

AN ATTEMPT TO ASSESS PRICE ELASTICITY OF DEMAND FOR PINE WOOD ON THE PRIMARY WOOD MARKET IN THE BYTNICA FOREST DIVISION IN THE YEARS 1997-2005*

Krzysztof Adamowicz, Artur Dyrzc

Poznań University of Life Sciences

Abstract. The study presents information on changes in the demand for wood on the primary wood market in the years 1997-2005. Results of analyses are presented together with an assessment of the relationship between changes in demand and changes in prices for wood assortments. The paper also discusses results of investigations concerning an analysis of sales of pine round wood, taking into consideration the analysis of price elasticity of demand. The study was also an attempt to present current problems connected with timber market.

Key words: forest economics, wood market, price elasticity of demand

INTRODUCTION

Forest economy in most European countries has been struggling for the last 30 years with increasing economic problems, observed with highest intensity in the last 15 years, resulting from stagnation or even a drop of wood prices, which is the consequence of the open wood market and a simultaneous increase of outlays incurred by forest economy to realize environment-forming and social functions of forests.

An increase in social welfare resulting from the non-production functions of forests is not reflected in the market wood prices or in the GDP (the share of forestry in gross domestic product in 2000 was 0.23% [statistical yearbook "Rocznik Statystyczny RP" 2001], for comparison the share of forestry in GDP in the last 40 years of the 20th century in West Germany decreased from 0.35 to 0.08%), while the separation of public services in the activity of forest economy and keeping separate financial and book records may have contributed to a change in this situation [Klocek 2003].

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It should be stressed that the model of Polish forest economy differs from the other solutions adopted in Europe. The main wood supplier on the Polish market is the State Forests National Forest Holding, which apart from purely commercial activity is also involved in several activities of ecological character. This situation results in some decisions undertaken in the management process being based on aspects other than economic. Additionally, almost all statutory goals to be realized in forest economy are financed from the production and sale of wood assortments. Sale of wood harvested in the State Forests is thus the primary source of its revenue. The percentage of income from wood sales in the total revenue of the State Forests is approx. 81%, which confirms their fundamental importance for the functioning of forest economy in the State Forests. In this situation and, at the same time, in view of the fact that approx. 94% wood harvested in Poland is under the administration of the State Forests, the policy of wood sales has a tremendous effect on economic and financial results of both the State Forests and conversion industry [MGPiPS 2003].

The concept of a monopoly or oligopoly, known from general economics, refers to a market situation in which there is only one or several big producers of specific goods or service supplier(-s). These forms of a market structure obviously differ from perfect competition, where there is a large number of small competing economic entities. The specific character of economic entities participating in the exchange of goods or services on each market have an effect on the functioning of market mechanisms, such as demand, supply and market equilibrium price [Adamowicz 2006]. The wood market is unique in character, since supply of this natural resource is strictly limited by the requirements of appropriate silviculture practice in forests, the volume of supply is to a relatively small degree determined by supply, which is a characteristic feature of the timber market. In Poland on the supply side of the timber market we have the dominating state producer, while demand is represented by a numerous group of buyers from several sectors, thus this situation limits the effect of the market mechanism on the timber market and leads to many negative consequences in branches of economy highly dependent on timber.

In the State Forests, in the period 1985-2004, yield potential in final cutting was utilized in 88.1%. In turn, the utilization of advance felling, estimated in cutting plans, was 123.8% and ranged from 102.7% in 1990 to 182.4% in 1985 [Raport roczny... 2004]. Higher than the expected utilization of advance cutting in relation to estimated guidelines for forest management plans did not result from the requirements of the market, but rather the necessity to remove dead standing wood, windbreaks and windfalls, resulting from natural processes as a consequence of pest gradations, natural disasters, disturbed water relations, air pollution and weather anomalies [Adamowicz 2007].

Due to the necessary adaptation of the wood market to the reality of the free-market economy, developing in Poland, the authors of this study are of the opinion that the indispensable element of this process consists in econometric analyses presenting the current status of the timber market, thus facilitating the determination of appropriate directions for market changes. In this study the authors attempted to assess the elasticity of demand for pine wood. The study was based on source materials from the Bytnica Forest Division, collected in the years 1997-2005.

