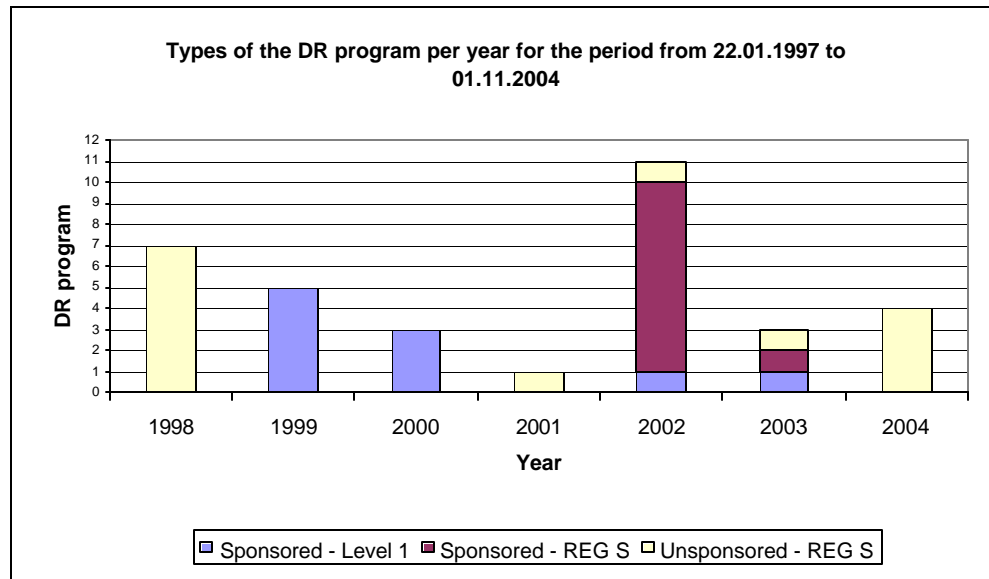
* Source: www.adrbny.com

Figure 3.1 – Types of the DR program per year for the period from 22.01.1997 to 01.11.2004

During the analyzed period 14 Unsponsored ADR/GDR programs, 10 Sponsored ADR/GDR programs and 10 ADR Level I programs were launched. Since 1998 to 2001 number of launched DR programs was constantly decreasing. In 2002 the biggest number of DR issues took place with further decline in 2003. In 2004, however, the number of the launched DR programs has slightly increased compared with 2003.

Based on the list of the launched DR programs, we determine the sample of the legal entities under investigation. The list is further reduced to only those shares of enterprises, for which Depositary Receipts were issued. Date of the program launching means that all necessary requirements were passed up to this day and DR issue could be performed. However, it does not imply that DR issue should be realized exactly at that day. Moreover, some programs were launched, however DRs were not issued for several years. We also disregard from the list those

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companies, which shares have never been listed at the PFTS or have been included into its listing after issue of DR. We correct our sample by ignoring the companies, which shares were listed at the PFTS but not traded. All above implies that our sample is somewhat reduced. The adjusted list of the launched DR programs is presented in Table 3.2. The Figure 3.2 exhibits the distribution of the DR programs by year of launching.

Types of the DR program per year for the period from 22.01.1997 to 01.11.2004
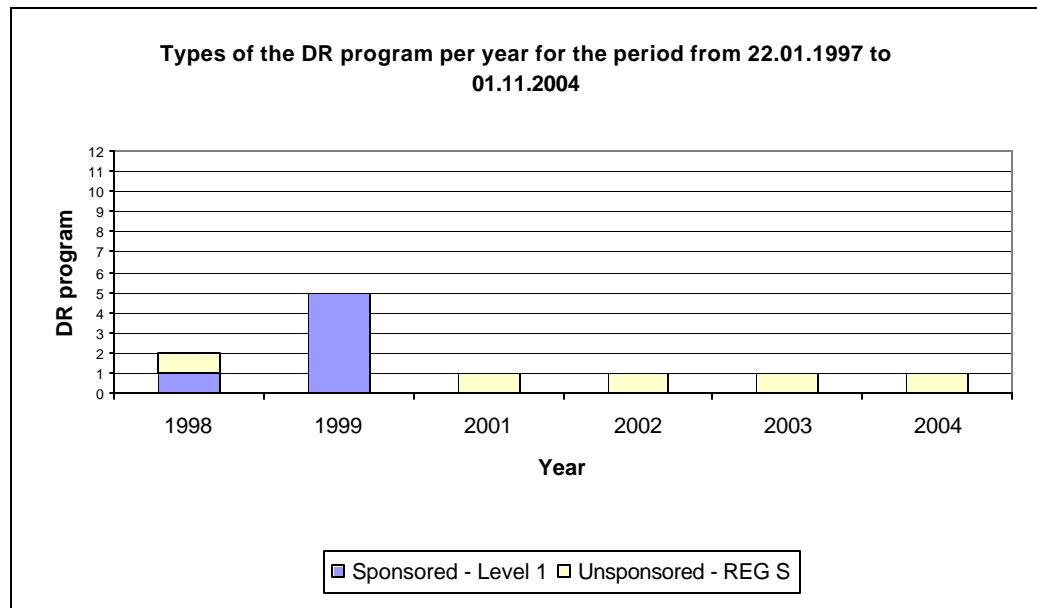
Figure 3.2 – Types of the DR program per year for the period from 22.01.1997 to 01.11.2004

