• *Gergely Csorba* •

EMPIRICAL INDUSTRIAL ORGANIZATION IN HUNGARY: A SURVEY OF RESEARCH AND APPLICATIONS*

This paper surveys Hungarian applications of Empirical Industrial Organization. The articles and methods are grouped primarily based on the complexity of the data used, starting with the simplest. The paper also discusses how the results can be applied in the main areas of competition policy and economic regulation, in supporting analyses of market definitions, and in evaluating market power and the effects of market behaviour.

INTRODUCTION

This paper surveys the Hungarian literature in the area of Empirical Industrial Organisation (empirical IO for short), focusing especially on the possible practical applications of the results. In this case, "Hungarian" means that I present articles analysing Hungarian markets; in practice this also means that I only survey papers written by Hungarian authors.[1] These articles use empirical IO methods to varying degrees, and this is represented in my discussion of them.

A paper is considered to fall under the cateogry of empirical IO if it not only describes a market using basic statistics, but also aims to test hypotheses, based on economic models, analysing the relationships between various variables (usually, but not always via regression analysis). It is of course not possible to exactly define the boundaries of empirical IO; based on their broader topics and methods, there are many papers that would fit the bill in labour economics (for example, *Brown et al.* [2006]), agricultural economics (e.g. *Fertő* [2009]), economic geography (e.g. *Békés and Harasztosi* [2013]) or the economics of international trade (e.g. *Békés and*

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[1] For empirical IO papers by Hungarian authors regarding non-Hungarian markets, see for example Paizs [2009] and *Koltay* [2012*a*]. I currently have no knowledge of exclusively non-Hungarian authors focusing on a Hungarian market.

Muraközy [2012]). However, these papers are not traditionally classified as empirical IO, and are therefore not discussed in this survey.

Empirical IO papers aim to reveal the relationships governing market behaviour, using empirical methods within an economic framework. They can thereby confirm or refute either various hypotheses arising in everyday or regulatory thinking, or the results of theoretical models. It is important to note, however, that the method employed by the analyst will always remain arbitrary to some extent, and will rely on simplifying assumptions and the choice of theoretical model, which can influence the results. It is impossible, even in theory, to find a universally applicable method or functional form to test; these must always be determined by the available data and the trends apparent in it, as well as the research questions. And finally, we can only trust the robustness of the results (and we can never be 100 per cent sure), if as many methods as possible point to the same conclusion.

There can be several practical applications of the results of empirical IO, in the fields of competition policy and economic regulation among others. These applications typically concern one or more of the following three main questions.

1. *Relevant market definition:* the analysis of substitutability between potentially competing products and thereby the definition of the (product or geographical) market within which firms exert effective competitive pressure on each other.
2. *Evaluation of market power:* the analysis of whether a given firm is able to maintain a price that is above the assumed (so-called effective) competitive price level.
3. *Evaluation of the effects of market behaviour:* the analysis of how the behaviour (for example, an agreement or merger) of certain firms affected or is expected to affect market outcomes, competitors and consumers.

There are serious microeconomic considerations behind each of these – both theoretically and practically – relevant questions, which are however outside the scope of this survey.[2]

The following chapter provides a short, methodological and historical review of empirical IO in general. Then, I survey empirical papers based on the kind of data they use, starting with the simplest.[3] I do this firstly because the available data greatly influences the type and depth of the research questions that can be answered, and secondly because the structure of the data essentially provides a grouping of the applicable empirical methods as well.

[2] For further details and references, I recommend *Bishop and Walker's* [2010] book, which comprehensively discusses the theoretical background, the suitable empirical methods and several competition policy applications related to these topics.

[3] From a historical perspective, the models could be presented starting from demand estimation, however, in practice the quality of the data is key; and it is especially important to establish the limitations of the simpler methods as soon as possible.

1. *Analyses based on price data only:* price data is the easiest to access, as it is often publicly available or accessible from statistical databases (like the Central Statistical Office, KSH). The papers usually apply time series analyses. It is rare that these methods alone lead to conclusive results, but they can provide useful illustrative evidence for questions relating to market definition or market power.
2. *Analyses based on price data and simple statistical indicators:* price data can be complemented with data concerning the number of firms on the market or other aggregate concentration measures, sometimes even from publicly available sources.[4] These analyses typically use reduced form cross-sectional or panel estimation methods. It is both an advantage and a disadvantage of such methods that they examine the relationship between market performance and market structure directly, without deriving it from an underlying economic model in a strict sense. These analyses typically concern market power, and especially the evaluation of market behaviour.
3. *Analyses based on price data and detailed quantity data:* data on demand or costs is in most cases only available from firms or public institutions, therefore it is rarely used for research purposes only. If such data is available, a multitude of regression estimation methods can be used, including structural models. These methods typically make it possible to build theoretically grounded models based on empirical observations, or at least test hypotheses related to them. They can be used to analyse all three types of questions.

