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**Composite Leading Indicators
for Ukraine:
An Early Warning Model**

**Prepared for the project:
Preparation of the system of early warning indicators**



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COMPOSITE LEADING INDICATORS FOR UKRAINE: AN EARLY WARNING MODEL

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List of acronyms

AA – Arithmetic average
CCI – Consumer confidence index
CEO – Chief economic officer
CLI – Composite leading indicator
CPI – Consumer price index
EU – European Union
FDI – Foreign direct investment
GDP – Gross domestic product
HP – Hodrick-Prescott (filter)
ICPS – International Center for Policy Studies
ICS – Index of current situation
IECU – Index of expected changes in unemployment
IEE – Index of economic expectations
IEF – Institute for Economics and Forecasting
IER – Institute of Economic Research
IIE – Index of Inflationary expectations
LI – Leading indicator
LS – Least squares (method)
MLAO – Mature limited access order
MLE – Maximum likelihood estimator
NBU – National Bank of Ukraine
NGO – Nongovernmental organization
OECD – Organization for Economic Cooperation and Development
PPI – Producer price index
QES – Quick Enterprise Survey
RPIST – Research and Project Institute for Statistical Technology
USD – U.S. dollar

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Summary

Our objective has been to experiment with diverse economic indicators in order to help equip Ukrainian policymakers with a relatively simple tool, which could deliver warning signals about a possibility of upcoming economic problems and thereby assist the Government in designing policy instruments which would help prevent or soften a slowdown or recession.

The project has undertaken the following tasks:

- Based on an analysis of the pattern of growth of the Ukrainian economy since the end of the post-Soviet recession (the year 2000) we have formulated the hypotheses concerning the factors preceding/affecting the upturns and downturns (with a focus on the latter) of the country's growth
- We have studied international "best practice" in early warning indicators in order to design a similar system for Ukraine
- We have selected the relevant indicators, consistent with our hypotheses and used a probit model in order to experiment with these indicators
- The final set of indicators used in the model included the following lagged independent variables: value of export, changes in real exchange rate of the hryvnya, a domestic price inflation index, bank credit interest rate, changes in the industrial output of the European Union; our dependent variable (which was used as a proxy for the overall economic growth) was changes in real industrial output
- The model was used to formulate a warning forecast for the Ukrainian economy for the second half of 2008 based on the data for the January 2000 – June 2008 period; all predictions for the second half of 2008 have delivered warning about a downturn of the Ukrainian economy
- We ran a few additional experiments with the model, and
- We have recommended several further steps of analysis toward a full implementation and institutionalization of such a model in the near future

1. Introduction

The financial crisis that struck Ukraine last summer was a surprise to many economic analysts who got used to a continuous growth during the last eight years. Similarly to the 1998 crisis, the downturn was sparked by external events affecting the global economy. Nevertheless it could be argued that in both cases, i.e., in 1998 and 2008, the crises were predictable and their occurrence should not surprise the analysts. What was difficult to predict was not the occurrence itself, but rather its timing and its depth. Today (in December 2008) we are not able to predict for how long this crisis will last and what effect on the long run Ukraine growth it will inflict. Such a prediction would require a thorough analysis and a complex econometric model. In Ukraine there are a number of research teams which develop and adroitly use these kinds of models and they are better equipped than our project to deal with these kinds of issues. However the chances for an accurate prediction are not very good. As have been documented in the literature, the econometric models are strong performers during relatively stable times but are not very good in predicting abrupt downward shifts due to some powerful external shocks (Klein and Burmeister, 1976).

When we began formulating the concept of this project (in January 2008) we were convinced that Ukraine is heading toward a crisis similar to that in 1998. As in 1998, Ukraine had experienced a period of relatively stable exchange rate which was not compatible with high inflation rates. Growing foreign trade deficit and current account deficit were sending warning signals, along with other worrisome indicators, such as prices of imported fuels remaining solidly below world market levels and exceptionally high metal prices, suggesting that Ukraine macroeconomic stability relied on shaky grounds. Ukraine was heading for yet another lesson in macroeconomics that a poor coordination between the fiscal policy and the monetary policy (especially exchange rate policy) will result in a breakdown, sooner or later. At the same time Ukraine, unlike most other countries at an equivalent or higher level of economic development, lacked any explicit “early warning” system that would alert about an upcoming danger. Obviously such a system is by no means a panacea for economic troubles but nevertheless may provide useful information to policymakers. The current global slowdown would hardly spare any country, regardless of its analytic capabilities, institutional foundations and macroeconomic policies, however a well established data and warning forecast system may help in abating the crisis and speed up the recovery.

This project is not at a position to provide a powerful forecasting tool that could be used as a substitute to comprehensive econometric models. Instead our objective has been to experiment with diverse economic indicators in order to help equip Ukrainian policymakers with a relatively simple tool which only task would be to deliver warning signals about a possibility of upcoming problems and thereby assist the Government in designing policy instruments which would help prevent or soften a slowdown or recession. A byproduct of this effort becomes a thorough analysis of the relationships between economic growth and several

macroeconomic aggregates which could improve our understanding of the workings of the Ukrainian economy.

Our tasks were as follows:

1. Based on an analysis of the pattern of growth of Ukraine economy since the end of the post-Soviet recession (the year 2000) formulate hypotheses concerning the factors preceding/affecting the upturns and downturns (with a focus on the latter) of the country's growth
2. Study international "best practice" in early warning indicators in order to design a similar system for Ukraine
3. Select the relevant variables and appropriate method/model
4. Experiment with the model to search for the best model specification (selection of relevant indicators)
5. Apply the model to formulate a warning forecast for the Ukrainian economy for the second half of 2008 based on the data for the January 2000 – June 2008 period
6. Check model performance based on actual data available for July-December 2008
7. Recommend further steps toward a full implementation and institutionalization of such a model in the near future

Given our objectives, our model had to satisfy a number of criteria:

- Degree of simplicity: A simple model is needed which could be easily updated, understood and used by non-experts (i.e., persons with an economics background without proficiency in advanced statistics and econometrics)
- Frequency of data: The variables used in the model must be monthly time series in order to enable short-term forecasts; data collected on a quarterly or annual basis would not be useful for the early warning purpose
- Categorical information: In its basic format, the model is not expected to provide highly accurate quantitative forecasts but instead be confined to categorical variables; at an initial stage this could be just a binary zero-one variable sending a warning signal if a downturn is expected
- Forecast horizon: The model should estimate a medium term trend pattern; the warning will be generated for each month during which a growth rate below the trend is predicted; thus a downturn is not an absolute decline of the economy, but is defined relatively to the trend¹

¹ It is worthwhile to note that the determination of the trend is easy but by no means a straightforward task. There are several algorithms for trend determination and, depending on which of them is used, the trend, and therefore the predictions of downturns, may differ from one another.

- Number of variables: The model should have a low number of predictors (independent variables) in order to secure the easiness of its applicability, simplicity, and transparency; a user of the model should be able to trace the impact/contribution of each variable (monthly time series) on the dependent variable (a growth indicator such as GDP growth rate or industrial production growth rate)
- Real time data: All variables used in the model should be real time data, i.e., data available at the moment of model application; the variables which are available with a greater delay (of several months) or which are subject to major corrections several months after their original publication should not be used in the model

Until the summer 2008 the Ukrainian economy was growing for the last eight years, although the pattern of this growth kept changing. Different activities—employment, investment, production, consumption and foreign trade—expanded at different rates due to a combination of factors. Over time Ukraine has been successful in introducing structural reforms and building an institutional infrastructure for its market economy, although this process has not finished yet. At this moment the Ukrainian economy can be classified as an advanced transition economy. It shares its features with other transition economies as well as with mature market economies.

Any systemic research on and forecast for this economy is a difficult task for a number of reasons, in particular:

- Rapid structural and institutional changes: It is difficult to discern a stable pattern, based on which longer-term relationships can be identified, policies evaluated and predictions made
- High volatility: The amplitude of short-term (month to month) shifts is very high. This is due to both real changes as well as, in some cases, it can be related to data quality problems
- High vulnerability: When measured in billions of dollars, Ukraine is still a relatively small economy which greatly depends on and is very sensitive to external events, such as political conflicts, shifts in world market prices, shifts in the economic situation of European Union countries or Russia, etc.

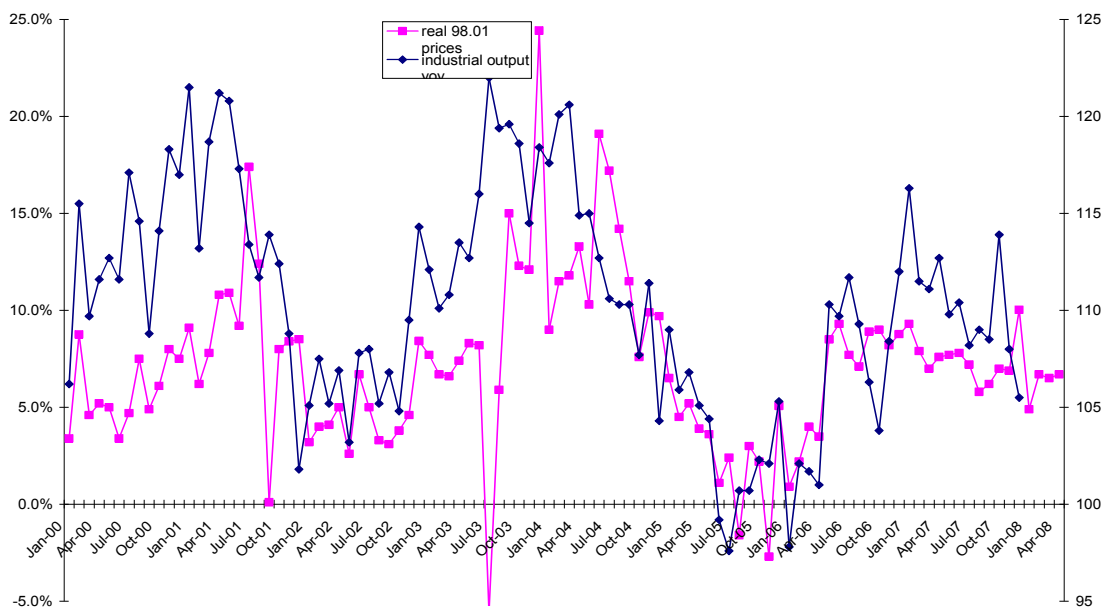
During the last quarter of century, a variety of models have been developed to explain and predict the direction of change as well as to provide “early warnings” in order to help both policymakers and investors in their decision making. As mentioned above, in Ukraine there are several forecast models but no operational early warning system has yet been designed and maintained for a longer period of time.

In the economic literature two main kinds of cycles are identified: business cycles and growth cycles. The latter may be treated as a special case of the former. The classical business cycles are composed of four stages: expansion, peak, recession, and trough. Growth cycles in turn, are defined as short-term

fluctuations of growth rates around a long-term trend. The data seem to suggest that the business cycles tend to be asymmetric (i.e., their expansion periods are often longer than contraction periods) and take longer periods of time, while growth cycles tend to be relatively more symmetric with similar lengths of accelerating rate periods and decelerating rate periods, and tend to be shorter² (see more discussion of cycles in Section 2).

In the 2000-08 in Ukraine we witnessed clear growth cycles (Figure 1) occurring with a quite impressive symmetry in both growth expansion periods and growth contraction periods, each one lasting for about 1.5 year. Each of the two Ukraine's growth cycles lasted for about three years. Interestingly some analysts of trends in other transition economies are also indicating a three year pattern of growth cycles (e.g., Jagric, 2002, Jagric and Ovin, 2004).

Figure 1 Ukraine, GDP and industrial output growth, monthly, Jan.00-Apr08



Source: CASE-Ukraine database

Well in accordance with the neoclassical growth model and other similar concepts, a less developed economy is expected to grow faster than a highly developed market economy. While typically for the latter economy a decline in growth by a few percentage points may result in recession (negative growth), in a

² An important difference between the two kinds of cycles is that the business cycles are expressed in standard growth rates (percent change in GDP, etc.), while the growth cycles are “detrended”, and the change rates are expressed in term of a medium-run trend—they are positive for the above-trend growth rates and negative for below-trend growth rates.

rapidly growing emerging market economy this decline may result in a slower, but still positive, growth rate.

In order to detect the factors responsible for business/growth cycles, numerous indicators/variables are designed and used. They are often classified into three categories: leading, concurrent, and lagging. This classification is always somewhat arbitrary and may be quite confusing. For example, a housing construction boom could be a concurrent indicator (simultaneous with a rapid growth of GDP), a lagging indicator (a catching up effect of a poor performance of this sector in the past), as well as a leading indicator resulting in both expansion (in short-term) and in recession (in a longer-term), typically due to “overshooting” of housing supply. Much caution is needed in using these kinds of indicators for economic forecasts.

One can also identify different kinds of factors, depending on their sources, in particular: endogenous factors, exogenous factors and external factors. Endogenous factors are the activities of investors, producers and consumers in a market economy, such as investment in fixed capital and/or inventories, supply of bank credits, household consumption and savings, etc., assumed to be outcomes of domestic market forces. Exogenous factors are events occurring in a country outside of its economy, especially due to politics and policymaking, such as institutional reforms undertaken by the governments or simply current decision making in monetary, fiscal, trade, social and other policies. Finally external factors are shocks from abroad, e.g., shifts in world prices of important goods (fuels, metals, agricultural products, etc.).

The three kinds of factors may be further subdivided into generic and specific. The former are “standard” macroeconomic aggregates applicable, by and large, to many market economies, while the latter are particular factors applicable to a given country.

Obviously in many cases it becomes difficult to clearly distinguish which kind of factor/indicator we are dealing with. Especially the exogenous and endogenous factors are tightly interconnected and we end up in simply assuming endogeneity or exogeneity of concrete variables used in a model.

A main challenge in growth forecasting is the selection of right leading indicators (LI), i.e., the variables, which possess a significant predicting power related to economic cycle shifts. Usually only a small number of LI are used for a number of reasons:

- Convenience: The smaller number of indicators the lower the data requirements are and the easier their processing and modeling
- Clarity: If a large number of indicators is used, it becomes difficult to sort out important relationships and understand what is going on in an economy
- Avoidance of redundancy; since many macroeconomic variables exhibit a herd behavior, being tightly interconnected and highly correlated with one another, well in accordance with the so-called Occam’s razor principle,

only a few of the mutually weakly correlated or uncorrelated variables are used³

A frequent problem is shifts in relationships over time. Sometimes macroeconomic variables behave in a “reverse” pattern, i.e., operate in a pattern inconsistent with a standard theory. While, in accordance with the so-called Phylipps theory, economic recessions (growing labor unemployment) tend to coincide with a declining wage/price inflation or even deflation, we have also witnessed periods of “stagflation” (e.g., in the 1970s in many developed countries) when a recession (and high unemployment) was accompanied by a high inflation.