The adjusted data sample consists of 11 DR issues. It decreased by 23 launching DR programs: 16 launching DR programs were never transformed into actual issue of the receipts, 1 was excluded due to its absence in the PFTS listing, 4 because they were not shortly traded at PFTS after the issue of DR and 2 because of the actual issuer of DR outside the period under investigation. With regard to the types of DR programs our sample consists of 5 Unsponsored ADR/GDR issues and 6 ADR Level I issues.

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In contrast to the data described above, the information from the PFTS trading archive that we used in our research has not been publicly available yet. In our research we used the daily trading results of the listed Ukrainian shares. Namely, we selected daily closing prices and trading volumes for the enterprises in our sample from the PFTS daily trading reports. Overall, the analyzed period included 1893 trading days at PFTS. We composed following characteristics of our data: Trading Coef, Volume and Volatility. Trading Coef computed as ratio of days when trading occurs to total days when underlined issue of shares was listed. We calculate Volume as an average number of traded shares and Volatility as a standard deviation of the changes in daily closing prices. Table 3.3 presents the descriptive statistics of the data sample.

Based on the descriptive statistics we would compose our sample only on those issues of shares that are actively traded at the PFTS (trading coefficient is greater then 20%) except UTEL and STIR because of low number of trading days before and after DR issue. The sample we will use in the econometrician model is presented in Table 3.4.

Table 3.4

Descriptive Statistics

In Table PFTS TICKER represents the code assigned by PFTS to the series of shares of the Ukrainian legal entity, ISSUE DATE represents the day of the actual issue of the receipts. All other values were computed based on the daily trading reports of PFTS. DAYS BEFORE and DAYS AFTER represent the factual days when underlined issue of shares was listed before and after issue of DR program. TRADING DAYS BEFORE and TRADING DAYS AFTER represent the factual number of days when underlined issue of shares was traded before and after issue of DR program. TRADING COEF calculated as ratio of trading days to factual days when underlined issue of shares was listed. VOLUME calculated as the average number of traded shares, this coefficient measures in the thousands of shares. VOLATILITY (CHANGES IN CLOSING PRICES) calculated as standard deviation of changes in closing prices. Both

VOLUME and VOLATILITY coefficients calculated for the periods before and after introduction of DR program.

PFTS TICKER	ISSUE DATE	DAYS, BEFORE	DAYS, AFTER	TRADING DAYS, BEFORE	TRADING DAYS, AFTER	TRADING COEF.	VOLUME, BEFORE	VOLUME, AFTER	VOLATILITY (CHANGES IN CLOSING PRICES), BEFORE	VOLATILITY (CHANGES IN CLOSING PRICES), AFTER
UNAF	Sep-99	648	1243	307	800	0.59	12.595	19.368	0.803	3.690
NITR	Apr-00	774	1118	230	187	0.22	11.317	16.104	1.062	0.291
DNEN	Jul-00	740	1045	313	362	0.29	0.632	1.163	19.580	11.844
CEEN	Oct-00	740	993	284	347	0.38	76.469	122.799	0.167	0.086
ZAEN	Jun-03	1498	330	512	137	0.08	2.940	3.045	2.888	1.708

* Source: PFTS daily trading reports, Internet sites.

According to our summary statistics all issues of shares exhibit increase in average daily volume of traded shares after the issue of the DR. Also, 4 issues of shares exhibit decrease in standard deviation of changes in closing prices after the issue of the DR. Thus, 4 issues of shares exhibit simultaneous increase in volume and decrease in volatility after the issue of the DR.

METHODOLOGY

In this section we present the theoretical model that allows us to investigate information linkages between domestic and foreign stock markets. The model was developed by Domowitz et al. (1998) for the first time. We start from investor's behavior modeling. Then we derive expressions for daily trading volume and price movements. The key resulting point is that stock price volatility can be decomposed into three elements: volatility of innovation, volatility of bid-ask bounce and expected daily trading volume corrected by the coefficient, equivalent to the inverse measure of market liquidity. We use this relationship further in our empirical estimations. Then we introduce a simultaneous listing of shares on a foreign market described by the same model as domestic one. Domestic price for a stock traded abroad equals foreign market price plus random variable. Based on the variance of the random variable we compose market integration and market fragmentation conditions.

