Reduction of structural distortions in transitional economies

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1. Introduction.

1.1 Structural distortions – definition and empirical evidences.

Structural distortion in economy can be defined as a regular imbalance in price and production. If economy experiences a chronic (not a singular) mismatch of demand and supply, this means that a price vector (or an exchange proportions vector) does not correspond to equilibrium volume of output, by which economy structure can be defined as distorted. The reason why such regular imbalance can exist is a subject to investigate on a case-to-case basis. Typically economies are self-regulating structures to which regular imbalances are abnormal. Thus, structural distortion would most likely have exogenous nature, imposed by a governmental policy or by a world market price shock, such as a natural resource market shock [Ishikawa, 1998].

Structural distortions have been observed throughout all economies in transition. To measure degree of structural distortion is a separate issue, which will be discussed in short later. One of the accepted approaches is to compare the existing structure of domestic and world prices by using some good price as a 'numeraire' – e.g. a price of crude oil. This comparison indicates that, for instance, the domestic price of textiles in the ex-Soviet Union in 1991, measured in crude oil, was ten times higher than world market price [IET, 1996]. Similar calculations made by IFC researchers [de Melo et al., 1997] indicate that the greatest degree of distortions was observed in former Soviet Union republics, while Poland and Czech Republic had the least distortions. The basic explanations of the observed distortions were that (a) in the planned economy, there existed non-responding supply, i.e. supply not related to demand given the price structure, and (b) prices were set up as a form of preferences to certain groups and categories of population and producers (and thus they were not 'real' prices). It can also be hypothesised that distortions would be related to a country size (Soviet Union, being significantly larger than e.g. Poland, would have a larger degree of distortions).

Another important fact is that in Eastern Europe countries still existed, concealed, some features of capitalist market economy[1].

1.2 Process of distortion reduction – facts and analysis.

Liberalisation programmes in various transitional economies assumed that price liberalisation of major intermediate and final goods markets would create an effective link between price, demand and supply which would allow for the reduction of structural distortions. A short period of decline caused by the price shock would then be followed by economy revival. That was the essence of 'shock therapy'.

However, in some cases, liberalisation policies were not applied consequently and ultimately. Some policies also have not taken into consideration individual economic, institutional and social specifications of particular countries. It was one of the reasons why some countries (e.g. Russia, Ukraine) were caught into a 'liberalisation trap', when high increment in price level has not resulted in immediate positive structural shifts [Wei et al., 1998] – instead, a production downfall has been observed.

Still, there are evidences that there has been a major structural change in both Eastern Europe and the Newly Independent States (NIS) countries [Berg, 1995]. Not only shifts in price structure have been observed, but also the gap decreased between domestic prices in transitional economies and world market prices [Bessonov, 1998]. Similarly, production structure has also undergone considerable changes. One of the most notable changes was that a shift in production from available resource limitation to demand limitation that occurred on the second or third year of transition – in other words, a linking mechanism has been established between supply and demand [Berg, 1999].

A standard approach for analysis of distortions reduction is in a thesis that market 'clears' all the imbalances. This methodology analyses a computable general equilibrium for economies in transition [Zalai, 1998]. However, a computable general equilibrium, proven relevant for institutionally steady markets (such as the US economy), is not as adequate in respect to economies in transition, especially those huge and distorted. It also does not appear to explain the initial price shock which has been observed in virtually all transitional countries in the beginning of transition process.

[1] As one will easily derive from the paragraphs below, our analysis does not include China, which had a very particular economy and also has undergone only minor liberalization. We will focus mostly on changes in the NIS and Russia, since the issue of the removal of structural distortions is crucial for these countries. Eastern Europe countries have been notably more successful in their transition process (probably due to their relatively smaller size).

Studies provide an empirical hint about the process that guided the structural transformations. There is evidence that structural shifts in outputs and prices were interdependent [Bessonov, 2000], which allows to suggest that structural distortions were (and, in a number of countries, still are) gradually eliminated by interactions in inter-industrial supply chains. To verify whether independent agents acting in the free (or partially free) market can eliminate existing distortions by themselves is an issue. The theory of traditional market economies assumes it is so. But it also has been accepted by most scholars that economies in transition are a totally new phenomena, and thus traditional theories can not suffice to describe them.

1.3 Problem definition.

The fact that a disproportional market structure is observed in transitional economies is generally accepted, as well as the fact that this structural distortion is gradually eliminated. However, it has never been questioned whether market interactions of agents guided by simple, but realistic set of decision-taking rules can reduce or eliminate structural distortions in a fast and efficient way – or is structural distortion a market failure phenomenon where intervention of non-market forces, such as state authorities, is required. In the present paper it is attempted to analyse this issue.

As this issues involves the rapidity in which distortions would be eliminated, it is crucial to analyse the process dynamics. Therefore, a dynamic simulation model of inter-industrial interaction could be built that captures the main market interaction features and represents a quasi multi-agent system. Similar methods have been used to predict distribution of bounded resources in an input-output model [Yaremenko, 1975] and to study market emergence in a transitional economy [Moss, Kuznetsova, 1995].

The model pursues following purposes:

(1) to analyse the process of the reduction of structural distortion in relation to the variation of inter-industrial and intra-industrial structure, e.g. based on different pricing schemes inside industries;

(2) to analyse the impact of conditions similar to the initial situation, before liberalisation, in transitional economies;

(3) to consider changes in the critical variables in a transitional economy (e.g. employment rate and arrears level) during the process of structural distortion reduction and to provide interpretation for dynamics of these variables;

(4) to consider impact of government policies designed to correct the imbalances and enable the structural distortion reduction process.

In Chapter 2, basic assumptions of the model, rules describing agent behaviour and structure of a five-industry model are presented . In Chapter 3, the process of distortion reduction is studied through a simulation and a further comparison with a time series from several economies in transition. In Chapter 4, arrears, an important phenomenon of transitional economies, is studied and its emergence due to structural distortions of a transitional economy is demonstrated. Chapter 5 summarises the main results of the paper.

2. Building a inter-industrial interactions model.

2.1 Basic model assumptions.

A model of inter-industrial interactions built according to MAS paradigm can be used to describe a multi-industrial economy in which structural distortion might take place. This is an quasi multi-agent system: firms inside each industry are aggregated to represent a single agent, which produces and prices a single product. This type of description is convenient to use, since it does not require to take into a consideration industry structure and decision strategy of particular agents, while still retaining the type of behaviour inside each industry: monopolistic, oligopolistic, or competitive. Agents follow simple algorithms to determine quantities of output and to set up prices.

