Session Number: Submitted Papers Session 7C
Session Title: Measurement Issues in Macroeconomics
Paper Number: 5
Session Organizer: Jacques Magniez, INSEE, Paris, France
Discussant:

*Paper Prepared for the 29th General Conference of*
*The International Association for Research in Income and Wealth*
*Joensuu, Finland, August 20 – 26, 2006*

# Flows and Stocks of Fixed Residential Capital: The Croatian Experience[1]

**Marija Gojević, Jukka Jalava, Ivan Šutalo, Markku Suur-Kujala**

For additional information please contact:
Marija Gojević
National Accounts Department, Central Bureau of Statistics, Branimirova 19, Zagreb 10 000, Republic of Croatia. E-mail: GojevicM@dzs.hr
Jukka Jalava
Pellervo Economic Research Institute, Eerikinkatu 28 A, 00180 Helsinki, Finland. E-mail: jukka.jalava@ptt.fi
Ivan Šutalo
National Accounts Department, Central Bureau of Statistics, Branimirova 19, Zagreb 10 000, Republic of Croatia. E-mail: SutaloI@dzs.hr
Markku Suur-Kujala
Economic Statistics, 6C, FIN-00022 Statistics Finland. E-mail: markku.suur-kujala@stat.fi

This paper is placed on the following websites: **www.iariw.org**

[1] We would like to thank Nadim Ahmad, Ole Olsen and Bo Simonsen for helpful comments without implicating them in any remaining errors. Jukka Jalava's research is partly financed by the Specific Targeted Research Project "EUKLEMS 2003. Productivity in the European Union. A Comparative Industry Approach" supported by European Commission, Research Directorate General, within the Sixth Framework Program, Contract No. 502049.

# 1. Introduction

Croatia declared its independence in 1991. After that it started to reorganise herself on most domains of the economy and social life. The official statistics of the Republic of Croatia was obviously one of the areas under transition. A little more than fifteen years ago the Croatian Central Bureau of Statistics (CBS) was just one of the regional statistical offices. Now the CBS is a central statistical agency responsible for the production of official statistics. The system of Croatian statistics is based on the statistics act (passed in 2003), and on the Code of Practise of the European Statistical System. In the development work the CBS has vigorously harmonised its programmes and methodologies with the statistics of the European Union.

An important prerequisite in the production of modern statistics is the utilisation of internationally comparable methodology and statistical classifications. Statistical data is a product with markets and users. For some statistical data there is a greater demand than for others and the quality of the statistical product changes over time, usually for the better. One important effort in developing statistics in Croatia was the Danish-Croatian EU Cards-project in years 2003-2004. One component of the project was the implementation of the system of national accounts (SNA93/ESA95) in Croatia. Besides Statistics Denmark also Statistics Finland participated in the development of national accounts. This meant that experts from three countries came together and they had ESA95 as a common starting point.

The SNA93/ESA95-component of the project included a sub-component, which aimed at developing a cost efficient methodology for the estimation of fixed assets. During the project there were many interesting discussions between experts. A number of proposals were presented for introducing capital stock estimates for Croatian national accounts. Contacts concerning the development work of the compilation of the fixed assets continued between Croatian and Finnish experts after closing the Cards-project and this paper is one result of the co-operation. This article is about the challenges and achievements gained in creating the residential capital stock for the economy of Croatia. For this project CBS had limited source material and scarce resources at its disposal. Hence, the conclusions of the project may be useful and interesting for national accountants facing the same kind of problems that Croatian statisticians did.

# 2. Starting points in developing capital stocks

The importance of the accumulation of fixed capital in the process of economic growth and expansion of a total economy is well known. The impact of productivity on a production process and the origins of productivity are very much in the centre of interest at the moment. There are vital discussions going on about the scope of capital and measurement of the stocks and services provided by capital embodied in the economic structure of the total economy.

The interface between intermediate consumption and accumulation is always topical in national accounts. In the current work of the ISWGNA working on updating the SNA93 there are some 44 individual issues, which are being reviewed for consistency and the overall integrity of the system. Twenty-two of these considerations are in the domain of non-financial assets. This is not to say that exactly half of the issues are rising from the asset side, but we can agree that definitions of investments are still the central point in the logical system of the SNA/ESA.

The flows and stocks of capital are important prerequisites in quantifying the impact of productivity on production. However, it is equally important to measure the market value of the wealth in the balance sheets of the national accounts system and the value of the consumption of fixed capital, that is, to estimate correctly a difference between "gross" and "net" concepts by sectors and activities in the national accounts.

## 2.1. Concepts related to the compilations of capital stocks

This paper focuses on residential capital stock, but it is useful to go through concepts at the general level. The capital stock is the stock of goods, which are used in a production process more than once. Capital goods are reproducible, which means that land is left outside. However, the increasing value of land was one of the main challenges when we attempted to estimate the value of the residential stock in Croatia.

All capital goods which are available for use in the production process within an enterprise are included. Capital stock comprises both owned and rented capital goods. Financial leasing is also included as are second hand capital goods. Operational leasing, however, is classified as an intermediate consumption of the lessee firm. Furthermore, the costs of ma-

jor repairs (considerable increase of the production capacity or essentially longer service-life) are included in the capital stock.

The valuation of wealth on the balance sheets of the SNA/ESA follows market prices. Capital stocks, which are used when the consumption of fixed capital is being estimated, are valued according to the actual values of the replacement. The actual value of the capital asset in use in an enterprise equals the price that the enterprise will have to pay for a new identical asset on the date under report. The value of the capital stock is related to the purchasers' prices of the asset. The purchasers' price includes also the transport and trade margins and taxes (excluding VAT).[2]

The capital stock can be expressed in gross or net terms. The difference between the gross stock and the net stock is accumulated depreciation.[3] In order to estimate the consumption of fixed capital we need information on the length of the service lives of the capital assets.

## 2.2. Means to collect data on the value of capital stock

An early famous example of an attempt to enumerate a country's fixed assets is the so called *Domesday Book* which was commissioned nearly a millennium ago by William the Conqueror. In modern days such an effort is too costly. Fortunately we have other options, such as those listed by OECD (2001).

*Published company accounts* are compiled for tax purposes and for the benefit of managers and stock owners. However, balance sheets are usually unavailable for unincorporated enterprises and also business accounting practices differ from national accounting standards. A serious problem is that business accounting uses historic costs in its balance sheets and book value consists of the purchasers' value of assets with varying vintages. The depreciation that has occurred since the purchase of the asset is already incorporated in the book value.