Following Glosten et al. (1985) we impose several assumptions for stock market modeling. The first assumption concerns type of trading orders at stock exchange. We assume only *market orders*. This implies that an investor instructs a broker to buy shares at the best available price. Contrary to *market order, limit order* implies instruction to broker to buy at the best possible price that does not exceed previously set limit price. Generally, limit orders have exact time period of validity. Therefore, the optimal investor's decision is based on the volume of limit order and time period when it is valid. To simplify the model, we do not consider *limit orders*.

The second assumption relates to unit trade. We assume that investor can sell or purchase only one unit of shares per one unit of time. By this we imply that a dealer is able to respond to the information available at the market through the revision of bid and ask prices.

Denote x_k as a market order preferred by the investor k, x_k is a discrete random variable with specific values $\{+1, 0, -1\}$, $x_k = +1$ refers to "buy 1 unit of asset", $x_k = 0$ means "do nothing" (or do not trade) and $x_k = -1$ refers to "sell 1 unit of asset". We also assume that both dealer and investor can observe present and past trading information and that dealer is aware about investor's appearance in the market.

The trading process described by our model is the following: an investor is informed about dealers' quotes and can either buy 1 unit of stock, sell 1 unit of stock or do nothing. After trading takes place a dealer revises his quotes in order to respond to the information brought with trading. Thus, a dealer can either leave old prices or set new ones before new trading. Investor in turn observes new prices and decides whether to trade.

Despite the fact that there are no restrictions on ownership for foreign investors in Ukraine, i.e. both domestic and foreign owners are treated equally, we would like to describe them separately for the sake of consistency of the model. Denote n_d and n_f a number of domestic and foreign investors correspondingly at the domestic stock market in a given time point. We assume Poisson distribution for probability structure for n_d and n_f random variables. Let $\boldsymbol{q}_d$ and $\boldsymbol{q}_f$ be a mean number of occurrences of domestic and foreign investors at the domestic stock market per one day respectively, $\boldsymbol{q} = \boldsymbol{q}_d + \boldsymbol{q}_f$.

To describe the share prices at the market we provide several notions: let v_k denote the fundamental share value; let $\boldsymbol{m}_k$ denote the expected fundamental share value that is based on the past information on trading, $E[v_k] = \boldsymbol{m}_k$. Let $p_k(x_k)$ denote the price quotation function, its value is observable at the market. Let y_k denote the private information of investor on shares. Therefore, from investors' side, the expected value of an asset equals $y_k + \boldsymbol{m}_k$. Let $\boldsymbol{r}^2$ denote the variance of $y_k + \boldsymbol{m}_k$, $\boldsymbol{r}^2 = Var(y_k + \boldsymbol{m}_k)$. Let h_k denote investor's income with variance $\boldsymbol{s}_k$, a denote a risk aversion parameter and u_k denote the investor's mean-variance expected utility function; k subscript refers to the k-investor. Following Domowitz et al. (1998) we write down the function for u_k conditional on entering the market:

$$u_k = (\boldsymbol{m}_k + y_k + w_k - p_k(x_k))x_k - a\boldsymbol{r}^2 x_k^2 + E[h_k] - a\boldsymbol{s}_k^2, \text{ (1)}$$

where $w_k = -2aCov(h_k, v_k)$. The increase in w_k increases share value as an investor hedges against income fluctuations. The first element in the mean-variance investor's expected utility function $((\boldsymbol{m}_k + y_k + w_k - p_k(x_k))x)$ reflects the mean profit from trading of shares; it contributes positively to utility increase. The second element $(a\boldsymbol{r}^2 x_k^2)$ exhibits the variance of profit from trading of shares and contributes negatively to utility increase. The third $(E[h_k])$ and the fourth $(a\boldsymbol{s}_k^2)$ elements exhibit investor's expected income and variance of investor's income respectively, they contribute similarly to the u_k as the first two elements. Investor's optimization problem is to select the x_k that maximizes his utility function.

According to Glosten et al. (1985) a dealer updates his expectation about the expectation of fundamental share value v_k after transaction takes place, particularly "…it is necessarily the case that expectation of v are revised upward in response to specialist sales, and revised downward in response to specialist purchases." Therefore, we can write $\boldsymbol{m}_k = \boldsymbol{m}_{k-1} + \boldsymbol{l}x_k$, where $\boldsymbol{l}$ is an information impact of trade. Following Domowitz et al. (1998) we state $p_k(x_k) = \boldsymbol{m}_k + sx_k$, where s captures "…both the order processing cost element of the bid-ask spread as well as any rents accruing to dealer market power". Glosten et al. (1985) found that trading frequency influences negatively the s.

