



**SZENT ISTVÁN UNIVERSITY**

**MANAGEMENT AND BUSINESS ADMINISTRATION  
PHD SCHOOL**

**METHODOLOGICAL IMPROVEMENT OF QUARTERLY GDP-  
ESTIMATION FROM PRODUCTION SIDE**

**Especially for sectors of non-financial corporations and households**

Thesis of (PhD) dissertation

Klára Anwar

Gödöllő

2011.

**Doctoral School**

**Denomination:** Doctoral School of Management and Business Studies

**Field of Science:** Management and Business Studies

**Head of School:** Dr. István Szűcs, DSc  
University Professor, Doctor of Hungarian Academy of Sciences  
Szent István University  
Faculty of Economic and Social Sciences  
Institute of Economic Sciences and Methodology

**Name of Supervisor:** Dr. Ugrósdly György, PhD  
University Doccens  
Szent István University  
Faculty of Economic and Social Sciences  
Institute of Economic Sciences and Methodology

.....  
Confirmation of  
Head of the School

.....  
Confirmation of  
Supervisor

## Contents

<b>1. INTRODUCTION.....</b>	<b>4</b>
1.1 ACTUALITY AND IMPORTANCE OF THE TOPIC .....	4
1.2 BACKGROUND OF THE RESEARCH .....	4
1.3 AIMS.....	6
<b>2. MATERIALS AND METHODS.....</b>	<b>7</b>
2.1 MAIN DIRECTION OF RESEARCH.....	7
2.2 DETAILS OF THE RESEARCH, SOFTWARES USED .....	9
2.3 INTERIM DATA SOURCE USED FOR THE RESEARCH.....	9
2.4 METHODS FOR THE ESTIMATION OF GROSS OUTPUT AND INTERMEDIATE CONSUMPTION .....	10
<b>3. RESULTS.....</b>	<b>11</b>
3.1 ESTIMATION OF OUTPUT.....	11
3.2 ESTIMATION OF INTERMEDIATE CONSUMPTION .....	15
3.3 ESTIMATES FOR THE SECTOR OF HOUSEHOLDS.....	18
3.4 THE RESULTS OF THE NEW METHODOLOGY OF ‘CONTRIBUTION TO GROWTH’ .....	19
3.5 NEW SCIENTIFIC RESULTS .....	21
<b>4. CONCLUSION AND RECOMMENDATIONS.....</b>	<b>21</b>
<b>5. LIST OF PUBLICATIONS CONNECTED TO THE TOPIC OF THE DISSERTATION .....</b>	<b>23</b>

## **1. INTRODUCTION**

### **1.1 Actuality and importance of the topic**

GDP is to measure the aggregate performance of the economy, and its interim indicator has recently become more and more important and widely used. Quarterly GDP and its components are the optimal short-range indicators of the development of the domestic economy, and therefore they are suitable for analyzing and forecasting business cycles. National statistical offices and the international statistical organizations pay more and more attention to the development of quarterly GDP methodology, to shorten its data processing period and to the publication of its up-to-date data. This is shown by the fact that the SNA 1993 did not contain recommendations on the quarterly national accounts but significant efforts have been done on this field in the last one or two decades. This is proved by the 'Handbook of Quarterly National Accounts' published by Eurostat, which was followed shortly by the 'Quarterly National Account Manual' compiled by IMF. In the latter a separate chapter was on the applicability of price and volume measures in the quarterly accounts.

Quarterly national accounts are more and more significant sources of information for the economic and monetary policy, and for economists and forecasters. The importance of the quarterly national accounts have grown in the last decade, as compared to annual one, and this tendency is expected to go on. The purpose of the quarterly accounts is to provide a comprehensive picture on the interim macroeconomic processes and the economic development. Quarterly accounts are regarded as simplified annual national accounts, which are tracing the developments of key macroeconomic indicators of the economy.

Since quarterly accounts adopt the same framework of annual accounts they have to be consistent over time with them. At the same time they have such specialities – stemming partly from their intra annual characteristics and partly the lack of basic data frequency required – that require the use of more advanced mathematic and statistical methods for getting their data. The available data sources and national characteristics are defining to a great extent the use of methodology by the individual countries and as a consequence, the national accounts data production processes also differ by countries. At the same time, there are attempt to classify this matter in two major categories: direct procedures and indirect procedures. We speak about direct procedures, if the quarterly calculations are based on similar data sources and the methodology as used to compile the annual accounts. The indirect procedures are used if mathematical or statistical methods are applied using short-term reference indicators to reach quarterly estimation.

The characteristics of the intra annual data make solution of methodological problems more difficult. A simple example for this is the case of seasonality, which affects only the quarterly accounts as in the case of annual data this phenomenon is not present. Another example can be the chain-linking methodology, which can be easily worked out in the annual national accounts, but in the case of quarterly accounts it requires elaboration of sophisticated methodological solutions. The calculation of contribution to growth is also similar to this, and its specialty lies in the characteristics of the methodology of quarterly chain-linking.

### **1.2 Background of the research**

In Hungary the methodological preparations have begun in 1993, for the estimation of quarterly gross domestic product (GDP). After the revision of the examples of international practice, the HCSO assessed the available data sources. Experimental calculations began in 1994 with connecting

different available data sources (short term statistical data collections, administrative data sources), and the differences of available data and data required for the calculations were also defined.

After the methodological studies and experimental calculations in June 1996, the HCSO published the first results of the estimation of quarterly gross domestic product (GDP). That time the GDP estimations have already been done using both production and expenditure approaches and the results were published on the 90<sup>th</sup> day after the respective quarter (T+90 days). In the first years publications were only contained some volume indices from the results of calculations still regarded of experimental kind.

Meanwhile – on the basis of accumulated experiences – the calculation method has been modified on several points, which made the results of quarterly estimations more reliable and more established. This made possible since 2000, the publication of flash estimation results on the 60<sup>th</sup> day after the respective quarter<sup>1</sup>, the harmonization of annual and quarterly national accounts, and also this made the basis for publishing detailed quarterly series starting back to 1995. The calculations based on the production side became more detailed, and the comparison of the calculation results for the four quarters and the final annual data also revealed further possibilities for increasing the reliability of quarterly estimations.

On the other hand, it was a serious deficiency of the quarterly GDP calculations that the current price estimations were only made on the expenditure side. The estimations on the production side were performed with the use of an indirect, so-called ‘indicator-method’. With this methodology the the base year was extrapolated at two-digit NACE level, and the gross value added growth was defined by the volume change of an available proxy indicator (e.g. industrial production index).

This meant that the quarterly GDP data on the production side was only available as an index and at constant prices. For the aggregation of the volume indices, the weights were provided by the base year (1995, 1998, later 2000) distribution ratio of the value added by branches.

This method – mostly taken from the British example – was based on the assumption, that on the short run the volume change of the gross domestic product corresponds to the interim volume change of production. In the last two decades structural changes – accompanied by considerable technological changes - occurred in the Hungarian economy, and also in certain branches the increasing role of foreign – mostly multinational – capital resulted in the lack of strong correlation between the annual data on development of production and of gross value added. Therefore, the Hungarian quarterly GDP estimations required the use of so called correction factor, besides the interim production and other data. The correction factors showed the relationship between the available interim data and the quarterly volume indices of value added calculated from the latest annual GDP compilation.

Constant price time series were calculated – by using mathematical and statistical methods – for the estimation of seasonally adjusted quarterly volume indices compared to the previous quarter, reflecting more business cycle developments. But due to methodological reasons, this resulted different volume indices compared to the corresponding quarter of previous year than the primarily calculated ones.<sup>2</sup>

The lack of quarterly production side data at current prices also meant, that current price GDP estimations in the first year were only made by one approach, i.e. from the expenditure side. It became necessary to work out the methodology of current price GDP production side calculations, in order to increase the reliability of quarterly and the first year current price GDP estimations, to meet the EU criteria laid down by regulations as compulsory requirements (European Commission regulation number 175 in 1998) – that the Hungarian statistical system failed to meet since several

---

<sup>1</sup> At the beginning it was mostly based on the calculations from production side, currently the expenditure side is also taken into consideration.