It is assumed that these agents are not profit maximisers. A paradigm of profit maximisation has been long criticised for a unrealistic assumptions regarding behaviour of economic agents it analyses [Shackle, 1973]. In fact there is no absolute knowledge of best opportunities and prices, especially in the ever-changing environment of a transitional economy. It is therefore realistic to assume that agent behaviour is guided by a set of simple rules, rather than that it is a maximising behaviour.

In order to analyse the net impact of inter-industrial interaction mechanism on structural distortion reduction, it makes sense to abstract from *external economic relations*. One of the hypotheses to be used is that inter-industrial interactions can bring an economy to a structurally proportional (equilibrium) state even in the absence of a world market proportional price structure to which domestic price structure tends. The accompanying effects of external trade (e.g. emergence of export-oriented industries and production decrease in import-substituting industries) complicate the basic analysis without a significant benefit, therefore they are not considered. However, these issues are briefly discussed separately.

The economy is modelled as a closed economy in which all household income, i.e. workers' wages and capital owners' profits, will be used in the final production market. In case this income cannot be spent, it will be saved for the next periods.

Another notable assumption is made regarding capital. In the model analysed, the author has disengaged himself from consideration of production capital. This assumption has several consequences: (a) since there is no capital market and no external relations, all available income would be spent on final production market; (b) since there are no investment opportunities, there is no opportunity cost of resources and thus no rigid price growth, (c) it is implicitly assumed that the economy possesses a certain 'stock' of production capital (obtained for 'free' through investments made in the past) which is gradually vanished by operational activities. There is some rationality about these assumptions, too. It is well known that in past few years asset retirement in most production sectors of economies of NIS has not been balanced by asset replacement – i.e. there have been great net loss of assets which have been basically eaten away [Yakovlev, 1999]. Also, current consumption until the last few years was highly preferred, thus any available income was immediately spent on goods available [Lenain, 1998].

It is implied that government has only a re-distributive role in the modelled economy. All taxes that are by paid by some of households will be transferred to other households, e.g. as social services or pensions. Since all incomes can only be used in domestic final production market, one can suggest there would be no changes in demand level. Therefore, initially it is possible to disengage from government consideration. Further, one would consider more active governmental role, e.g. government procurements and economic policies.

2.2 Agent behaviour hypotheses.

Decision on pricing. Pricing can be based on following basic assumptions:

(1) major pricing method is a *cost-based pricing*, i.e. enterprises determine unit price as unit cost plus unit profit margin. This is quite an adequate assumption: according to surveys, approx. 90% of enterprises in the NIS and Eastern Europe still use cost-based pricing [Krasnova, Smorodina, 1998];

(2) as a consequence, there are cost-pushing and cost-taking industries; cost is formed by upstream industries (in first turn, raw material industries); *inflation is cost-pushed*;

(3) *wage* level can become an additional source of disturbances in economy if it is in some way tightened to price level. Two major types of wage adjustment are typically considered: either it is strictly linked to price level (and thus fluctuates with prices) or it only grows rigidly [Perry, 1998];

(4) *price* adjustment can be *linked to supply and demand* volumes by the simple rule: in case of excess supply prices go down, in case of excess demand prices go up. Pricing flexibility can be delimited by the requirement not to sell at price lower than unit cost;

(5) *margins* are determined based on assumption about intra-industrial structure:

- in a *competitive* industry, margins are zero;
- in a *monopolistic* industry, margins are non-negative (and are consistently non-zero);
- in an *oligopoly* / *monopolistic competition* case, margins can be set as well below zero.

Decision on quantities. Production and consumption can be determined by following rules:

(1) *input* (intermediates) *demand* is based on production requirement (or production plan), which is, in turn, determined by output demand. Every industry would demand input volumes required to produce outputs which will be sufficient to fulfil all orders (existing or forecasted);

(2) final *consumer demand* is determined by product price, consumer income and consumer preference (for each product a fixed share is assumed in a basket of goods; Engel's effect is not considered);

(3) *production supply* is volume of output plus volume of stocks;

(4) volume of *output* is determined by expected output demand (which can be forecasted according enterprise experience, based on observations of previous periods), inputs available (determining ceiling level of output) and stock volumes available;

(5) *stocks* of output (finished production) are formed as excess production (production which is not sold out within a period is carried over to next period). It is assumed there are no significant raw material stocks, which to some degree a reasonable assumption. Input stocks would 'freeze' enterprise financial funds, which is not acceptable for enterprises in transitional economies, suffering liquidity crisis;

(6) actual volume of sales in the market (market equilibrium) is equal to the lesser of two values: an amount of supply and an amount of demand. Excess final production demand will result in savings increase (this phenomenon has been observed during the last few years of the Soviet Union's existence [Belousov, 1999]). Excess production supply will lead to production stock increase, and

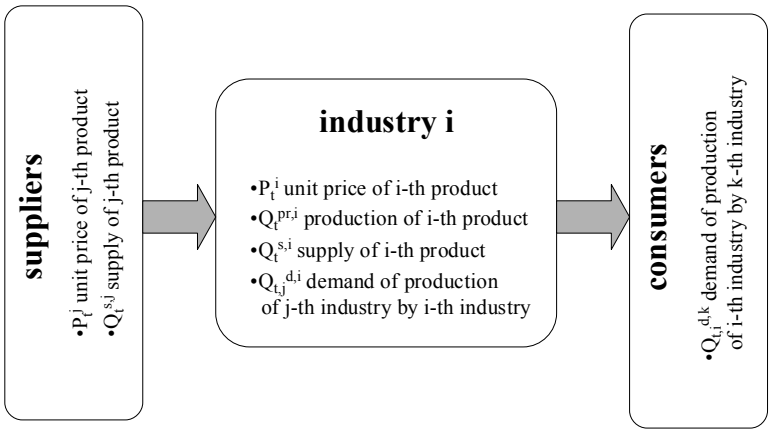
(7) if total demand in industries exceeds a potential supply, a certain priority of distribution has to be set. One may assume there is no priority of any industry, so orders are fulfilled on first-come-first-served basis. In case of deficit, orders are fulfilled proportionally to requests received from each industry.

This set of assumptions about agent's behaviour could be in a more formal way. The figure below (Fig.1) illustrates the inter-industrial interactions and the values defined.