I will be very brief in introducing the theoretical models and econometric expressions and methods used in the surveyed papers. The interested reader will find the detailed descriptions in the referenced papers themselves.

A HISTORICAL REVIEW OF EMPIRICAL INDUSTRIAL ORGANISATION

Empirical IO aims to analyse the S*tructure-Conduct-Performance* (the so-called *SCP*) paradigm. Research in this field, which began in the 1950s, initially took a rather simplified view of these relationships, assuming that market structure, and the technological and entry barriers behind it, completely determined price, as well as other variables important for consumer welfare. Consequently the first empirical papers analysed the causal relationship between some measure of concentration (like the number of firms, or an index calculated from market shares), which described market structure, and prices; typically across several industries.[5] Such analyses led

[4] Sometimes data is available on margins or similar performance measures (such as profitability or innovations), instead of prices. The analyses can be conducted in a similar way and I refer to all these measures, for the sake of simplicity, as "prices".

[5] These are sometimes called *cross-industry analyses*.

to many erronous results, mainly due to the endogeneity between the dependent and the independent variables (that is, that causality runs both ways between structure and performance), and the fact that it is difficult for a competition agency, for example, to draw practical (or policy-related) conclusions about markets or market behaviour based on comparisons between different industries.[6] Analyses took a new direction in the second half of the 1980s, and *new empirical IO* was born.[7] These empirical investigations are firmly grounded in theoretical models of industrial organisation, which use modern economic (primarily, but not exclusively game theoretical) tools to describe firms' behaviour. *New empirical IO analyses* and *structural empirical IO models* are therefore often used as synonyms, but this is misleading: *new empirical IO* is part of a wider family, since many modern empirical IO papers estimate reduced form regressions. Over the past years, confidence in the "superiority" of structural models has been shaken in several areas,[8] and these is an ongoing debate among leading experts about whether, in some cases, it is sufficient or even better to use reduced form models.[9]

New empirical IO focuses primarily on analyses within given markets, and therefore leads to clearer and more easily applicable conclusions. More specific questions also enable the researcher to control for other independent variables, which eliminates several econometric problems; this, however, requires a lot of data. The specificity of the analysed questions often reverses the usual relationship between theory and applications: new methods used in empirical IO and published as research results are often developed because new problems were encountered when analysing a given market – for example, when consulting with agencies or firms in competition policy or regulatory cases.

ANALYSES BASED ON PRICE DATA

The academic community is often sceptical of empirical analyses based solely on price data, since the researcher is usually unable to use and control for the reactions to price changes.[10] It would be wrong to completely discount price analyses, however, because often price data is all that is available to the researcher, and they

[6] *Schmalensee* [1989] provides a comprehensive overview of this.

[7] This was first discussed by *Bresnahan* [1989], while *Berry and Reiss* [2007], and *Doraszelski and Pakes* [2007] provide more recent surveys. *Davis and Garces* [2010] give a detailed discussion of empirical methods and competition policy applications, mainly with European examples.

[8] See *Weinberg* [2011] and his references about the "errors" made in the popular area of merger simulations.

[9] See *Einav and Levin* [2010] and *Nevo and Whinston* [2010] for the debate in the Journal of Economic Perspectivesben.

[10] See *Werden and Froeb* [1993] for a thorough (though perhaps too strong) critique.

can be useful, for example, in establishing stylised facts; these can form the basis for hypotheses which may be investigated with more advanced methods later.

It is worth mentioning an empirical method which typically relies on price data, even though, in itself, it seldom leads to scientifically valuable results: the correlation between the prices of two products or firms. If two products belong to the same (relevant) market, then the correlation between their prices over time is expected to be high; otherwise, an opportunity for arbitrage would arise, the customers would take advantage of it, and the relative price would return to the equilibrium.[11] The stability of the relative price can also be investigated using econometric methods, so-called stationarity tests. The analysis of the "closeness of competition" between given firms can also be illustrated using correlation analysis.[12] The main drawback of correlation analyses is that there is no fixed threshold above which correlation can be said to be high enough; furthermore, it is important to control for factors (such as common costs), which can cause false correlation. This is usually achieved by differencing the time series.