METHODOLOGY

Price elasticity of demand for individual wood assortments was defined on the basis of a ratio of relative change in the volume of demand for specific goods to a relative change in its price.

where:

$E_{d(p)}$ – price elasticity of demand,

$\frac{\Delta Q_d}{Q_d}$

– a change (expressed in per cent) in announced demand for specific goods expressed in pieces,

$\frac{\Delta p}{p}$

– a change in the price, expressed in per cent.

Since the demand curve has a negative slope, we divide the positive percentage change in the quantity or amount (an increase of demand) by the negative percentage change in the price (a decrease of the price) or the negative percentage change in the quantity or amount (a decrease of demand) by the positive percentage change in the price (an increase of the price). Price elasticity of demand is thus a change taking place in the negative demand curve. As a consequence of this fact, the result obviously has to be a negative number. However, in case of paradoxes, such as e.g. the Giffen or Veblen paradoxes, it may be very different.

In case when $E_{d(p)}$ reaches high negative values demand is elastic, and the more negative the number, the more elastic the demand, and thus the more sensitive it is to a price change. When $E_{d(p)}$ is expressed by a small negative number, demand is relatively only slightly affected by a change in the price*. If the demand line is a straight line, elasticity of demand will decrease as we move down along the line. Only in two special cases this statement is erroneous. The first case is the function of perfectly elastic demand, assuming the shape of a horizontal straight line. It results from the fact that the price does not change and the demand does (elasticity = $-\infty$). The other case is the function of completely inelastic demand, assuming the form of a vertical straight line, since the price changes, but the demand does not (elasticity = 0).

However, usually price elasticity changes, since the demand function takes the form of a curve. This results in a situation when at different price levels the price elasticity of demand varies [Begg et al. 2003]. In case of timber assortments the shape of the curve illustrating this phenomenon may be disturbed.

In microeconomics, depending on the obtained results, the following types of price elasticity of demand may be distinguished:

* The terms “large” or “small value” refer to absolute values. In the mathematical sense obviously the relation e.g. $-2 < -1$ holds true. However, when we talk of a smaller negative value at the adopted methodology we need to also take into consideration the relation $|-2| > |-1|$.

- $E_{d(p)} = -\infty$ – perfectly elastic demand,
 $E_{d(p)} > -1$ – elastic demand,
 $E_{d(p)} = -1$ – unit elasticity,
 $E_{d(p)} < -1$ – inelastic demand,
 $E_{d(p)} = 0$ – fixed demand.

It needs to be remembered that the coefficient of price elasticity of demand informs us on the volume of consumer response to changing prices of goods. Depending on the existing market situation, it may be as follows:

- high elasticity ($E_{d(p)} > 1$) – a change of demand is bigger than the change of the price,
- unit elasticity ($E_{d(p)} = 1$) – a change of demand is proportional to the change of the price,
- low elasticity ($E_{d(p)} < 1$) – a change of demand is smaller than the change of the price.

RESULTS

In the years 1997-2005 in the analyzed forest division over 503 000 m³ pine wood were harvested and allocated for sale. The biggest sales in terms of the volume of pine assortments were recorded for middle-sized wood (S). In the investigated period the sales of this quality group amounted to 320 591.5 m³, which constituted 63.7% total harvested volume of pine wood. It needs to be stressed that large-sized wood grade A (WA) was sold in the amount of 3 489.49 m³, which constituted less than 0.7% (Fig. 1).