---

[2] Lock, 1985.

[3] We use the terms (time series) depreciation and consumption of fixed capital interchangeably. By depreciation is in the productivity literature usually meant the difference in price at the same time point in time between two otherwise identical capital goods of successive vintages. This is the loss in value due to aging, which is often called cross-section depreciation (Diewert, 2001; Hill, 1999).

*Statistical surveys* have also been carried out in market economies. The Dutch version is a rolling benchmark that approximately every five years covers the same mining, quarrying and manufacturing sub-industries. Finland carries out a survey for a sample of all mining, manufacturing and utility establishments. The latest one was carried out for the statistical year 2002. The use of *administrative records* is an alternative method.

A version of the *perpetual inventory method* (PIM), first introduced by Raymond Goldsmith in 1951 (Goldsmith, 1951) to calculate capital stocks, has been used in practice by the most advanced countries. The perpetual inventory method implies that the investments by vintage can be derived from investments statistics. Estimating the economic service life for each kind of asset allows the determination of the vintages of the investment goods which are still available. By means of price indexes, which are derived according to the type of asset, values are converted into actual prices and so the actual value of the capital stock appears. Next year the retired capital goods must be taken out of the stock. This consumption of fixed capital is calculated with the help of the estimates of the service lifetimes. The next step is that newly purchased investment goods in that year are added to the stock and new revaluation is carried out leading to the new capital stock.

An additional source is *insured values*. For enterprises the value of the capital assets available is often appraised for fire insurance. There are, however, many cases where assets are not insured. For instance, general government does not insure its property, but bears the whole risk by itself. This leaves a big part of assets of infrastructure outside. The vast majority of the houses are not insured against fire risk in Croatia. Files concerning fire insurance policies of different sectors in Croatia were not suitable for use in compiling statistics of the capital stock.

*Balance of Fixed Assets* was the method used in the formerly centrally planned economies where the state owned firms annually reported their opening balance sheets, yearly acquisitions and withdrawals and the closing balance sheets.

# 3. Gross and net capital stocks

Traditionally there are two stock measures in the national accounts. In the *Gross Capital Stock* (GCS) the capital good is assumed to retain its complete productive capacity until it is retired. Thus it is the value of the capital used in production as if there was no decline in efficiency (valued at as-new-prices, without regard of age or actual condition). Only when a fixed asset's service life ends is it retired from the capital stock. The GCS consists of the cumulated past investments less the cumulated retirements of fixed assets. Aulin-Ahmavaara and Jalava (2003) define the GCS at the end of year *t* as the following perpetual inventory equation:

$$(1) \quad K_t^G = \sum_{s=0}^{S-1} d_s^G I_{t-s} ,$$

where $d_s^G$ is the surviving share of the vintage of fixed assets that are $s$ years old in year $t$ and $S$ is the maximum average service life of the asset type. The relative share of survivors converges towards zero. In the national accounting framework the GCS is needed only as an intermediate step in calculating Net Capital Stocks (NCS). However, as the US Bureau of Economic Analysis now directly calculates NCS the GCS might become obsolete itself if other countries follow suit (Katz and Herman, 1997; Fraumeni, 1997).

*Net capital stock* reflects the market value of the capital stock. The net value of the capital good equals the current purchaser's price of a new asset of the same type less the cumulated consumption of fixed capital (SNA93, para. 6.199). Consumption of fixed capital is a production cost (SNA93, para. 6.179). It is the decline in the value of capital during the accounting period due to physical deterioration, normal obsolescence, normal accidental damage and aging (SNA93, para. 6.179.; ESA95, para. 6.02.; Katz and Herman, 1997).

An important parameter in the PIM is the choice of the depreciation profile. Usually either the straight-line method or geometric depreciation is used. In the straight-line method an identical share of the original constant price investment is depreciated.[4] With geometric

[4] Often the first year's depreciation is half since investments are assumed to be made at mid-year. Thus e.g. an investment of 100 with a service life of five years is depreciated in consecutive years by: 10, 20, 20, 20, 20 and 10.

depreciation an identical share of the remaining constant price investment is depreciated.[5] Another essential parameter for the PIM is the appropriate average service life for each fixed asset. Finally, in order to be able to compile series on the stocks of fixed capital the flows, i.e. the investments and appropriate deflators for them have to be compiled

[5] Assuming that the declining balance rate is 2 and the service life is five years gives a rate of depreciation of 0.4 (=2/5). Usually the first year is depreciated by half also in the geometric case. The amounts depreciated from an original investment of 100 in consecutive years are when rounded: 20, 32, 19, 12, 7 and 4.

# 4. Situation in Croatia at get-go

When starting this project there were no estimates of fixed assets in Croatian Central Bureau of Statistics. The latest available estimation of national wealth was done by Ivo Vinski (1959) for the year 1953 for the former Yugoslavia. CBS has collected information about the value of the investments of the enterprises in different branches in economy for more than 35 years. Back series exist, but with frequent changes in methodology and coverage and huge inflation introduction of perpetual inventory method (PIM) is somewhat difficult.

## 4.1 Pilot survey on capital stock

For fixed assets a Pilot survey was carried out in 2002. The sample for this Pilot was; 80 biggest investors in non-financial sector, 3 banks, 3 insurance companies, 10 government agencies and 3 non-profit institutions serving households. The response rate was 59% for enterprises; 3 out of 10 governmental agencies replied, 1 bank, 1 insurance company and none of 3 NPISH's. The questionnaire was designed in a way that in addition to data on capital stock enterprises answered also questions concerning depreciation method and data on the average expected life for new assets. The straight line method was the most popular one (90% of all known answers). Other methods used were geometrical or functional depreciation.[6]

The issue of deflation was also taken into consideration. I.e., whether they use producer price indexes, consumer price indexes, cost of living indices, or revalued fixed assets in some other way. Furthermore, the questionnaire asked whether they estimated market value (in case of privatization) or whether acquisition prices were used in calculating depreciation. Seven enterprises estimated the market value of their assets (this was most likely due to privatization), and 5 used the producer price index. Most of them did not re-

[6] Functional depreciation is the method of depreciation which is close to SNA definition of consumption of fixed assets but unfortunately it is not popular among accountants. Value of depreciation is different every month depending on number of shifts, and on how many hours machine was employed in production. Number of produced outputs can also be used as indicator of how capital is used to generate output. Firms which use this method scale average service life of one asset into number of expected working hours or in case of transport equipment into expected kilometers or tonnes/passenger kilometer (tonne/passenger kilometer is a unit of measure representing transport of one tonne/person over a distance of one kilometer). Every month the value of the asset is decreased depending on the percentage of the chosen indicator realized during the month to the total expected value of the chosen indicator.

value because Croatia has a low inflation rate; the average rate for 2004 was 2.1 per cent and there was no legal obligation to revalue data in balance sheets.