<sup>2</sup> The difference is caused by Denton Method used to get the consistency of annual and quarterly data. The Denton Method focuses primarily on the quarterly data compared to the previous quarter.

years –, to fulfill the data transmission obligation of Hungary, and to the introduction of chain-linking in the quarterly time series.

These were the reasons that led me to deal with this field of research. My research was supported by the fact that I have been working for the HSCO since 1998, and I am dealing with the estimation of quarterly GDP on the production side from that time. Using the methodology that I worked out – in cooperation with some of my colleagues in some practical matters – the first results were published by HSCO in December 2006. (I have been continuously developed the quarterly production side GDP estimation methodology since that time.)

Further EU expectation on behalf of the data users – primarily in order to modeling forecasts – that articulated the need of formulating long term consistent backward time series (recommendation of the European Parliament and the European Council in 2005, amending the regulation number 2223/96 of the European Commission). This meant that the implementation of this new methodology was required on the GDP time series back to its beginning. At the same time, it became also compulsory for the EU member states changing over to NACE 2008 in the field of national accounts in publications following 31<sup>st</sup> August 2011. All of these are great challenges, as the former classification system significantly changed in its structure, compared to its previous version.

### **1.3 Aims**

My primary aim was in my research the development of an established methodology in the field of the production side of GDP calculations. Out of the five institutional sectors of national accounts, I primarily focused my attention on the methodological development of non-financial corporations and households sectors' quarterly GDP estimation. The estimation of quarterly value added of the sectors of general government and non-profit institutions serving households require a different approach. Similarly, in the case of estimating the sector of financial corporations, specific problems expected to arise. The estimations of the sectors of (non-financial) corporations and households are also rather complex, containing several minor statistical methodological specialities. In this framework the tasks listed below need to be dealt with:

1. My aim is elaborating the estimation methodology of current price quarterly output broken down into branches for the sectors of non-financial corporations and households (at current prices and at previous year's prices).
2. My further aim is elaborating the methodology of quarterly intermediate consumption estimation and therefore value added broken down into branches for the sector of non-financial corporations and that of households (at current prices and at previous year's prices).

For the quarters much less data sources are available as compared to annual level, therefore elaboration and implementation of specific estimation methods is inevitable in the field of quarterly GDP calculation. A reasonably detailed level should be found, which could meet the principals of timeliness, precision, comprehensiveness and coherence as well.

3. This is followed by chain-linking, i.e. implication of chain-linking methodology into the quarterly national accounts. On annual level, the introduction of chain-linking into the constant price calculations is a relatively simple task and it shows minor differences as compared to the fixed base methods applied earlier. Whereas on the quarterly level it requires the elaboration of a more complicated methodology. The Eurostat outlined three kinds of chain-linking techniques depending on the choice of data of different time period selected as linking factor. As a consequence, the use of the three different methods provides three different results.
4. The calculation of contribution to the GDP growth requires the elaboration of new methodology after the introduction of chain-linking in the quarterly series. One of the essential consequences of the application of chain-linking is that the additivity between the individual components and their aggregate is lost in the case of time series chained back for a common reference year. On

the other hand it is one of the basic requirements of the calculation of ‘contribution to GDP growth’. Therefore the old conventional calculation method cannot be used in the case of the new time series, the elaboration of new methodology became indispensable.

On the basis of the aims listed, I laid down the following hypotheses:

1-2. Estimation can be done for the development of quarterly output and intermediate consumption with the use of annual data and quarterly statistics.

3. The third aim was the application of one of – the international level – recommended techniques in the production approach of quarterly GDP estimation. The use of one of the three quarterly chain-linking techniques is recommended in order to harmonize quarterly GDP methodology between the European countries. Therefore this goal has no separate hypothesis.

4. Such a methodology can be elaborated, which can be used in assessing the branches’ contribution to GDP growth after the introduction of chain linking.

## 2. MATERIALS AND METHODS

The methodological part of the research was based on the revision of the relevant literature, the revision of practices used in other countries and on the former researches done in this field in cooperation with the staff of the HSCO. The methodologies of other countries have also developed parallel with the development of the Hungarian methodology. These methodological descriptions were mostly published in 2008, so they were not available at the start of my research. At the same time they proved the relevance of the method introduced in several aspects. I have started my research in 2003-2004.

### 2.1 Main direction of research

It is one of the quality considerations of the quarterly national accounts, how close are the indicators and value data used for the quarterly estimations to the respective data sources used for annual calculations. It is a principal of selecting and further developing data sources used for the GDP compilation to select such indicators and indices that reflect the most the data to be measured. In some cases primary data are available in a format that can be used directly or after minimal adjustment for the estimation. In other cases, primary data should be further processed in order to be used for the estimation.

According to the ‘Handbook of Price and Volume Measures in National Accounts’ published by Eurostat, the value added at current price can be defined as the difference between the output (at basic prices) and the intermediate consumption (at purchasers’ prices) at current prices, i.e. the value added is a balancing item in the system of national accounts. There is conceptually no price or volume component of value added, since it is essentially an income concept. However, if GDP volume growth is calculated according to the production approach, the value added of all branches is summed (plus taxes less subsidies on products), so that it is necessary to have a measure of value added at constant prices.

The ESA 95 defines value added at constant prices as the difference between output and intermediate consumption at constant prices:

$$VA_{p_0q_1} = p_0^O q_1^O - p_0^{IC} q_1^{IC} \quad (1)$$

Where:

$p_0^O$  : price component of output in the base period;

$q_1^O$  : volume component of output in the current period;

$p_0^{IC}$  : price component of intermediate consumption in the base period;

$q_1^{IC}$  : volume component of intermediate consumption in the current period;

$VA_{p_0q_1}$  : value added at base period prices, which stemmed from the difference.

The suitable method for calculating value added at constant prices is the double deflation method, i.e. separate deflation of the two kinds of economic processes of production account (the output and the intermediate consumption), and the difference of these two items gives the desired value. In the case of the output and the intermediate consumption it stems from a definition, that if out of the components (price, volume and value) two of them are available, the third one can be derived. In the case of value added the situation is different, because – stemming from the principle of double deflation – the price component can be calculated implicitly from values and volumes:

$$\frac{VA_{p_1q_1}}{VA_{p_0q_1}} = \left( \frac{p_1}{p_0} \right)^{VA} \quad (2)$$

As a consequence, it is needed to estimate both the output and the intermediate consumption in order to make possible the calculation of the value added at both current and constant prices. On the basis of this condition, the experimental calculations begun by sectors. The topic of my thesis covers the sectors of non-financial corporations and households. These two sectors together give about 80% of the value added total. The data sources are described in the literature overview of my dissertation. In the ‘Results’ chapter first I described in detail the estimation of output, and then of the intermediate consumption for the non-financial corporations and after that I gave account on the estimation for the households sector.

Since the experimental calculation began, the EU regulation on the quarterly sector accounts has become simpler, due to the multilateral negotiations. The compulsory detailed data provision – unless different decision is made – only relates to countries that contribute to the GDP of the EU total more than 1%, otherwise only value added data need to be supplied from the production account. For the time being, Hungary needs only to provide data on general government, rest of the world and sectors total. At the beginning of the work connected to current price quarterly calculations, output and intermediate consumption at current prices and the households sector have been also included in the draft version of the regulation.