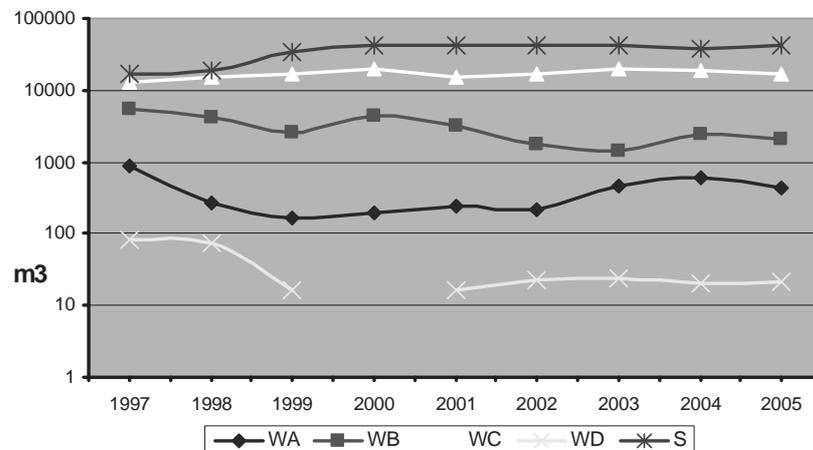


Fig. 1. Sales of pine wood by the Bytnica Forest Division in the years 1997-2005 depending on assortments [Gierat and Kowalczyk 2007]

Rys. 1. Sprzedaż drewna sosnowego przez Nadleśnictwo Bytnica w latach 1997-2005 [Gierat i Kowalczyk 2007]

In the years 1997-2005 the smallest sales of pine assortments were observed for large-sized wood grade D (WD). During the analysed period the volume of sales did not exceed 300 m³, while the annual sale of WD timber ranged from around a dozen to several dozen m³, whereas in 2000 this assortment was not sold.

It should be pointed out that in the investigated period the volume of assortments purchased on the primary wood market in the Bytnica Forest Division increased and decreased, marking certain short-term business cycles. When analyzing figures (Figs 1 and 2) we may observe a lack of synchronization of changes between individual assortments. Relative changes in the harvested volume for individual pine assortments in the Bytnica Forest Division in the years 1997-2005 are presented in Figure 2.

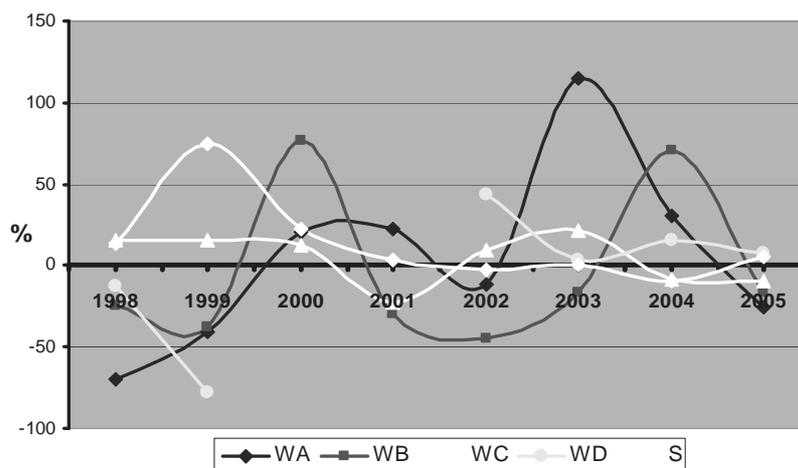


Fig. 2. Relative changes in volume of harvested wood in the Bytnica Forest Division in the years 1997-2005 [Gierat and Kowalczyk 2007]

Rys. 2. Względna zmiana miąższości pozyskiwanego drewna w Nadleśnictwie Bytnica w latach 1997-2005 [Gierat i Kowalczyk 2007]

When analyzing financial records concerning the sales of wood it was found that prices for individual pine assortments changed. Based on an analysis of prices at the beginning of the period of the study (1997) and the end of the study (2005) we may state that the prices for pine assortments, except for that of assortment WB, increased. For the group of large-sized assortments grades C and D in 2005 it reached the maximum value. It needs to be stressed that up to 2002 the price of assortment WB exceeded that of assortment WA, superior in terms of quality. This is an economic paradox, in which specific goods of higher quality, and thus higher value, on the market are sold at a lower price than goods of lower quality. Undoubtedly this problem requires further studies aiming at an explanation of this phenomenon (Fig. 3).

In the years 1997-2005 for pine assortment WA four periods were recorded, in which demand was elastic in relation to the price. In the years 2001, 2003 and 2005 an increase of the price resulted in reduced response to purchased assortment WA, while in 1999 the price was observed to decrease and demand for this timber increased (Fig. 4). Demand was highly elastic in 1999, 2001 and 2003, when elasticity of demand reached

high negative values of -4.94 , -9.01 and -21.76 , respectively. In 2005 demand was less elastic, as the recorded value was -1.36 .