The basic idea of data editing of the survey method used in the Pilot is that the data and information on methods of depreciation and revaluation used by each firm is taken from the questionnaires, and using corresponding price indexes acquisition price, consumption of fixed capital and values for capital stock are calculated. The Pilot showed us that this method is not the most accurate, because most of the firms wrote down only values, they did not specify which methods they used. But even when you have all the information it is possible that it cannot be used. For example, if a firm uses functional depreciation, one cannot reconstruct acquisition price, since the data on production, shifts, etc. is missing.

Because of the above mentioned reasons, it was decided that the Pilot was not to be continued as an ongoing survey. The most acceptable method chosen is a combination of calculating benchmark values for 1997[7] year with direct observation of capital (DOC) and the perpetual inventory method for following years.

## 4.2. Central bureau of statistics as the main source

Identification of suitable data source was one of the first steps we took during the Finnish Danish Cards-project. Ideally the best source is a survey on investment, but only in cases when dealing with long time series (at least 20 years). This was not the case in Croatia. We have been conducting surveys on investment since 1967, but the methodology was adapted to SNA as late as 1996. Furthermore, the other problem was that Croatia had hyperinflation until 1995.

We, therefore, concluded that the main source should be CBS. The best method was to make one internal questionnaire in which quantities and prices would be collected. That questionnaire (a quasi-metadata model) is still being developed. Some challenges are that the largest part of the basic statistics is currently switching to structural business statistics (SBS) and hence the linking of data from different departments is a demanding task.

[7] Years prior to this year will be estimated. CBS has introduced National Classification of Activity in 1997. Classification used before is not compatible with current Classification which is compatible with NACE.

## 4.3. Administrative data sources

In addition to data from the statistical bureau, administrative sources are a valuable source, especially when containing separate data on quality and price and with full coverage. The *tax administration* collects data on fixed assets for entrepreneurs, but it does not edit them to date. This will most likely change as they will help in editing data on fixed assets owned by craftsmen. This could also be an excellent source for improving the coverage of the investment survey. Numbers yielded from investment survey cover legal entities, while natural entities are estimated in CBS. Administrative sources are also often used for transport equipment. The Ministry of Interior will deliver data on the acquisition, selling and retirements of cars.

# 5. Empirical results

The results of our attempt to calculate the value of dwellings is presented in the table below.

**Table 1. Values of dwellings for year 2001, in euros**

| | Denmark | Finland | Croatia |
|---|---|---|---|
| Gross capital stock for dwelling per inhabitant | 75 119 | 48 570 | 24 225 |
| Net capital stock for dwelling per inhabitant | 41 582 | 28 546 | 15 054 |
| Gross capital stock for dwelling per $m^2$ | 1 245 | 1 302 | 833 |
| Net capital stock for dwelling per $m^2$ | 689 | 765 | 518 |

*Data sources: Own calculations and*
*http://www.statbank.dk/statbank5a/default.asp?w=1024*
*http://www.stat.fi/tup/rakas/data/html/engl0020.html*

We calculated values of dwellings, the largest item in the capital stock, using the data from the *Census of Population, Housing and Dwellings* held in 2001 and the Annual Census of Construction for the years after the Census. Many assumptions had to be made. Much information was available on the quantity and quality of dwellings at the level of town/municipality, but we had some difficulties with prices.

**Defining dwellings as fixed assets**

The problem of defining exactly which premises will be classified as dwellings (A.1111) and which as non-residential buildings (AN.11121) appeared at the very beginning. According to the *Recommendations for the 2000 Censuses of Population and Housing in the ECE Region*, as premises are defined living quarters which are either designed for permanent human habitation at a fixed location and are not used wholly for other purposes at the time of the census or are actually used as the principal usual residence (whether or not so designed, whether fixed or mobile and whether permanent or temporary). Living quarters may be an occupied or vacant house (conventional dwellings); an occupied hut, cabin, caravan, houseboat, or any other shelter used for human habitation (non-conventional dwellings) and a hotel, institution, camp, etc. (collective living quarters).

The definition of tangible fixed assets (SNA93, chapter XIII, annex) makes the distinction between dwellings and non-residential buildings. For the value of non-residential building, all buildings other than dwellings are evaluated. This causes confusion as to what to do

with dwellings which are place of production, for example solicitor's offices, consultant offices, agencies, dwellings used for renting to tourists, etc.

The other not so clear case is that concerning conventional dwellings which are only used in the season of agricultural works. They can be included in the residential capital stock, because the only purpose of these flats is to use them for living, but they are used temporarily, so they could be seen as some sort of non-conventional dwellings similar to hotels, but without paying any fee to the owner of the "hotel". CBS evaluated these two problematic categories, but we did not include them in the residential capital stock.

Some collective living quarters which are used as a place of usual residence could be allocated to dwellings and to non-residential buildings. Collective living quarters include sets of premises such as nurses' hostels, residences for students, monasteries, prisons, military and police barracks, welfare institutions, etc. The first three categories besides the benefits they give to theirs users are primarily used as the place of usual residence. This could mean that square meters used in this type of collective living quarters are contributing to dwelling services. Or if we think that they are part of a non-residential building, then the value of square meters will contribute to the production of output of different services (depending on the type of services the institution supplies to its occupants such as; education, health, social work). The user cost of these types of collective living quarters will include the part which belongs to dwelling services.

**Price of dwellings**

The statistical offices' construction department conducts a quarterly survey on the price of a sold new dwelling for Zagreb (capital of Croatia) and one series for all other settlements. We decided to multiply this average price for all settlements except Zagreb with an index of disposable income, to get a proxy for prices at a regional level.