Workforce is initially distributed between sectors based on industrial needs. One may assume that labour supply to each industry is a fixed value, i.e. labour in each industry is specialised.

However, from practice it is known that there is a high degree of labour flexibility in economy, especially if labour is not specialised. Thus, a more sophisticated assumption can be introduced, that workforce flows from industries with consistent over-employment to those with consistent under-employment.

Figure 1: Inter-industrial interactions of i-th industry



Based on these definitions, one may build a model of multi-industrial economy with a deliberate number of industries. See Appendix 1 for an analytic description of n-industry model to be used for simulations. By its analytic representation, this model resembles a discrete macro model of disequilibrium economy developed by J. Eckalbar [Eckalbar, 1985]; however, Eckalbar's model does not consider inter-industrial interactions, and thus it is irrelevant to the core subject of this paper.

1.3. Basic structure of five-industry model.

The author has analysed the basic case of two-industry model elsewhere [Luksha,2000]. The case of a two-industries model gives insights concerning the variety of supplier-consumer interactions and the process of distortion reduction (see Section 5 for details). A multi-industrial model, however, would behave in a more realistic way; at the same time, simulation becomes crucial (and perhaps the only) approach due to a complex behaviour of such a model.

In the present paper, a case of a five-industry economy with a cost-pushing monopolist energy industry is considered. The design of this model captures major features of economies of such transitional countries as Russia and Ukraine [De Broeck, Koen, 2000].

An economic system has three intermediate good industries (an energy sector, a mineral resources block represented by metal industry, and an agricultural sector), a capital goods industry (machinery, which is not exactly a capital good industry in the model, because capital is assumed to be consumed like any other current resource), and a final product

industry (food industry). It also has households buying food in the final good market and supplying labour to all five industries.

Inter-agent interactions in five-industry model are summarised in the Table 1. See Appendix 2 for a graphic representation of this industrial structure and input-output balance of industries.

An energy industry acts as a cost-pusher – it deliberately increases and decreases its monopolist margin attempting to maximise its expected income in accordance with algorithms outlined in Section 2.2. All other industries are cost-takers. Energy industry has been chosen for this role because (1) it is adequately described as a monopolistic or quasi-monopolistic industry (thus, it has higher bargaining power in prices regulation), (2) this industry supplies its product to all other industries in the economy, and therefore it has an immediate impact on their price dynamics. Empirical observations indicate that there are only two industries with such characteristics, namely, energy and transport. Their impact on inflation spin-off has been widely discussed [Belousov, 1999].

Table 1: Inter-agent interactions in five-industry economy model

type of agent	intermediate industry 1	intermediate industry 2	intermediate industry 3	capital product industry	final product industry	house-holds
production	energy	metal	agriculture	machines	food	labour
consump-tion	machines, labour	energy, machines, labour	energy, machines, labour	energy, metal, machines, labour	agriculture, machines, labour	food

Since the scheme described has a circular inter-dependence of production volumes and prices in metallurgy, energy and machinery industries, if resource limitation cap is introduced for each of these industries, then output reduction by any one of these industries will cause a rapid collapse of overall output. To avoid this, it has been assumed that machinery industry does not imply a resource limitation cap on other industries, but has an influence on their pricing through fluctuations of its own prices. This assumption closely follows the nature of machinery industry [Granberg, 1978].

The five-industry model has a discrete time. One interval of time corresponds to an average time required to convert inputs into output (in terms of financial analysis, it is an average period of unfinished production turnover in assets turnover cycle). Based on empirical evidences, one may point out that this period in economic practice is equal to approximately

three months [Makeev, 1996]. The initial period of the model (t=0) is the last period before the transition.

3. Dynamics of a five-industry model.

3.1 Analysed data and initial conditions.

In order to analyse the process of structural distortion liquidation, one would focus on several major groups of variables critical for an economy in transition. Such variables to be tracked in dynamics are: total industrial output and output per industry, price level in economy and in particular industries. Specific indicators specific to transitional economies should also be introduced and their dynamics needs to be considered, such as total arrears, overdue debt to work force, unemployment in total and per industry.

An structural changes index will allow the estimation of the structural shift for output and price level in each model period. One of the possible representations can be

$$g(v_t) = \left\| \frac{v_t}{\|v_t\|} - \frac{v_{t-1}}{\|v_{t-1}\|} \right\|$$

where v_t is a vector of outputs or prices observed at period t. If only proportional growth (decline) occurs between periods (t-1) and t, then $g(v_t)$ is zero. An important feature of this index is its scale invariance, which allows for comparison of economies of different scale. This index is argued to be the best method of structural shifts measurement [Bessonov, 2000].

Analysed variables in the model depend on changes in supply and demand volumes and adjustment of prices in each of industries, defined by agents' decisions. Agents use data available in current period, and they as well may use data from previous periods e.g. in attempt to forecast future demand. Since all decisions are functionally dependent on observed variables from previous periods, the model evolutionary dynamics is determined solely by initial conditions and parameters.

The following assumptions are used about the initial pre-transition period:

(1) *imbalance structure of supply and demand*: excess demand in industries (intermediate and consumer goods deficit is typical for most transitional before liberalisation, especially for Russia and ex-Soviet Union republics [Berg, et al., 1999]);

(2) *imbalance price structure*: prices are determined not by market conditions but defined by authorities (evidences supporting this point of view has been discussed in Section 1.1);

(3) there is *no* inter-industrial *arrears and overdue debt* to labour force, because central planning system performs directive business accounting between economic agents (in

spite of the situation in a liberalised economy where debts are covered with enterprises' cash available);