In 1998 a decrease in the price for assortment WA led to the simultaneous reduction of demand for this assortment, while in the years 2000, 2002 and 2004 an increase in demand was simultaneous with an increase in the price. In the investigated period the phenomenon of inelasticity of demand was not observed.

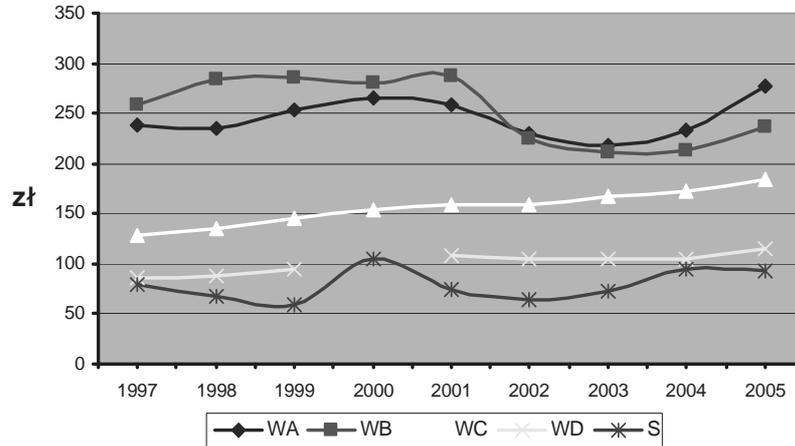


Fig. 3. Mean annual sale price of volume of pine assortments in the years 1997-2005 in the Bytnica Forest Division [Gierat and Kowalczyk 2007]

Rys. 3. Średnia roczna ocena sprzedaży miąższości sortymentów sosnowych w latach 1997-2005 w Nadleśnictwie Bytnica [Gierat i Kowalczyk 2007]

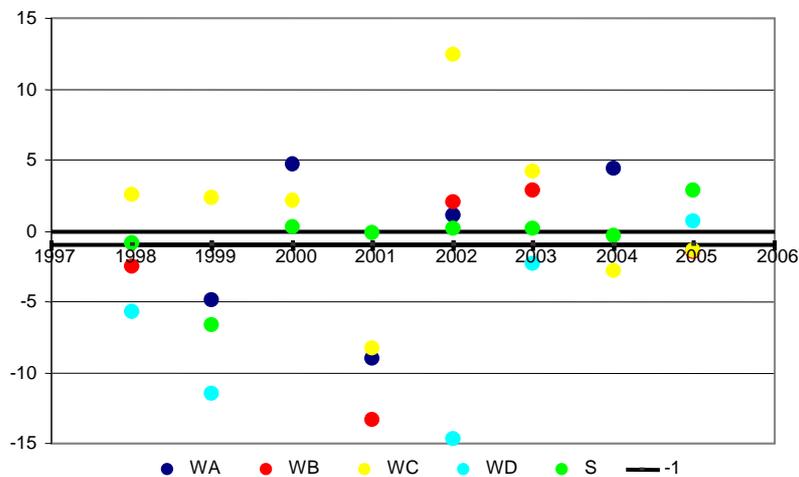


Fig. 4. Values of price elasticity of demand for sales of pine wood in the years 1997-2005 for the Bytnica Forest Division

Rys. 4. Średnia roczna ocena sprzedaży miąższości sortymentów sosnowych w latach 1997-2005 w Nadleśnictwie Bytnica

Demand for assortment WB was elastic as many as 5 times in the course of the years of the study, i.e. in 1998, 1999, 2001 and 2005 elasticity was caused by increased sales of this assortment and a simultaneous decrease of the price, in 2000 elasticity was connected with an increase in the price and reduced interest in the purchase of this assortment. In 2002 the price and sold volume decreased simultaneously, while in 2003 and 2004 higher sales were connected with an increase in the price, thus leading to a paradox.