The price of 1 $m^2$ of a dwelling sold includes the following; construction price (demolition of the existing facilities, cleaning of construction-site, excavation works, erection of building, erection of roof covering and frames, installation and final works) as well as the constructor's profit margins and other costs (fees on acquiring building permits, building design and drafting, land surveying activities, supervision of construction, and different taxes and insurance). Costs of building-sites were excluded. We decreased other costs by 5% - this is the cost which goes on acquiring necessary permits. We also decreased the

constructor's profit by 1% in 2001 (which equals the change in the value of the land in the past 18 months). This was necessary since this amount of kunas belongs to the value of the land (non produced asset) and not to the dwellings. The construction permit increases the value of the land as land without a permit is less valuable.

**Defining quantity and quality of dwelling**

The value of sold new dwellings was adjusted with different coefficients to get new values more suitable for existing dwelling stock. Coefficients were calculated depending on quality of dwelling, year of construction, demographic and geographical factors. Coefficients for dwellings of different quality were checked with prices on the real estate market for dwellings of different quality at the same location (settlement).

Census data were for 1.4.2001, so we multiplied data on quantity (quality) with price using the Quarterly Report on Prices of Sold New Dwellings for second quarter for 2001. To move these values to 31.12.2001 we needed to know the price movement from 1.4. 2001 to the end of the year for the stock.

After we calculated average prices a table of occupied dwellings by auxiliary facilities and installations by towns/municipalities was made. Then we were able to multiply $m^2$ with different coefficients depending on installations. According to data from the Census 36% of occupied dwellings have central heating and we assigned them the coefficient 1, i.e., the value will not be changed for them. For dwellings without central heating value is lower for 7% than average price. From the Purchasing Power Parities (PPP) for Croatia approximately 7% of all costs of building houses go on the installation of central heating. Dwellings without kitchen, bathroom and toilet have 12% lower values. This percentage is also calculated from PPP.

Dwellings for vacation and temporarily inhabited dwellings have a value per $m^2$ of 91% of the average value and dwellings used in the season of agricultural activities only 54% (according to PPP). Abandoned dwellings are not valued because they were withdrawn from production; they are not used in production of dwelling services anymore.

In the first version dwellings were assigned coefficients depending on location. According to data from the real estate market we concluded that the value for all settlements except Zagreb has just 75% of the average value and for Zagreb it is 20% above average. This is

logical because almost one forth of Croatian population (18%) lives in Zagreb and the percentage of persons in employment that are working in Zagreb is even higher, 22%. Upon reflection we decided not to use this coefficient since location is all about land, not the dwelling. Buildings on the coast reflect the higher value of the land they sit on, and not necessarily the building itself.

The next phase was to adjust values using demographic and geographical factors. It was assumed that dwellings located in bigger settlements (urban) with higher density, will have higher values, because demand/price for them is higher than in rural places. Higher values are assigned to dwellings in urban settlements also because towns have better infrastructure which increases the quality. Dwellings in towns have 5% higher values and ones in other settlements are 80% cheaper compared to average prices.

**Table 2. Demographic coefficients for value adjustments - density per km$^2$**

| Population density per km$^2$ | Coefficient | Number of town/municipalities which have this density/coefficient |
|---|---|---|
| Under 100 | 0,80 | 410 |
| 100-499 | 1,00 | 124 |
| 500-1000 | 1,05 | 7 |
| Over 1000 | 1,15 | 5 |
| Republic of Croatia* | | 546 |

* Territorial constitution with the situation as on 31st March 2001.

An important correction to the value of dwellings was done by calculating coefficients based on the year of construction. In the first version we used different legal documents to determine the net value of dwellings and some expert statements. The legal documents were prepared by civil engineers, who thought that depreciation rates depend on the vintage of the building. The rates of depreciation differ due to the quality of materials used for construction. But one could argue that even when you have higher quality of the material used in one decade you could have less efficient construction process in the same decade.

The quality of a dwelling is a function of material, construction process and many other factors which influences the value of expected capital services. We decided that after a period of 5 years the value of dwelling starts decreasing 1% percent per year. Net capital

stock for unknown year of construction and for incomplete dwelling is 50% of the value of the new dwelling (see table 3).

**Table 3. Coefficients for value adjustment – year of construction**

| Year of construction | Before 1919 | 1919-1945 | 1946-1960 | 1961-1970 | 1971-1980 | 1981-1990 | 1991-1995 | 1996 - 2001 | Unknown | Incomplete dwelling |
|---|---|---|---|---|---|---|---|---|---|---|
| *Share of vintage in total occupied dwellings* | *9.1%* | *7.3%* | *10.9%* | *20.1%* | *23.1%* | *17.2%* | *3.4%* | *5.0%* | *3.5%* | *0.4%* |
| *Share of vintage in total temporarily inhabited dwellings* | *11.6%* | *8.0%* | *9.3%* | *11.7%* | *14.2%* | *13.5%* | *3.5%* | *8.5%* | *19.6%* | *0.0%* |
| *Share of vintage in total dwellings for vacation* | *9.5%* | *2.5%* | *2.8%* | *4.8%* | *14.5%* | *19.2%* | *3.7%* | *4.6%* | *38.3%* | *0.0%* |
| Coefficients for year of construction | *0.1* | *0.46* | *0.5* | *0.65* | *0.75* | *0.85* | *0.85* | *1.0* | *0.5* | *0.5* |

Net value of square meter was adjusted with coefficients depending on whether it is a house or a flat. According to data obtained from property market; houses have a value 23% less than the value of a flat. In County of Zagreb a flat is just 6% more expensive than a house.

The last corrections were made for dwelling depending on the number of rooms. Coefficients are based on the values collected from property market. The problem is that this ratio of value on dwellings is calculated using the data on values asked by a seller, not on actual transaction data. CBS is still searching for a good data source which will give us transaction data on acquisitions of dwellings by at least basic features of dwellings. The tax administration is a good candidate.

**Table 4. Coefficients for value adjustment – number of rooms**

| 1 room | 2 rooms | 3 rooms | 4 rooms | 5 rooms | 6 rooms | 7 rooms | 8 and more |
|---|---|---|---|---|---|---|---|
| 1.08 | 1.01 | 1.05 | 1.08 | 1.03 | 0.86 | 0.84 | 0.88 |

Table 5 shows how average price changed (usually decreased) after different phases of the valuation of dwellings.