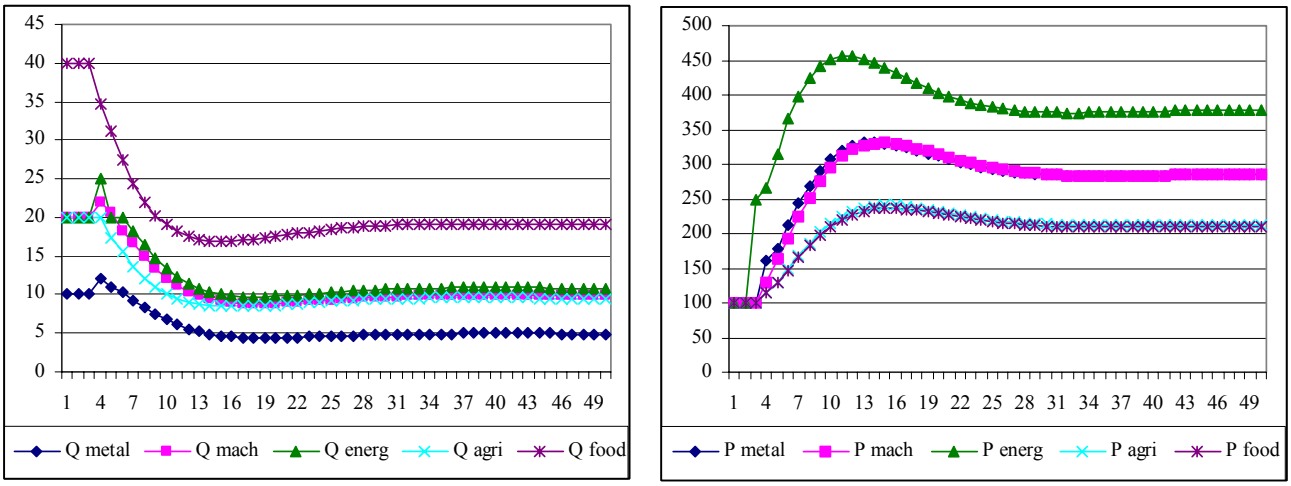
(4) initially, there are *no stocks of production* due to total deficit.

Total income and labour available in economy are set by exogenous variables. All exogenous variables were adjusted to hold proportions similar to observed in transitional economies of NIS.

3.2 Simulation of a distorted economy.

Initial conditions have been defined as imbalance in markets of intermediate and consumer goods. Demand exceeds supply in final production market, and so it correspondingly does in intermediate production market. Enterprises cannot fulfil all requests because they are regulated by central planning system and thus are forced not to react to market signals. Once the transition occurs, rules are changed and each industry begins to behave 'selfishly', trying to maximise its own benefit, even at an expense of all other economic agents. Also, enterprises can now only pay to their workers no more that they earned, which means an abandonment of guaranteed income and of guaranteed employment for every unit of available labour force.

Figure 2: Dynamics of prices and outputs in five-industry simulation model



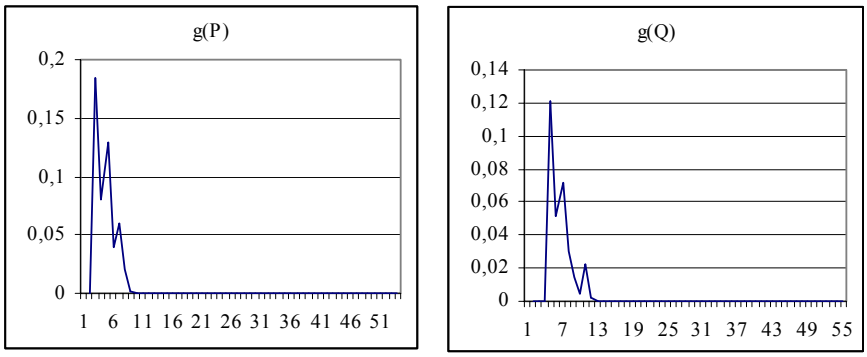
The result obtained through simulation (see Fig. 2) can be qualitatively described as following. A drastic leap of prices occurs in the energy industry, caused by energy resources deficit. This price shock is then transferred to other industries, leading to overall price level increase. At the same time, industries try to increase their production volumes, subject to resource limitation cap, to fulfil an expected demand. Consumer good prices increment leads to consumer demand and to a consequent decrement in output.

Afterwards, an initial price shock returns to the energy industry through prices increased in machinery industry, leading to additional increments in energy price. The third price shock is related to initial output increment that happens in the first periods. Sharp price growth causes rapid industrial output decline and growth of unemployment. At the same time, inter-industrial arrears emerge and increase.

Finally, faced with the negative impact of its own pricing policy and with a collapse of demand for its production, energy industry gradually commences to decrease its price. Stabilisation and gradual decrement of prices consequently lead to stabilising and slowly increasing outputs. As outputs grow and price go down, inter-industrial arrears decrease (this important issue will be considered in more detail in Chapter 4). After a certain number of periods (depending on a measure of initial imbalance, i.e. a degree of initial deficits in relation to initial outputs), an economic system comes towards an equilibrium state – more exactly, it will have insignificant fluctuations around the equilibrium point. The new equilibrium is typically characterised by higher prices level and lower output level than initial position.

Indices of structural shifts in output and prices indicate that there occur several shifts in price structure (three peaking shifts) and several consequent changes in output structure. These shifts, as it has been already described, are caused by initial imbalances and reactions to initial price shock (see Fig. 3).

Figure 3: Structural shift indices for price level and output



From these basic simulations it is possible to conclude that (1) 'selfish' and 'narrow-sighted' economic agents guided by simple decision rules (as set out in Section 2.2 and Appendix 1) can indeed *bring an structurally distorted economic system into an equilibrium state* (as postulated already by classical economists [Smith,1976]), (2) in course of moving towards this equilibrium state, an economic system undergoes a number of *structural shifts* in output and price structure, and (3) a new equilibrium state achieved has a *higher level of prices* and *lower level of output*.

The results indicate that an emergent behaviour exists in the simulated system. Interactions between agents, each following a relatively simple set of rule and being unable to observe a system as a whole, give rise to a spontaneous order. This simulation, as I may imply, is therefore in some sense similar to wide-known Artificial Life simulations such as the Boids model [Reynolds, 1987].

The affect of specific policy implications can be observed from the basic model, since authorities could intervene into the process of structural distortion reduction. One can hint that a liberalised economy can have different degree of freedom in different industries, i.e., opposite to laissez-faire policy, government can reserve to itself a right of price regulation in certain industries. This right could be used to smooth down the transition process by delimiting price increase in cost-pushing industries. For the case considered, a maximal price could be set in energy industry for every next period, i.e. state would increase energy price gradually allowing the rest of economic system to adjust to it. Considered is probably one of the cases when free market interactions appear less efficient than partially-controlled markets. However, a better solution can be proposed if a monopolistic industry is transformed into a competitive industry by a gradual process of restructuring and privatisation (unless this industry is a natural monopoly). In the latter scenario, the intermediate production industries will no longer be shock generators in the economy.