The ideal method is commensurable; it is the least complicated one that based on the widest range of primary data. At the same time much less data are available on the quarterly level as compared to the compilation of annual national accounts, therefore the use of simplified methodology that based on estimations it is inevitable. Paragraph number 12.04 of the ESA 95 decrees on this as follows: *“The statistical methods used for compiling quarterly accounts may differ quite considerably from those used for the annual accounts. They can be classified in two major categories: direct procedures and indirect procedures. Direct procedures are based on the availability at quarterly intervals, with appropriate simplifications, of the similar sources as used to compile the annual accounts. On the other hand, indirect procedures are based on time disaggregation of the annual accounts data in accordance with mathematical or statistical methods using reference indicators which permit the extrapolation for the current year. [...] The choice between these approaches depends, among other things, on the information available at quarterly level.”*

I have not thought yet about the use of an approach based on supply and use tables (SUT), because the SUT integration of the annual national accounts has not been done until this far. This expected to be done by October 2011 on annual level, and only after that it would be possible to include the quarterly accounts into this framework. This predicts a further possible way of methodological development.

Besides the current price approach estimation of the value added, my further aim was the introduction of the chain-linking into the production side's quarterly constant price calculations and also the elaboration of contribution to growth calculations. Elaborating the latter was needed because of the characteristics of the chain-linking prevented the use of the old conventional calculation methods. This newly developed method, which is one of the new results of my research, will be described in the 'Results' chapter.

## **2.2 Details of the research, softwares used**

During my research I made estimation for the non-financial corporations and households sectors broke down into two-digit NACE level, which meant 60 branches in every quarter. The estimation was elaborated since the first quarter of 2000, as the interim data collection has started only since 1998. I made separate estimations on the output and on the intermediate consumption, and the difference between the two defined the quarterly value added by branches and sectors.

First, I calculated the indicators on the average prices of the previous year for branches and sectors by deflating the current price data, and then with chain-linking technique I chained the time series back to reach data at the average prices of 2000. I calculated the deflators according to the annual methodology, and in my calculations I also used the latest available source and use tables in order to weight price indices.

For the estimation of output I made investigations at current prices using the SPSS software. For the investigations I used the version 17 of SPSS.

For the estimation of the intermediate consumption, I made the investigations aimed at detecting its possible methods of estimation at the average price of 2000, because in the database no basic data was available on it. I wanted to study the relationship between the intermediate consumption and the output by excluding the price effect. This time I made the analysis with use of SPSS software, version 15<sup>3</sup>.

Furthermore, I used the software Demetra – which was developed by Eurostat for defining trends of time series, seasonal adjustments and adjustment for calendar effects –, to work out a possible alternative way of calculation for the intermediate consumption. The IMF handbook gives a recommendation for the estimation of intermediate consumption in the current quarter. It recommends the method of trend extrapolation on the time series of annual rates of intermediate consumption and output at constant prices.

For these calculations, I set the trend for the time series of technological coefficients by branches with the use of the Demetra software version 2.04.

## **2.3 Interim data source used for the research**

The interim statistical data collection for performance of companies having more than 49 employees is on full-scope basis. In the case of the companies having 5 to 49 employees there is representative data collection. On the basis of data collected a grossing-up is made for the segment of these companies.

---

<sup>3</sup> By technical reasons, there is a difference in the version numbers of SPSS used in estimating the output and intermediate consumption.

Besides the performance data, in the questionnaire there are also data collections on their employment, investments, stock of orders and contracts. The gross value of production is a calculated indicator of the interim statistical data collection, which can be expressed as follows:

$$\begin{array}{l}
 \text{Returns on sales (including excise tax)} \\
 - \text{Purchasing cost of goods sold} \\
 - \text{Value of mediated services} \\
 + \text{Own work capitalized} \\
 \pm \text{Changes in own-produced stocks} \\
 \hline
 \text{Value of production}
 \end{array}$$

In the interim statistical data collection the value of production data is close to the output data of the national accounts but it does not cover it completely. One of the basic, although manageable, differences is that while the value of production contains excise and energy taxes from 2004, – earlier, from 2001 it contained value added and excise taxes on industrial production – these items are not included into the output figure of the national accounts but their sum are included into taxes on products.

## 2.4 Methods for the estimation of gross output and intermediate consumption

For estimating the actual quarter, extrapolation is the simplest and most effective method from the mathematical and statistical point of view. The basic hypothesis of extrapolation is that the y variable shows similar temporal development to the x indicator, which development is known. It can be assumed that the two variables are changing at the same pace from one quarter to another:

$$\Delta y_q \approx \Delta x_q, \text{ where}$$

$$\Delta y_q = \frac{y_q - y_{q-1}}{y_{q-1}} \quad (3)$$

In order this hypothesis is to prove true, the two indicators should cover interrelated economic phenomena showing close association with each other. This assumption also includes that the two indicators vary in the same way in every economic situation. If this proves to be true, then the simple extrapolation equation can be used, i.e.:

$$y_{q+1} = y_q (1 + \Delta x_{q+1}) \quad (4)$$

When the new  $x_{q+1}$  data is available, it could lead to the modification of previous data due to the regular revision process or to the seasonal adjustment. In such a case the y data need also to be revised according to the new altered indicator. At the same time this equation can only be used if the y data do not show seasonality (either they do not bear seasonality or they are already seasonally adjusted).

In the case of the seasonality it is indirectly assumed that the indicator and index to be estimated vary at the same pace with seasonal delay. In this case extrapolation can be described with the following equation:

$$y_{q+1} = y_{q-3} (1 + \Delta_4 x_{q+1}), \quad (5)$$

$$\text{where: } \Delta_4 x_q = \frac{x_q - x_{q-4}}{x_{q-4}}$$

$$\Delta_4 y_q = \Delta_4 x_q$$

Therefore, the estimated data ( $y_q$ ) will contain all the characteristics of  $y$  time series, as it will provide the benchmark. At the same time it is a basic convention that as soon as the annual data for  $y$  is available, the quarterly data need to be adjusted to the annual one. By this, better reliability of the newly estimated  $y_{q+1}$  can be assured. Furthermore, the accounting consistency needs also to be met in every quarter of the time period. This latter also strengthens the extent of reliability. This model of extrapolation is a simple one, but not always reflects adequately the development of the economy. It can happen that the  $\Delta y_q = \Delta x_q$  hypothesis is not met, not even if in some cases it is acceptable as being used as an approximate estimation. This assumption can be maintained in an equilibrium situation for the long term, but on the short term it can overly be regarded valid. Many factors can interfere the  $\Delta y_q = \Delta x_q$  equilibrium level, among others the different reaction time within the business cycle or the different judgement of certain future events or some coverage problem in the sample.

Therefore, the further developed version of the extrapolation equation could provide better results. Such an equation, that already considers the correction of basic relationship between the two indicators as well. The simplest and the most used form of this is as follows:

$$y_{q+1} = y_q (1 + \Delta x_{q+1}) + w_q, \quad (6)$$

Where  $w_q$  is a random-like variable that shows the extent of correction. This variable might contain facts shown by other variables used for external validation, former estimation errors on the basis of revisions and estimates of experts in a certain economic situation. Out of these factors listed, the former two are of more determinative nature, while the latter is a slightly subjective one, although experience of experts can amend the quality of the quarterly estimation.

On the whole it can be stated, that this model can be applied, if the movement of the aggregate to be estimated can mostly be explained by the movement of the indicator. This is the case between the value of production observed in the basic statistics and the output defined in the national accounts, therefore this method can well be applied on them. Having revised the practice of the EU countries) I learnt that a number of countries are applying similar methodologies for the calculation of output.

For the estimation of intermediate consumption I based my estimation on the regression model, which due to the lack of space and its basic feature I would not discuss in details.

### 3. Results

#### 3.1 Estimation of output

My hypothesis is that the total value of production indicator of the interim economic statistics provides a suitable base for estimating the output of the corporations' sector.