**Table 5: Adjustment of average price of $m^2$ after different coefficients; in kunas**

| | After coefficients from PPP | After demographic and geographical coefficients | After coefficients for year of construction |
|---|---|---|---|
| Average price of $m^2$ for **occupied dwellings** | **6 091** | **6 183** | **3 582** |

| | | | |
|---|---|---|---|
| *change in price after adjustment with coefficients* | *-7.7%* | *1.5%* | *-42.1%* |
| Average price of $m^2$ for **temporarily inhabited dwellings** | **5 113** | **5 062** | **3 074** |
| *change in price after adjustment with coefficients* | *-22.5%* | *-1.0%* | *-39.3%* |
| Average price of $m^2$ for **dwellings used for vocation** | **5 019** | **4 458** | **2 697** |
| *change in price after adjustment with coefficients* | *-24.0%* | *-11.2%* | *-39.5%* |
| Average price of $m^2$ for **other inhabited premises** | **3300** | **2 909** | **797** |
| *change in price after adjustment with coefficients* | *-50.0%* | *-11.8%* | *-72.6%* |

In the Census they did not collect data on surface area of collective dwellings and other inhabited premises and objects that are not dwellings by definition. Number of other inhabited premises and objects that are not dwellings by definition is multiplied with 10 (average size of this object is 10 $m^2$), and for the value this number is multiplied with half of the average price. The value of collective dwellings is also one of the weakest points of this simple model. We made the assumption that people living in collective dwellings (members of institutional households) use 75% of average surface area used by person living in private household for corresponding town/municipality. For other persons temporarily living in a collective dwelling we assumed they use 65% of the average used by private household for corresponding town/municipality. Then we multiplied that number for town/municipality with 75% of the average price.

Value of garages is obtained in a way that we assumed that 20% of all cars owned by natural persons have garages. This is the number equal to one fourth of number of one and two dwelling buildings. Another assumption is that garages have 10 $m^2$ surface areas and that the value of one $m^2$ is 5% of the value of dwelling.

From this Census we could not get data on sectors (we will try to get this data from next Census – 2011). Dwellings by ownership from Census 2001; natural persons 97% and 3% are owned by legal entities. The value of dwellings is increased by rate of net undercount from Post Enumeration Survey; 3.4 per cent for other settlements and 6.6 per cent for Zagreb.

**Perpetual inventory method for dwellings**

Value of dwelling stock is valuated at the date of Census, the beginning of the second quarter of 2001. To bring that value to the end of the same year, we took 75% of the amount of investment, retirement and consumption of fixed capital for 2001.

**Price indices** used in this simple formula are cut out for net capital price change end year (before the current year) to end of current year ($\frac{t_{XII}}{t-1_{XII}}$) and for consumption of fixed capital the price change from end of the year prior the current year to the average of the current year ($\frac{t_{\varnothing}}{t-1_{XII}}$).

Data for years after Census are based on the annual *Report on Completed Buildings and Dwellings* which covers total number of completed buildings and dwellings. The source of information for enumerator is a directory made up from the data on building permits issued for buildings.

Data source for value on retirements is a survey of construction department: data on dwellings excluded from the dwelling stock. This survey is also used for valuation of other changes in balance sheet; dwellings excluded from dwelling stock due to the conversion to non-residential facilities and the evaluation of war damage. The only value from this survey used for retirement is data on demolished dwellings. This value does not represent the whole value of dwellings which stopped being members of dwelling stock; it is not a substitute for mortality function. We can say that one part of retirement is in this number and the other part is incorporated in geometrical depreciation (see paragraph 7.4, OECD Measuring Capital).

Net value on dwellings is calculated by adding investment and subtracting consumption of fixed capital from the net value of the previous year:

$$NCS_t = NCS_{t-1} + GFCF_t - CFC_t .$$

NCS = net capital stock

GFCF = gross fixed capital formation

CFC = consumption of fixed capital

It is assumed by some construction engineers that the value of dwelling declines linearly in time, but only in case where there is enough maintenance works; major improvement every couple years and maintaining every year. Since this type of asset does not have a high

technical component which loses larger amounts in the initial period of service life, we concluded that obsolesce is not so important for dwellings. Hyperbolic decline (declines by larger amounts as the asset ages) is the choice of Croatian construction engineers, because as the end of the service life of dwellings approaches, the parts which are expensive are starting to stop functioning (installations, roof, etc.), and because of this the value (and efficiency) is vertically declining. Croatia does not have high values on improvement in the existing dwelling stock; most of the major improvements are done on houses which had been damaged during the war time. These are the reasons why we did not choose the linear function.

CBS at the end chose the geometrical function. It was the simplest way and as it is stated in paragraph 7.4 in OECD Manual Measuring Capital; we used geometric depreciation with depreciation factor (g) equal to 0.0113 (declining balance rate R is 0.91) and service life is 80 years. Average service life is calculated from shares of different vintages, at the level of county.

The Central Bureau of Statistics made one estimate of dwelling stock based on the Census 1991. Now we are trying to stress test our numbers by implementing our methodology on information from the Census 1991. Facts that are slowing us down include; coverage and methodology are not the same between censuses; territorial constitution has been changing considerably between the last two censuses. We wish to make an estimate of value on dwellings for the last two censuses (and in-between years). Back series for the years prior to the 2001 are calculated with the formulas mentioned above, that is we are calculating capital stock for 2000 from the data on capital stock in 2001 and all available information on flow transactions for 2000, until the 1995. The years between 1995 and the census year 1991 have a high inflation.

# 6. Conclusions

In this paper we tried to show what we achieved during this project. Objectives of the project were to create a cost/efficient methodology for compilations of fixed assets, to identify the main source statistics and special studies needed for actual compilations, to identify domains of the source statistics and special studies, which have to be developed in order to upgrade compilations of fixed assets, GFCF and CFC. Furthermore, the final results of the project are a sub system of national accounts, which is connected and used with compilation of national accounts, a database and documentation of the fixed assets' system in Croatian national accounts and upgraded figures for GFCF and CFC especially in the total economy's non-market sector which has a direct impact on the level and growth rate of GDP.

Currently we are "scanning" our surroundings, we are looking for all potential sources of information needed to create a database of all input data and a database which will be used for checking our data on flows and stocks and to expand our computations to encompass all fixed assets. Our impression is that the best way is to base this research primarily on data collected by other CBS departments (censuses, annual reports on investment and business statistics), then administrative data sources such as different registers (mostly on transport equipment), data sources on public infrastructure (roads, bridges, dams, etc), and other missing data from surveys or simply expert estimates.