Only a single case of industrial organisation has been considered so far. A total m^n different types of organisation can be potentially considered, where m is a number of different industrial; pricing models (m=3 in our case), and n is a total number of industries (n=5 in this case, i.e. total of 243 different models could have been considered even for this single case), all types potentially having different behaviour. It could be argued that there is no need to consider all these cases.

It has been shown by the author [Luksha,2000] through generalisation of results received from two-industry simulations that (1) process of distortion reduction primarily depends on initial conditions and intra-industrial structure of intermediate production industries (raw material suppliers in first turn), (2) initial conditions in consumer production industries will only have more significant impact if intermediate production markets are already cleared, i.e. have no observable output deficit. It has been also shown that monopolistic pricing model most adequately reflects actual pricing strategy of intermediate industries. This implies that a model that would demonstrate a behaviour corresponding to observed empirical evidences will have a monopolistic pricing raw material industry and monopolistic / competitive pricing consumer good industries.

3.3 Evidences from economies in transition.

General dynamics of a five-industry model of inter-industrial interactions could be compared with time series available from transitional economies (e.g. from Interstate Statistical Committee of the CIS, former Goskomstat) to see if it generally reflects the dynamic processes observed.. Following indicators can be compared: (1) industrial output, (2) producer price level, (3) arrears level (to be considered in Chapter 4).

Figure 4: Real industrial output in Russia and model simulated output

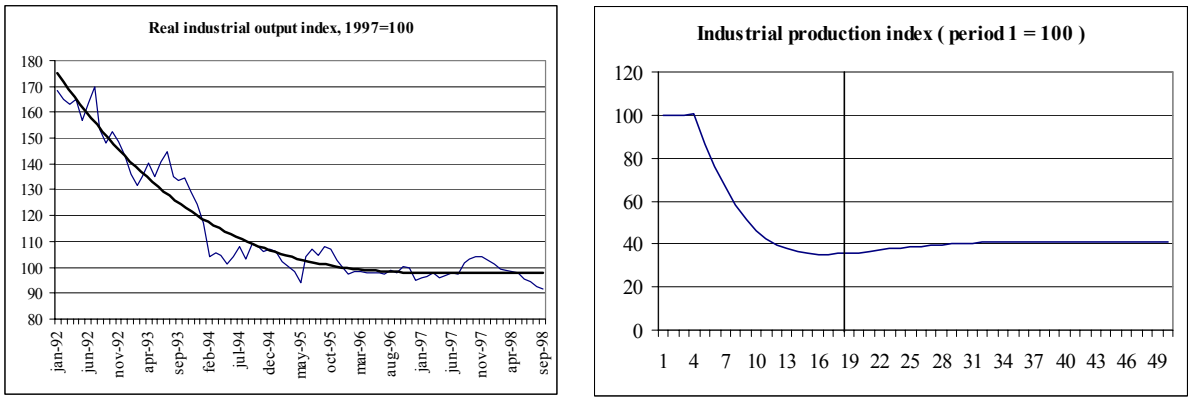
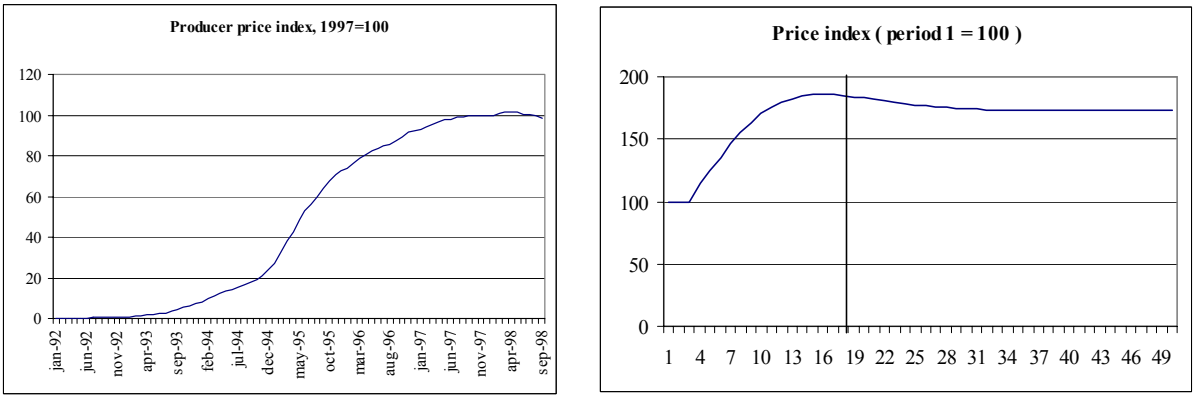


Figure 5: Producer price index in Russia and model simulated price level



The comparison (see Fig. 4 and 5, also Fig. 6) gives insight that model dynamics has a close qualitative similarity with industrial output and price dynamics in transitional economies (price increment, output decline and arrears growth). Russian economy has been used as a sample, and other transition economies (especially those of NIS) have a similar dynamics.

A state achieved by Russian economy by the middle of 1998 (i.e. five and half years after the commencement of transition) corresponds to a structurally stable condition in the model (requires approx. 20 periods to stabilise after the beginning of transition, which corresponds

to five years according to our estimations of one model interval). This result to such a detail is a mere coincidence, but nonetheless the similarity is obvious.

Analysis of price level increment and price structure evolution in transitional economies indicates a high dependency of overall price growth on natural monopolies pricing behaviour – in first turn, on energy and railway transportation services [Kantorovich et al., 1995]. A simulation demonstrates a qualitatively similar dynamics; correspondingly, it may be suggested that a model which captures important components of transitional economy inter-industrial interactions 'black box' has been obtained.

3.4 Introducing additional assumptions.

Some additional assumptions could have been introduced into a model to make it more realistic, which have been first omitted in order to study an 'instant' effect of inter-industrial interactions. It is possible to follow the model logic in case these additional assumptions were introduced (these assumptions can be simulated as well):

(1) consideration of *external trade*. One can assume there exists a certain structure of world prices, and there are external economic relations in the economy. In such an economy, cheaper goods will be of demand in the domestic market (thereby increasing their output) and they will be of demand in world markets (increasing output to even a higher degree). Correspondingly, output of such good increases and so does their price. Similarly, more expensive goods will be of less demand in domestic and world market (and they will compete with less expensive imported goods). Thus, their output and price will decrease.