The total value of production indicator of the interim economic statistics is the closest indicator to the estimation of output indicator, concerning its content. On quarterly basis the manageable difference is the excise and energy taxes, which is included into the production value indicator, but it is not among the components of output according to the national accounts. The examination of the connection between the two indicators showed a significant correlation (see table 1), and therefore confirmed that significant part of the non-financial corporations' output can be described with the corrected total value of production.

**Table 1**

**Summary of the model<sup>b</sup>**

NACE Code	Denomination	R	R <sup>2</sup>	corrected R <sup>2</sup>	F
C	Mining	.806 <sup>a</sup>	.649	.579	9.252
D	Manufacturing	.999 <sup>a</sup>	.998	.997	2234.201
E	Electricity, gas, steam and water supply	.965 <sup>a</sup>	.931	.917	67.688
F	Construction	.927 <sup>a</sup>	.860	.832	30.738
G	Trade and repair	.986 <sup>a</sup>	.972	.967	176.292
H	Hotel, accommodation and catering	.989 <sup>a</sup>	.977	.973	216.791
I	Transportation, storage, post and telecommunication	.994 <sup>a</sup>	.988	.986	412.517
K	Real estate and business services	.987 <sup>a</sup>	.974	.969	187.122
M	Education	.938 <sup>a</sup>	.879	.855	36.397
N	Healthcare and social security	.986 <sup>a</sup>	.972	.967	176.784
O	Other public and community services	.925 <sup>a</sup>	.855	.827	29.600

a: external variable: corrected total production value data of the branch

b: dependent variable: output of the branch regarding the non-financial corporations

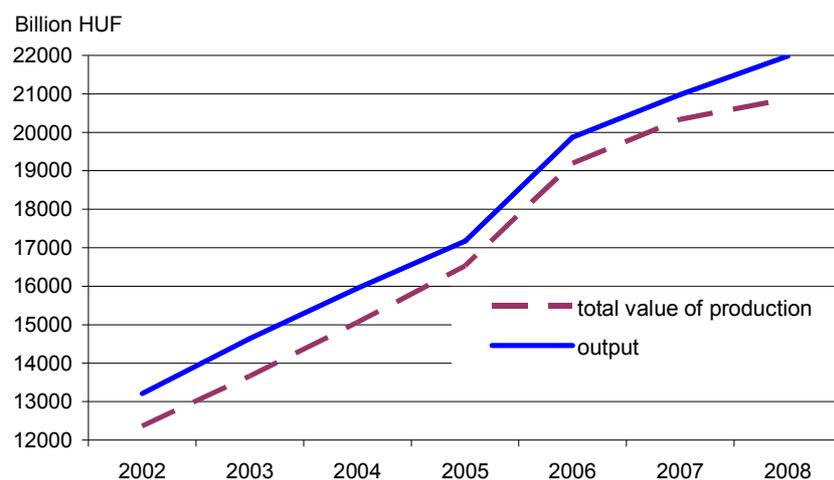
Source: the author's compilation on the basis of SPSS output

No data is available for the movement of quarterly output, but there are data available for the quarterly total value of production. On the basis of the significant correlation and the difference of the two variables expressed in percentage, I concluded, that the breaking down of annual output into quarters (with use of interpolation) should be done by projecting the quarterly movement of the corrected total value of production to the annual output.

I did not use the integrated interim data of economic statistics in the case of interpolating the output of agriculture, because a special treatment of agriculture is prescribed by the ESA, therefore statistical experts made/make distinct estimation for this branch. According to this the output of agricultural products should be taken into account as the output of the branch would be of a continuous nature, and not simply at the time the crop is harvested or the livestock is slaughtered. According to this, I used for the previous period the annual distribution estimated by statistical expert for generating quarterly output data.

The branch of advocacy activities – with the NACE code of 91 – was an exception, because in its case the difference expressed in percentage showed rather weak correlation. This branch includes the activities of business, employers and professional membership organisations, activities of trade unions, religious and political organizations and activities of other membership organisations and not elsewhere classified (n.e.c.) organizations. In this branch the non-profit institutions serving households (85%) have the biggest weight out of the domestic economy. Therefore, because the lack of data I assumed that interim development of this branch in the sector of non-financial corporations (representing a weight of only 15%) is similar to the bigger part that is in the sector of non-profit institutions serving households.

For the estimation of the actual quarterly data I conducted further examinations. There was not a time series with sufficient length available, and this prevented the testing of Chow-lin method used by Belgium, Cyprus and the EU, and it also did not make possible to base my calculations on regression model estimations.



**Diagram 1: The development of output and the total value of production in the manufacturing**

Source: the author's compilation on the basis of HSCO data

Table 1 shows the development of output and the total value of production in the manufacturing industry. It can very well be seen that the output shows a more balanced variation compared to the total value of production. This also proves the need of a  $w_q$  correction coefficient in the extrapolation equation calculating the output, which is also recommended by Eurostat as well in its quarterly handbook (see chapter 'Materials and methods'):

$$y_{q+1} = y_q (1 + \Delta x_{q+1}) + w_q$$

At the same time, as it is shown on Diagram 1, the use of the correction coefficient as a multiplying factor is more reasonable in the case of the Hungarian practice, i.e.:  $y_{q+1} = y_q (1 + \Delta x_{q+1}) \times w_q$

I studied the relationship of output and total value of production in their movement related to each other, their standard deviation and their range indicator. The difference in the volume indices of the two indicators expressed in percentage is shown in Table 2.

**Table 2**

Difference between the value index of production data of the branches of the domestic economy calculated from the respective interim statistics and the value index of output in the national accounts\* (in percentage), and the standard deviation of the two indicators related to each other

Denomination	2003	2004	2005	2006	2007	Standard deviation
Mining	1.00	0.98	1.13	1.16	1.14	0.14
Manufacturing	1.00	0.99	0.98	1.00	1.00	0.01
Electricity, gas, steam and water supply	0.95	1.03	1.07	1.05	0.96	0.05
<i>Industry, total</i>	<i>1.00</i>	<i>0.99</i>	<i>0.99</i>	<i>1.00</i>	<i>1.00</i>	<i>0.01</i>
Construction	1.00	0.98	0.95	1.01	1.06	0.05
Trade and repairs	0.86	1.05	0.98	0.94	0.97	0.05
Hotel, accommodation, catering	0.96	1.04	0.97	1.01	1.02	0.04
Transportation, storage, post and telecommunication	0.94	1.03	0.96	1.00	1.04	0.03
Real estate and business services	0.86	1.10	1.04	0.96	1.03	0.05
Education	0.68	1.11	0.99	0.96	0.85	0.11
Healthcare and social security	0.82	1.10	1.02	0.85	1.00	0.09
Other public and community services	0.80	1.09	1.03	0.93	0.93	0.08
<b>Total</b>	<b>0.96</b>	<b>1.01</b>	<b>0.99</b>	<b>0.99</b>	<b>1.00</b>	<b>0.02</b>

\* Previous year = 100.0

Source: author's calculations, on the basis of HCSO data

I did not include the difference in output of agriculture expressed in percentage in table 1, because – as I had mentioned earlier – this branch needed a special treatment: the output of agricultural should be taken into account as if the production of the sector would be continuous in the respective period, and not only at the time when the crop is harvested. For this reason during the year, experts of statistics make separate estimations for every quarter and they estimate the total expected output of agricultural activity and its intermediate consumption. In the system of the Hungarian national accounts however, all the activities of the companies ranked into this branch should be counted into the branch of their main activity.

Subsidiary agricultural activities of companies ranked into other branches are counted into the branch to which they belong according their main activity. There is information in the supply and use tables on the activity of branches used by other branches during their production. From this source we can find out which branches' activities are included by the branch of agriculture, hunting, forestry and fishing. Weighting the output indices of agriculture and other branched with the weight received this way, we can get the output index of agriculture, hunting, forestry and fishing and the existing time series can be continued. The procedure is similar in the case of calculating constant price data, because experts of statistics make estimations not only on value indices but on volume indices as well.