Some variables tend to behave erratically and are not useful for making any predictions. On the other hand an apparent stability of some indicators in Ukraine, such as official unemployment, eliminates them from a collection of useful predictors (see below for further discussion).

The weakness of market institutions in Ukraine affects the relationships among standard predictors. E.g., transmission of monetary policies is weaker and takes more time in Ukraine than in more developed market economies. The stock market contributes little to investment financing and its effects on the economy are not as strong as in the countries with highly developed capital markets⁴.

Our hypotheses as to how the economy operates today and what variables should be used for short-term warning forecasts have to be based on concepts which could not be easily empirically tested with the existing time series data. Under the Soviet system, the “horizontal” linkages between the economic variables (supply, demand, prices, exchange rates, interest rates, profitability, etc.) were weak and the economy was managed mostly by an ad-hoc “vertical” decision making (bureaucratic administration). During transition, stronger horizontal relationships have been established and endogenous economic factors have begun playing a much greater role than in the Soviet system.

Emergence of market-driven interrelations is however a mixed blessing. On the one hand it helps in predicting impacts of changes in one variable upon some other variables, due to the strengthened market linkages, based on the existing theory supported by ample empirical experience. On the other hand, however, a tightly interlinked market economy encompasses a plethora of connections making unambiguous conclusions difficult. E.g., growing imports may indicate both a dynamic growth of domestic demand and be a manifestation of economic expansion as well as a declining competitiveness of domestic products and indicate economic decline. Also time lags between an event (e.g., a currency real

³ Alternatively several correlated variables can be represented by their (linear) combination. This method however diminishes the clarity of forecasts.

⁴ Ironically, a low level of development of financial and capital markets may help Ukraine and other emerging market economies reduce the negative effect of global financial crisis by making them less vulnerable to the current vagaries of the global equity and credit markets.

appreciation) and its effect (e.g., a high foreign trade deficit) are difficult to predict⁵.

Because of these endogenous complexities, as well as many hard-to-predict exogenous and external shocks, a simple, and at the same time reliable, system for early warning forecasts is a challenging task. Importantly, one should try to overcome a frequent weakness of many macroeconomic forecasting modeling and analysis efforts is their focus on mechanics of trend cycles rather than on an underlying socio-economic logic, based on which some explicit hypotheses are formulated and tested. Many publications present advanced mathematical/econometric work but are somewhat superficial in identifying, describing and explaining the interrelations between the variables, short-term and long-term causalities, and their institutional and structural fundamentals.

The high complexity of economic cycles motivates establishments of systems of interacting composite leading indicators (CLI). More often than not it is not possible to predict effects of changes in one indicator without checking the shifts in some other indicators.

2. A brief overview of business cycles

Empirical and theoretical literature on business cycles distinguishes the short-term cycles (appr. 40 months, as defined by Kitchin, 1923)⁶, the mid-term cycles (usually 9-11 years), and the long-term cycles lasting for more than 15 years (e.g., Kondratieff waves of 50-60 years). Their theoretical explanations vary from external factors of nature (e.g., the Sun cycle of 11 years) and fundamental characteristics of the human nature (such as the Chinese 12-year “mid-term” cycle, and 60-year “long-term” cycle) to the purely technical economic reasons (Zarnowitz, 2007). The latter, in turn, are related to the systemic nature of an economy, which is penetrated with a dense net of positive and negative feedbacks. Due to the time lags, inertia, “frictions”, and various kinds of inflexibilities, these feedbacks work imperfectly, and this leads to cycling oscillations. The most important typical cases are: negative feedbacks with inertia or time lags that usually result in sinusoidal oscillations; and positive feedbacks with a “limit” (or “shedding”) that result in the relaxation of self-excited oscillations. At the next level of inquiry one can find that the above mentioned imperfectness of feedbacks is, in turn, caused among other things by the imperfect information (like erroneous expectations)⁷, so the availability of accurate leading indicators can help in smoothing of the cycles.

The short-term (Kitchin) cycles are usually associated with accumulation and discharge of inventories. According to Metzler (1941), firms are trying to keep

⁵ In general, the weaker the market institutions (endogenous economic linkages) the longer it takes for the effects of exchange rate alterations to occur.

⁶ Business Cycles and Depressions: An Encyclopedia. By David Glasner, Thomas F. Cooley Contributor David Glasner Published by Taylor & Francis, 1997

⁷ Among other reasons are institutional factors (like inflexible wages or prices), low liquidity of investments into the fixed assets, effects of economies of scale, etc.

their inventories proportional to current sales. Under these circumstances, when the sales increase, production should increase in order to fill in the stocks and keep the above mentioned proportion. But according to the Keynesian theory, increasing production follows an increasing demand, which further boosts the sales. This process tends to converge to a new and higher level of sales. However, any incremental decrease from this level spurs the opposite trend driven by similar feedbacks (multiplier effects). Due to inertia in the processes of stocking and de-stocking of inventories, this process under certain parameters results in sinusoidal oscillations. Moreover, increasing inventories require borrowing money from the banks. A higher demand for the money results in higher interest rates, thereby making stocking of inventories more expensive for the firms. This effect further shrinks the multiplier, but again with a lag related to a delayed reaction of the financial markets, and inertia in the firms' internal routines for computing the necessary amounts of stocks.

The mid-term cycles are the best studied, and most often referred as "business cycles" in general. The variety of proposed theoretical models include excessive (and often inefficient) investments in the fixed assets, which are inflexible by their nature; discrepancies between aggregate supply and aggregate demand caused by inflexibility of prices and wages; inherent instability of an economy driven by a Keynesian multiplier, which leads to explosive growth that is unsustainable and has to face a "limit" or a non-linear "sealing" of some kind; and so on.

The evidence for the existence of the longer cycles studied by Kuznets and Kondratieff is less convincing. Since the economy of independent Ukraine has existed for less than twenty years, these cycles are beyond the scope of this report.

3. Cycles in Ukraine

Distinction between advanced market economies and the economy of Ukraine can be best understood within the framework put forward by North et al. (2005, 2006, and 2007). According to their classification, Ukraine falls into the category of the "mature limited access order" (MLAO) states. This means that although non-state economic and civil organizations exist and sustain, they still need a patronage. Such an arrangement provides state officials with discretionary power that they use to (at least partially) control business entry, thereby limiting the competition and protecting the market power of their loyal clients. This way, a great deal of market power becomes an inherent feature of economic structure of the MLAO states⁸. But as long as those countries undergo a rapid transition (which is especially true for Ukraine), the degree of this market power is subject to complex and uneven evolution. These features have important implications for the nature of business cycles in the post-Soviet transition countries.

⁸ A high rate of market concentration in Ukraine was among the findings of the OECD country report of 2007.

First of all, the economies with high concentration of substantial market power demonstrate a different kind of macroeconomic behavior than the predominantly competitive ones. In a competitive market economy the windfall transitory quasi-rents from arbitrage or innovations attract investments, so the rapid expansion of respective industries diminishes those quasi-rents. The main cause of possible problems can be overinvestment during the period of a boom. In a MLAO economy, the most important sources of rents are protected from exhaustion that can result from competition. So, they tend to persist for a long time. An overinvestment due to uncoordinated actions of many independent investors that all are being attracted with the same lucrative opportunity is unlikely to happen, because such investors will not be allowed to enter the industry due to various formal and informal restrictions on the internal capital mobility. Besides, monopolized economies are less susceptible to usual kinds of price and demand shocks as considered in the literature, because monopoly rent in a short run can serve as a sort of “safety valve”. Furthermore, the same market power of buyers at the labor market allows the firms to conduct flexible wage policies⁹. Therefore, indicators characterizing the demand and external shocks should have less predicting power in the MLAO countries comparing to the advanced market economies.

By the mid-2008 the **mid-term business cycles** in Ukraine were not observed. The long-term recession of 1990-1999 was attributed to the collapse of Soviet system and hardships of further recovery. The longitude of decline, in turn, was caused by predominantly institutional problems. They had little in common with the factors that are believed causing recessions in the market economies. This is one of the reasons why we consider only the period starting from the year of 2000, and recommend extra caution in using the data for this year.

It is also unlikely that a kind of classical recession could be observed in Ukraine in the near future.

Firstly, Ukraine is a small open economy, with the exports/GDP ratio amounting to 45% for the year of 2007. Thus, the world economy’s outlook, particularly the demand for major export commodities (steel, wheat, sunflower, and others) play at least not less important role than internal demand that drives “classical” business cycles.

Secondly, the labor market is quite flexible and relatively open. During the recession of the 1990th the excess labor was absorbed by the informal sector or by foreign countries to which thousands of job seekers migrated. Given a high demand (until recently) for low-skilled labor in the neighboring countries of EU and in Russia, the unemployed Ukrainians in mass have been finding jobs abroad, and supporting their families with remittances. These remittances

⁹ All of this means that the MLAO economies are also less sensitive to traditional counter-cyclical policies prescribed by the Keynesian theory. In particular, the trade-off between inflation and employment may provide an inadequate framework for economic policymaking in such a country. When a recession occurs in an economy with a high concentration of market power, the monetary and fiscal expansion makes little effect, and instead can result in stagflation, as Olson (1982) suggests.

constitute a substantial part of household incomes (up to USD 21 billion by the estimations of the NBU specialists¹⁰).

Thirdly, an important part of domestic demand – the investments – are largely driven by exogenous (predominantly political) and external factors (political, financial, etc.) rather than the cyclical ones. The FDI that is playing an increasingly important role, depends on such exogenous and external factors as the prospects for EU accession, overall investment climate, privatization of the large and lucrative fixed assets, and the situation at the world markets. The domestic investments depend on the necessity of replacement of depreciated fixed assets, access to and price of credits, and so forth. Both domestic and foreign investors are highly sensitive to the protection of their property rights and contract enforcement. In particular, the so called “re-privatization” resulted in a dramatic decline of investments, despite the fact that it confined to a single case of Krivorizhstal’.

Finally, the potential of the Ukrainian economy for catching-up remains very high. Still unused business opportunities and possible productivity gains, as well as gains from trade, competition, and entrepreneurial potential are very large comparing to the mature market economies. Under these circumstances even marginal improvements in the development of market institutions provides a large economic payoff. Accordingly, any delay or step back in this process incurs a high price, and may even lead to a recession. However, these causes are contingent upon political developments rather than cyclical instability of the economy. Instead, the main risks to economic growth include fragilities and imbalances of various other kinds.

We will consider the following candidates for CLIs.

External factors. The Ukrainian economy is susceptible to terms-of-trade shocks due to, e.g., the fall of the world prices on major export commodities, first of all steel; or a large increase of gas prices charged by Russia. The latter factor is also politically contingent. Therefore, certain proxies for terms of trade are definitely needed regardless to their past prediction power.

Financial/banking system. The banking system is still immature; a decade ago it was the weakest one in the region (share of domestic private sector liabilities to GDP was only 7.7% as of January 1998 and has increased eight times since then). Such a rapid growth is usually considered as a factor of high risk. Until recently the national currency was remarkably stable, while the trade balance became highly negative with little chance for improvement. It was partly offset by capital inflows which are, however, quite unstable. The remittances are susceptible to the EU and Russia’s policies towards Ukrainian labor migrants, many of which are employed in the informal sector. The most of banking credits are short-term, so their contribution to capital account is positive only as long as net domestic credit expands. The FDI contributions are sporadic by the nature. Last but not least, the state budget is still not balanced. While until recently the

¹⁰ http://www.newsru.ua/arch/finance/23oct2007/zarobitchane_print.html

deficit was relatively low, it was run at the stage of a boom. Since the state liabilities are relatively inflexible, and taxation is by and large based on negotiations with the biggest taxpayers, the fiscal risks are high and politically loaded. Meanwhile, the financial and banking crises almost inevitably result in declines in the growth rates, or even lead to recessions. For this reason, the respective proxies deserve to be included into the CLI, even though their prediction power in the past was modest.

Natural and technical factors. Ukraine has got a large agrarian sector. Food processing constitutes a substantial part of the industrial sector. Therefore, a poor harvest can affect economic growth for a couple of percentage points. Besides, Ukraine's infrastructure is predominantly obsolete and can become a source of technical disasters of unpredictable size. Some early warning indicators for both factors are worth consideration.

Unlike the mid-term cycles, the short-term cycles can be analyzed by our study, which covers the period of more than two Kitchin-type cycles. However, if they exist, their causes should be different from the ones described above. The discussed above Metzler model is hardly applicable to Ukraine, as well as to any kind of open economy, merely because of the very loose connection between domestic production, total sales, and domestic aggregate demand. The role of credit in determination of amounts of inventories has increased during the last years, but it still can hardly be a major factor. Finally, the inventories play a less important role in the Ukrainian economy, than, for instance, in the USA. While in 2000 the U.S. inventories amounted to more than 150% of GDP, in Ukraine the respective ratio was only 45% in the same year; since then it decreased to 39% at the end of 2007.

Instead, we argue that the short-term cycles in Ukraine can be caused predominantly by other factors.

Firstly, the short-term cycles are observed in the advanced market economies, particularly in the EU (see Figure 1A in the Appendix), which is an important trade partner of Ukraine. Of course, due to the abovementioned strong impact of external factors, these cycles in the countries of destination for Ukrainian exports should bring about the cycling in Ukraine.

Secondly, we hypothesize that cyclical behavior could be caused by inflexibility of prices, which under certain circumstances may result in cyclical oscillations of growth. Such inflexibility, in turn, is caused by institutional factors acting through their impact on the economic structure. Namely, slackness of the capital markets, and general internal closeness of equity markets impede the vertical integration. While formal and informal restrictions on business entry lead to a high concentration of market power, which in Ukraine is further supported by an inherited high concentration of industries. Then, the price inflexibility and cyclical developments take place because complimentary industries with significant market power act like the Cournot's complimentary monopolies.