Impact of external trade can be summarised as following: (a) it will increase market reaction of specific industries, i.e. increments and decrements of outputs and prices will have larger amplitude due to influence of the world market, (b) domestic price structure will come as close as possible to world market price structure (accordingly, output structure will correspond to world market output structure).

(2) one can consider an important aspect of *shifts in quality*, which means that production does not have the same quality level all over the transition period[2]. As quality improves with time, domestic production becomes more competitive. Quality indicator could be introduced, as a component of demand function. Enterprise decision about quality level can be undertaken as apart of decision process. Especially in a case domestic goods compete with imported goods, it can be shown that high quality is a beneficial competition factor. On the other hand,

[2] In some studies of transitional economies, this aspect is considered as emergence of new-type, customer-oriented, enterprises and gradual disappearance of old-type rigid, planning-economy, enterprises. New-type enterprises target higher quality, and therefore quality increases with the time [Exeter, Fries, 1998].

it can also be shown that low quality domestic industries unable to compete with imported high quality products can face disastrous consequences (one of the samples is consumer electronics industry of Eastern Europe and NIS countries, which completely has been ruined by relatively cheap high-quality imports from Western Europe and Asian countries).

(3) an important aspect of *government procurements* can also be considered. Government has to purchase part of output to fulfil its functions, e.g. for the purpose of national defence. Therefore, it should be included into a model as a decision-taking agent, with its own incomes obtained by taxation (one of the possible models for this representation has been suggested by the author [Luksha,1999]) and its own expenditure decisions. Government procurements can seriously change the equilibrium output and price structure (e.g. quasi-equilibrium output structure of the Soviet Union in mid-70s included a large output of defence industry, and so it did in the United States).

4. Arrears.

4.1 Explanatory approaches to a phenomenon.

Arrears is one of the most important 'problematic' phenomena observed in economies in transition. Arrears have affected all transactions in NIS countries, delimiting enterprises' activities and lowering their liquidity. There are evidences that arrears in NIS transitional economies constitute around 20% of GDP; in Eastern Europe this ratio is smaller but still notable, around 5-7% of GDP [Ivanova, Wypolosz, 1999].

One may encounter several explanations of the emergence and growth of arrears, which can be grouped into three major groups:

(1) *monetary explanation*: the major reason behind the emergence and development of arrears is a significant cash deficit in real sector. This deficit is strictly linked to sharp cut in effective consumer demand due to increased gap between price level and households' and enterprises' income. Thus, monetary mass deficit is believed to be at the core of the problem [Levin, 2000]. As a possible solution, monetary emission either directly financing households' income increase (through increased wages at state enterprises) or subsidising real sector enterprises (through donations and inexpensive credits) is suggested.

(2) *structural explanation*: arrears have been caused by initial distortions of economy, both in price and production structure. Output, manufactured at a non-competitive price, could not find demand in the market; accordingly, producers could not pay their debt to raw material suppliers. Due to this, arrears spread out to all of the economy, much like

metastases. A solution suggested could be industries' sanation, cutting-off bankrupt enterprises with inefficient pricing policy, transfer of ownership to efficient entrepreneurs keenly sensing market opportunities and being able to undo a tangled skein of arrears [Guriev, Kvasov, 1999].

(3) *benefits explanation*: the arrears phenomenon is caused by narrow-sighted behaviour of firms acting in a transitional economy. In the beginning of economic liberalisation most enterprises uncontrollably increased their prices, which led to even greater distortions. However, as the time went by, arrears have become beneficial to enterprises [Yakovlev, 1999]. First, in barter bargains any deliberate exchange proportions can be applied, depending on bargaining parties interests (this has been used as a tool for pumping liquid funds out of industrial enterprises by their 'robber' owners[3]). Second, arrears can be used as a way to avoid tax payments. At some moment arrears have changed into a self-developing phenomenon, most enterprises being not interested to alter the situation [Kuznets, 1998].

Consideration of the arrears problem using the inter-industrial interactions model indicates that there are elements of truth in each of these points of view.

4.2 Arrears in a simulated economy

Initial condition of the model before the transition, again, is a supply deficit in intermediate and consumer good industries. After the beginning of transition, enterprises increase their output in order to cover deficit observed, and increase price of their production at the same time. Growth of prices leads to consumer demand decline, which consequently leads to a decline in intermediate goods demand. This cutback in demand means lower cashflow for enterprises; thus, enterprises do not have sufficient funds to cover debts to their input suppliers and to labour force. Due to this, in first model periods, arrears sharply increase (see Fig.6, left graph). At the same time, stocks of finished products grow.

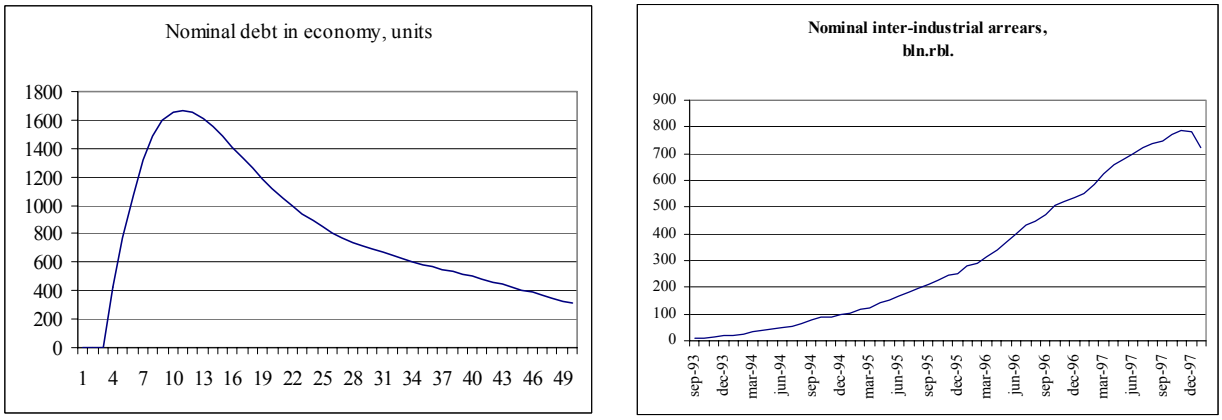
Consequent gradual elimination of structural distortions leads to cash generation and efficient resource utilisation by enterprises. As a result, inter-industrial debts as well as debts to workforce are decreased – since, utilising less labour and less inputs, enterprise can earn cash by selling stock of previous periods in order to cover debts of previous periods. More specific

[3] One of consequences of the unbalanced privatization process in Russia and some other republics of ex-Soviet Union was that inefficient owners emerged, following robber strategy. These owners, faced with instability of domestic economies, re-sold any liquid assets of their enterprises transferring cash into stable developed countries afterwards, and left enterprises 'stripped' off their working capital. There are evidence, however, that this strategy no longer dominates [Gurova, 2000].

model behaviour will depend on a structure of economy, as well as on its initial pre-transition conditions.