The standard deviation of the value indices of the two indicators compared to each other on the branch level shows clearly, that education and healthcare services are those branches where standard deviation is the largest. In the case of mining, the difference expressed in percentage was relatively high since 2005, i.e. interim current price data of economic statistics underestimated the changes of the output of this branch, while for the preceding years this factor can be regarded adequate. The weight of this branch is rather low in the gross output and quite a few companies are pursuing such activity, therefore every minor deviation causes more significant changes. As few companies pursue activity of this kind, therefore it is expedient to examine this on the individual company level in every quarter.

In the case of education and healthcare services the integrated interim economic statistics observe only a few companies, and on that basis the gross-up is done. In the case of education the weights of private institutions taking part in the education system and other educational centers (e.g. training institutions, language schools) might differ from their annual proportions, therefore I used their annual weights of their output received from the latest available national account statistics besides the use of their interim data received from economic statistics for the estimation of this branch. With indicator calculated by weighting, I continued the time series of value of output.

In the case of healthcare and social security – as it was mentioned earlier –, the gross-up done on the basis of few observed items might bias the difference expressed in percentage. In this case the activity of private dental clinics, private clinics is significant, there are many doctors working in private practice, and almost all of them – due to the low number of employees – fall out of the scope of the interim economic statistical observations.

If these branches are taken out from the scope of observation – because of their requiring a special treatment – then the annual standard deviations of the other branches show improvement of the results in the first period and unchanged results afterwards (see table 3).

**Table 3**

The relative annual dispersion of the value index of output in the national account and value index of production data of the branches of the domestic economy calculated from the respective interim statistics

Name	2003	2004	2005	2006	2007
<b>Aggregate data of branches*</b>	0.07	0.04	0.04	0.04	0.04

\*Aggregate data of branches, except agriculture, fishing, mining, education and healthcare.

Source: author's calculations, on the basis of HCSO data

For the estimation of the current quarter, extrapolation is the simplest, the most effective and the most frequently used method from the mathematical and the statistical point of view. I have already described this in detail in the ‘Materials and methods’ chapter. Extrapolation can be applied if the aggregate data can partly be explained by the change of the indicator. This is the case between the production value and the output, therefore the use of extrapolation is established theoretically as well.

At the same time both variables show interim seasonality, therefore in every quarter I continued the series with the data of the corresponding quarter of the previous year extrapolated by the production value index of the respective quarter. Although, as it had already been explained at the beginning of this chapter, the differences expressed in percentage and the standard deviations suggested that it was inevitable to continuously validate these indicators during the calculations with other available indicators. Because of this I considered necessary to introduce a  $w_q$  multiplying factor into the equation (see part 2.4 in the ‘Materials and methods’ chapter). The extrapolation equation was modified as follows:

$$y_{q+1} = y_{q-3}(1 + \Delta_4 x_{q+1}) \times w_q, \quad (7)$$

Where  $w_q$  is different variable in every quarter for every branch, in that I took into account the information derived from the development of other external variables (e.g. index of industrial production, production index of construction, retail trade turnover, turnover of catering etc.) for the process of validation, together with other ‘soft-information’ and the differences between the data of branches derived from the previous years’ GDP data finalized by annual calculations and the sum of the four quarters deriving from the quarterly calculation expressed in percentage as well.

Besides the statistical and administrative data collected, Eurostat define as ‘soft’ information, the information that branches or larger companies either tell about themselves or it is published about them by other sources in newspapers, in news and official statements. During the estimation of the quarterly GDP, considering the estimation errors of previous estimations can also help in estimating the current period. The consideration of all these factors can improve the quality of the quarterly estimation.

This way the estimated data ( $y_{q+1}$ ) will show all the characteristics of output of national accounts, since the time series of output serves as a benchmark (i.e. this is the base for continuing the series).

On the basis of all these I concluded that my first hypothesis, i.e. with the use of annual and quarterly statistics the quarterly output can be estimated, is verified.

### 3.2 Estimation of intermediate consumption

In 2004, the previous condition of data did not permit to base my estimation of intermediate consumption on the integrated interim economic statistics. In the following year it was already removed from the interim data collection. Lacking the suitable basic data, an alternative estimation method should have been found for estimating the intermediate consumption, reflecting the most the quarterly movement of intermediate consumption.

During my research I tested three kind of methods to estimate the quarterly intermediate consumption of the non-financial corporations sector:

- On the basis of the widespread international practice, I made estimations on the basis of the previous year’s technological coefficients by branches. On the first place this was integrated into the quarterly production side estimations.
- Using the method of regression, I examined the relationship between the output and the intermediate consumption, and by using a loglinear function I described the relationship between the two variables by branches of the domestic economy.

- I tested the methodology recommended by IMF on the Hungarian data: continuing the time series of the ratio of the constant price intermediate consumption and the output by fitting a trend function on the time series of the technological coefficient.

I described three different kind of methods of estimating the quarterly intermediate consumption. The first one calculates the intermediate consumption for the current quarter – according to the conventional and internationally spread practice – from the annual calculations by using the ratio of the latest available constant price intermediate consumption and output. This method based on the assumption that the technological coefficient are constant in the short run, in other words the flexibility of intermediate consumption with the output at constant prices equals 1.

The realignment of the foreign working capital within a group of companies results in changed structure of production and the structural transformation of the economy in such a small and open country like Hungary. Therefore it is particularly difficult to estimate the technological coefficient.

Setting out of this, I elaborated alternative methods that can be used for the development of estimations on intermediate consumption. I studied the relationship between the intermediate consumption and the output, and the results showed that there is a strong and significant association between them. If I estimate the intermediate consumption in the current quarter by using loglinear regression (second method), I have to set the hypothesis that the flexibility of intermediate consumption with the output is constant on the short run (but not necessarily 1) and the structure of the economy does not change either.

In the case of the third method I started from the ratio of the intermediate consumption to the output in the latest period – on the basis of the available data – , and I made a correction on this figure with the movement of the tend function fit on the time series of this ratio. That is I took into account the change of this ratio from one period to the other.

The latter two methods do not assume that the ratio of intermediate consumption and the output is constant, but it depends on the trend of the data and on the association between them in the previous periods. The first method considers only the past one year in the estimation of the quarters of the following year.

Unfortunately the series that I could examine contained only 14 elements, as methodologically consistent annual time series are available since 1995. Such a low number of elements does not make possible the testing and the comparison of the results of the different methods by cutting one or two years from the end of time series and the intermediate consumption is estimated for these years by using different methods.

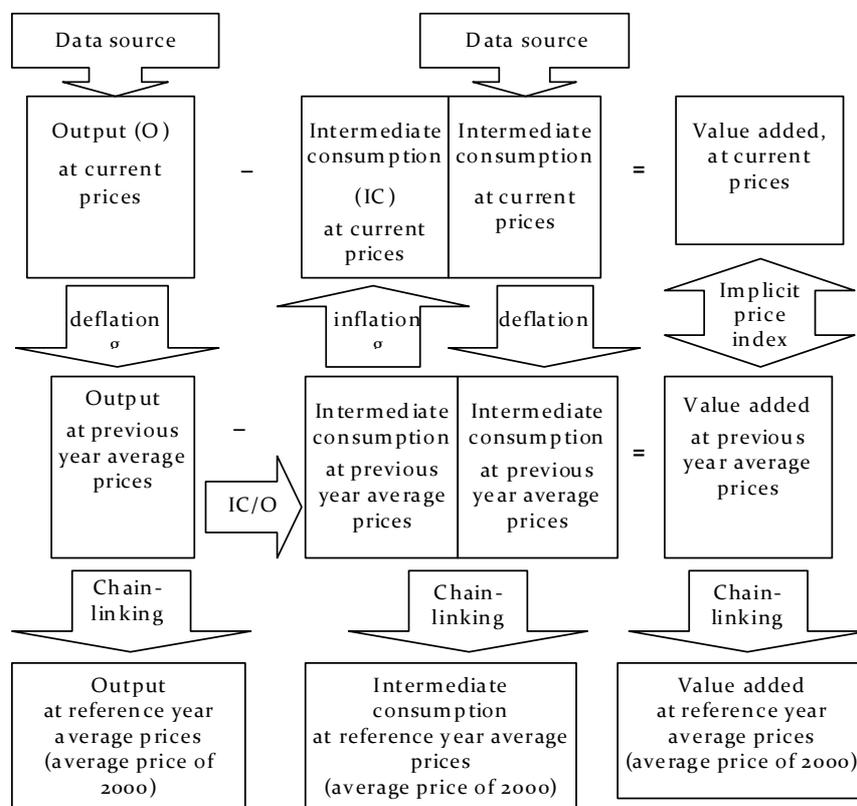
In such a case it is more suitable to make preliminary calculations on the subsequent year, in my case for 2009 and compare this with the final 2009 data published in September 2011, in order to evaluate the soundness of the different estimation methods. Unfortunately, because of the wold economic crisis started in 2008, this method would not lead to the desired results either.