For pine assortment WC the highest incidence rate of the above mentioned phenomenon was recorded. An increase in the price with a simultaneous increase in the demand for this assortment was observed throughout the entire analysed period, apart from 2001 and 2004, when demand was elastic and caused by a decrease in the price and an increase of sales.

As a result of conducted analyses we may state that these processes occurred 4 times for assortments S and 2 times for timber WD. No inelasticity of demand was recorded for timber WD, while demand for timber S in 1998, 2001 and 2004 was inelastic, in 1998 it was characterized by low inelasticity, with the recorded value of -0.83 , and in 2001 and 2004 it was inelastic, with calculated values of -0.13 and -0.32 , respectively.

When investigating price elasticity of demand in individual years it was shown that special years in terms of the simultaneous increase in the price and demand for timber were: 2000, with a simultaneous increase of the price and demand in the group of assortments WA, WC and S; in 2003 there was an increase in the price and demand in the group of assortments WB, WC and S, while in 2002 a simultaneous increase was recorded in the price and demand for assortments WA, WB, WC and S.

CONCLUDING REMARKS

At present the main problem in the process of timber sales in Poland seems to be a disturbed freedom of market mechanisms. The wood market is characterized by slight elasticity, which results in a situation when there is a real problem with adjusting supply to demand at a rapid boom in the wood market. On normally operating markets, in accordance with the logic of market economy, the factor determining demand for timber is demand for wood products, which in turn affects the level of forest production [Ratajczak 2001]. A practice commonly applied by the administrative units of the State Forests National Forest Holding, disadvantageous from the point of view of economics, is the procedure of dividing a 10-year prescribed yield* into equal wood quotas to be sold in individual years. This enhances the negative phenomenon of limiting elasticity on this market [Adamowicz 2007].

In the analysed period, based on relative changes in sales of wood (Fig. 2) it was found that the volume of harvested assortments increased and decreased considerably. However, when analysing data concerning actual changes in the volume (Fig. 1) the authors arrived at a conclusion that despite large relative changes in individual assortment groups the total sale volume remained similar. These results suggest a hypothesis

* Prescribed yield – periodical volume of felling in ha or m³ commercial volume (also given in both units at the same time), defined for a working circle or complex, administrative unit (forest division), based on data from the forest management plan [Podgórski et al. 2001]. The yield is defined for the period of 10 years.

that business changes are adapted rather to the harvest plans resulting from prescribed yields constituting 1/10 of a 10-year plan, and not to market needs. However, this statement requires further studies on the economic evaluation of business cycle market changes.

When analyzing mean prices for wood paid on the primary wood market changes were recorded for all assortments (Fig. 3). An increase in the price was not always accompanied by a decrease in demand, which would correspond to the neoclassic definition of demand. Moreover, an increase of demand with an increase in the price – and vice versa – were also observed (Figs 1 and 3). In market economy it constitutes an obvious paradox, which was confirmed by the results concerning price elasticity of demand. In 17 cases the volume of price elasticity of demand reached a level exceeding unit elasticity (Fig. 4). In these cases it shows a slight effect of the price on demand. On this basis we may state that the price for analyzed wood assortments in the investigated period was not in all the years of the study adapted to the current state of the wood market, created by the forest division and buyers.

Based on the investigations it may be concluded that marketing activities connected with timber trade should rely first of all on the analysis of the wood market and market data, facilitating forecasts of future economic fluctuations on the wood market and adaptation of harvested volume to the needs of this market, and not to the quota defined in advance and connected with the prescribed yields. It is obvious that in view of concerns for the sustainability of forest resources in Poland it would be a mistake not to plan harvests resulting from silvicultural and ecological goals of forest economy. The problem seems to lie in the annual planning of harvesting, based on the mechanical division of the 10-year prescribed yield into annual quotas. Planning of harvested volumes should be characterized by considerable elasticity connected with the requirements of the market. Freely acting mechanisms of demand and supply would define the market equilibrium price and the incidence of market paradoxes would be limited to the minimum or completely eliminated. This situation would undoubtedly be accompanied by a clear and transparent situation on the wood market.