As one can see (Fig.6) dynamics of arrears in the model demonstrates notable likelihood with arrears dynamics in the transitional economy of Russia, at least in the initial period. However, dynamics of arrears in Russia had no notable decreasing tendency during the stabilisation period, which is probably due to the specifics of inter-industrial economic relations (the above-mentioned beneficial aspects of arrears, which are beyond the scope of this modelling).

Figure 6: Dynamics of arrears in five-industry model
and comparative dynamics in Russia



An earlier studies of a two-industry model [Luksha, 2000] allow to derive additional properties of arrears emergence and liquidation process:

(1) pricing model in industries has notable impact on arrears dynamics, and, if one of industries follows oligopoly pricing, arrears reduction is slower;

(2) in case of wage level oscillating along with overall price level, arrears increase at a greater degree and also decline slower.

Overall, it is possible to conclude that emergence of inter-industrial arrears and overdue debt to labour force in a transitional economy is an *unavoidable consequence* of *initial structural distortions*. Dynamics of arrears depends on de-stabilising factors which exist in this economy.

According to results of simulation, there is a certain rectitude of scholars blaming money supply deficit as well as of those blaming structural problems as a cause of arrears. Reduction of solvent demand indeed caused uncovered overdue debts to emerge. However, this crisis, as well as enterprises' inability to sort it out, are due to a distorted economic structure.

It is worth noticing that, in the simulated model, arrears always decrease whenever structural distortions are reduced. This can explicitly stated as one of entailed results of the model: one

of the major methods to fight arrears problem is to keep up financial discipline and lawful execution of contra-agent responsibilities while general economic stabilisation takes place.

4.3 Policy implications and outcomes

Let us consider the governmental possible policies to solve the emerged problem of arrears. Government has an opportunity of indirect and direct intervention into the hazard. Empirically, two known methods are applied which can be simulated: (1) partial debt coverage e.g. of state-owned enterprises by monetary emission or (2) directive inter-firm debt writing-off. Other solutions, involving institutional reforms and non-economic administrative control, are again beyond the scope of the model.

Government can attempt to partially cover existing debts in the economy. It thereby creates a new wealth in the economy because it subsidises enterprises in their debt repayment e.g. by monetary emission. Enterprises repay labour force debt: savings of households increase, and debts to labour force decrease, by the same amount. The economy shifts towards a disequilibrium state, as it is adjusted to a final good demand level determined by lower wealth, and the wealth has grown. After a number of oscillations, however, system comes into a equilibrium again, with a higher level of prices and a higher output.

Since direct subsidy is a structural shift by itself, it determines a new proportional industrial structure. Therefore, by means of direct subsidising, the whole economy can be cast away from the structurally proportional state even into a greater structural distortion. Partial debt coverage can provide a temporary reduction of arrears; but it does not appear to be an efficient solution for this problem either -however, it can bring an economy to a new, higher level of output. This conclusion, should it be noted, is valid only for a closed-type economy, in which excess cash cannot be exported out of country or spent to purchase imported goods.

Another scenario is a direct writing off all, or a part of, inter-industrial debts. In this case new wealth is not injected into economic system. Thus, this method of arrears reduction does not imply a new equilibrium state and thereby does not create a cause for new arrears to emerge. However, this conclusion is valid unless such a decision stimulate enterprises to reduce their business accounting discipline and to create new uncovered debts (this was an important factor in arrears increment in Russian economy after mid-1992, when inter-industrial liabilities have been officially written off). To consider this type of unfair behaviour, however, would require a serious model complication, a shift from inter-industrial interaction model to socially intelligent agents model.

5. Conclusion

The major results presented in this paper can be summarised as following.

It has been shown that, if economic agents in the network of inter-industrial interactions act selfishly and narrow-sighted (following a set of simple rules set and using their non-perfect knowledge), and if an economy is in disequilibrium state, overall stabilisation can take place.

Thus, economic agents can reduce structural distortions through inter-industrial interactions. As it has been shown earlier by the author (and quoted in this paper), structural distortions are reduced faster if there are fewer disturbing factors: competitive economies clear market faster than economies with monopolistic industries, and economies with monopolistic industries clear market faster than oligopolistic industries. Structural distortions at intermediate goods supplier level have more impact on economy performance and take longer time to reduce.

If model initial conditions are similar to those of transitional economies short before liberalisation, the dynamics of the model stabilisation process has a notable qualitative similarity with the one observed in transitional economies. Moving towards an equilibrium state, the modelled economic system undergoes a number of structural shifts in output and price structure, as does a real economy in transition. This new equilibrium state is characterised by higher prices level and lower output level. It has been also argued that government can delimit negative impacts of transition implying partial price control in cost-pushing industries.

An important hazard of transitional economies, the phenomenon of arrears, is studied in the model. It has been shown that arrears emerge because of structural distortions, and are eliminated when structural distortions are reduced. Elimination of arrears in a closed-type economy with fairly-behaving agents is best achieved through partial debt writing-off.

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Appendix 1: Model equations.