From the first two elements from the utility function we derive the investor's trading condition:

$$(\boldsymbol{m}_k + y_k + w_k - p_k(x_k))x_k > a\boldsymbol{r}^2 x_k^2, \ (2)$$

Particularly, investor will buy share $(x_k = +1)$ when $(\boldsymbol{m}_k + y_k + w_k - p_k(x_k)) > a\boldsymbol{r}^2 \Leftrightarrow y_k + w_k > a\boldsymbol{r}^2 + s$; investor will sell share $(x_k = -1)$ when $-(\boldsymbol{m}_k + y_k + w_k - p_k(x_k)) > a\boldsymbol{r}^2 \Leftrightarrow y_k + w_k < -a\boldsymbol{r}^2 - s$. Denote $\boldsymbol{x}$ as a probability that investor will not trade $(x_k = 0)$, thus $\boldsymbol{x} = \Pr ob[x_k = 0] = \Pr ob[|y_k + w_k| < a\boldsymbol{r}^2 + s]$. Therefore, probability increases with increase in both processing costs s and variance of the expected value of an asset $\boldsymbol{r}^2$ multiplied by risk aversion parameter a.
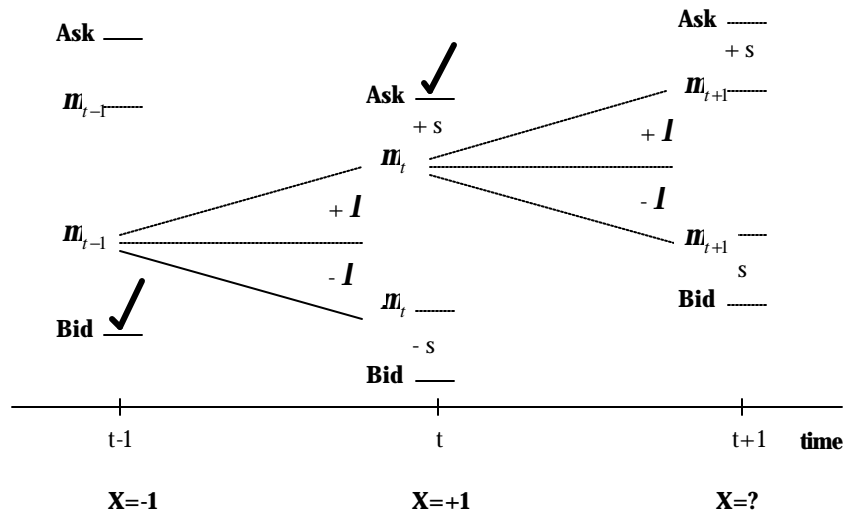
Trading process is presented at the Figure 4.1

Figure 4.1 – Trading process

Suppose at time $t-1$ investor sold one unit of stock to dealer, $x_k = -1$. Dealer revises his expected fundamental value of stock $\boldsymbol{m}_k$ by the value of obtained information asymmetry $\boldsymbol{l}$. Thus, taking into account processing costs s dealer establishes new Bid and Ask prices for period t. Investor observes new prices and decides to buy an asset, $x_k = +1$ in period t. Dealer again revises $\boldsymbol{m}_k$ and establishes new Bid and Ask prices for period $t+1$.

Consider the trading volume per one day. By unit trade assumption it equals $\sum_{k=1}^{N} |x_k|$. Based on the probability that investor would not trade we can set expected daily volume of unit trade equal to the product of two expressions:

$$E\left[\sum_{k=1}^{N} |x_k|\right] = (1-\boldsymbol{x})(\boldsymbol{q}_d + \boldsymbol{q}_f), \ (4)$$

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In equation (4) expected daily trading volume is negatively related to $\boldsymbol{x}$, consequently it depends negatively on both processing cost element s and variance of the expected value of asset $\boldsymbol{r}^2$ multiplied by risk aversion parameter a.

Following Domowitz et al. (1998) the change in opening and closing prices and its variance equals to:

$$p_N - p_0 = \boldsymbol{l} \left(\sum_{k=1}^{N} x_k \right) + s x_N , \quad (5)$$

where p_N, p_0 are closing and opening prices respectively.

In equation (5) both impact of trading and processing costs influence positively the change in prices. Moreover, "…enclosed term represents the cumulative order imbalance, and the last term represents the effect of bid-ask bounce" (Domowitz, 1998). We see, that the influence of the first element on the intraday price change is measured by the value of $\boldsymbol{l}$. The higher the $\boldsymbol{l}$, the greater the impact of cumulative order imbalance. From this result we can derive new explanation of $\boldsymbol{l}$ as an inverse measure of market liquidity. Equivalently market liquidity is measured by $\boldsymbol{l}^{-1}$.

$$Var(p_N - p_0) = \boldsymbol{l}^2 (1 - \boldsymbol{x})(\boldsymbol{q}_d + \boldsymbol{q}_f) + (s^2 + 2\boldsymbol{l}s)Var(x_N) , \quad (6)$$

Denote $\boldsymbol{w} = (s^2 + 2\boldsymbol{l}s)Var(x_N)$, whereas processing costs influence positively bid-ask bounce volatility $\boldsymbol{w}$, whereas market liquidity $\boldsymbol{l}^{-1}$ influences negatively bid-ask bounce volatility $\boldsymbol{w}$. Hence we can rewrite our expression as:

$$Var(p_N - p_0) = \boldsymbol{l}^2 (1 - \boldsymbol{x})(\boldsymbol{q}_d + \boldsymbol{q}_f) + \boldsymbol{w} , \quad (7)$$

Using equation (4) we derive that intraday price volatility depends on the expected daily trading volume with coefficient that is an inverse measure of market liquidity plus bid-ask bounce volatility.