The relationship between prices at different levels of a product chain is a well-researched topic. The typical approach is to conduct a so-called price-transmission analysis, which determines the pass-through by a downstream vertical level (retail, for example) of the price changes implemented by an upstream vertical level (wholesale, to continue the example). The main idea is that in the case of perfect competition, the pass-through for costs should stand at 100 per cent, and therefore any lower value indicates market power at the lower vertical level. The possible asymmetry of price transmission can also be analysed; if there is market power present, then the retail price may respond more to an increase in wholesale prices than to an identical decrease.

These hypotheses can be tested using regressions on the differenced time series of the price changes in the following simplified form:

$$\Delta p_t = \alpha + \beta_1 \times \Delta w_t \times D^+ + \beta_2 \times \Delta w_t \times D^- + \varepsilon_t,$$

where p_t and w_t are the retail and wholesale prices at time t, and D^+ and D^- are dummy variables, taking on a value of 1 if the wholesale price increased or decreased in the given period, and 0 otherwise. The β_1 and β_2 parameters shows the level of transmission, and the hypotheses to test are H_0: $\beta_i = 1$ (perfect transmission), and H_0: $\beta_1 = \beta_2$ (symmetric transmission).

Farkas et al. [2009] test these hypotheses for the wholesale and retail prices of gasonline. The level of price transmission is 0.98 for price increases, and 0.97 for

[11] A stable relative price / sufficiently high correlation is not, in itself, enough evidence of belonging to the same relevant market, however.

[12] These methods are demonstrated for gasoline markets in Chapter 5 of *Farkas et al.* [2009].

decreases; these coefficients do not differ significantly from each other, but they do from 1. Based on these results, the hypothesis of asymmetric price transmission can definitely be rejected. The hypothesis of complete (100 per cent) price transmission can be rejected in a statistical sense, but 98 per cent transmission can effectively be considered perfect.[13] These results therefore show no market power at the retail level.

The process of price adaptation can also be described using more complex, dynamic models, where the lagged dependent and independent variables, as well as the so-called error correction factors appear on the right-hand side of the estimated equation. Such error correction models provide a more detailed picture of price relationships, and enable the speed of transmission to be measured.[14]

An econometric method is also available to measure which vertical level affects which level's prices. The so-called Granger causality test may be capable of achieving this goal, using methods of time series analysis similar to those above. However, it is important to handle the results with care when interpreting them as evidence of market power, as there is no underlying microeconomic model behind the hypotheses. *Popovics and Tóth* [2006] use this method in a detailed analysis of the Hungarian milk product chain, looking at the prices at the production, processing and retail levels, and conclude that the price at the processing level Granger-causes both the production and the retail level prices (and the reverse does not hold), which they interpret as evidence of market power at the processing level.

ANALYSES BASED ON PRICE DATA AND SIMPLE STATISTICAL INDICATORS

There are several motivations for analysing the relationships between price data and structural measures. Firstly, they address one of the main issues of the structure-conduct-performance paradigm directly – namely, how market structure determines various performance indicators. Secondly, it is an important practical consideration that such analyses can be relatively easily conducted using publicly available databases. And finally, the results of such empirical investigations can typically still be understood by a professional audience of non-economists (like lawyers and decision-makers), and their results are therefore easier to implement than those presented later.

[13] Especially considering that the price of gasoline is available at most at a precision of one decimal, while the largest weekly wholesale price change is not greater than 15 forints.

[14] The paper by *Farkas et al.* [2009] conducts a simplified form of this analysis for the case shown in the previous paragraph, but the results changed only very slightly. Such so-called vector error correction models (also referred to as ECM or VECM models) are especially widespread in agricultural economics, see for example *Bakucs and Fertő* [2009].

Price-concentration analyses

A price-concentration analysis is a widely used method, which seeks to establish the relationship between prices and the level of concentration in a given industry. If there is a significant, positive relationship between price and concentration, then the concentration measure used may be a good indicator of market power, that is, if the level of concentration in the industry is high or is increasing (due to a merger, for example), then the probability of competitive concerns arising is higher.