REFERENCES

- Adamowicz K., 2006. Próba charakterystyki rynku drzewnego w Polsce w kontekście ekorozwoju obszarów wiejskich [An attempt to characterize wood market in Poland in view of sustainable development of rural areas]. *Rocz. Nauk. Stow. Ekon. Roln. Agrob. Book 2*, 11-15 [in Polish].
- Adamowicz K., 2007. Rola polityki agrarnej w rozwoju leśnictwa [The role of agrarian policy in the development of forestry]. In: *Quo vadis forestry?* Ed. Z. Sierota. Wyd. IBL Warszawa: 86-93 [in Polish].
- Begg D., Fischer S., Dornbusch R., 1998. *Ekonomia [Economics]*. Wyd. PWN Warszawa [in Polish].
- Gierat Ł., Kowalczyk M., 2007. Próba oceny pierwotnego rynku drzewnego Nadleśnictwa Bytnica i Lubsko w kontekście zmian miąższościowo-cenowych w latach 1997-2005 [An attempt to assess primary wood market for the Bytnica and Lubsko Forest Divisions in terms of volume and price changes in the years 1997-2005]. [Manuscript; in Polish].
- Klocek A., 2003. *Ekonomiczne aspekty leśnictwa w krajach Unii Europejskiej i w Polsce [Economic aspects of forestry in European Union member countries and in Poland]*. *Sylwan 1* [in Polish].

- Strategia dla przemysłu drzewnego do 2006 roku [Strategy for wood industry to the year 2006]. 2003. Minist. Gosp. Pracy Polit. Społ. Warszawa [www.mg.gov.pl; in Polish].
- Państwowe Gospodarstwo Leśne Lasy Państwowe. Raport roczny 2004 [The State Forests National Forest Holding. Annual report 2004]. [www.lp.gov.pl/media/biblioteka/raporty; in Polish].
- Podgórski M., Beker C., Biczkowski Z., Najgrakowski T., Turski M., 2001. Podstawy wyceny lasów [Principles of forest pricing]. Wyd. ZCO Zielona Góra [in Polish].
- Ratajczak E., 2001. Rynek drzewny. Analiza struktur przedmiotowych [The wood market. Analysis of subject structures]. Wyd. ITD Poznań [in Polish].
- Rocznik Statystyczny Rzeczypospolitej Polskiej 2001. [Statistical yearbook of the Republic of Poland 2001]. GUS Warszawa [in Polish].

PRÓBA OCENY ELASTYCZNOŚCI CENOWEJ POPYTU NA DREWNO SOSNOWE NA PIERWOTNYM RYNKU DRZEWNYM W NADLEŚNICTWIE BYTNICA W LATACH 1997-2005

Streszczenie. Praca zawiera informacje na temat sprzedaży drewna na pierwotnym rynku drzewnym Nadleśnictwa Bytnica. Wykonano szczegółową analizę sprzedaży drewna sosnowego w ujęciu miąższościowym i cenowym. Na podstawie wyników badań stwierdzono dynamikę zmian procesu sprzedaży drewna sosnowego. W badanym okresie wykazano, na podstawie względnych zmian sprzedaży drewna, że wzrastała i malała miąższość pozyskiwanych sortymentów drzewnych. Analizując dane dotyczące rzeczywistej zmiany miąższości, autorzy doszli do wniosku, iż ogólna sprzedaż jest utrzymywana na podobnym poziomie, mimo dużych względnych zmian w poszczególnych grupach sortymentowych. Analizując średnie ceny drewna uzyskiwane na pierwotnym rynku drzewnym, stwierdzono ich zmiany dla wszystkich sortymentów sosnowych. Wzrostowi cen nie zawsze towarzyszyło zmniejszenie zapotrzebowania, co odpowiadałoby neoklasycznej definicji popytu. Zaobserwowano również zjawisko zwiększenia zapotrzebowania wraz ze wzrostem ceny i odwrotnie. Na podstawie wykonanych badań autorzy doszli do wniosku, że cena na rozpatrywane sortymenty drzewne w badanym okresie nie była dostosowana we wszystkich latach do aktualnego stanu rynku drewna kreowanego przez nadleśnictwo i odbiorców.

Słowa kluczowe: ekonomika leśnictwa, rynek drzewny, cenowa elastyczność popytu

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