Let e equal to the innovation between the last day closing price and the today's opening price, therefore, the change in closing prices equals to $p_N - p_0 + e$. Based on the equation (7), variance of the change in closing prices equals to:

$$Var(p_N - p_0 + e) = l^2(1-x)(q_d + q_f) + w + Var(e), \text{ (8)}$$

Denote $g = w + Var(e)$, hence we can rewrite our expression as:

$$Var(\Delta p) = l^2(1-x)(q_d + q_f) + g, \text{ (9)}$$

We provide the following interpretation for the derived expression: the first element ($l^2(1-x)(q_d + q_f)$) exhibits the expected daily trading volume with the coefficient that is an inverse measure of market liquidity, the second element g is the sum of volatilities, one is the volatility of the bid-ask bounce, other one exhibits the volatility of innovation.

Let's introduce domestic shares traded abroad. Foreign market is modeled in the same way as domestic market. The only difference is the notation: we use capital letters for foreign market and small letters for domestic market. Let foreign quotes for the share are observed in the following form at domestic market at time t: $P_t(X_t) + Q_t$, where Q_t is a random variable with variance $Var(Q_t)$. We distinguish between integrated and fragmented markets based on the value of the $Var(Q_k)$. Suppose $Var(Q_t)=0$, hence values of the price quotation function $P_k(X_k)$ are freely observed at domestic market or we can say that markets are

integrated. On the other hand, $Var(Q_t)=\infty$ exhibits the market fragmentation, which means absence of information linkages between the two markets. It is possible a partial fragmentation case, when $Var(Q_t)\in(0,+\infty)$. Partially fragmented markets reflect the situation, when some segments of domestic stock market are integrated with foreign ones and others are fragmented. Therefore, $Var(Q_t)$ is an inverse measure of market transparency that reflects the information linkages in terms of quoting prices between two markets.

There are several common conditions regardless the level of information linkages between the two markets. After the introduction of trading of shares abroad it is naturally to assume that the cost of entering the foreign market C_k is lower then the cost of entering the domestic market c_k for the investor k, $C_k < c_k$. Otherwise, the introduction of trading of domestic share abroad would be meaningless. Therefore, there might exist an investor intended to enter the domestic market but not doing so because of high entering costs. Such an investor will go abroad. Consequently, we would expect that intensity of trading will either stay the same or decrease at domestic market after the introduction of trading of shares abroad, simultaneously the combined intensity at two markets will either increase or stay the same. From equation (4) the expected daily volume of unit trade relates directly to the trading intensity. Ultimately, we can state that regardless the level of information linkages between the two markets the expected daily volume of unit trade at domestic market will either fall or stay the same if trading intensity decreases or does not change respectively. Simultaneously, the combined expected daily volume of unit trade will either increase or stay the same if trading intensity increases or does not change respectively.

Consider the case when $Var(Q_t)=0$. This implies that markets are integrated. Therefore, we examine one market instead of foreign and domestic markets

separately. At integrated market the prices for the same stock are equal $p_k = P_k = m_k + sx_k$. Moreover, $s < s_{old}$, where s denotes processing costs after the introduction of trading of shares abroad, s_{old} denotes domestic market processing costs before the introduction of shares abroad. This relation holds because trading intensity influences negatively processing costs. Following Domowitz et al. (1998) we express information asymmetry costs l as $l = E[y_k \mid x_k = 1] = E[y_k \mid y_k + w_k > ar^2 + s]$, therefore, the decrease in processing costs s reduces information asymmetry costs l. Equivalently, with decrease in s the market liquidity l^{-1} increases. The combined expected daily volume of unit trade increases because of the increase in the probability of trading $(1 - x)$. This happens due to inverse relationship between s and $(1 - x)$. We would also expect the decrease in bid-ask bounce w, because it directly depends on both information asymmetry and processing costs and decrease in $Var(e)$ because of perfect information linkages between the two markets. From the equation (9) we conclude that g decreases because of the decrease in w and $Var(e)$.

Finally, in case of integrated market the market processing costs decrease, both market liquidity and market volume increase. The order flow migration also increases comparing with the period before introduction of trading of shares abroad. Appearance of new investors will increase order flow. Our conclusion also holds for domestic market as a constituent part of the combined integrated market.