The simple estimated equation in a price-concentration study is typically the following:

$$price = f(concentration, controls).$$

The name of the method is somewhat restrictive in that it is not only the price that can be explained by concentration, but also the margin or other performance indicators.[15] The use of the margin is typically recommended (although of course the data does not always allow for this), firstly because the structural behavioural equations derived from theoretical IO models usually refer to the margin (competitive interactions are better represented in the margin), and secondly because certain econometric problems, like endogeneity and in the case of time series, stationarity, can be better handled.[16]

Regression analyses are typically conducted on cross-sectional databases, making use of the cross-sectional variation in levels of concentration. Therefore, data on several separate markets is required; often, geographically separated markets are good candidates.[17] Of course, if there is variation over time in the concentration measures, panel methods can also be employed; this, however, partly overlaps with a method I will discuss later in the chapter.

Looking to the explanatory variables, there is no clear-cut answer concerning the correct concentration measure to use. C_1, C_4 and the Herfindahl–Hirschmann-index (HHI) are often used in the literature.[18] The results are easier to interpret if the number of competitors on the market is used as a concentration measure:[19] the C_4 measure is insensitive to the merger of the second and third largest firm, for example, while the change in the HHI is difficult to interpret. We can achieve even more useful re-

[15] *Halpern and Muraközy* analyse in this book the relationship between Hungarian firms' R&D activity and various concentration measures using a regression methodology, and find an upside-down U-curve.

[16] A time series of prices is usually non-stationary, while a time series of margins is more often so.

[17] It is important that we observe variation in prices. For example, if supermarkets employ uniform prices in their outlets, then it doesn't help that concentration is different in various regional markets – the price-concentration analysis cannot be conducted.

[18] The C_i measure is the simple sum of the market shares of the largest i firms, while the HHI is the sum of the squares of (some type of) market shares of all the firms on the market.

[19] In this case the hypothesis to test is a negative relationship: we expect that a decrease in the number of competing firms on the market leads to a price increase.

sults if the presence of the larger competitors is coded using dummy variables, as this makes it easier to handle the possible non-linear effects of changes in concentration.[20]

Control variables are variables that also influence the price or the margin, but whose effect we wish to partial out, in order to answer the main question: how the level of concentration in itself influences the price. There are two basic types of control variables: demand and supply controls. For example, the size of a given regional market (the number of inhabitants), or its purchasing power are demand controls, while the price of main inputs (like labour or real estate), or the density of competitors in the given region are supply controls.[21]

There are two factors that can bias the estimates: possibly omitted variables, and the endogeneity of the relationship between price and concentration. Unfortunately, typically neither problem can be eliminated completely (often due to a lack of data), but this does not mean that the results are meaningless; it is worth verifying them using multiple methods, testing their robustness. One way to alleviate the endogeneity concern is to use two-step estimation, with the first step investigating the effect of demand controls on the density of competitors, and the second step estimating the effect of this density on prices or margins, using an instrumental variable approach.[22]

Farkas et al. [2009] conduct a price-concentration study for regional retail gasoline markets, estimating the relationship between the margin and the number of firms. Using various specifications, a significant negative relationship is found, however, it is not significant in an economic sense: the presence of a further competitor decreases price by 0.3-0.6 forints, less than 1 per cent of the average retail price.

Price-concentration studies can be combined with the price transmission analyses presented in the previous chapter, to investigate whether the level of concentration or the composition of firms influenced the level of price transmission.[23] *Farkas et al.* [2009], in the analysis of the gasonline market mentioned above, find no such relationship between the level or asymmetry of transmission and the number of firms; *Koltay* [2012*b*] on the other hand analyses the pricing of each network of stations separately and finds a small degree of asymmetric transmission for certain networks.

The price-concentration studies discussed above may give the impression that the data limitations can be overcome, this is however often not the case for researchers: the data may be available, but it constitutes a business secret. Typical applications in this field are so-called *bidding studies*, where the markets are the

[20] It is very likely, for example, that if the number of competing firms decreases from three to two, there is a larger effect on price than if it decreases from seven to six.

[21] The strength of competition may be different, for example, if four competitors in a given area each have one, or if they each have five outlets.

[22] This is the method employed by *Békés et al.* [2011].