At the end of our arduous task of creating stocks of residential capital for Croatia we can corroborate Hicks' famous quip that capital stock statistics is indeed one the nastiest job that economists have set to statisticians. However, a word of consolation: it is doable.

# References


Aulin-Ahmavaara, P. and Jalava, J. (2003): "Capital and its Productivity in Finland, 1975-2001", *Scandinavian Economic History Review* 50, 62-79.

Diewert, W.E. (2001): "Measuring the Price and Quantity as Capital Services Under Alternative Assumptions", Discussion Paper No. 01-24, Department of Economics, The University of British Columbia.

ESA95 (1996): *European System of Accounts*, Luxembourg: Eurostat.

Fraumeni, B.M. (1997): "The Measurement of Depreciation in the U.S. National Income and Product Accounts", *Survey of Current Business*, 7-23, July.

Goldsmith, R.W. (1951): *A Perpetual Inventory of National Wealth*, Studies in Income and Wealth XIV, New York: NBER.

Hill, T.P. (1999): "The Productive Capital Stock and the Quantity Index for Flows of Capital Services", paper presented at the meeting of the Canberra I group in Washington, D. C., November.

Katz, A.J. and Herman, S.W. (1997): "Improved Estimates of Fixed Reproducible Tangible Wealth, 1929-95", *Survey of Current Business*, 69-92, May.

Lock, J. D. (1985): "Measuring the Value of the Capital Stock by Direct Observations", *Review of Income and Wealth, Series 31, Number 2,* June 1985.

OECD (2001): *Measuring Capital: OECD Manual on Measurement of Capital Stocks, Consumption of Fixed Capital and Capital Services*, Paris: OECD.

SNA93 (1993): *System of National Accounts 1993*, Brussels/Luxembourg, New York, Paris, Washington, D.C.: UN, OECD, EU, IMF, World Bank.

Klisović, M. (1998): "Godišnji izvještaj o investicijama u dugotrajnu imovinu", *Metodološke upute 27; Državni zavod za statistiku,* 27, 1998.

Recommendations for the 2000 Censuses of Population and Housing in the ECE Region, Statistical Standards and Studies No. 49, *United Nations Economic Commission for Europe and Statistical Office of the European Communities;* New York, and Geneva; 1998.

Vinski, I. (1959): "The National Wealth of Yugoslavia at the end of 1953", The Measurement of National Wealth. Income and Wealth, Series VIII – 1959, Publication of the International Association for Research in Income and Wealth.

# Annex

**Figure A1. Share of net values of dwellings by counties, 2001**

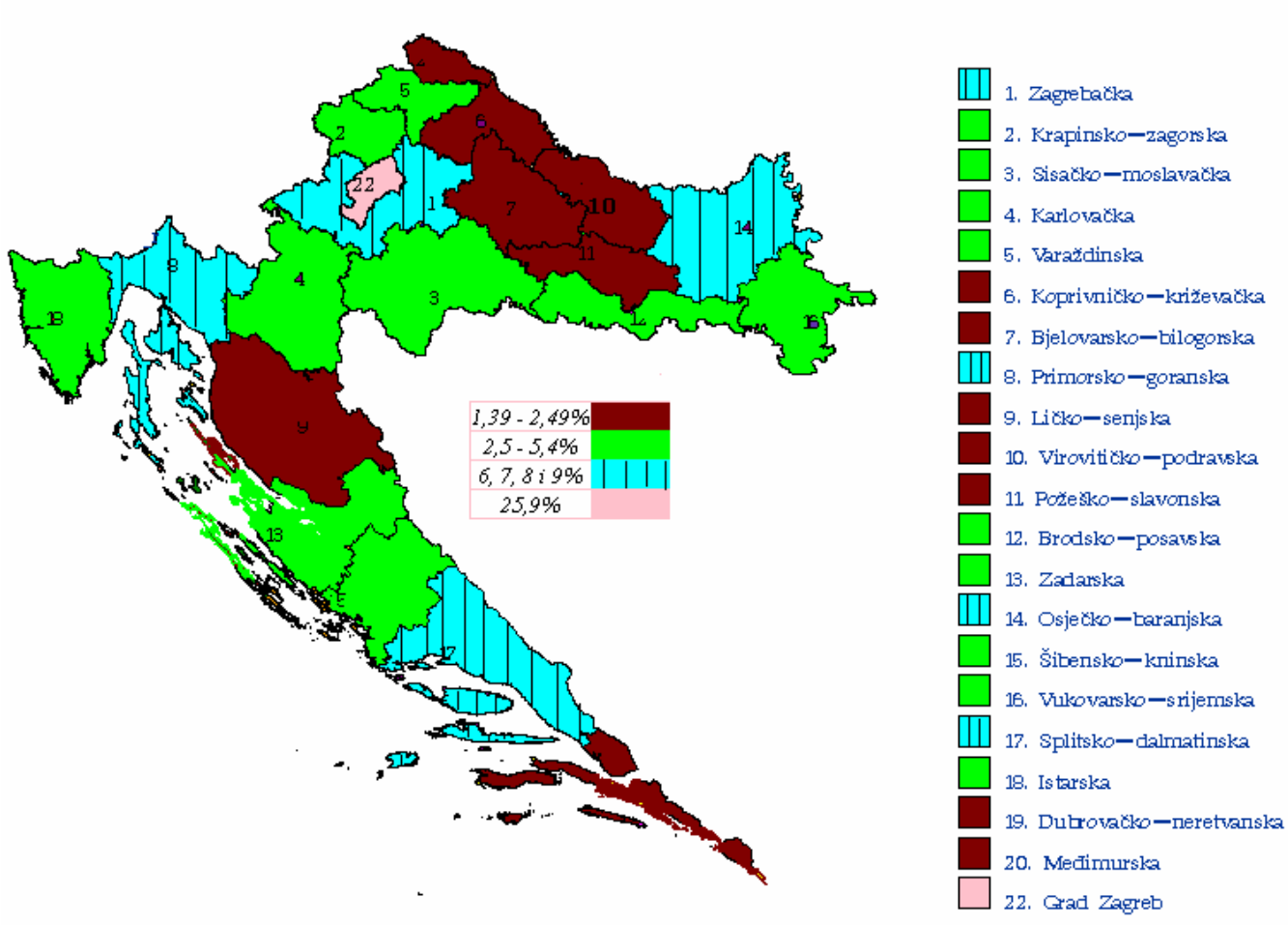
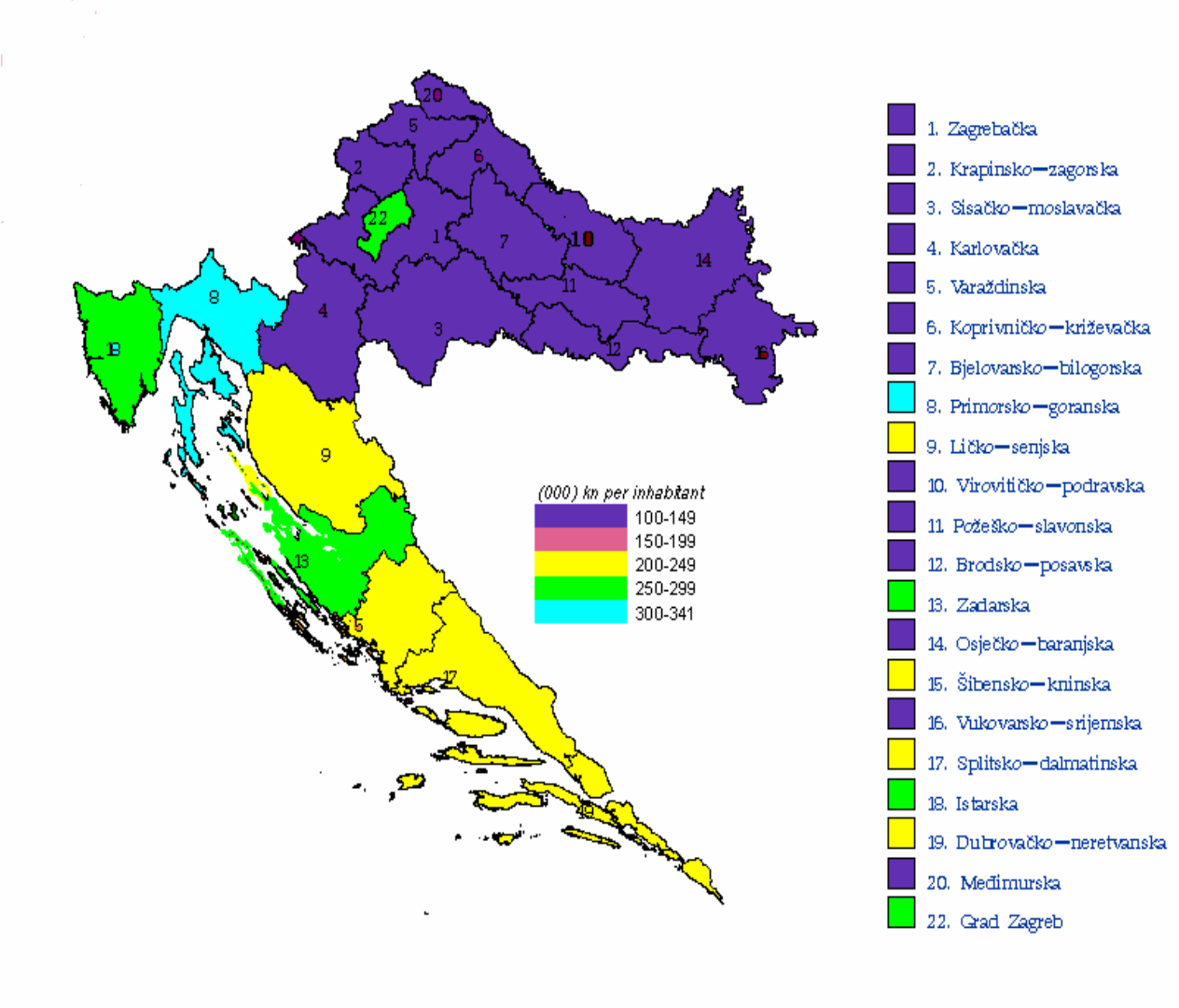