Contrary to market integration we consider market fragmentation case. The domestically observed foreign price quotation function equals to $P_t(X_t) + Q_t$, $Var(Q_t) = \infty$. This implies that there is no transparency at two markets. We

would expect the orders of investor k for whom $C_k < c_k$ to flow out to the foreign market. Therefore, the trading intensity will decrease at domestic market. As a result, the processing costs s tend to increase together with the decrease in trading volume. Using the same logic as above, we conclude that information asymmetry costs l increase or equivalently the market liquidity l^{-1} decreases. Oppositely to market integration case, the g increases because of the increase in w and $Var(e)$. Order outflow will prevail under order inflow.

In partial fragmentation case both cases described above are absorbed. This is a more complex situation depending on whether the $Var(Q_t)$ converges to 0 or $+\infty$. Distinguishing feature of the partially fragmented market is the appearance of both arbitrage opportunity and competition between the two markets. Perfect information linkages would presume optimal price discovery at combined market. Therefore, it will be the case at both foreign and domestic markets as constituent parts of the combined market. Hence, observable true and genuine foreign prices for shares exclude both arbitrage opportunity and competition. Oppositely, the lack of information linkages makes foreign prices unobservable at fragmented markets. Thus, the arbitrage opportunity and price competition are also excluded. However, at partially fragmented market we do observe foreign prices at domestic market with $Var(Q_t)$ bias. Therefore, we can assume the existence of investors that are more informed comparing with the others that allows performing arbitrage. Generally, such market conditions would make dealers suspicious and treat every investor as those that obtain private information and intend to arbitrage. Therefore, the asymmetry costs l increase at domestic market with the decrease in domestic market liquidity l^{-1}. As a result, investor orders would outflow abroad.

Also it might be the dealers at domestic market that compete with foreign dealers. As a result, the processing cost element s decreases. From the expression $l = E[y_k \mid x_k = 1] = E[y_k \mid y_k + w_k > ar^2 + s]$, we conclude the decrease in information asymmetry costs l and increase in domestic market liquidity l^{-1}. Decrease in l will cause the increase in probability of trading $(1 - x)$. From equation (4) we derive the increase in volume and observe the order inflow.

Described above two opposite influences on the domestic market liquidity testify to implicit overall effect.

Let us consider some shares that are actively traded abroad to such a degree, that we could assume that price discovery process appears at foreign market. This implies the increase in the innovation influence $Var(e)$ on domestic prices. Considering the equation (9) the increase in $Var(e)$ would contribute positively to increase in closing price volatility, however the overall effect is ambiguous.

EMPIRICAL RESULTS

In our empirical model we measure information linkages between two markets based on the analysis of volatility and volume of traded shares before and after DR issue. According to the relationship from the theoretical model, volatility of close-to-close prices depends on the expected daily trading volume with coefficient that is an inverse measure of market liquidity, volatility of bid-ask bounce and volatility of innovation. Combining the latter two terms into one aggregated variable $\boldsymbol{g}$ (base-level volatility) we obtain equation (9):

$$Var(\Delta p) = \boldsymbol{l}^2(1-\boldsymbol{x})(\boldsymbol{q}_d + \boldsymbol{q}_f) + \boldsymbol{g} \quad (9)$$

Also, we assume that the close-to-close price difference is proportional to the variance of close-to-close price difference in the case when there are a large number of traders (Domowitz et al. 1998). Hence, the model we use for estimation explains the changes in close-to-close prices in terms of volume of shares and base-level volatility. Also, it is naturally to assume that yesterday change in close-to-close prices influences its today's value. We introduce dummy variable to distinguish the influence of the issue of DR. Following Domowitz et al. (1998), we build the following model:

$$(\Delta P_t)^2 = \boldsymbol{g}_t + \boldsymbol{d}_t(\Delta P_{t-1})^2 + \boldsymbol{l}_t V_t + \boldsymbol{h} \, , \, (10)$$

In the equation (10) $(\Delta P)^2$ denotes squared close-to-close price change with subscript t and $t-1$ referring to the today and yesterday values respectively, $\boldsymbol{g}_t$

stands for base-level volatility, d_t measures the influence of the lag value of squared close-to-close price change, l_t exhibits influence of volume and information asymmetry, V_t denotes the volume of traded shares and h is a disturbance term.

In order to measure the influence of the issue of DR we introduce into the model dummy variable ADR in the following form:

$$g_t = g_0 + g_1 ADR_t$$
$$d_t = d_0 + d_1 ADR_t \text{ , (11)}$$
$$l_t = l_0 + l_1 ADR_t$$

In the equation (11) subscript 0 refers to the state before the issue of the DR and 1 refers to the state after the issue of DR. From the theoretical model we can distinguish integrated and fragmented markets based on the value of the base-level volatility g_1 and measure of information asymmetry costs l_1. In the case of integrated market the issue of DR decreases both the base-level volatility $g_1 < 0$ and information asymmetry costs $l_1 < 0$. When markets are fragmented the information asymmetry costs l of domestic market increases $l_1 > 0$ and base-level volatility also increases $g_1 > 0$. In the partial fragmented market case we expect mixed values of the mentioned above coefficients.