[23] The hypothesis is that in a market with many participants, competition is close to perfect, and therefore pass-through is (close to) 100 per cent, but in two-firm markets, for example, pass-through may be lower, which could indicate market power.

separate auctions or tenders, and the final price is compared to the number of firms submitting bids, or dummy variables showing their presence. This method is often used to measure the strength of competition between competitors and the pressure they exert on each other on so-called bidding markets.[24]

Impact assessments

The other main method measuring the result of changes in stuctural indicators identifies this effect using not the differences between markets, but the actual changes over time within a given market. Since these changes typically relate to entries and exits, the methods are sometimes called *event studies*, or *shock analyses*. However, in a broader sense they belong to the family of *impact assessments* used in many policy areas.[25]

The estimation strategy most often used for panel data in this area is based on the so-called *difference-in-differences* (or simply *"diff-in-diff"* or DID) method. This quasi-experimental approach applies when the researcher is able to observe various units (like markets and their prices) over time, some of which were exposed to some "treatment" (like an entry or a merger), and some of which were not. Therefore the effect of the given event (treatment) can be identified from the difference between the treated and control group (controlling, of course, for other factors). A panel database enables the use of cross-sectional and time fixed effects, which diminishes the omitted variable problem as well.

A paper by *Csorba et al.* [2011] applies a difference-in-differences approach to analyse the effects of two 2007 mergers, Agip-Esso and Lukoil-Jet, on retail prices in Hungarian local gasoline markets. The paper discusses the predictions of several IO models, for example that the prices of the merging companies increase more than those of their competitors; or that the price effect is larger on markets where the merging parties are each other's competitors. The fact that the two mergers took place almost simultaneously makes the identification of the effects more difficult, however, the variance in the companies' presence on the specific local markets enables the separation and estimation of the various effects. The analysis confirms several theoretically predicted asymmetric effects, but the *ex post* price effect of the mergers is minimal, although positive (according to the results, the price effect of each merger was smaller than 1 per cent).

Such models can be used to evaluate the *ex post* welfare effects of various policy interventions (in the previous example, the merger clearance decisions), and agen-

[24] *Csorba* [2008] discusses such a study in detail for the case of a Hungarian merger.

[25] These methods are especially widespread in labour economics, for example. The "In focus" chapter of the 2012 edition of "The Hungarian Labour Market" concerned this topic only (see *Kézdi* [2012]). *Imbens and Wooldridge* [2009] provide a thorough methodological survey.

cies can use them to assess planned mergers or interventions by analysing events from the past.[26] The method is also suitable for evaluating smaller scale changes, caused by specific market players: *Horváth et al.* [2013], for example, use a difference-in-differences method to assess how the prices of flats which participated in a large energy efficiency-increasing renovation changed compared to similar flats that did not. Their results show a treatment effect of close to 10 per cent in flats belonging to the renovated building.

ANALYSES BASED ON PRICE AND QUANTITY DATA

The typical area of empirical analysis between prices and quantities is demand estimation, and especially the estimation of own and cross-price elasticities, since these have many applications in competition policy and regulation. The most well-known application is the H*ypothetical Monopolist Test* and its variants (like Critical Loss Analysis), used in relevant market definition:[27] if the own-price elasticity estimated for a product or group of products is not low enough, then a hypothetical monopolist of this product group would not be able to profitably raise prices; therefore, the relevant market should be wider. Further products should be included in the hypothetically monopolised market until the repeated demand estimation yields a sufficiently low elasticity.

It is worth noting that due to a lack of data and the difficulties of estimation the need may arise to measure consumer behaviour directly, typically using survey methods. While these methods are not usually considered standard tools of empirical IO, their results can be widely used, especially in practical applications.[28]

[26] See, for example, *Ashenfelter et al.* [2006], which discusses the probably most well-known merger (Staples–Office Depot), where these econometric methods were used and seriously debated in American courts.

[27] The test is also called the HMT-test, or the SSNIP-test. See *Muraközy* [2010], which discusses hypothesis testing in telecommunication markets, for demand estimation methods used to implement the HMT and other tests. *Bölcskei* [2010] also surveys research questions arising in relation to telecommunications markets, and presents the empirical methods developed to answer them, as well as results for various countries.

[28] *Édes et al.* [2010] looked at the substitution between fixed and mobile telephone service providers, among other methods also using elasticites, pointing out the asymmetry in the direction of substitution. *Lőrincz and Nagy* [2011] used the results of a consumer survey to analyse the components of switching costs for various telecommunications services (fixed and mobile telephony, internet), and estimated their size. *Pápai et al.* [2011] conducted a critical loss analysis to test whether the package deals offered by telecommunications companies could be considered a separate relevant market. Finally, *Szolnoki and Tóth* [2008] provide an example for energy markets. The authors estimated a function for the switching behaviour of consumers of electricity, based on a household survey, and then used it, together with other market data, to calibrate a theoretical model.