Therefore the applicability of the different methods can only be compared on theoretical level, since the crisis, started at the end of 2008, has an effect on structural changes. Staring from the data of the previous period, we cannot draw conclusion in a crisis for the current period. The crisis can modify the course of trend into unexpected directions. The principal of the constant flexibility cannot be maintained either in a crisis. The constant ratio of intermediate consumption and the output cannot be declared in Hungary not even in a crisis-free period. In periods marked by crisis, the probability of change in this ratio is more likely. On the other hand in a period marked by crisis, the use of a constant is better than the estimation with a model having a long history.

My results show that there is no undoubtedly good method which could be applied for the current period marked by crisis. Therefore I chose the method that caused the least distortion even in a period of crisis.

It projects the possibility of development in the future, that the board of directors of HCSO made a decision in 2010 on the involvement of the figure *value of material, energy, services and other services used* in the questionnaire of interim economic statistics for the companies having 50 or more employees. After getting data for some periods, it will be possible to make investigations on the relationship between this indicator and the intermediate consumption, and on the possible ways of estimations on this ground.

On the basis of these I arrived at the conclusion, that a fourth, further developed method is the most suitable for estimating the intermediate consumption. With this method I would integrate the direct observation of a newly introduced indicator in the data collection and the method used earlier in the cases of the scope being outside of the data collection. In the case of the branches of the non-financial corporations sector the weight of large companies (having more than 49 employees) can be defined on the basis of annual data as much as the weight of the ones outside of this circle. The intermediate consumption of large companies can be estimated on the basis of the *value of material, energy, services and other services used*. While in the case of the smaller companies we can assume that the technological coefficient is relatively stable. This is shown on Diagram 2.



**Diagram 2: The possible calculation process of the quarterly value added for the sector of non-financial corporations in the future**

Source: author's own sources

On the basis of all these I conclude, that my second hypothesis is verified, i.e. estimation can be done on the quarterly development of the intermediate consumption with the use of annual and quarterly statistics.

### 3.3 Estimates for the sector of households

According to the ESA, the sector of households includes individuals and groups of individuals, on the one hand as consumers and on the other hand occasionally as such entrepreneurs who produce goods for the market and provide financial or non-financial services (i.e. market producers). In the case of entrepreneurs the condition of being listed in the sector of households is that the economic activity should not be done by a separate organizational unit that ought to be treated as a quasi-enterprise. Such individuals and groups also belong to this sector that exclusively produce goods and provide non-market services for their own consumption.

The sector can be distributed into two major groups on the basis of these: households as entrepreneurs (sole proprietors) and households as consumers (who produce goods and provide services for their own consumption, e.g. owner occupied dwelling or own primary producer activities).

This latter has a significant weight in three branches of the households sector, while in other branches it is negligible. These branches are: agriculture and hunting, construction and real estate services.

As far as sole proprietors concern, I sought to the distribution of annual output into quarterly ones in several ways:

For estimating the output of sole proprietors a suitable proxy can stem from enterprises having a small number of employees. This is an accepted international practice in the system of national accounts, which was also proposed by Ken Mansell, a British national account expert, during his visit to Hungary in the first years of the 21<sup>st</sup> century.

For the years between 2000 and 2003 I started from the movement of interim production value data of enterprises having 5-9 employees observed representatively in the interim economic statistics. From this calculation it became obvious that the interim economic statistics cannot provide a suitable basis for the grossing-up of enterprises with 5-9 employees, because the receipt of data is deficient therefore the data on them is not representative. In the interim economic statistics there is only representative survey of enterprises having 5-49 employees and that data is grossed-up. In this segment the weight of companies with 5-9 employees is little.

Following this – lacking other data – I accepted the hypothesis that the interim output of sole proprietors, having a similar development compared to the output of the non-financial corporations sector, taking also into account the change in the number of sole proprietors. Within the year this is the only data available on sole proprietors, until completing the estimations.

As far as the other part of the sector of households is concerned (i.e. who produce for own consumption), unfortunately there is no data available for quantifying their performance. I studied branches with larger weights: in ‘agriculture, hunting, forestry and fishing’ a significant portion of production is the production for own consumption in the households sector. In the case of the corporations sector I mentioned that statisticians – dealing with agricultural activities – make estimations on the output and intermediate consumption in every quarter. This includes all kind of agricultural activities, and its development reflects on the development of this branch of the households sector. I broke down the annual data of the past into quarters, and in calculating the current quarter I used the value and volume indices for extrapolating the existing data, adjusted to the annual ones.

Quarterly estimations are available on owner occupied dwelling (which also include garages and holiday homes for own use) at current and constant prices. That made possible the extrapolation of output time series of households sector on this basis and it also facilitated the distribution of annual output data of the past into quarters.

In the case of construction, statistical experts make estimations on the aggregate constructing activity of construction on the basis of interim economic statistics. I used this for extrapolation of the time series of construction.

In the cases of other branches I assumed during the estimation of output that the development of the households sector compared to the corresponding period of the previous year is similar to the development of the corporations sector corrected with the change in the number of sole proprietors compared to the corresponding period of the previous year. In the households sector, due to lacking available indices, I also used this method for estimating the output on the average price of the previous year but in this case the basis was the average of the previous year (at current prices) instead of the corresponding quarter of the previous year. For estimating the intermediate consumption similarly to the corporations sector I used the ratio of intermediate consumption and output but implicitly the corresponding ratios relating to the households sector.

I have not mentioned yet a sole branch which cannot be estimated on the basis of non-financial corporations sector because it is a financial corporate activity namely the auxiliary financial activity. I estimated this latter on the basis of the same branch of the sector of financial corporations in a way that I extrapolated the existing time series with the growth rate of this sector assuming that, this branch of the households' sector changes in a similar way like the same branch of the financial corporations sector.

I inflated the time series of intermediate consumption at the previous year average prices with the deflators of the non-financial corporations sector in order to get the intermediate consumption at current prices. This way I calculated the value added at current prices and at previous year average prices.

### **3.4 The results of the new methodology of 'Contribution to growth'**

With the introduction of chain-linking, additivity ceased to exist in the case of time series chained back to a selected reference year i.e. the sum of subtotals were not equal to aggregates, and respectively it was not possible to calculate the volume index of the aggregate from the volume indices of the subtotals directly. This made necessary the elaboration of a new method of calculating the contribution to the quarterly GDP growth.

In the case of the annual overlap chain-linking method, which is used in the quarterly national accounts in Hungary, the average price of the previous year is the weight for every quarter in the current year. The linking factor is derived from the annual data. I.e. the current quarter at previous year average prices is connected to the average quarter of year (t-1) on the average prices of year (t-1).