Cournot has showed that the uncoordinated complimentary monopolies fail to share total monopoly rent in an efficient way. Each of them tries to set its markup

as high as possible, in order to capture a larger share of the total producer's surplus. Even when they finally reach the equilibrium, their cumulative price appears to be higher, and joint output lower, than the ones of a single vertically integrated monopoly. Therefore, a segmented economy, where the competition at the horizontal level is limited, and possibilities to purchase vertical counterparts or merge with them is restricted, exhibits higher prices and lower total output than it would when being a competitive one.

But if the demand instantly grows, it naturally results in higher prices, and increasing monopoly rents. This leads to an even higher inefficiency, because monopolies fail to share gains from such a growth smoothly. Every time when increasing demand breaks the above-described inefficient equilibrium, they become engaged in a similar kind of competition for the share of total rent. But since each of them tries to set its markup as high as possible, they would permanently overshoot the equilibrium market price. At the macro level, the producers in mass will face declining growth in aggregate demand, so they halt price increases until the demand catches up. However, while retail sector receives the market signal of the price overshooting immediately, the producers react with a lag, which is higher for those at the beginning of a production chain. Lagged negative feedbacks usually result in cyclical oscillations around the main trend, as we can observe in the Ukrainian economy.

Similar effect may take place even if the final product of such kinds of complementary monopolies is being sold at the competitive market, as in the case of ferrous metallurgy. We have witnessed numerous conflicts between producers of ore, coal, coke, and steel, as well as railways and ports that all strived for a larger share of extra profits brought about by increases in the world prices of steel. Such kinds of conflicts tend to impede output growth. Due to the effect of different time lags for various stages in the production chains, such slowdowns are likely to be oscillating¹¹.

All of these effects may end up in cyclical oscillations around the growth trend. But they normally should not lead to recessions or economic crises. However, the suppressed competitive selection results in deteriorating economic efficiency. From time to time it would lead to the "clean-up" crises that screen out the least competitive firms, and generate fresh deliveries of the Shumpeterian "creative destruction". Such kinds of crises are likely to be triggered by the exogenous (e.g., political) or external factors, and occur less often than the cyclical slowdowns of growth described above. Unlike the latter, the recession phase in the case of such a crisis should be abrupt and may be quite deep, while the recovery would have an exponential/sinusoid shape.

Reallocation of market power and vertical integration may be another cause of accelerating or decelerating growth. Yet another source of such kind is changing bargaining power of the labor force (trade-unionism, or political developments), which can result in respective changes of business costs, on the one hand, and

¹¹ Systems of differential equations with time lag tend to have oscillating solutions of sinusoid shape.

in demand, on the other hand. These kinds of effects are likely to be politically-driven. Moreover, in Ukraine the dominating industries are capital-intensive and export-oriented. Their business costs are not significantly affected by wage increases. They only marginally depend on domestic demand. However, such kinds of effects may become important in the future.

4. Previous attempts of building a CLI index for Ukraine

There are two main veins of constructing a CLI index for Ukraine:

- Survey-based indicators (index of consumer expectations (ICPS), indexes or separate indicators of business expectations (IER, NBU, and DerzhComStat); and
- Indicators based on hard data (ICPS and IEF)

The surveys are run on a regular basis, while at present, no hard-data based CLI is compiled.

4.1 Survey-based indicators

IER: The Quick Enterprise Survey (QES)

Starting from July 2002 the Institute for Economic Research and Policy Consultations (IER) has been running a survey, which was originally launched in 1996. It covers 300 enterprises, randomly chosen in Southern, Western, Eastern, and Central Ukraine.

The survey belongs to the group of business tendency surveys and follows a methodology developed at the IFO institute in Munich, Germany. Such surveys are a meaningful supplement to standard economic statistics as they provide insights concerning perceptions and expectations of economic agents. In many countries, such information is widely used by economic analysts, policymakers and businessmen alike, in order to obtain a clearer picture of current performance and to forecast changes in the short- and medium-term run.

The main objective of the Survey is to indicate the influence of economic policy on business development through monitoring perceptions and expectations of managers regarding changes in general economic conditions (business-, regulatory- and lending climates), production (e.g., output performance, impediments to production and employment), and financial performance at the firm level (e.g., prices, profitability, and arrears).¹²

¹² http://www.ier.kiev.ua/English/qes_eng.cgi

The CEOs of firms are asked about their expectations and current changes during the face-to-face interviews. Then,

all indices are calculated using the same methodology. For each positive answer a score of “+1” is applied; for each negative answer a score of “-1” is applied; and for each answer indicating no change a zero score is applied. The industrial confidence indicator is defined as the arithmetic mean of the answers to the questions on production expectations, assessments of the order books, and assessment of the stock of finished products (the latter with an inverted sign).¹³

In general, this methodology corresponds to the one of *The Joint Harmonized EU Programme of Business and Consumer Surveys*. However, it is not clear whether it yields good CLIs for Ukraine. Its prediction performance has been mixed. Currently the IER together with Swiss partners (CIRET) re-evaluates the methodology of calculating the index. A weakness of the QES is its small sample size, restricted to the manufacturing sector only. Moreover, the ferrous metallurgy industry and the large firms in general are underrepresented. This is unfortunate, since these sub-sectors produce the lion's share of Ukrainian GDP (about 25%).

The NBU's Business Expectations of the Ukrainian Enterprises Project (in Ukrainian only) summarizes and analyzes the results of a survey of 1200 or more firms (a representative sample). Among other questions, the respondents are asked about their expectations of growth (or decline), for the coming 12 months, concerning the country's overall economic activities (GDP), the expected volume of sales of firms' own products, as well as of inflation and exchange rate. They are also asked about their self-assessment of economic performance of their firms, change in the stocks and employment, etc. The answers are further analyzed in the quarterly bulletins. They are broken down by industries, firms' sizes, and regions. However, no synthetic indexes are calculated. Unfortunately, this survey was launched only at the fall of 2006, so the time series available now are much too short for standard econometric estimations.

The DerzhComStat's Research and Project Institute for Statistical Technologies (RPIST) is running its own **Survey of Business Performance and Expectations**. The respondents are asked about current situation and trends, and their expectations of current and future trends in output, demand, capacity utilization, prices for their own goods or services, and stocks. Unlike the rest of indicators under review, the authors (Пугачова, 2006) are trying to correct for seasonality. Then they build composite indexes by sectors (industry, construction, and trading) using simple averages of respective balances of responses normalized by their standard deviations. Compositions of indexes differ from sector to sector. In most cases the indexes include self-assessments of current and future trends in output formulated in the ways specific to particular sectors (like stocks in the industrial sector; future contracts in construction, and expected sales in trade). Then the authors propose to build a composite index for

¹³ *ibid*

GDP by aggregating of sector-specific indexes weighted by the share of each sector in the total value added.

However, a chart produced by the authors does not convincingly prove that the proposed indicator works well as a CLI, at least during the period covered by the study¹⁴. More recent results show a somewhat better predicting power starting from 2005. However, the peaks occurring every four quarters that are so well predicted by a model may be attributed to the mere seasonal effects (either underestimated, or overestimated). It may be suggested that, for example, in the year of 2005 some kinds of structural changes have led to a sharp increase in the magnitude of seasonality effect, and perhaps also to some changes in the period of oscillations.

Figure 2 Seasonally adjusted month-to-month changes in the industrial output: actual (lower line) and forecasted using the RPIST's CLI (upper line)



Source: RPIST's bulletin, <http://www.ntkstat.kiev.ua/nedos1.2008.htm>

The common weakness of both surveys may be a selection bias that is hard to assess. The firms often ignore surveys of this sort, and even if they decide to fill in the survey questionnaire they delegate mid-level personnel (which is often not competent) instead of the CEOs.

¹⁴ <http://www.ntkstat.kiev.ua/nedos1.2008.htm>

The ICPS calculates the **Index of Consumer Confidence** as follows:

In Ukraine, the Consumer Confidence Index (CCI) is compiled from a random sample survey of country's population; the survey includes 1,000 people aged from 15 to 59. The people of this age make up 61.3% of the Ukrainian population, and they are the most active consumers. The survey sample is representative by gender and age, and it is stratified by the type and size of settlement. Statistical error does not exceed 3.2%.

To define the CCI, respondents are asked the following questions:

1. How has the financial position of your family changed over the last six months?
2. In your opinion, how will your family's financial position change during the next six months?
3. In your opinion, will the next twelve months be a good time or bad time for the country's economy?
4. In your opinion, will the next five years be good time or bad time for the country's economy?
5. Is it now a good or bad time to make large purchases for your needs?

With regard to these questions, the corresponding indexes are calculated:

- * Index of current personal financial position (x1)
- * Index of expected changes in the personal financial position (x2)
- * Index of expected changes in economic conditions of the country within the next year (x3)
- * Index of expected economic conditions in the country within the next five years (x4), and
- * Index of propensity to consume (x5).

The indexes are constructed in the following way: from the number of positive answers the number of negative answers is deducted, and to this difference one hundred is added in order to eliminate the occurrence of any negative values. On the basis of these five indexes, three aggregate indexes are calculated:

- *Consumer confidence index (CCI)—arithmetic average (AA) of indices x1–x5
- * Index of the current situation (ICS)—AA of indices x1 and x5, and
- * Index of economic expectations (IEE)—AA of indices x2, x3, and x4

Index values range from 0 to 200. The index value equals 200 when all respondents positively assess the economic situation. The index totals 100 when the shares of positive and negative assessments are equal. Indices of less than 100 indicate the prevalence of negative assessments.

To determine the Index of Expected Changes in Unemployment (IECU) and the Index of Inflationary Expectations (IIE), the respondents are asked the following two questions:

1. In your opinion, during the next twelve months the number of unemployed (people who do not have a job and are looking for it) will increase, will remain roughly the same, or will decrease?
2. In your opinion, will the prices for major consumer goods and services increase during the next 1–2 months?

The IECU and the IIE are calculated in the following way: from the number of answers that indicate the growth of unemployment/inflation, the number of answers that indicate the decrease of unemployment/inflation is subtracted, and to this difference one hundred is added to eliminate the occurrence of negative values. The values of indexes can vary within the range of 0 to 200. The index totals 200 when all residents expect an increase in unemployment/inflation.¹⁵

¹⁵ http://www.icps.kiev.ua/eng/publications/ccj_calculation.html

4.2 Hard-data based indicators

Although potentially useful as one of the possible components of a tentative CLI, the survey-based indicators on their own could not be good predictors for GDP growth rates in Ukraine, at least as long as the economy remains predominantly export-oriented. All of these indicators share common inherent problems of survey data, including the quarterly periodicity. For these reasons all of our candidate LIs are based on the hard data. However, to our knowledge, as of now none of such kinds of indicators is being compiled in Ukraine. In this section we review two attempts that were made in the past.

The ICPS's CLI was calculated for 19 consecutive months starting from January, 2006. Now this work is discontinued. This indicator includes five components, namely:

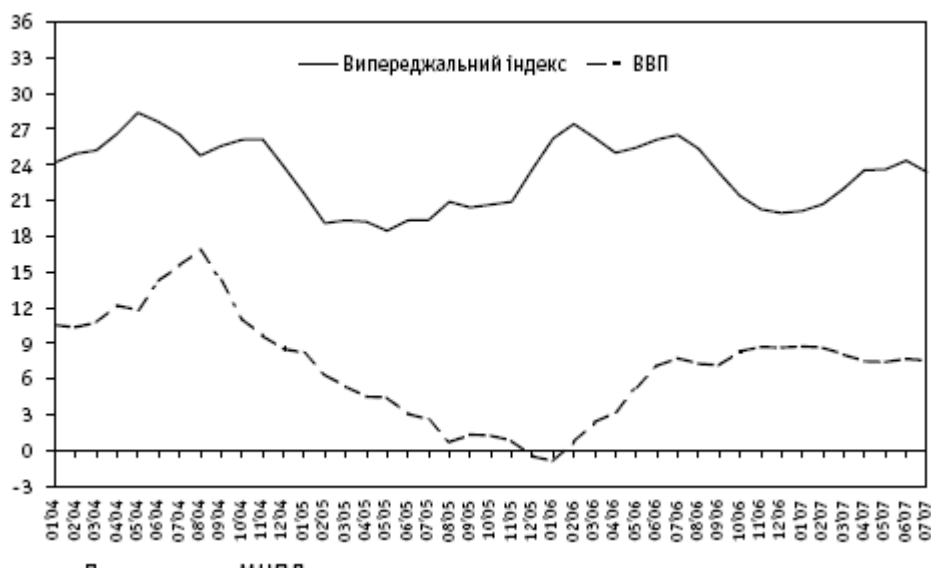
- World prices of ferrous metals
- Retail turnover
- Monetary aggregate M3
- Hryvnya deposit interest rates
- Private sector long-term liabilities (banking loans only)

These components are aggregated similarly to the ones of BCI (The U.S. Conference Board).

The results, as shown in Figure 3, are interesting but ambiguous, as they do predict a few important shifts in trends, but fail to do it in several other cases, and provide too many false signals. While the interest rates may have coincided with GDP growth at some moments, but it seems that their inclusion is not well justified. This indicator could bring a lot of noise. The retail turnover is also likely to be rather a coincident indicator than a leading one.

The IEF approach is based on analysis of the national accounts. Instead of using proxies, the attempt is made to estimate theoretical components of the GDP (both those on the expenditure side and the income side). Although theoretically justified (in general), such an approach has a weakness of being based on the quarterly data that are, in addition, available only with a substantial lag after the end of the quarter.