**Figure A2. Net value of dwelling per inhabitant, by counties, 2001**



## Table A1. Housing units by counties, Census 2001

| | Total number of occupied dwellings | Occupied dwellings with combination of the following: | | | | | |
|---|---|---|---|---|---|---|---|
| | | dwellings with central heating | kitchen, toilet and bathroom | kitchen and toilet | kitchen only | other combinations of auxiliary facilities | without kitchen, bathroom and toilet |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The Republic of Croatia | 1 421 623 | 514 386 | 1 229 976 | 27 900 | 123 098 | 35 695 | 4 954 |
| County of Zagreb | 91 376 | 45 155 | 78 152 | 2 189 | 9 250 | 1 347 | 438 |
| County of Krapina-Zagorje | 42 402 | 16 129 | 32 242 | 1 234 | 7 890 | 669 | 367 |
| County of Sisak-Moslavina | 60 541 | 15 565 | 48 673 | 3 028 | 7 229 | 1 256 | 355 |
| County of Karlovac | 47 839 | 16 985 | 38 694 | 2 562 | 5 529 | 761 | 293 |
| County of Varaždin | 53 852 | 27 077 | 43 586 | 635 | 7 431 | 1 940 | 260 |
| County of Koprivnica-Križevci | 38 215 | 10 426 | 27 162 | 522 | 7 140 | 3 134 | 257 |
| County of Bjelovar-Bilogora | 43 091 | 10 176 | 29 500 | 723 | 9 247 | 3 442 | 179 |
| County of Primorje-Gorski kotar | 108 662 | 29 706 | 102 447 | 2 317 | 2 275 | 1 519 | 104 |
| County of Lika-Senj | 19 072 | 2 443 | 14 336 | 1 902 | 2 485 | 276 | 73 |
| County of Virovitica-Podravina | 30 372 | 5 010 | 21 243 | 281 | 6 467 | 2 290 | 91 |
| County of Požega-Slavonia | 25 975 | 7 907 | 20 113 | 302 | 4 483 | 980 | 97 |
| County of Slavonski Brod-Posavina | 52 178 | 15 401 | 40 570 | 811 | 8 815 | 1 717 | 265 |
| County of Zadar | 50 622 | 6 490 | 46 278 | 1 104 | 2 376 | 773 | 91 |
| County of Osijek-Baranja | 107 987 | 34 655 | 88 641 | 1 098 | 13 924 | 4 030 | 294 |
| County of Šibenik-Knin | 38 467 | 4 055 | 32 832 | 1 129 | 3 744 | 620 | 142 |
| County of Vukovar-Sirmium | 59 147 | 14 622 | 49 430 | 776 | 7 267 | 1 519 | 155 |
| County of Split-Dalmatia | 138 491 | 18 360 | 126 737 | 2 489 | 6 856 | 2 176 | 233 |
| County of Istria | 70 562 | 18 252 | 66 029 | 970 | 2 468 | 1 007 | 88 |
| County of Dubrovnik-Neretva | 37 346 | 4 431 | 34 983 | 677 | 1 116 | 521 | 49 |
| County of Međimurje | 34 243 | 19 439 | 28 906 | 301 | 3 621 | 1 127 | 288 |
| City of Zagreb | 271 183 | 192 102 | 259 422 | 2 850 | 3 485 | 4 591 | 835 |