1.1 Price equations

- price in industry i

$$P_t^i = \sum_j^n \beta_i^j \cdot P_{t-1}^j + \alpha_i \cdot W_{t-1} + M_t^i$$

- margin in industry i

(1) in a competitive industry
(2) in an oligopoly
(3) in a monopoly

$$M_t^i = \begin{cases} 0 \\ \mu_i \cdot (Q_{t-1}^{i,d} - Q_{t-1}^{i,s}) \\ \begin{cases} \mu_i \cdot (Q_{t-1}^{i,d} - Q_{t-1}^{i,s}) \; if \; Q_{t-1}^{i,d} - Q_{t-1}^{i,s} \\ 0 \quad otherwise \end{cases} \end{cases}$$

- wage in economy

(1) fixed wage
(2) flexible wage
(3) rigidly growing wage

$$W_t = \begin{cases} W \\ W \cdot P_{t-1} \\ \begin{cases} W \cdot P_{t-1} \; if \; W \cdot P_t > W_{t-1} \\ W_{t-1} \quad otherwise \end{cases} \end{cases}$$

1.2 Output quantities and labour utilisation

- supply of output i $\quad Q_t^{s,i} = Q_{t-1}^{pr,i} + Q_{t-1}^{I,i}$
- inventory of output i $\quad Q_t^{I,i} = Q_t^{s,i} - Q_t^{a,i}$
- planned production of output i $\quad Q_t^{pl,i} = \sum_h^p \lambda_h \cdot Q_{t-h}^{a,i} \quad and \sum_h^p \lambda_h = 1$
- demand of input j by industry i $\quad Q_t^{d,ij} = \beta_{ij} \cdot Q_t^{pl,i}$
- demand for output i $\quad Q_t^{d,i} = \sum_k^n Q_t^{d,ki}$
- actual sales of i to industry k $\quad Q_t^{a,ki} = \min[(\frac{Q_t^{d,ki}}{Q_t^{d,i}} \cdot Q_t^{s,i}); Q_t^{d,ki}]$
- actual sales of output i $\quad Q_t^{a,i} = \sum_k^n Q_t^{a,ki}$

- actual production of output i $Q_t^{pr,i} = \min[(\beta_{ij} \cdot \underset{j=\overline{1\mathrm{K}\,n}}{Q_t^{a,ij}}); Q_t^{pl,i}]$

- employment $E_t = \sum_i^n E_t^i$ and $E_t^i = \frac{Q_t^{pr,i}}{\alpha_i}$

- unemployment rate $U_t = \frac{N_t - E_t}{N_t}$ and $N_t = N$

1.3 General economic indicators

- Paasche price index $P_t = \frac{\sum_i^n P_t^i \cdot Q_t^{pr,i}}{\sum_i^n P_{t-1}^i \cdot Q_t^{pr,i}}$

- gross domestic product $GDP_t = \sum_i^n [M_t^i + \alpha_i \cdot W_t] \cdot Q_t^{pr,i}$

- industrial production index $Y_t = \frac{\sum_i^n [M_t^i + \alpha_i \cdot W_t] \cdot Q_t^{pr,i}}{\sum_i^n [M_t^i + \alpha_i \cdot W_t] \cdot Q_{t-1}^{pr,i}}$

1.4 Households

- available income of households $Y_t^{av} = Y_{t-1}^{ea} + S_{t-1}$

- demand of final consumer good $Q_t^{f,d} = \frac{Y_t^{av}}{P_t^f}$

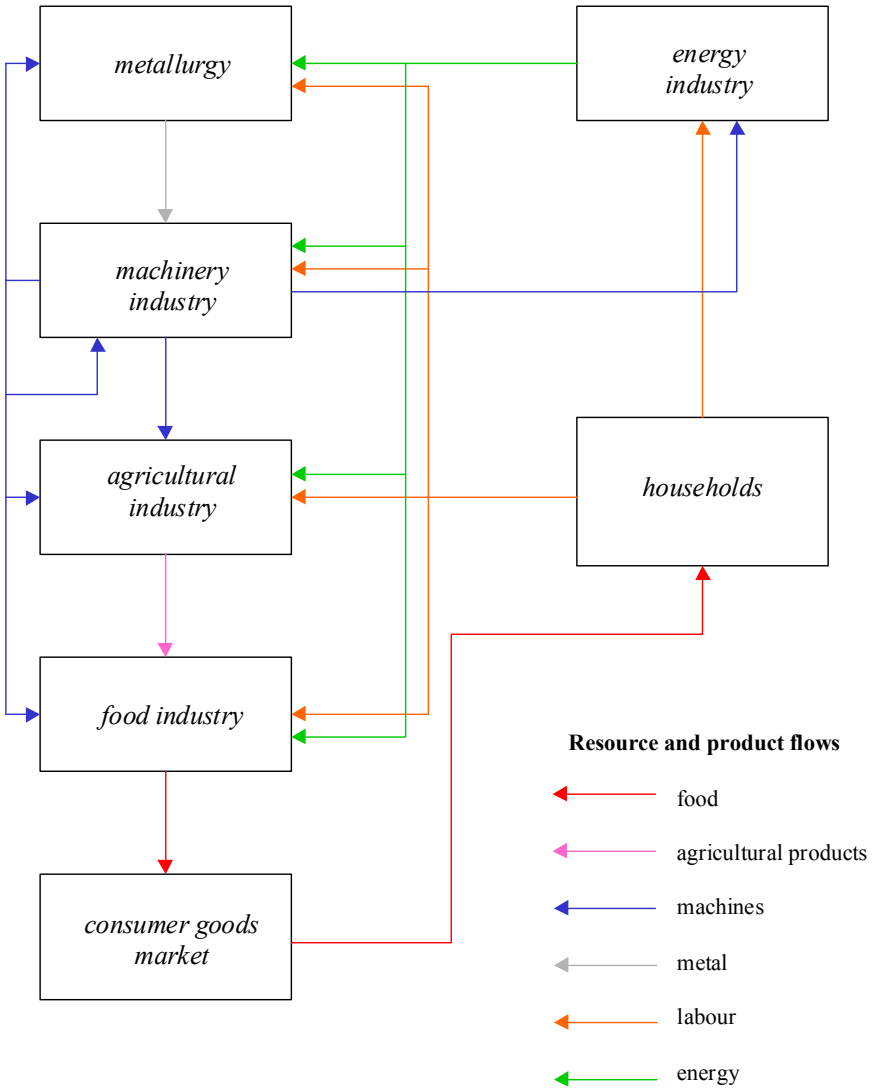
- expenditures on final consumer good $Y_t^{sp} = P_t^f \cdot Q_t^{f,a}$

- savings of households $S_t = Y_t^{av} - Y_t^{sp}$

- earned income of households $Y_t^{ea} = Y_t^{sp}$

Appendix 2: Setting of the five-industry model.

2.1 Structure of five-industry model resource and product flows (a sample for simulation)



2.2 Inter-industrial balance matrix (a sample for simulation)

	energy	metal	machinery	agriculture	food	final
energy	0	0.4	0.3	0.1	0.2	0
metal	0	0	1	0	0	0
machinery	0.25	0.25	0.25	0.15	0.1	0
agriculture	0	0	0	0.3	0.7	0
food	0	0	0	0	0.1	0.9