Figure 3 The ICPS's Leading Index (solid line) and changes in real GDP (moving average)



Source: ICPS and DerzhComStat

The components of this index include:

On the expenditure side (flows):

- real final household consumption
- real final government consumption
- export
- import
- real investment

On the income side (stocks):

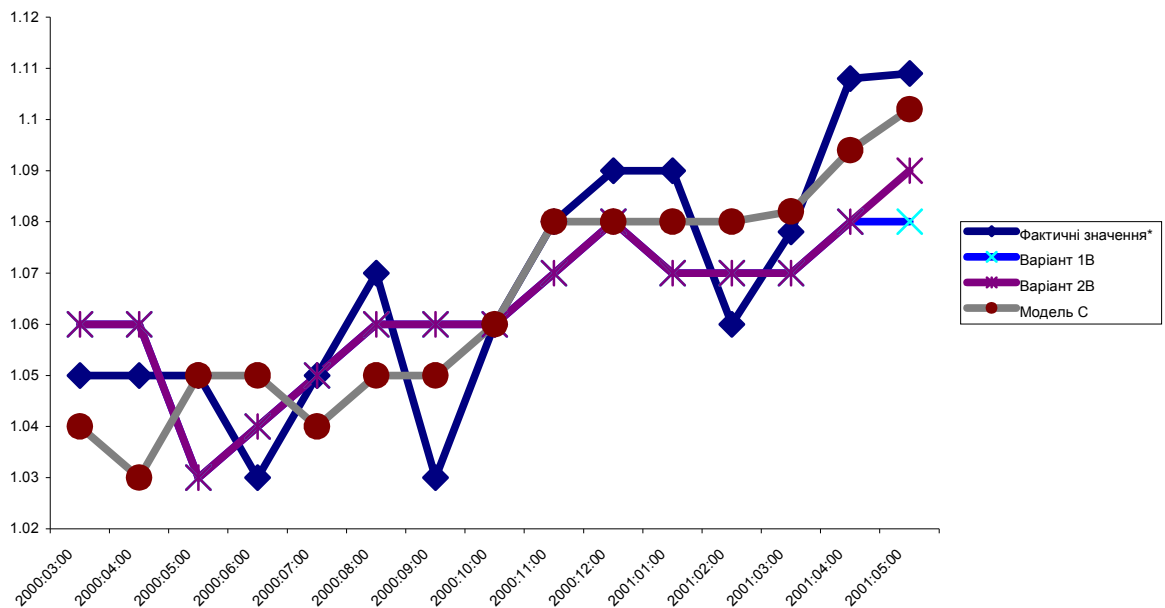
- real increase in fixed assets
- real change in total liabilities on banking loans
- real total cash balances on the bank accounts

Their changes (quarter to quarter) are calculated with lags up to one year.. In other versions the authors are trying a number of other components, particularly of the “social sector” (employment, transfers, disposable household incomes, and wage arrears).

This indicator was calculated in a few versions, none of which, however, provides a really good prediction (see Figures 4 and 5). Although the authors claim that their CLI for “demand” and “supply” sides could be good predictors for GDP

growth with a lag of four quarters (one year) with probabilities of 74% and 79%, respectively, the time series presented in the report are clearly insufficient for any reliable evaluation. The composition of indexes is arguable, since, for instance, there is little evidence of a strong relationship between investments in fixed assets (which is used twice!) and future GDP growth in Ukraine. However, the idea of using these components with some time lags is interesting and deserves further consideration.

Figure 4 Actual and predicted GDP growth (IEF indicators, versions 1B, 2B, C)

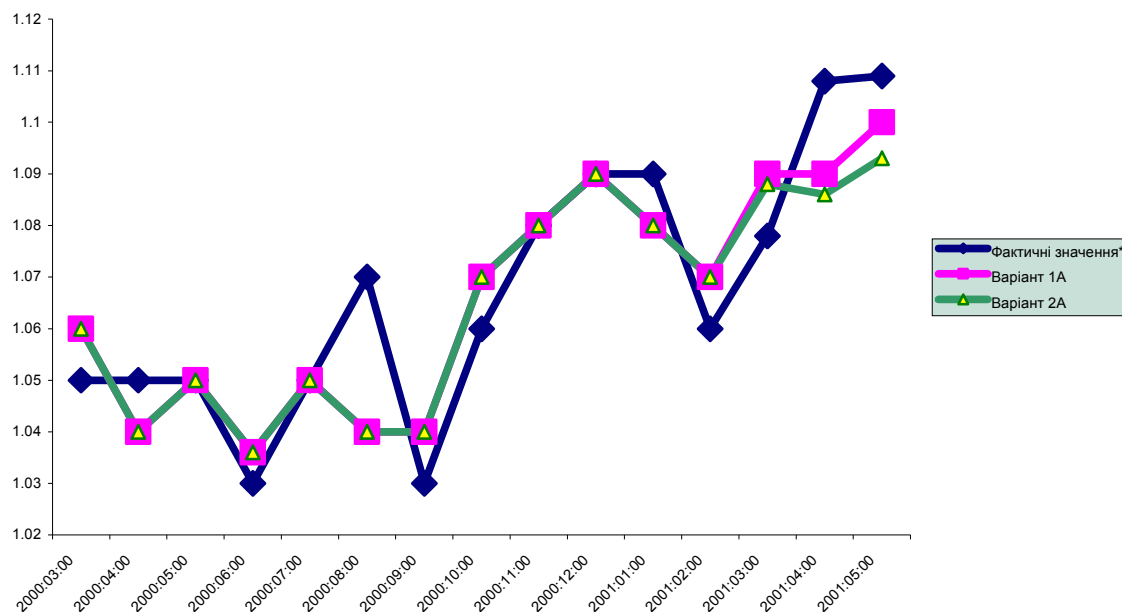


Source: IEF report

4.3 CLI index for Ukraine: Conclusions

There were several attempts of building the CLIs in Ukraine, some of them resulted in proposed composite indexes. As of now, none of these CLIs is calculated on a permanent basis, with a possible exception for the expectation index put forward by DerzhComStat. Among the accessible LIs, no one demonstrates sufficient predicting power, at least based on the time series used by their authors.

Figure 5 Actual and predicted GDP growth (IEF indicators, versions 1A, 2A)



Source: IEF report

There is an attempt of building a composite index of confidence based on the results of surveys. However, the field for building an index based on hard data is almost empty. Hence as of now the existing leading indicators fail to provide a decently reliable early warning signals for downward shifts in economic growth rates. We could suggest the following reasons for this.

The most developed of them are survey-based. Although being a potentially useful component of a good CLI, the survey data have numerous shortcomings. First of all, they by definition cannot capture the effects of “overshooting” or “undershooting” that are important sources of cyclical slowdowns of growth and recessions. While a survey-based CLI may predict continuation of growth, the turn may occur that is caused precisely by the excessively optimistic perception of market players that is reflected in this kind of CLI. It may be a result of a collective mistake. The latter may become quite large in transition economies due to insufficient experience of the market players.

The hard data indicators have not been well developed. The initial research efforts involving the use of hard data for CLI have been discontinued. Partly, this is because of their insufficiently good performance. Another possible reason is wrong targeting. The ICPS CLI was built according to the U.S. Conference Board methodology, thus aimed at prediction of cyclical recessions driven predominantly by contraction of the domestic demand, which thus far have not

happened in Ukraine and are unlikely to happen in the near future¹⁶. The IEF attempt was rather about building a comprehensive econometric model for GDP growth, which is a far more challenging task, remaining beyond the scope of our project.

Time series that are available for calculations of econometric parameters and testing model results are quite short. Moreover the economy keeps rapidly evolving, which makes previously defined structural parameters obsolete within a few years. In particular, we see no sense in using the pre-2000 data, even if they were accurate and available¹⁷. Furthermore, substantial changes occurred around the year of 2004. In particular, we have found that the financial indicators appear more significant than foreign trade indicators if the data for 2003-2008 are analyzed. Another visible effect of this is a change in the behavior of the RPIST's survey-based CLI: it looks like the seasonality smoothing that worked decently in the previous years (and was probably tuned on the past data) has failed afterwards.

We are going to address these shortcomings in the following ways.

- For a comprehensive CLI we should consider the components based on both the hard data and survey-based data.
- We are going to test the predictive power of selected indicators for warning against economic downturns (the situations in which the growth falls below a medium-term trend).
- Prediction of downturns (including recessions, i.e., negative growth) is a complementary task to the standard econometric modeling based on long time series of macroeconomic aggregates (indicators). It can improve the predictive power of such a modeling, at least at the qualitative level. These downturns have already been observed in Ukraine, in particular in 2002 and 2005. However, we do not pretend on building an econometric model for the economic growth able to predict both short-term and long-term changes in the rate of growth.

We put forward some ideas on the ways of improvement of currently used methodology in order to adjust it to the conditions of rapidly evolving economies, such as the Ukrainian one.

5. Selection of the candidate LIs for Ukraine¹⁸

Selection of the candidate LIs was made in three stages.

¹⁶ This sentence was written in summer 2008. Today (in December 2008) we already know that the occurrence of a recession in the Ukrainian economy is not an unlikely event.,

¹⁷ Firstly, the data are unreliable. Secondly, they should be adjusted for unpaid arrears, barter, and other phenomena that constituted the so called virtual economy. Thirdly, these data can be misleading, since at that time Ukraine experienced an unprecedented recession, which was caused by decay and then breakdown of the USSR, while not having much in common with standard business cycles.

¹⁸ For an overview of economic indicators see: Frumkin (2000) and The Economist Guide (2003).

At the first stage, we studied the available literature on the leading indicators. There were 14 OECD countries¹⁹ and 18 emerging markets²⁰ for which we found the literature on such kinds of indicators. Table in Appendix 1 summarize our findings at this stage.

Next, we selected our candidate LIs given their availability in Ukraine, and theoretical reasons described above. For some of them we tried to find or build proxies. Besides, we decided to include a proxy for price disproportions or inflexibility, which is based on the index of producers' prices (PPI). Similar indicator of the wholesale price index is used in the Philippines. The PPI matters in comparison to the CPI, and should be adjusted to the world prices on export commodities. As a result, we ended up with the following a list of candidate variables (Table 1).

For the next stages all of the candidate variables were detrended, as recommended by the OECD. Following these recommendations²¹ we used the Hodrick-Prescott (HP) filter with a smoothing parameter $\lambda=14400$ for isolation of the long-term trend, and then subtracted it from the original data. This also made the mean for each of the variables zero.

Still, if we try all of the abovementioned candidate LIs, the total number of independent variables would be much too high for a time series regression model with only about 90 observations. For this reason we performed the preliminary qualitative analysis in two ways.

At the first sub-stage, we have drawn the charts of detrended, smoothed (using HP filter with $\lambda=50$) and normalized by dividing to the standard deviation data series for each of available candidate variables comparing them to the similar kind of series for industrial production. Some examples of those charts are provided in the Appendix. Then we skipped the potential LIs that behave qualitatively different from the target variable, namely:

- Money aggregate M2
- Retail turnover
- Households incomes and expenditures

They were excluded from further considerations.

¹⁹ Australia, Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Japan, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and UK.

²⁰ Brazil, China, Cyprus, Czech Republic, Hungary, India, Indonesia, Jordan, Korea, Lithuania, Malaysia, New Zealand, Philippines, Poland, Russia, Singapore, Slovak Republic, and South Africa.

²¹ Nilsson and Gyomai (2007)

Table 1 List of candidate LI variables

Factor	Desirable indicators	Availability, proxies
Price shifts	Adjusted PPI	A ratio of PPI to CPI divided by the index of metal prices; also the reciprocal PPI
Business confidence and expectations	Survey-based indexes	Available on the quarterly basis only
Domestic demand	Retail turnover	Poor quality of data
	Households incomes or expenditures	Poor quality of data
Foreign trade	Terms of trade	Index of the world prices on steel (not available directly, instead the IMF's metal price index is used)
	Trade balance	Available
	Volume of exports	Available
Financial markets	Volume of loans	Available
	Interest rate on loans	Available; also its reciprocal was tried
	Bad loans	Not available; poor quality of data even if available
	Money aggregate M2	Available
Purchasing power of domestic currency	Real effective exchange rate	Available (in the version: the effective exchange rate adjusted for CPI)
External markets	GDP growth in the basket of main trade partners	Industrial production indexes for the EU and Russia

This analysis has also suggested to us that the lags for independent variables comparing to the dependent one should be taken within a range of 18 months at least, since average duration of a cycle is about 3 years, which perfectly corresponds to the Kitchin's result. It was also helpful in choosing the optimal

forms for particular variables (as reciprocals), which may better work as the LIs. Particularly, we decided to try the reciprocal interest rate, and reciprocal PPI.

Then we built the Pearson correlation tables for all remaining indicators and their lags for 3, 6, 9, 12, 15, and 18 months. Their analysis allowed us to select the variables that have the highest correlations with industrial production, and, at the same time, are independent from each other. They were included in the initial specification of the model.

At the same time we tried another way, which is methodologically to some extent akin to the approach used by the U.S. Conference Board. The latter predicts the probability of recession basing on the raise or decline of the leading indicators, and the composite Leading Index. Similarly to this, we tried to build a simplified version of leading index that would predict episodes of lower-than-average growth basing on the binary representation of leading indicators, and the composite binary index.

For each of our candidate LIs we calculated two kinds of binary forms. The “positive” one is equal to 1 if the value of the original variable is above the trend, and 0 otherwise, and the “negative” one works vice versa. Similarly we have built the “positive” form for the target variable, which was later used as a dependent variable for the probit model. For the lagged variables with consecutive lags varying from 3 to 18 months with a step of three months we calculated the percentage of correctly predicted observations for the binary form of industrial output²². These numbers can be treated as “predicting power” of each of the candidates, because they characterize the percentage of correctly predicted below-the-trend or above-the-trend points of industrial output.

For the binary variables built in such a way, mere constant or random numbers would have a predicting power of about one-half. Moreover, if the cycle was perfectly sinusoid, the 3-month lag of dependent variable (or a fully coinciding one) would have a predicting power of two-thirds. Therefore only the indicators having a significantly better predictive power are worth of consideration within this approach. In Table 2 we provide the best performing individual LIs with a predicting power over 70%. As one can see, the LIs with lags of 18 and 6 months have the highest predicting power. For instance, exports alone can predict a slowdown in 18 months with a probability of 79%. Lagged industrial output also has a predictive power of about 77% in 18 months (and over 78% in 17 months, not reported here). In the meantime, there is a period of 12-15 months lags with almost no good LIs.

²² In practice, we used sum of square differences between a binary candidate LI and the binary industrial output, divided to the number of observations, and then subtracted from a unit. As soon as the difference is zero in case of coincidence, and either 1 or -1 otherwise, sum of squares gives mere a number of discrepancies.