In the case of data calculated at previous year average prices additivity still exist, but as the data is chained to a common reference year (this was obtained in one step with the use of 'classical' constant price method) additivity disappears straightaway. I utilized this specific characteristic of data on the average price of the previous year, and I started out of these data during calculating the contribution to the quarterly GDP growth at production side.

Within a given year the quarters are expressed on the same prices, but the data of the previous year is available at the prices of the year prior to the previous year. At the same time the current price data of the quarters of the previous year are expressed on the prices of the current quarter not on the average price of the current year, which I would need for the comparability of the data of two subsequent years.

As a first step I calculated the data of the quarters at the average price of that year (e.g. the 1<sup>st</sup> quarter in 2008 was calculated on the average price of 2008). It expressed as follows for the 1<sup>st</sup> quarter of 2008:

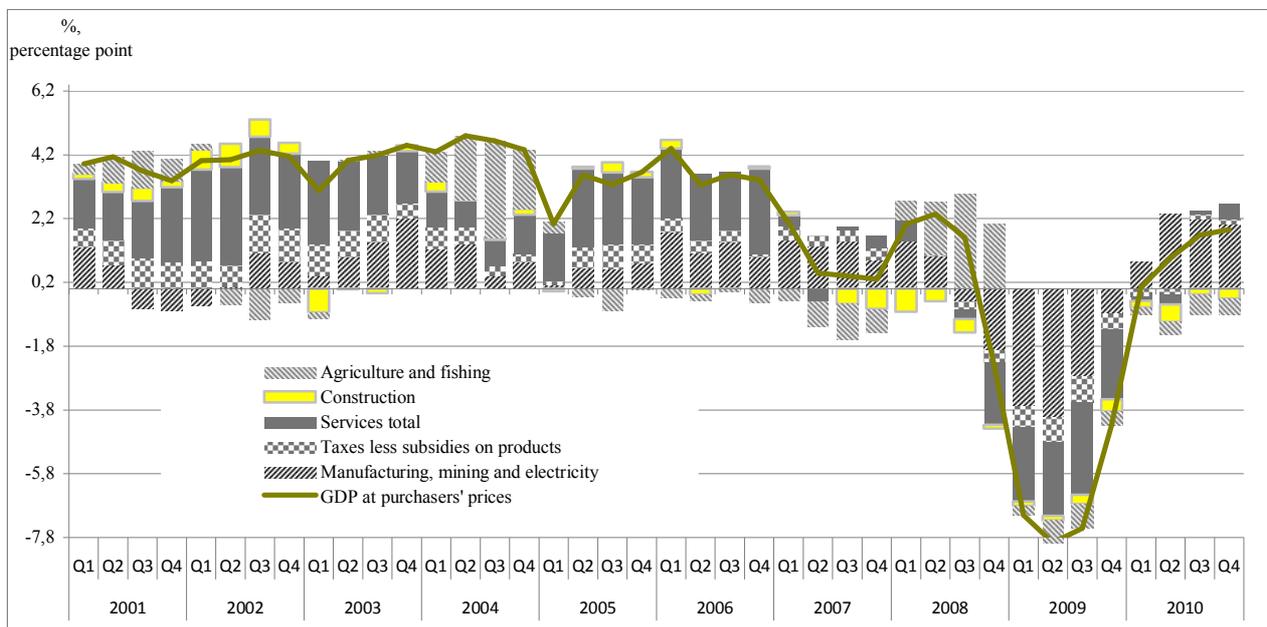
$$\frac{\bar{p}_{2007}q_{2008}^I}{\frac{1}{4}\sum_{i=I}^{IV}\bar{p}_{2007}q_{2008}^i} \cdot \frac{1}{4}\sum_{i=I}^{IV}\bar{p}_{2008}q_{2008}^i \quad (8)$$

Then contribution to growth can easily be calculated. E.g. contribution of agriculture to the GDP growth in the first quarter of 2009 can be expressed as follows:

$$\frac{\bar{p}_{2008}q_{2009}^I - \bar{p}_{2008}q_{2008}^I}{\sum \bar{p}_{2008}q_{2008}^I} \quad (9)$$

I.e. the contribution of agriculture to the GDP growth can be expressed in such a way that the data of the 1<sup>st</sup> quarter in 2008 at the average price of 2008 is subtracted from the data of the 1<sup>st</sup> quarter in 2009 at the average price of the previous year, and this difference is divided with the GDP aggregate of the 1<sup>st</sup> quarter in 2008 (at average price of 2008).

By this method the value added of branches at the average price of the current year can be calculated at the end of every year. As a result the calculated values for two subsequent years are comparable and they are additive as well. Therefore in the case of contribution to growth calculated this way, additivity should be realized i.e. the sum of the branches together with the taxes less subsidies provide the volume growth of GDP. The method is definitely simple, which is an important point in the case of short term statistics. This calculation technique permit of detecting the extent of contribution by each component to the volume change of GDP compared to the corresponding period of the previous year. By this my third hypothesis is verified i.e. a method can be developed that is suitable to measure the contribution of branches to the growth of GDP after the introduction of chain-linking.



**Diagram 3: Contribution to GDP growth, based on production side**

*Source: HCSO, author's compilation*

In the case of analyzing short term processes – as on this time range demand is the decisive factor – it is suitable analyzing the contribution of expenditure side components to the GDP growth. In analyses of longer term, it is suitable to approach to the contribution of branches to the GDP growth of production side, as I demonstrate on diagram 3.

Calculations of the contribution to the change of GDP can provide effective assistance in analyzing short term and long term processes in the economy. As the calculation method depends on the calculation methodology of constant price quarterly GDP therefore switching to the moving base

procedure – due to the chain-linking – made the course of calculation more complex. At the same time it provides additional information for analysts and for those interested in the subject.

### **3.5 New scientific results**

In my research I dealt with elaborating the estimation method of current price quarterly GDP for the sectors of non-financial corporations and households. In this framework my results can be summarized as follows:

1. I elaborated a methodology of estimating quarterly current price GDP from production side, and within this of estimating the output and the intermediate consumption. On the basis of the analyses I arrived at the conclusion that for estimating the output of the majority of the branches: for estimating quarterly data from annual data of the past the most suitable data were the interim distributions derived from the interim economic statistics, and for estimating the data of the current year the most suitable data were the corrected (taking into account some specialties e.g. change of tax rates) value indices of production value for extrapolation. I noted that the validation of the calculated data should be assigned special attention in estimating the quarterly GDP. For this estimation it is necessary to use available indicators, internal account coherency or any other ‘soft’ information e.g. from different media sources. With this there was a significant growth in the data- and information content of the quarterly national accounts, as in every sector estimations are made in the case of 60 branches for output, intermediate consumption hereby for the gross value added in every quarter at current prices, at previous year average prices and at reference year prices.
2. I tested the methods and the models of intermediate consumption available in the literature and I made calculation with them using Hungarian data. I recommended the use of a new method having less distorting effect even during an economic crisis and integrate the effect of efficiency and that of structural changes as well.
3. I worked out the methodology of calculation the contribution to the growth of GDP by the individual branches. With the elaboration of this method it became possible – contrary to the non-additivity caused by chain-linking – to obtain the contribution to the GDP growth by branches.

## **4. CONCLUSION AND RECOMMENDATIONS**

The results of my analysis showed that in the case of calculating the current price indicators of the sector of non-financial corporations the interim economic statistics data could serve as a suitable starting point for estimating the output in most branches. For breaking down annual data relating to the past into quarters I used interim distributions derived from interim economic statistics. In the case of current price calculations I used the corrected value indices of production (taking into account some specialties e.g. changes of taxes) for the extrapolation. The estimation can be validated with using all the available indicators – in natural term and relating to turnovers – and ‘soft’ information in the case of the quarter is to be estimated.