For the sake of clarity we combine equations (10) and (11) into one equation:

$$(\Delta P_t)^2 = g_0 + g_1 ADR_t + d_0 (\Delta P_{t-1})^2 + d_1 ADR_t * (\Delta P_{t-1})^2 + $$
$$+ l_0 V_t + l_1 ADR_t * V_t + h \text{ , (12)}$$

We estimate the coefficients of the model using Generalized Method of Moments. This method is applied in our research because of its robustness to

possible autocorrelation and heteroscedasticity. The results are presented in Table4.1

<center>Table 4.1</center>

<center>**Estimates of the Coefficients of the Model**</center>

In Table 3.3 PFTS TICKER represents the code assigned by PFTS to the series of shares of the Ukrainian legal entity, COEFF. ST.ER and P-VALUE stand for coefficient value, its standard error and p-value. Coefficients are estimated by the Generalized Method of Moments utilizing the model proposed by Domowitz et al (1998):

$$(\Delta P_t)^2 = g_0 + g_1 ADR_t + d_0 (\Delta P_{t-1})^2 + d_1 ADR_t (\Delta P_{t-1})^2 + l_0 V_t + l_1 ADR_t V_t + h$$

In this model $(\Delta P)^2$ denotes squared close-to-close price change with subscript t and $t-1$ referring to the today and yesterday values respectively, ADR_t denotes the dummy variable, V_t denotes the volume of the traded shares (measured in tens of millions of shares).

PFTS TICKER		g_0	g_1	d_0	d_1	l_0	l_1
UNAF	COEFF	0.842	8.415	0.144	0.299	16.317	36.542
	ST.ER	0.225	2.636	0.083	0.146	21.605	38.823
	P-VALUE	0.00	0.00	0.08	0.04	0.45	0.35
NITR	COEFF	0.719	-0.414	0.486	-0.487	205.756	-201.960
	ST.ER	0.590	0.607	0.149	0.150	162.341	162.373
	P-VALUE	0.22	0.50	0.00	0.00	0.21	0.21
DNEN	COEFF	487.100	-200.314	0.167	-0.175	363.979*	-373.172*
	ST.ER	145.784	183.320	0.088	0.089	273.378*	276.802*
	P-VALUE	0.00	0.27	0.06	0.05	0.18	0.18
CEEN	COEFF	0.023	-0.013	0.325	-0.011	0.774	-0.770
	ST.ER	0.009	0.009	0.153	0.178	0.508	0.508
	P-VALUE	0.01	0.17	0.03	0.95	0.13	0.13
ZAEN	COEFF	14.628	-10.903	0.031	0.205	589.065	-661.766
	ST.ER	3.663	3.804	0.032	0.148	734.374	792.604
	P-VALUE	0.00	0.00	0.32	0.17	0.42	0.40

Superscript * denotes measurement in thousands.

The presence of the lag value of dependent variable among explanatory variables may indicate the presence of autocorrelation in the model. The occurrence of

autocorrelation, in turn, may be also the consequence of either incorrect functional form or excluded variable case.

In order to perform the test for serial correlation we employ Correlogram and Ljung-Box Q-statistics method. On the basis of the resulting correlograms for 10 lags of disturbance term from the volatility-volume regression we can conclude that for different shares we can not reject the null hypothesis of the absence of serial correlation. For UNAF, NITR and DNEN issues the value of the second order ACF is significant at the 5% confidence level; for ZAEN issue the value of the third order ACF is significant at the 5% confidence level order. Correlograms for CEEN do not show the presence of serial correlation.

The only variable that is not predicted by the methodology but that is present in our regression is lag of squared close-to-close price change. We introduce this variable into the model based on the serial correlation test. By this we try to examine the omitted variable bias. The summary results are presented in Table 4.2. Regression results are present in Table 4.3. Based on the obtained results we can say that we managed to find the specification of the model that produces uncorrelated disturbance terms. However, the obtained models do not have precise theoretical explanation and can be treated only from econometric point of view.

From econometric theory it is known that the serial correlation in disturbance term produced by OLS estimation method leads to linear and unbiased estimates, but inefficient. Also in large samples they obtain a consistency characteristic. In our research we use GMM method with specifying all explanatory variables as instruments that are uncorrelated with disturbance term. Therefore, we could treat our GMM estimators as OLS estimators. Thus, our estimators even in the presence of serial correlation are BLU. Moreover, we can state that our control variables g_1 and I_1 do not change the sign with respect to the added lags in the

regression. Since we are mostly interested in signs of the estimates described above, the problem does not prevent us to proceed to the statistical inference of our model.