Table 2 Best performing leading indicators (binary form)

Negative:

Export	Exports ⁻ (-18)	79.0%
Industrial Output	INDOutput ⁻ (-18)	77.0%
Value of Bank Credits	Credits ⁻ (-18)	75.0%
Interest Rate	Credit% ⁻ (-6)	71.0%

Positive:

Real Effective Exchange Rate	REXrate ⁺ (-6)	77.0%
EU's Industrial Output	EUoutput ⁺ (-6)	75.9%
Adjusted PPI	AdjPPI ⁺ (-18)	74.7%
Real Effective Exchange Rate	REXrate ⁺ (-9)	72.4%

These binary form LIs can be added (in terms of Boolean sum, which is equal to 1 if at least some of its arguments is 1), or multiplied. By simple comparison of a few possible combinations we derived a primitive composite leading indicator that can issue a warning signal in 18 months with a probability of 81.6%. It is

$$CLI1 = \text{Exports}^- (-18) + \text{AdjPPI}^+ (-18)$$

Where “+” means logical (Boolean) sum. In other words,

If either the adjusted PPI is below the trend, or export is above the trend, then with a probability of 81.6% in a year and half (hence, one half-period of the cycle) the industrial production will appear below the trend, and vice versa.

For instance, from Dec, 2004 to May, 2006, the index of industrial production year-on-year appeared below the long-term trend. Those times many experts attributed this slowdown mostly to political reasons, such as uncertainty related to presidential elections, political crisis of the Orange revolution, and diverse controversial policies. However, with the proposed indicator in hand, this slowdown could be almost precisely predicted in 18 months²³ before, when these political changes could be hardly predicted.

6. An early warning forecast model for Ukraine.

²³ apart from a single episode of higher than average growth in Jan. 2005 that according to prediction was displaced for March, 2005, and April 2006, for which this indicator predicts the end of slowdown, while in fact it has ended next month.

6.1 Recession and Growth Cycle Modeling Literature

Under leading indicator we understand (as in OECD (1987)) an indicator whose cycle turns consistently a fixed number of months before that of growth cycle indicator.

Empirical literature on recession modeling vastly uses probit models to conclude on leading indicators showing good performance in business cycle forecasting.

Earlier generation of empirical studies relied on static binary time series models. Such models estimate probability of economy being in recession (binary outcome) as a function of explanatory variables and their lags and leads only. Result of Estrella and Mishkin (1998) about recession forecasting power of interest rate spreads and stock prices was received using a static binary model. Variables such as interest rates and spreads, stock prices, and monetary aggregates, together with other financial and nonfinancial indicators, are tested for potential early warning properties. The analysis focuses on the out-of-sample performance from one to eight quarters ahead. Results show that stock prices are useful with one- to three-quarter horizons.

Similar econometric methodology applying static model was used by Bernard and Gerlach (1998). The authors look for cross-country evidence on the usefulness of term spreads (difference between long-term and short-term rate of interest) in predicting the probability of a recession within the subsequent eight quarters, using quarterly data for eight countries – Belgium, Canada, France, Germany, Japan, the Netherlands, the United Kingdom and the United States, spanning from 1972 to 1994.

Most recent econometric works use dynamic probit models. The key difference between a dynamic and a static probit model is that the former includes, among other indicators, lagged values of the dependent variable as an explanatory variable (and potentially a leading indicator).

The importance of using dynamic specification was first pointed in Duecker (1997). The author shows that simple dynamic models perform better - static models neglect significant information in autocorrelation structure of dependent variable, which is helpful to make better prediction. Valckx et al. (2002), Moneta (2003), Kauppi and Saikkonen (2007), Nyberg (2008), Chauvet and Potter (2005), Duecker (2005) all use dynamic probit models.

Valcks *et al* investigate whether interest rate and stock market volatility play a role as recession indicators. The results show that interest rate and stock return volatility do not contribute systematically to the forecasting of recessions in the U.S., but do so, to some extent, in the forecasts for other OECD countries. Moneta (2003) uses dynamic probit model to test whether slope of the yield curve can be a good predictor of recessions in the euro area. Estimation results show that the yield spread between the ten-year government bond rate and the three-month interbank rate outperforms all other spreads in predicting recessions in the euro area. Kauppi and Saikkonen (2007) develop dynamic binary probit models for predicting U.S. recessions using the interest rate spread as the

driving predictor. The models use recession dummy lags - lags of the binary response - to allow and test for the potential forecast power of lags of the underlying conditional probability.

Chauvet and Potter (2005) compare early warning performance of four different specifications of the probit model: a time-invariant conditionally independent version, a business cycle specific conditionally independent model, a time-invariant probit with autocorrelated errors, and a business cycle specific probit with autocorrelated errors. The business cycle specific probit model with autocorrelated errors is found to perform better in modeling business cycles in the U.S. economy using yield curve information.

Following the most recent empirical methodology and empirical findings in favor of dynamic specification of the probit, we formulate our general a priori specification as probit model, where dependent variable is growth cycle dummy (year-to-year changes in real industrial output in Ukraine) and explanatory variables include two lags of the growth cycle dummies and potential early warning indicators for the domestic economy.

6.2 Probit Models

In binary time series analysis the dependent variable y_t is a time series realization of the stochastic process that takes on only binary values.

In our growth cycle modeling the value of the observed growth cycle indicator is defined in the following way:

$$y_t = \begin{cases} 1, & \text{if the growth cycle is at fast growth at time } t \\ 0, & \text{if the growth cycle is at slow growth / decline at time } t \end{cases}$$

y_t has a Bernoulli distribution, conditional on information set observable at time (t-1). If p_t is the conditional probability that $y_t = 1$,

$$E_{t-1}(y_t) \equiv p_t = \Phi(z_t)$$

In probit models $\Phi(z_t)$ is standard normal probability density function.

As we explained above, dynamic probit models demonstrated better performance in explaining and forecasting business cycles compared to static models. Therefore, following the most recent empirical literature, we specify our model as follows:

$$z_t = \alpha + x'_{t-k} \beta + \delta y_{t-1} \quad (1)$$

where x_{t-k} - vector of explanatory variables, y_{t-1} - lagged value of explanatory variable.

In all of the above models the dependent variable is binary – 0 or 1. Binary models estimate the probability of a dependent variable taking value of 1 as function of explanatory variables:

$$P(y_t = 1 | x) = \alpha + x'_t \beta$$

Since probability is contained between 0 and 1, we cannot use least squares estimators, both linear and non-linear, as they get predictions outside the [0;1] interval.

Probit and Logit are the two most common methods to analyze binary dependent variable models. Probit uses cumulative distribution function of a normal distribution as an assumed relationship between probability of a binary outcome of a dependent variable and explanatory variables. Logit relies on logistic function²⁴ to specify the relationship between the probability of a binary outcome and explanatory variables. Both cumulative the normal distribution function and logit function capture all important properties of probability. Most important, they are contained between 0 and 1. Probit function, in addition, defines probability of observing a binary variable outcome assuming normal distribution of explanatory variables.

Probit models (and Logit models) are estimated using Maximum Likelihood Estimator.

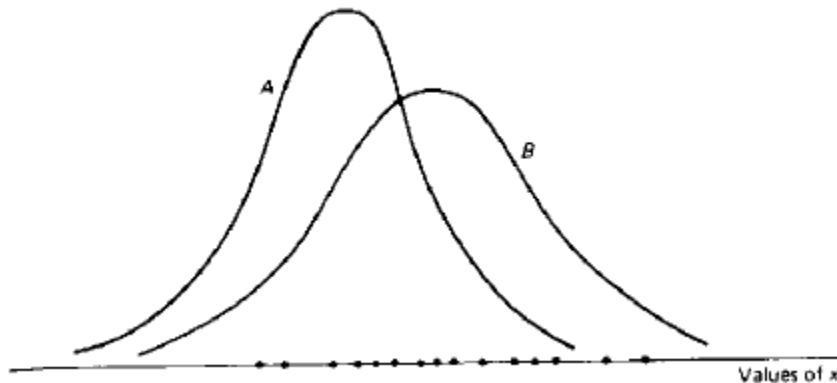
Following the literature, we rely on dynamic probit model to estimate the probability of slowing growth in each month.

²⁴ Logistic function is defined $G(z) = \exp(z) / [1 + \exp(z)]$, where z – standard normal variable.

Maximum Likelihood Estimator

Maximum Likelihood Estimator (MLE) principle is based on the idea that the sample of data we observe is more likely to have come from a particular population characterized by particular parameters than from a population characterized by any other set of parameters. The Maximum Likelihood estimate of parameter values is a particular parameter that gives the largest probability of obtaining the observed sample assuming that the underlying population is normally distributed.

The mechanics of MLE is as follows²⁵. Each of the observations we have in our sample is a random draw from some normal distribution. It can be a draw from a normal distribution A characterized by its parameters, mean_A and variance_A , or a normal distribution B with mean_B and variance_B . To determine the underlying population distribution, MLE first specifies likelihood function and then finds parameter values that maximize the likelihood function.



Likelihood function is found as a product of probabilities of each specific observation in our sample. Probability of each observation point is expressed using probability density function of a normal population.

MLE has important statistical properties. It is consistent and asymptotically efficient.

Re: Consistent estimator converges in probability to the population parameter as the sample size grows.

Asymptotically efficient estimator: for consistent estimators with asymptotically normal distributions, the estimator with the smallest asymptotic variance.

Since MLE properties critically depend on the normality assumption, one has to make sure the sample at hand is large enough to minimally satisfy the assumptions of normality. The smaller the sample size, the worse is the statistical performance of MLE.

²⁵ This picture and interpretation are borrowed from Peter Kennedy's "A Guide to Econometrics", one of the most intuitive and simplest explanations we met in the literature.

6.3 Model application

Our qualitative analysis of variables concludes that growth cycle changes are related and, possibly, preceded by the following economic variables (their respective growth rates, calculated year-on-year):

- Export (Exports)
- Russian industrial production (RUSoutput)
- Interest rates on loans charged by the domestic banks (Credit%)
- European industrial production (EUoutput)
- PPI adjusted to reflect steel prices (AdjPPI)
- Bank credit (Credit)
- Real effective exchange rate (REXrate)

Therefore, in the original general specification binary growth cycle variable (INDoutput) was specified as a function of own two lags and of the variables listed in Table 3 (**Model 1A**).

Table 3 List of variables used in Model 1A

Variable	Lags
Change in real industrial output (dependent variable)	INDoutput(-1), Indoutput(-2)
Intercept	C
Real effective exchange rate, %	REXrate(-3), REXrate(-6), REXrate(-9), REXrate(-12)
Change in real EU industrial output, %	EUoutput(-3), EUoutput (-6), EUoutput (-9), EUoutput (-18)
Bank credit interest rate, %	Credit%(-3), Credit% (-9), Credit% (-12), Credit% (-18)
Adjusted PPI, %	AdjPPI(-3), AdjPPI (-6), AdjPPI (-9)
Change in real Russia industrial output, %	RUSoutput(-12)
Value of exports, USD million	Exports(-3), Exports(-6), Exports(-9)

This specification is less general than one ideally would have to allow. General principles for econometric specification maintain that “testing down” is more suitable than “testing up” in a sense that it reduces chances that a statistically significant variable will be erroneously excluded. Therefore, one should begin with the general unrestricted model and then systematically simplify it in the light of sample evidence and understanding of the underlying economic phenomena in question.

While working on the original formulation above we made it as general as our data set allows so that we can reasonably be sure we are moving from a more general to a simpler specification testing for joint significance of coefficient sets.

Model 1A is the most general specification we could estimate given limited data set size and the nature of our task – developing a simpler warning tool, rather than a complete model. In particular,

- We did not include any contemporaneous explanatory variables. As we aim to develop earlier warning, contemporaneous variables dilute the relevance of warning. In other way, a trade-off exists between relevance and accurateness of model predictions. We put a stronger emphasize on relevance and practical importance of the tool and, for the purposes of our task, consider accuracy being secondary.
- Generally, we include third, six, ninth and twelfth lags in this specification. European industrial production index and bank credit interest rates enter with an additional eighteenth lags. Data analysis suggests that these two variables signal earlier than others.
- Similarly, inverse bank credit rates were included based on pre-estimation examination of the data. Exports and PPI do not include twelfth lags, which were not significant in our prior estimations, before we decided to include longer lags. (When all these variables are included, the model becomes unidentifiable because of the limited degrees of freedoms.)
- Bank credit was not included into this specification - we first estimate the model using the Jan.00–Jun.08 sample. During the first half of the sample period Ukrainian banks did not play a major role in channeling investments into the economy; bank credit level remained at quite a low level. Starting 2003-04 as banks were becoming more sophisticated and businesses and households started using bank credits more extensively, the banks became a factor affecting growth cycles – the hypothesis we later empirically confirmed by testing 2003-08 data.

6.4 Estimation Results

The model was estimated using monthly data on year-on-year growth rates for the variables explained above. Estimation results for this and all subsequent specifications are presented in Appendix .

To simplify the model we test for joint significance of the variables having sizeable associated p-values of their respective coefficients. F-tests for various sets of variable coefficients were implemented to identify a coefficient set with the highest probability that these coefficients are jointly equal to zero. Appendix documents results of this testing. Variable set 4 was excluded and reduced model estimated and tested for performance and variable significance.

Simplified model results (Model 2 in Appendix) suggest that EUoutput(-3), Credit%(-3), Credit%(-6), Credit%(-18), RUSoutput(-12), Exports(-3) are all significant, statistically and economically, and lead growth rate changes with varying leads – from three months to eighteen months. Exports(-9) is marginally statistically significant.

Our estimation results show that both lags of binary dependent variable are not statistically significant and do not support hypothesis that lags of the growth cycle are useful warning indicators for the Ukrainian economy. As we discussed above, dynamic probit models demonstrated better performance in a number of empirical works studying business cycles thus warranting original dynamic specification. Informational content (or absence of such) of the lags in the model for Ukraine presents a standalone empirical question beyond the scope of our analysis.

European industrial production and bank lending rates show the largest economic significance, while contribution of exports is much lower. Coefficient sign on the Russian industrial production, contrary to expected, is negative.

Based on macroeconomic theory and the fact that trade turnover with Russia and European Union represent major part of Ukraine's trade flows, one can hypothesize that Exports, EU industrial output index and Russian industrial output index can have low joint significance.

We tested for the joint significance of EUoutput(-3), RUSoutput(-12), Exports(-3), and Exports(-9) and all subsets of these variables. The largest probability that they are together insignificant is 2% for the set of RUSoutput(-12), Exports(-3), and Exports(-9).

Contrary to our expectations, both lags of dependent variables were found statistically insignificant.