I should be taken into consideration that the data of the interim economic statistics are available only on the 53<sup>rd</sup> day following the actual period at the earliest (and the data are subject to changes retroactively). The results of the quarterly GDP estimations need to be published on the 70<sup>th</sup> day following the actual period, which means the estimations should be completed by the from the 63<sup>rd</sup> to the 65<sup>th</sup> day following the actual period, as the chain-linking should be done and the contribution to growth needs also be calculated, the time series should be seasonally and also with the calendar effect adjusted, then time consistency should be assured for the adjusted data as well. This ten-day

period that contain at least one week-end, is shortened to 8 days. During this time all the calculations should be completed in order to provide reliable quarterly estimation at current and constant prices. Because of this simplicity and temporality of the method were also important aspects besides its accuracy and reliability.

The more the post work following the estimations shortened, the more time remains for the estimations themselves. At the same time Eurostat expressed its demand on completing the quarterly GDP calculations by the 60<sup>th</sup> day following the actual period. This further reinforces the requirements of temporality and simplicity not only in the case of quarterly GDP estimation but also in the case of chain-linking, calculating the contribution to the growth of GDP as well as in the case of other post works. This led Eurostat also to the decision that in the case of calculations on EU-27 the method of quarterly overlapping – which is preferred the most by Eurostat – should not be used, but the more simple method of annual overlapping instead, which is compatible with the Hungarian practice. In addition to this, most of the member countries make the chain-linking with this method as well.

This was the main line in developing the estimation method of contribution to growth that I followed. Developing this method made possible to receive the contribution of branches to the development of GDP in spite of the inadditivity of data caused by chain-linking.

There is no basic data available for estimating the intermediate consumption, therefore it should have been estimated. Instead of the conventional, internationally widespread practice (this is the first method) – which calculates the intermediate consumption of the actual quarter from the latest available annual data by defining the ratio of intermediate consumption and output at constant prices – I elaborated additional alternative estimation methods and made their comparison. I proposed the use of a new method, that integrates the direct observation of large companies and the use of technological coefficients in the case of units out of the scope of direct observations. This way in the time of crisis the estimation is the least subjected to distortions and includes the effect of efficiency and the change in the structure of the economy. Testing of this method can only be possible in two years at the earliest; anyhow it projects promising possibilities of methodological development that could strengthen the quarterly production side GDP estimations.

A further task that is getting more important, the consideration and introduction of methodological developments stemming from the integration of annual national accounts and supply and use tables (SUT) into the quarterly production accounts, which are going to be published for the first time in the first third of December by HCSO. This development in the annual national accounts will open up new prospects of methodological developments in the quarterly accounts since it would make possible to do research on the quarterly estimations of supply and use tables and to make their experimental calculations.

## 5. LIST OF PUBLICATIONS CONNECTED TO THE TOPIC OF THE DISSERTATION

### 1. Scientific articles

#### *Scientific articles published in English*

1. **Anwar, Klára**: Current Price Approach of Quarterly GDP Estimations, Hungarian Statistical Review, Budapest, 2008. Special number 12. 45-57 pp. ISSN 0039 0690
2. **Anwar, Klára** – Ugródsy, György: New aspect of the methodological improvement of quarterly GDP estimation, Bulletin of the Szent István University, 12/2009, Gödöllő, 2009. 98-102 pp. ISSN 1586-4502

#### *Scientific articles published in Hungarian*

1. **Anwar, Klára** – Szőkéné Boros, Zsuzsanna: Contribution to Growth, *Statistical Review*, Budapest, Issue 10-11<sup>th</sup> 2010, pp. 1123-1131, ISSN 0039 0690
2. **Anwar, Klára** – Szőkéné Boros, Zsuzsanna: The Use of Chain Indices in the National Accounts, *Statistical Review*, Budapest, Issue 7-8<sup>th</sup> 2008 pp. 713-731, ISSN 0039 0690
3. **Anwar Klára**: How Quarterly GDP for the EU Total is Calculated, *Statistical Review*, Budapest, Issue 2-3<sup>rd</sup> 2012. ISSN 0039 0690 (under publication)

### 2. Lectures on scientific conferences, published in conference editions

#### *In English*

1. **Anwar, Klára** –Ugródsy, György: Methodological Improvement of Quarterly GDP Estimation in Hungary, MendelNet Conference, Mendel University of Agriculture and Forestry in Brno, Brno, 2008. ISBN 978-80-87222-03-4
2. **Anwar, Klára**: Methodological Aspects of Current Price GDP Estimation in Hungary, Firm and Competitive Environment Traditional International Scientific Conference, MUAF in Brno, Brno, 2009. 182-189 pp. ISBN 978-80-7392-084-5
3. **Anwar, Klára** –Ugródsy, György: Quarterly GDP from an other point of view, Erdei Ferenc V. Tudományos Konferencia, Kecskeméti Főiskola Kertészeti Főiskolai Kar, 3-4<sup>th</sup> September 2009, 252-256 pp. ISBN 978-963-7294-74-7
4. **Anwar, Klára**: Possible approaches of the Quarterly GDP Estimation, In: Proceedings of the Challenges for Analysis of the Economy, the Businesses, and Social Progress International Scientific Conference, Szeged, November 19-21, 2009, edited by: P. Kovács – K. Szép – T. Katona, Szeged, 2010. 1280-1286 pp. ISBN 978-963-06-9558-9

5. **Klára Anwar**: Is there only One Method to Estimate Quarterly GDP on Production Side? In: Shifting Environment – Innovative Strategies HARMONY Science in the Economy and the Society International Scientific Conference, Sopron, November 2, 2011. ISBN 978-963-9883-87-1 (under publication)

#### *In Hungarian*

1. Kondiné **Anwar, Klára**: The Use of Chain Indices in the Quarterly National Accounts, Tradition and Innovation International Conference, Szent István University, Faculty of Business Sciences, Gödöllő, 2007. ISBN 978-963-9483-85-9
2. **Anwar Klára**: Sesonal Adjustment of Quarterly National Accounts, Ferenc Erdei 5th Scientific Conference, Faculty of Horticulture of the College of Kecskemét, 3-4<sup>th</sup> September 2009, 257-261 pp. ISBN 978-963-7294-74-7

#### **c) Other publications in printed or in electronic format**

##### *Research reports*

1. Co-author of the quarterly report of HCSO on the development of quarterly GDP, which is published on the webpage of HSCO: [www.ksh.hu](http://www.ksh.hu).
2. The author was participating in the European level work of the joint Eurostat and European Central Bank's Task Force on Seasonal Adjustment of Quarterly National Accounts and represented the Hungarian Central Statistical Office in this work. The task force was working continuously during the year 2007 and had four few days long meetings, two in Luxembourg and two in Frankfurt. The mandate of the Task Force was to review and specify further the recommendations for seasonal adjustment of quarterly national accounts of 2002 that may be affected by the introduction of chain-linked QNA volume measures, i.e. the recommendations on accounting identities and the treatment of discrepancies of seasonally adjusted components and aggregates, as well as the time consistency between adjusted quarterly and annual results. The main aims of the Task Force were to review Member States' practices and prepare the treatment of chain-linked volume data, seasonal and working-day adjustments for the harmonization.
3. In April 2010, the author was participating in the TAIEX expert program, being invited by the European Commission. The subject of the expert mission was the seasonal adjustment of quarterly GDP data. The location of the expert mission was the Central Bank of Egypt. The Egyptian partner was satisfied with the level of expertise, the quality of the work performed and with the results and expects the author for another expert mission.
4. In 9-10<sup>th</sup> June 2011. the author has represented the Hungarian Central Statistical Office in the „Euroindicators Working Group” held by Eurostat. Its aim was to review the already realized tasks of the Working Group and its planned tasks for the year 2012. The Euroindicators Working Group was focused on the improvement of the PEEI (Principal European Economic Indicators) and its harmonization processes.