Basically, estimators g_0 and l_0 are positive in all 5 regressions in both cases: with and without serial correlation in residuals. This implies that our empirical results support our theoretical model, namely, the decomposition of stock price volatility on base-level volatility and trading volume. According to the information linkages between domestic and foreign markets we can make the following conclusions: estimators g_1 and l_1 in 4 out of 5 regressions in both cases are less then 0. Based on the theory we can conclude that domestic stock market is integrated with foreign one. Contrary, the coefficients g_1 and l_1 of the UNAF regression are positive in both cases that maintains the conclusion of market fragmentation.

Finally, we can conclude based on the majority of our results that introduction of DR improves the market characteristics: base-level volatility decreases and market liquidity increases.

CONCLUSIONS

In this paper we investigated the influence of international cross-listing on the Ukrainian stock market. We found that introducing shares abroad within the sample under investigation improves market characteristics: base-level volatility tends to decrease and market liquidity tends to increase. According to the methodology developed by Domowitz et al (1998) we conclude that Ukrainian market is integrated with abroad market.

Precise attention was paid to the analysis of the Ukrainian stock market. We performed an overview of the legislation and presented market structure. Our conclusions highlighted such disadvantages of the market as huge number of professional members that complicates management of stock market and undercapitalization of market members that increases the counterparty risk. We also indicated the dynamics of trading volume with respect to the Regulated and OTC market. We presented several reasons that explain the predominance of the OTC trading over Regulated market: unwillingness of the investors to disclose their names moved them from Regulated market to the OTC market. Also, performing settlement in Ukrainian currency hryvnia causes appearance of liquidity risk that also moves investors to OTC market with hard-currency settlement (mostly in dollars). We highlighted possible estimation bias of any research performed in the Ukrainian stock market – the small ratio of Regulated market trading comparing with OTC trading exhibits that the stock market data might be unrepresentative.

We performed the analysis of the regulated market trading places and provided arguments for choosing PFTS as leading trading place.

Peculiarities of the Depositary Receipts issues for shares of Ukrainian enterprises are also discussed in the thesis. We showed that existence of single market participant (ING Bank Ukraine) implies the monopoly in the stock market, however for the moment it is the only participant, in contrast to most other components of local market infrastructure meeting the US SEC requirements, which introduces a new instrument for Ukraine -Depositary Receipts.

Data description was performed in two steps. We selected the number of launching DR programs and provided their basic description. At the second stage we composed our sample from domestic stock based on the list of the launched DR programs. Based on the descriptive statistics major of shares exhibit increase in volume and decrease in volatility after the issue of the DR. This implies the improvement of the characteristics of particular traded share, however, we can't make a general conclusion for the whole market.

The model we used in order to measure the cross-listing effect is based on information linkages. It was firstly developed by Domowitz et al. (1998). We approved this model in order to better suit to the Ukrainian environment. We aggregated several common conditions regardless the level of information linkages between the two markets. Namely, the expected daily volume of unit trade at domestic market will either fall or stay the same if trading intensity decreases or does not change respectively. Simultaneously, the combined expected daily volume of unit trade will either increase or stay the same if trading intensity increases or does not change respectively. Because of the absence of ownership limits for foreign investors we mainly focused the explanation of the partial fragmentation case on the market mechanism behavior instead of stock behavior. We considered the presence of arbitrage and competition as main

characteristics of partial fragmentized markets. Together with fundamental model of Domowitz et al. (1998) that treats domestic and foreign investors differently our amendments to the model can be in use when investors are treated equivalently.

The empirical model is also based on specification form proposed by Domowitz et al. (1998). We did not get rid from the nonstationarity in time series because of the expected long-term relationship between variables. Because of the undeveloped stock market and market customs of trading that do not report the results we composed our data sample from large samples of actively traded shares. We employed Generalized Method of Moments estimators because of its robustness to possible serial correlation and heteroscedasticity. We estimated 5 volatility-volume regressions for issues of the Ukrainian entities. Before we proceeded to the statistical inference, the serial autocorrelation was expelled. Based on the conditions from the theoretical model we found that major of the DR issues contribute to market integration case. However, there is an evidence of market fragmentation case.

Possible direction for further research may lie in the field of adjustment the change of the nominal prices of shares. Most emerging markets experienced periods of huge inflation. More liquid stocks rose in prices together with money value, however less liquid stocks such as stock of the large plants remains mostly undervalued. Therefore, it is a common approach for large Ukrainian enterprises to either increase the nominal value of shares or to issue additional shares in order to increase statutory fund (both decisions can be passed only at the Annual Shareholders Meeting). In Ukraine some enterprises increased their nominal stock value in 10-50 times. We assume that such increase in the stock nominal value will influence the price of the stock. However, we didn't manage to take this

effect into account because of the absence of unique database on Annual Shareholders Meetings.

This thesis amends both the existed literature on emerging stock market cross-listing effects and literature concerning Ukrainian stock market analysis. We enlarge the theoretical model to the condition, when foreign and domestic investors are treated equivalently. Also, we provide comprehensive analysis of the Ukrainian market structure, trading customs and DR issue procedures.

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