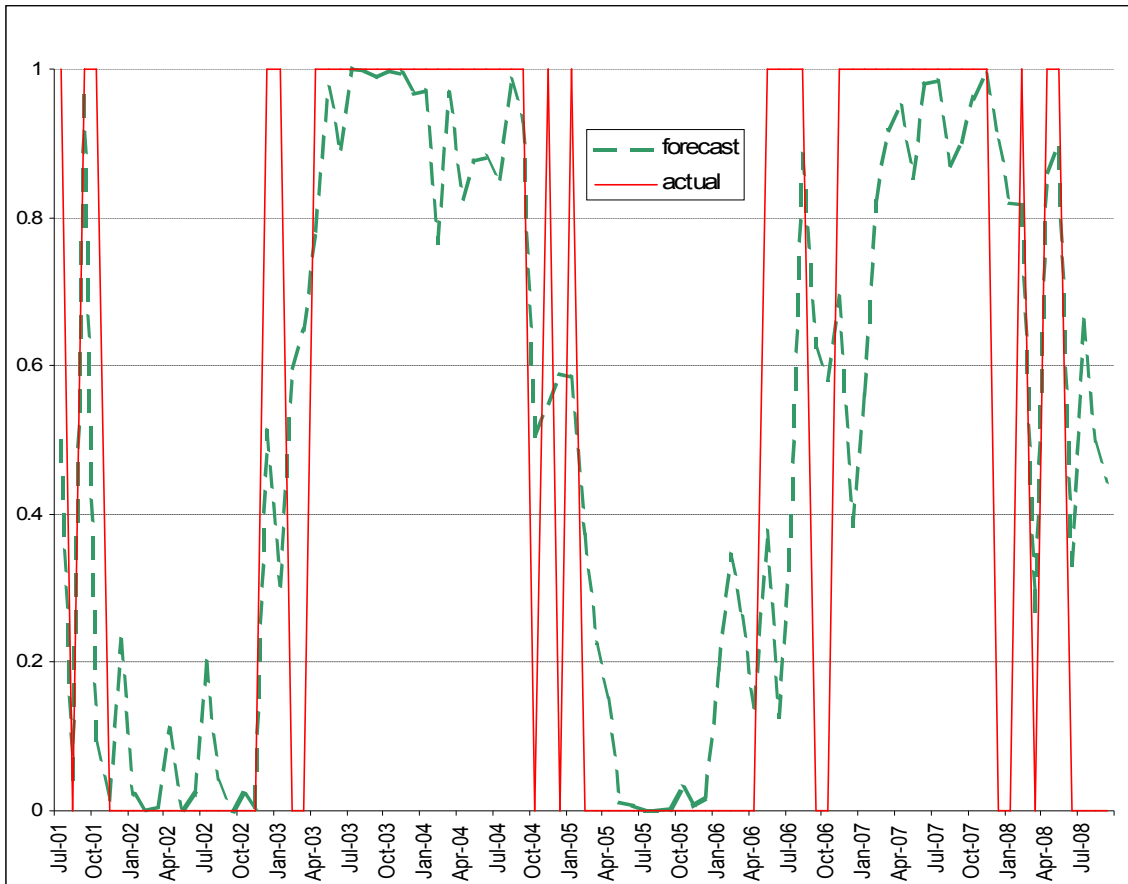
6.5 Model Performance

Most important goodness-of-fit measure in the limited dependent variable models is the percent of dependent variable values that are correctly predicted by the model. Model 2 correctly predicted 71 out of 87 growth cycle observations, and the McFadden R-squared of 50%. Actual values of growth cycle and those predicted by Model 2 are presented in Figure 6.

Performance of the model was tested using forecasted probability of dependent variable as predicted by model 2. Table 1 illustrates actual and predicted from Model 2 values of binary growth cycle dummy.

Most important goodness-of-fit measure in the limited dependent variable models – percent of dependent variable value that are correctly predicted by the model. Model 2 correctly predicted 71 out of 87 growth cycle observations, sum of squared residuals is 9.98 and the McFadden R-squared of 50%.

Figure 6 Actual and Predicted Values of Growth Cycle (Model 2)



6.6 Models with Longer Lags

As discussed, we aim to receive the earliest possible warning of growth cycle changes. As a next step we specify our model using the similar functional form as in Model 1, however shift focus to longer lags – eighteenth lag of each variable is included instead of the third lag. Limited number of observations does not allow to include both third and eighteenth lags or any additional lags which make the model unidentifiable.

Binary Model Diagnostic Statistics

McFaden R-squared

McFaden R-squared is an analogy of R-squared used for binary response models. McFaden R-squared is often called pseudo R-squared to reflect the fact that interpretation of the measure has parallels with R-squared reported for least squares models, however the definition and functional form are different. There are alternative, less commonly used, definitions for pseudo-R-squared.

Re: Conventional R-squared, or coefficient of determination, reported for models involving LS estimators provides total variation of dependent variable explained by variations in the explanatory variables. Algebraically, total variation of the dependent variable y about its mean ($\sum (y - \bar{y})^2$) is called the total sum of squares. The “explained” variation, the sum of squared deviations of the estimated values of the dependent variable \hat{y} around their mean ($\sum (\hat{y} - \bar{y})^2$) is called the regression sum of squares. Coefficient of determination, R-squared, is defined as ratio of regression sum of squares to total sum of squares.

McFaden R-squared is defined as (1-likelihood function for estimated model/likelihood function for a model with only intercept). This definition does offer some parallels with explanatory power interpretation of a conventional R-squared.

For models estimated using MLE Likelihood function for estimated model including any explanatory variables is always smaller or equal to likelihood function for a model with only intercept. If the variables in the model have no explanatory power the ratio is equal to 1 and R-squared equals zero. As explanatory power gets better, increases the difference between the two likelihood functions as captured by McFadden R-squared.

McFadden R-squared is useful, however, is rarely used alone to measure binary model performance. A single most important measure of binary model performance is proportion of the dependent value outcomes predicted correctly by the model.

We present McFadden R-squared statistics for our model results for convenience of ultimate users of the model, who routinely use R-squared statistics and may find McFadden statistics provide intuitive analogy.

p-value

p-value has a conventional interpretation in probit model. Re: probability to reject a null hypothesis when it is true, called level of significance of the hypothesis test. p-value is the smallest significance level at which the null hypothesis would be rejected. The smaller the p-value, the stronger the evidence against the null hypothesis in favor of an alternative hypothesis.

In our model we test for coefficients in front of each explanatory variable to be equal to zero (null hypothesis). That is we assume that there is no relationship between an explanatory variable in question and the dependent variable and look for empirical evidence in the data to reject the null. p-value is the smallest significance level at which we can reject the null (confirm that coefficients are non-zero). If a p-value, for example, is 5% we conclude that we can reject the null at 5% significance level or, simpler, that the probability that the coefficient equal zero is 5%.

z-statistic

z is a standard Normal variable. z-statistic (rather than t-statistic) is used because Probit models assume normal distribution of explanatory variables (to construct likelihood function, see the box on Maximum Likelihood Estimator). For this reason standard normal distribution is used for inference in hypothesis testing for binary models.

Similarly, we test this model for joint significance of coefficient sets to arrive at reduced model. Reduced model results are presented in Appendix 1 (Model 3). REXrate(-9), EUoutput(-6), EUoutput(-12), Credit%(-6), Credit%(-18), and RUSoutput(-12) are all statistically significant in this specification. The model correctly predicts 73 out of 87 observations on dependent variable; McFadden R-squared slightly higher than for the previous model. Credit%(-6), Credit%(-18), and RUSoutput(-12) are significant in both short-lag and long-lag specifications. Bank lending rates, as before, are the strongest warning indicator, judging from its coefficient size, whereas EU industrial output has lower economic significance in this specification.

Testing for joint insignificance of REXrate(-9), EUoutput(-6), EUoutput(-12), and RUSoutput(-12) and their subsets produces the largest p-value of 4.8%.

7. Conclusions

The main kinds of cautions in using the proposed indicators are related to a short period of observations, on the one hand; and rapid changes in the Ukrainian economy, on the other hand.

The observed period was shorter than a typical mid-term cycle. Only in the last quarter of 2008 we observed a recession that is partly caused by the global crisis, but to a certain extent it is likely to be a sort of “cleanup” after the boom. Now it is too early to derive any conclusions from the recent events. But although even our primitive two-component indicator does predict the slowdown (below-the-trend rates of growth) for the whole period July-December 2008, and so does the model based on the data for Jan00-Jun08, they could not foretell the depth of this slowdown, i.e., could not tell us whether to expect a recession (a negative growth), or just a continued growth at a below-trend rate. In fact, it was not designed for this purpose. Only when at least a couple of mid-term cycles occur, one can try to build an early warning indicator for such kinds of slowdowns based on some statistic evidences. As of now, we can only hypothesize about possible leading indicators for slowdowns and recessions occurring within a mid-term cycle.

The parameters and compositions of proposed indicators are optimal for the observed period of time. But they will not necessarily hold in the future. Moreover, it is almost certain that they will evolve along with the whole Ukrainian economy. For this reason we strongly recommend to make annual revisions, and adjust the computations of CLI respectively. We hope that at least for several years adjustments of weights in the CLI would be sufficient to preserve a descent predicting power. But sooner or later the structural changes will alter its composition too.

In order to account for this, we propose for the future imposing additional weights representing the proxies for impacts of each particular sector. For instance, exports may be weighted to the export/GDP ratio; interest rate – to the domestic credit/GDP ratio; stock market index – to the ratio of equity sales/GDP, etc. Such

kinds of weights would automatically adjust the contributions of respective components to the CLI accordingly to the changing roles of respective factors. Our preliminary results suggest that such an amendment could significantly improve the predicting power of CLI. For instance, we have found that the coefficients at the LIs related to financial sector (as the interest rate) dramatically increase if the data after 2003 are considered (Model 1C). This corresponds to the historical fact that in Ukraine consumer loans became widespread only after 2003.

Next improvement to be considered is defining the peaks and troughs of detrended data (the so-called turning points). The OECD recommends to use the Bry-Boschan routine for this, and it is worthwhile to try for Ukraine, although the shortness of data time series may limit its applicability.

And, of course, if the surveys be run on a monthly basis, then their results could be used for early warning predictions. There are a number of good CLIs among the survey collected data (like the business confidence index or inventory reports). Even if no monthly data is available it would be interesting to try to use the quarterly data subjected to interpolation and smoothing techniques. These experiments remained outside of the work conducted by our project.

However, the most important improvement that should be made is development of the LIs for the “shedding” of positive trends, hence the “crises”.

By taking advantage of the experience of other countries, Ukraine should not only develop its analytic capacities to produce early warning CLIs, but also find a way to institutionalize them by delegating this job to a governmental agency or an NGO think-tank. In addition to all kinds of analyses and models, Ukraine needs a systematic monitoring system of the economy, whose main (and perhaps only) task would be to produce on a monthly basis early warning indicators and use them for a comprehensive analytic work. It seems that the U.S. Conference Board would provide a good example to follow (<http://www.conference-board.org>).

It would also be helpful to develop a close cooperation with similar organizations, both governmental and NGOs, which are working on similar issues, especially in the emerging market economies, which share many features with Ukraine.

For now, the most important task is to study the factors behind and effects of the current crisis and look for policy measures which would help the economy to return to a rapid growth path, as fast as possible.

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Appendix 1 Leading indicators for the OECD countries

INDICATORS	Japan	Australia	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherl.	Norway	Portugal	Spain	Sweden	Switzerl.	UK
Employment		T							T; Weekly								
Business situation	Prospects				Prospects		Bus.Clim				Bus.Clim	Prospects		CapUtil			Profits
Bottlenecks					%BN									%BN			
Stocks, volume	1					FinG	FinG		FinG	FinG	FinG	RawM	RawM		FinG	FinG	RawM; FinG
Demand				FT											PurchRM		
Order books/new orders		T	L	T	T	T;L		L	L	L;T			T	L;FT	L;T	T	L
Production		T	Metals;FT		T,FT	FT		FT		FT	FT	Dom; FT	Ch;EGW	FT		T	FT
Construction		Permits		Starts.R				Permits					Permits		Dwelling		
Sales								5	Retail		Retail			Cars			Cars
Money supply	M1+QM	M1+QM	M1	M1+QM	M1	M3	M1	M	M1	QM	M1				M1+QM	M1	
FinMarket rates	CallRate			CallRate			Gov.Bond		3Month TB	Gov. Bond	Gov.Bond				Gov.Bond	Gov. Bond	3Month TB
Deposits&loans/Forex	2				FX1, FX2			6			Dep						Credit
Prices/Costs				FT		Raw.M at	M&M	Const;WS			Input p.	Const			Labor		
Share prices	Index	Index		Index		Index	Index		Index			Index			Index	Index	Index
Terms of trade/OECD.LI	TT		F,G,I,U K			TT			TT	TT	TT					TT	
Export/Import	3		4		Wood;Pap			Orders				7	Orders		Orders		

Source: OECD (1987)

%BN = % of firms expecting bottlenecks
 3MonthTB = 3 month treasury bill rate
 Bus.Clim = Business climate indicator
 CallRate = Call money rate
 CapUtil = Capacity utilization
 Cars = New passenger cars registered
 Ch = production of chemicals
 Const = Construction price index
 Credit = Consumer credit
 CU = Rate of capacity utilization
 Dep = Savings deposits
 Dom = Production of goods for domestic market
 Dwelling = Construction of dwellings in progress
 EGW = Production: electric, gas, water
 FinG = Stocks of finished goods, level
 FinMarket = Financial market
 FT = Future tendency
 FX1 = Bank of Finland foreign reserves
 FX2 = Foreign exchange reserves of other holders
 Gov.Bond = Yield on long-term government bonds

I = Employment in industry
 Index = Share price index
 Input p. = Input price index
 L = Level
 Labor = labor costs per unit of output
 Layoffs = Notices of lay-offs
 M&M = Labor cost in mining and manufacturing
 OECD.LI = OECD leading indicators for selected countries: France, Germany, Italy and UK
 Orders = Export order books, level
 Pap = Finland exports of paper industry products
 Permits = Construction permits issued
 Profits = Gross trading profits
 PurchRM = Purchase of raw materials, tendency
 QM = Quasi money
 Raw.Mat = raw materials price changes
 RawM = Stocks of raw materials, level
 Starts.R = Construction starts, residential housing
 T = Tendency
 TT = Terms of trade

Weekly = Weekly hours of work, manufacturing
 Wood = Finland exports of wood industry products
 WS = Wholesale price index