(continued)

| | Number of dwellings/housing units | | | | | |
|---|---|---|---|---|---|---|
| | temporarily inhabited dwellings | swellings for vacation and recreation | dwellings used in the season of agricultural activities | dwellings only for performing an activity | other inhabited premises and objects that are not dwellings by definition | collective dwellings |
| | 8 | 9 | 10 | 11 | 12 | 13 |
| The Republic of Croatia | 196 633 | 182 513 | 8 418 | 25 546 | 2 812 | 929 |
| County of Zagreb | 9 342 | 16 528 | 841 | 201 | 91 | 38 |
| County of Krapina-Zagorje | 4 216 | 9 916 | 333 | 66 | 28 | 21 |
| County of Sisak-Moslavina | 12 941 | 4 900 | 876 | 147 | 197 | 22 |
| County of Karlovac | 7 399 | 4 691 | 166 | 222 | 110 | 29 |
| County of Varaždin | 4 576 | 5 055 | 1 565 | 131 | 71 | 28 |
| County of Koprivnica-Križevci | 3 998 | 4 668 | 1 654 | 67 | 60 | 18 |
| County of Bjelovar-Bilogora | 5 891 | 3 239 | 322 | 107 | 49 | 13 |
| County of Primorje-Gorski kotar | 14 816 | 28 271 | 148 | 5 460 | 532 | 111 |
| County of Lika-Senj | 5 927 | 7 096 | 114 | 972 | 57 | 5 |
| County of Virovitica-Podravina | 4 189 | 581 | 102 | 44 | 47 | 8 |
| County of Požega-Slavonia | 3 934 | 414 | 38 | 52 | 31 | 18 |
| County of Slavonski Brod-Posavina | 5 753 | 1 175 | 19 | 96 | 108 | 14 |
| County of Zadar | 10 851 | 25 305 | 180 | 2 755 | 66 | 33 |
| County of Osijek-Baranja | 13 912 | 5 340 | 115 | 352 | 87 | 41 |
| County of Šibenik-Knin | 7 633 | 14 468 | 524 | 1 956 | 87 | 30 |
| County of Vukovar-Sirmium | 7 952 | 938 | 249 | 73 | 190 | 15 |
| County of Split-Dalmatia | 20 968 | 22 498 | 645 | 4 949 | 221 | 129 |
| County of Istria | 11 858 | 14 696 | 148 | 3 062 | 135 | 47 |
| County of Dubrovnik-Neretva | 6 226 | 5 559 | 243 | 967 | 88 | 58 |
| County of Međimurje | 2 967 | 2 332 | 35 | 72 | 171 | 16 |
| City of Zagreb | 31 284 | 4 843 | 101 | 3 795 | 386 | 235 |

**Table A2. Net capital stock, gross fixed capital formation and consumption of fixed capital by counties, 2001 and 2002**

Thousand kuna

| | $NCS_{2001}$ | $GFCF_{2002}$ | $CFC_{2002}$ | $NCS_{2002}$ | Share of net values of dwellings by counties, $NCS_{2001}$ |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| The Republic of Croatia | 474 591 334 | 7 879 343 | 5 804 929 | 539 824 036 | 100.0% |
| County of Zagreb | 34 051 021 | 775 721 | 438 975 | 40 772 017 | 7.2% |
| County of Krapina-Zagorje | 11 928 950 | 135 853 | 149 118 | 13 790 874 | 2.5% |
| County of Sisak-Moslavina | 16 789 946 | 504 009 | 210 855 | 19 648 135 | 3.5% |
| County of Karlovac | 12 482 680 | 252 354 | 160 310 | 14 875 646 | 2.6% |
| County of Varaždin | 15 974 884 | 212 026 | 202 519 | 18 740 491 | 3.4% |
| County of Koprivnica-Križevci | 10 758 996 | 104 829 | 134 329 | 12 414 192 | 2.3% |
| County of Bjelovar-Bilogora | 11 566 111 | 163 413 | 143 290 | 13 265 689 | 2.4% |
| County of Primorje-Gorski kotar | 37 766 470 | 794 601 | 474 925 | 44 093 799 | 8.0% |
| County of Lika-Senj | 6 038 570 | 173 442 | 78 734 | 7 329 622 | 1.3% |
| County of Virovitica-Podravina | 7 180 169 | 77 048 | 87 041 | 8 042 939 | 1.5% |
| County of Požega-Slavonia | 6 610 874 | 255 975 | 82 260 | 7 691 171 | 1.4% |
| County of Slavonski Brod-Posavina | 12 858 659 | 368 894 | 157 210 | 14 646 006 | 2.7% |
| County of Zadar | 20 778 619 | 354 727 | 256 697 | 23 798 152 | 4.4% |
| County of Osijek-Baranja | 28 452 856 | 581 209 | 352 188 | 32 687 423 | 6.0% |
| County of Šibenik-Knin | 12 260 140 | 353 560 | 155 285 | 14 461 789 | 2.6% |
| County of Vukovar-Sirmium | 15 063 751 | 976 784 | 189 129 | 17 862 086 | 3.2% |
| County of Split-Dalmatia | 43 702 246 | 620 152 | 540 630 | 50 058 141 | 9.2% |
| County of Istria | 25 623 404 | 610 963 | 324 462 | 30 156 322 | 5.4% |
| County of Dubrovnik-Neretva | 11 357 852 | 361 417 | 143 540 | 13 383 324 | 2.4% |
| County of Međimurje | 10 375 019 | 16 447 | 127 883 | 11 779 538 | 2.2% |
| City of Zagreb | 122 970 117 | 185 917 | 1 395 550 | 130 326 680 | 25.9% |