Japan
 1. Stocks of finished goods, level; Total stocks in manuf; Producer inventory ratio to shipments
 2. New loans for equipment; ratio of loans to deposits
 3. Excess of imports over exports
 Austria
 4. German new orders
 Greece
 5. Retail sales, clothing and footwear; Sales, future tendency
 6. Bank credit to manufacturing
 Norway
 7. IP export goods; Domestic goods for export; Stocks of imported products; export orders, tendency; Value of exports+B2

Appendix 2 Leading indicators for non-OECD countries and new OECD member states

Indicator	Countries where it is used
Foreign trade	
Export volume	BRAZIL, INDONESIA, Philippines (Hotel occupancy rate, tourist/visitor arrivals), JORDAN (Growth rate in the demand for domestic exports), Malaysia; Singapore (Total non-oil sea borne cargo handled; U.S. Purchasing Managers' Index (Manufacturing))
Import volume	CHINA, HUNGARY, INDONESIA, the PHILIPPINES, INDIA, SINGAPORE (Total non-oil retained imports (NORI))
Net trade	SLOVAKIA, RUSSIA, KOREA (BOP, Capital & financial accounts)
Terms of trade	BRAZIL, the PHILIPPINES
Cargo handled at ports	CHINA
Prospects for major export articles	RUSSIA (World price of oil), CYPRUS (Composite leading indicator for tourism)
Performance of trade partners	MALAYSIA (Industrial production in Korea, U.S. Federal Reserve rate)
Exchange rate	CYPRUS, INDONESIA, the PHILIPPINES, INDIA; POLAND LITHUANIA (Real effective exchange rate); SINGAPORE (Domestic liquidity indicator)
Net usable reserves of the Central Bank	JORDAN
Prices	
CPI, WPI	The PHILIPPINES
Tendencies (prices)	The CZECH REPUBLIC, SLOVAKIA, RUSSIA
Production	
Production of certain kinds of non-durables	BRAZIL, CHINA, INDIA, POLAND
Stocks	The CZECH REPUBLIC, KOREA, BRAZIL, RUSSIA (Stock level, retail trade), SINGAPORE

Expectations	
Business confidence (production)	KOREA, NEW ZEALAND, HUNGARY, SLOVAKIA, SOUTH AFRICA (Building plans, Business confidence, manufacturing), CYPRUS (business climate indicators for manufacturing, tourism and services), INDIA, RUSSIA (Business situation, construction); Singapore (wholesale)
Consumer expectations	The CZECH REPUBLIC, NEW ZEALAND
Entrepreneurship	the PHILIPPINES, (Number of new business corporations), SINGAPORE
Domestic demand	
Demand level (industry) or order inflow, manufacturing	RUSSIA, SOUTH AFRICA, BRAZIL (Order books)
Retail trade sales	SLOVAKIA, NEW ZEALAND
Motor cars sales	SOUTH AFRICA, CYPRUS, BRAZIL
Dwelling permits	SOUTH AFRICA, CYPRUS
interest rates	
Interest rates	KOREA (Long term bond yield), NEW ZEALAND (Yield 3-month bank bills), INDONESIA (Discount rate), HUNGARY (Central bank base interest rate), POLAND (3-month WIBOR inter bank rate), INDIA (Deposit interest rate, inverted), JORDAN (interest rate spread between three-month Jordanian CD rates and the corresponding U.S. treasury bill rates); Lithuania (5-years loans), Singapore (Domestic liquidity indicator)
Banking	
Interest rate spread	SOUTH AFRICA,
Net credit to the private sector	JORDAN, LITHUANIA (Domestic credit)
Foreign currency deposits in banking institutions;	LITHUANIA
Government lending funds in deposit money banks;	
Foreign Assets	

Money supply	INDIA, HUNGARY, NEW ZEALAND (M1); CZECH REPUBLIC, KOREA, CHINA, RUSSIA, SINGAPORE (M2); CYPRUS, the PHILIPPINES, MALAYSIA, LITHUANIA (Quasi-money)
Stock market	RUSSIA, SOUTH AFRICA, SLOVAK REPUBLIC, HUNGARY, INDONESIA, INDIA, the CZECH REPUBLIC, BRAZIL, CYPRUS, the PHILIPPINES, JORDAN, MALAYSIA, SINGAPORE
Labor market	
Unemployed	NEW ZEALAND, HUNGARY, LITHUANIA
Unfilled job vacancies	POLAND, CYPRUS
Hours of work, manufacturing	HUNGARY

Sources: Ahmad (2003), Bersales et al. (2004), Demetriades (1999), Everhart and Duval-Hernandez (2000), Hoos et al. (1997), Mongardini and Saadi-Sedik (2003), Nilsson (2006), Nilsson and Brunet (2005), Nilsson and Guidetti (2007) and Zhang and Zhuang (2002),

Appendix 3 Candidate indicators for Ukraine

Factor	Desirable indicators	Availability, proxies	Formula	Details	Sources	Variable name
Price inflexibility and disproportions	Adjusted PPI	A ratio of producers' price index (PPI) and consumers' price index (CPI) divided on the index of metal prices (IM); reciprocal PPI	AdjPPI=PPI/CPI/IM	PPI and CPI (12/2002=1); IM (2005=100)	DerzhComStat and IMF	AdjPPI
			RecPPI=1/PPI			RecPPI
Business confidence and expectations	Survey-based indexes	Available on the quarterly basis only	Not used			
Domestic demand	Retail turnover	Poor quality of data	Not used in the final version		DerzhComStat	
	Households incomes or expenditures	Poor quality of data	Not used in the final version		DerzhComStat	
Foreign trade	Terms of trade	Not available directly. We would like to substitute it with an index of the World prices on steel, but it is unavailable either. Instead, the IMF's metal price index was used	Not used in the final version		IMF	

Exports	Volume of exports	Available		in mln USD (nominal)	DerzhComStat, based on the information from customs	Export
	Trade balance	Available		in mln USD (nominal)	DerzhComStat, based on the information from customs	TBal
Financial markets	Volume of loans	Available		In bln UAH (nominal) Also real credit (Cred/CPI) was tried unsuccessfully	NBU	Credits
	Interest rate on loans	Available; in practice reciprocal was used		Also real interest rate (Credit% /CPI) was tried unsuccessfully	NBU	Credit%
	Bad loans	Not available; poor quality of data even if available				
	Money aggregate M2	Available	Not used in the final version		NBU	

Purchasing power of domestic currency	Real effective exchange rate	Available (in the version: effective exchange rate, and the one adjusted for CPI)	$RXrate = 0.7 * Xrate(UAH/USD) + 0.3 * Xrate(UAH/EUR)$	Also real effective exchange rate in the version (EER/PPI) was tried unsuccessfully	NBU	RXrate
			$REXrate = RXrate / CPI$			REXrate
External markets	GDP growth in the basket of main trade partners	Industrial production indexes for the EU (2000 = 100%)			Eurostat http://epp.eurostat.ec.europa.eu	EUoutput
		and Russia (2005=100%)			UNECE (http://w3.unece.org)	RUSoutput

Appendix 4 Examples of graphical analysis of selected candidate indicators

Figures 1A-5A present monthly data for the period of Jan00-Dec07. In all cases the original series were detrended using the Hodric-Prescott (HP) filter with a smoothing parameter of 14400, smoothed by the same filter with a parameter of 50, and then normalized by dividing by the standard deviation. In all cases Ukrainian industrial output served as the target variable.

Figure 1A The EU industrial output index (used in the final version)

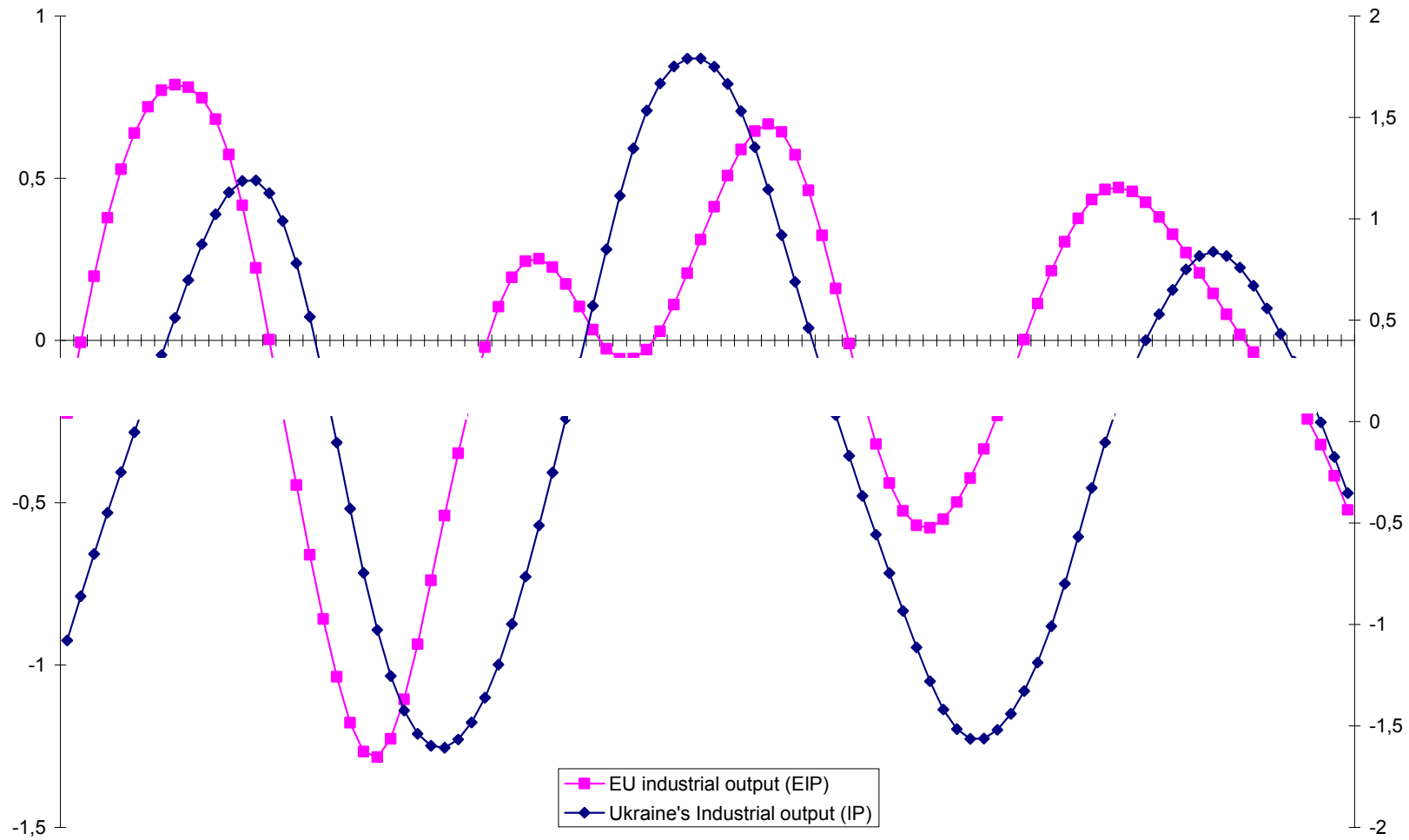


Figure 2A Exports (in mln. USD) (used in the final version)

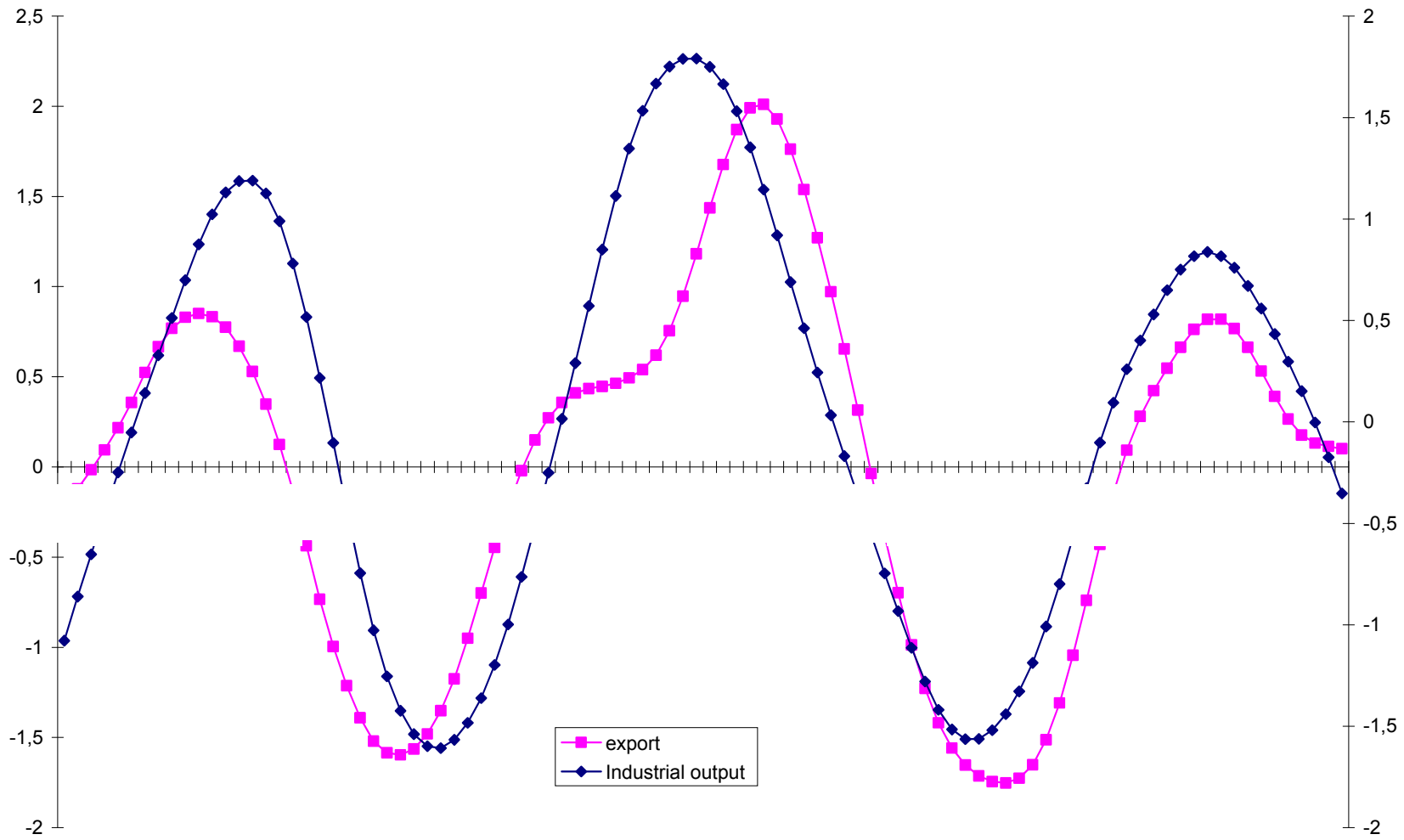


Figure 3A Reciprocal average interest rate on bank loans (used in the final version)

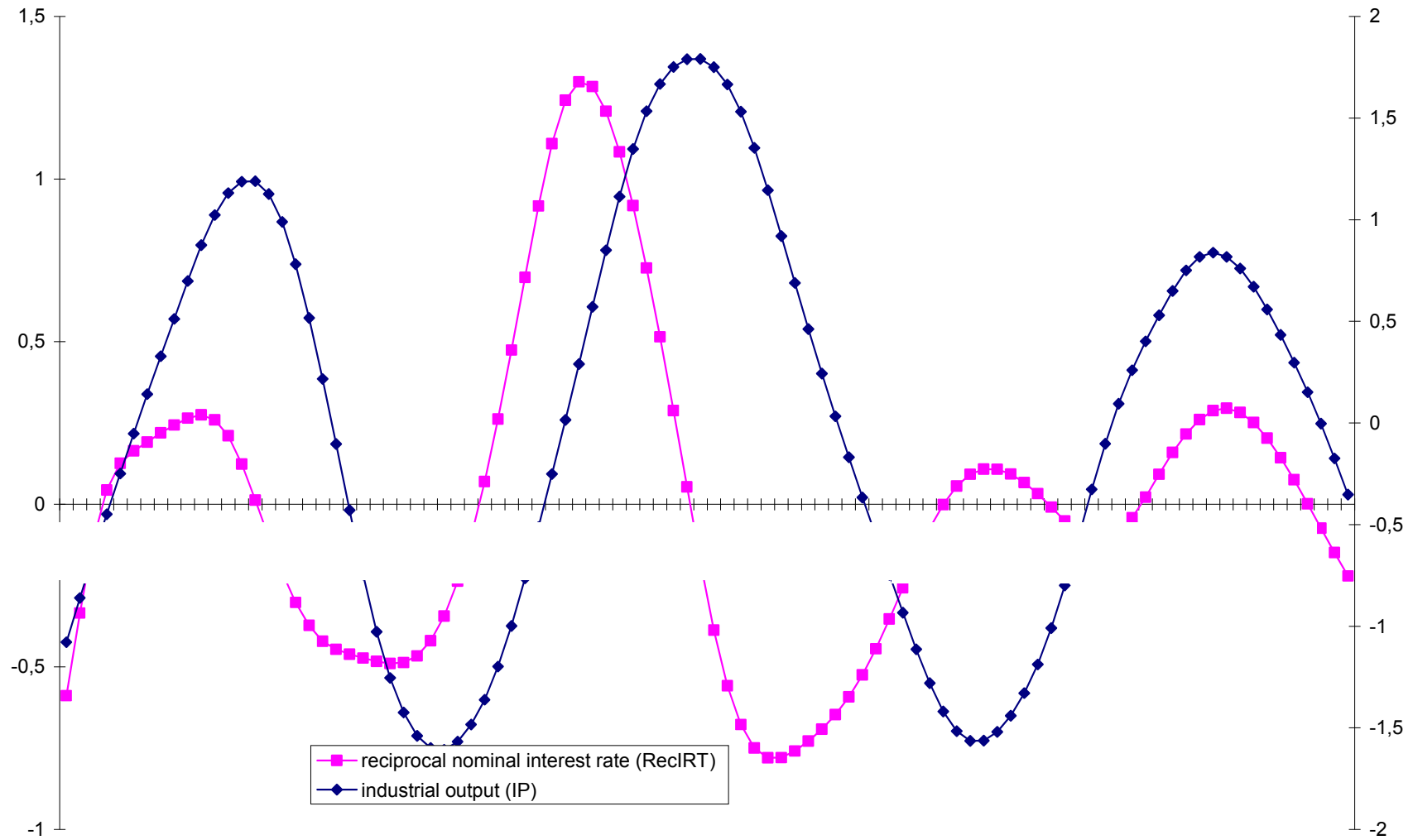


Figure 4A Real households expenditures (not used in the final version)

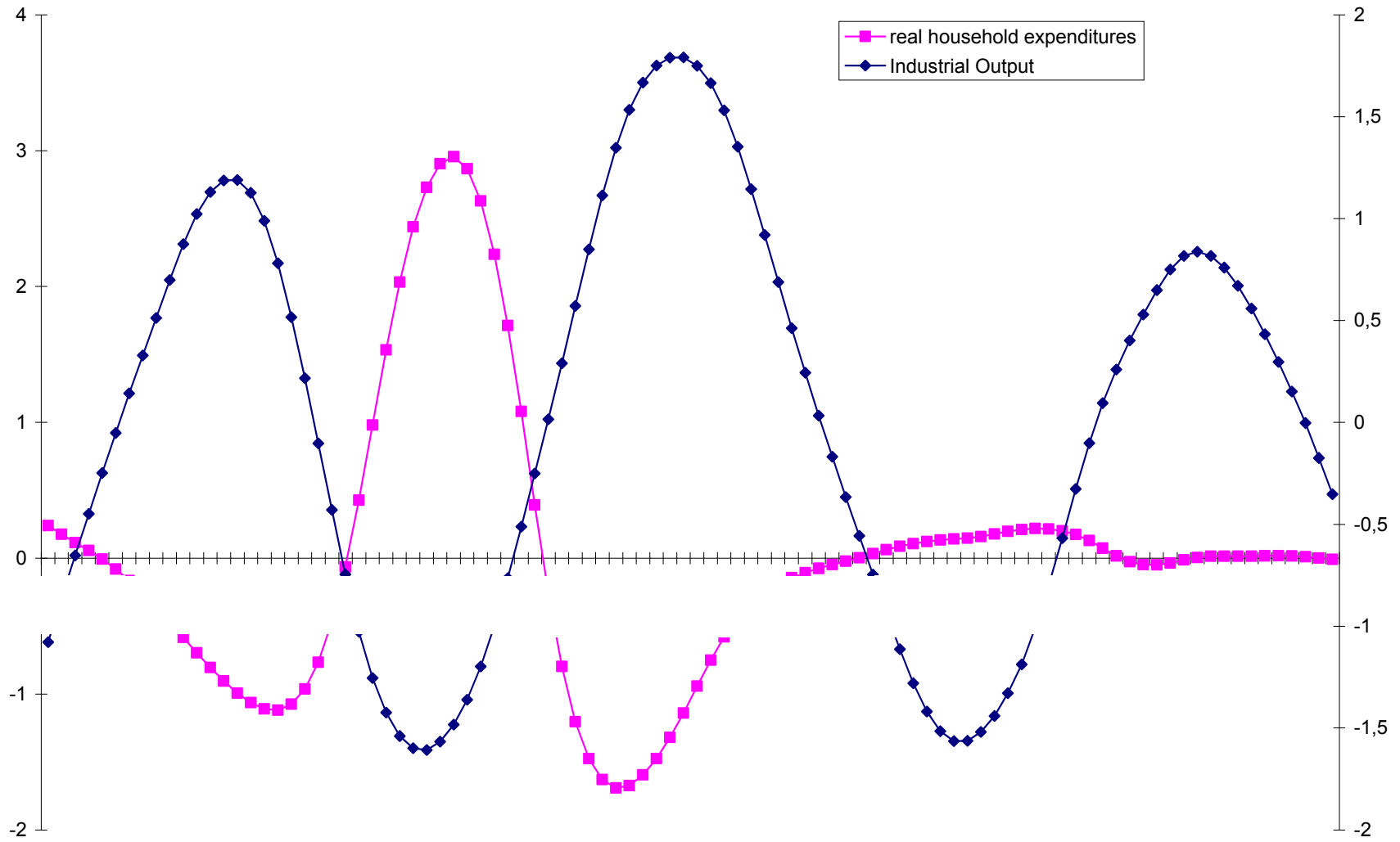
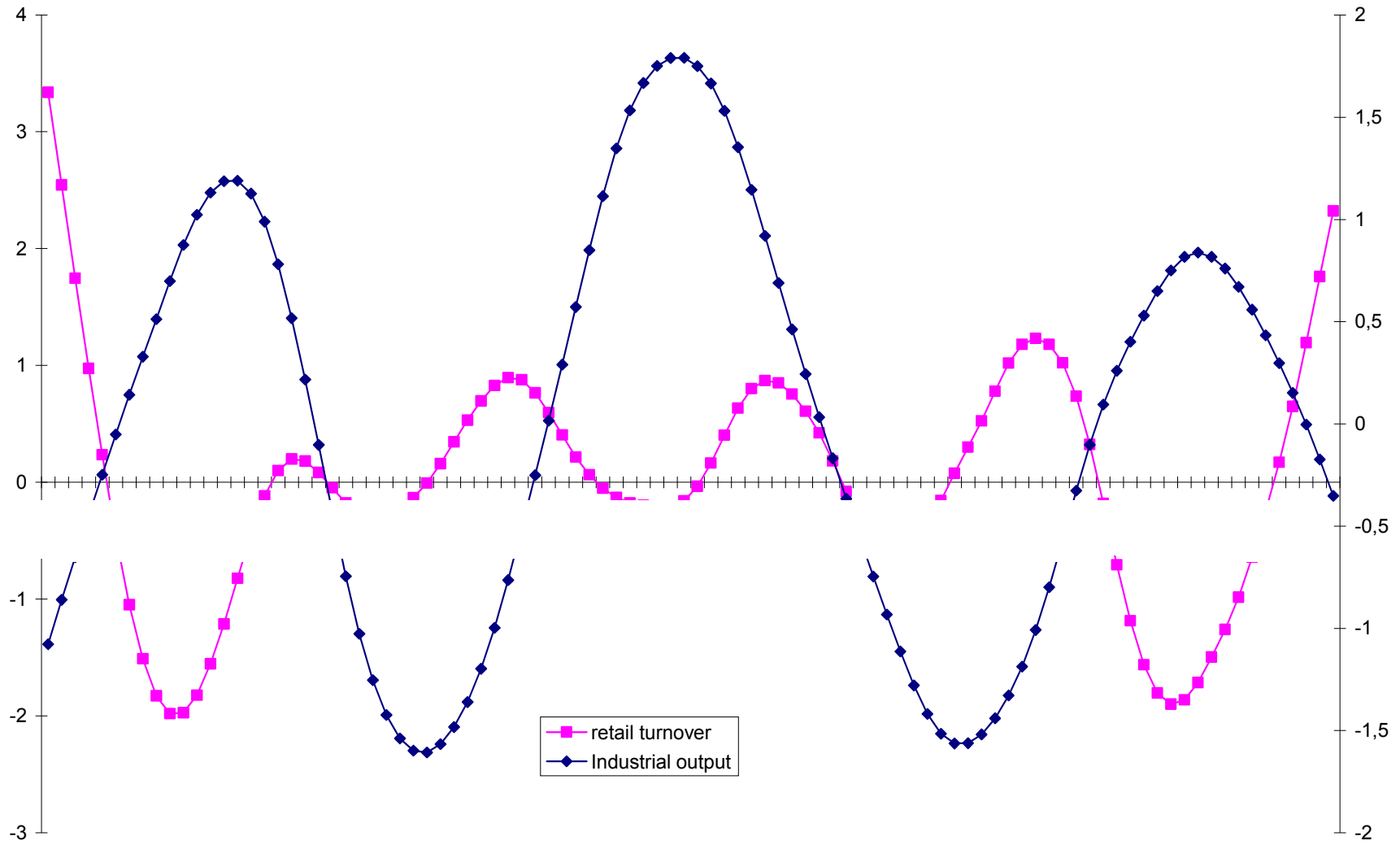


Figure 5A Retail turnover (nominal, in UAH) (not used in the final version)



Appendix 5 Results of modeling experiments

		Sample: Jan00-Jun08			Sample: Jan03-Jun08			Sample: Jan00-Sep08								
		Model 1B			Model 1C			Model 2			Model 3			Model 4		
Variable	Lag	Coeff	z-Stat	p-value	Coeff	z-Stat	p-value	Coeff	z-Stat	p-value	Coeff	z-Stat	p-value	Coeff	z-Stat	p-value
Constant		0,4469	1,3594	0,1740	0,0991	-0,3038	0,7613	0,0045	-0,0234	0,9814	0,2844	-1,2653	0,2057	0,6081	-1,8851	0,0594
REXrate	-6	1,2750	2,3995	0,0164										0,6936	2,9062	0,0037
REXrate	-9				1,0278	2,3825	0,0172									
EUoutput	-3							0,9529	3,3642	0,0008						
EUoutput	-6	2,4475	2,9615	0,0031							1,3816	3,7782	0,0002	1,0929	3,1133	0,0019
EUoutput	-9	0,8321	-1,5239	0,1275	2,7667	2,7480	0,0060									
EUoutput	-12										0,7972	-2,7847	0,0054	0,5000	-2,1439	0,0320
Credits	-3													1,7985	3,9781	0,0001
Credits	-9				1,0015	-2,1315	0,0330									
Rcredit%	-3	1,9055	2,0211	0,0433												
Rcredit%	-6							1,3228	3,5879	0,0003	1,9547	3,9733	0,0001			
Rcredit%	-9	1,8690	3,1383	0,0017	2,6541	3,6531	0,0003									
Rcredit%	-18							0,6400	2,3551	0,0185	1,2182	3,5594	0,0004			
AdjPPI	-6	1,9671	-2,8340	0,0046	1,1445	-2,4553	0,0141									
RUSoutput	-12							0,6539	-2,6679	0,0076	0,5921	-2,3666	0,0180			
Exports	-3							0,3918	1,8096	0,0704						
Exports	-6	1,0114	-1,9618	0,0498												
Exports	-9	1,0163	1,8581	0,0632												
Exports	-9							0,2953	1,4079	0,1592						

McFadden R-squared	0,6788	0,5774	0,4985	0,5169	0,5665
Obs with Dep=0	42	28	42	42	42
Obs with Dep=1	51	38	45	45	51
Total obs	93	66	87	87	93
Correctly predicted values	84	57	71	73	80
Prediction accuracy	90,3%	86,4%	81,6%	83,9%	86,0%