Classic demand estimation

A regression for demand estimation takes the following simplified functional form:

$$q_i = f(p_i, p_{-i}, X_i) + \varepsilon_i,$$

where q_i is the quantity demanded of product i, p_i is product i's price, p_{-i} is the price charged by potential competitors, and the X matrix contains the necessary control variables (income, or other demand- or supply-side controls, for example). The equation can be estimated for several functional forms; the choice between them must be determined by the data and the assumptions of the model used. A common choice (which still, however, needs to be justified to some extent by the analyst) is to use the variables' logarithms. In this case, the parameters estimated for p_i directly provide the own-price elasticity. Observations may be available for different consumers or consumer groups (or even settlements) in a give time period (cross-sectional form), for the same consumers over time (time series form), or for a combination of both (panel form).

As already discussed in the case of price-concentration analyses, the endogeneity between the dependent and independent variables can bias the estimates. While this problem was slightly less acute for price-concentration analyses where the structural indicators on the right-hand side changed quite slowly over time, it is very important in the case of demand estimation. One way to tackle this identification problem is to use the previously mentioned instrumental variable method. However, it is not easy to find good instruments (and good data for them), and there are consequently only very few Hungarian demand estimation analyses to be found.

Nagy et al. [2012] use a well-designed stepwise method to estimate the demand (elasticity) for fixed-line telephones. The demand estimation method takes advantage of the fact that subscribers faced different prices depending on whether they were located in Magyar Telekom's or Invitel's area of service, and this price difference was exogenous, since the consumers' current demand could not have influenced the assignment of concessions 20 years prior. Using this fact, the paper first calculates the difference in demand in settlements in Magyar Telekom and Invitel areas that are otherwise similar, second, estimates the price difference between the two, and finally calculates the arc elasticity of demand using the first two results. Using cross-sectional data from 2011, the estimated elasticity is low for both residential and business customers (between –0.1 and –0.2), far from the critical elasticity. Their panel estimations yield similar results, even though this estimation is better for controlling for unobserved heterogeneity between the regional markets. Based solely on the results of the demand estimation, one can draw the conclusion that fixed-line telephone services are a distinct relevant market, and the hypothesis of fixed-mobile substitution can be rejected.[29]

[29] The authors also estimated the elasticity of demand based on a consumer survey. They expected the calculated elasticity to be a little higher (–0.5 was their best estimate), but even that result is enough to reject the hypothesis of fixed-mobile substitutability.

Kézdi and Csorba [2012] also estimate the relationship between price and quantity data, investigating consumer lock-in in the Hungarian market for personal loans. The applied method is also similar to the difference-in-differences (DID) method introduced in the previous chapter: the authors compare the demand reactions of new consumers with those of old consumers, based on the assumption that the latter, who are locked in, can be considered a treated group, while the former can be their control group.[30] The various estimation results show that the old consumers' reaction to price changes is 70-80 per cent lower than that of the new consumers, which means that even the hypothesis of total lock-in (prohibitively high switching costs) cannot be rejected.

Demand estimation based on discrete choice models

One of the limitations of classic demand estimation techniques is that they hardly make any assumptions on the structure behind the factors influencing demand. Therefore, a large number of parameters must be estimated, which severely limits the applicability of the method. For example, if one wishes to estimate a complete demand system for 10 products, then, even without the control variables, there would be $10^2 = 100$ parameters to estimate, causing serious identification problems.

One solution to this problem is to use a discrete choice model, where the consumers' main choice is not how much of a given product to purchase, but which supplier to choose.[31] Such models use a microeconomic model of consumer choice to derive linear demand equations. During estimation, their assumptions concerning substitution patterns translate into parameter restrictions, which significantly decrease the number of parameters that need to be estimated. The most common method is to assign products to groups (high and medium quality domestic and import products, for example), and estimate a "common" cross-price elasticity for substitution between and within the groups. It is worth noting that demand estimation based on discrete choice models is not the only possibility for estimating demand choices based on discrete choices, as demonstrated by the Hungarian papers discussed in the previous chapter. I will not discuss the further details of the approach based on discrete choice models, and refer the interested reader to a good survey provided in *Muraközy* [2010].

In general, the use of structural models, that is, the equations describing both demand and supply side behaviour are derived from theoretical models and then estimated, is most common in the case of estimation based on discrete choice mod-

[30] In this case, for example, it was not possible to use adequate instruments, therefore the authors also used lagged price changes to estimate the demand reactions.

[31] The primary, but not only form of a discrete choice is when demand is either zero or one; examples include automobiles, or most telecommunications services and public utilities.

els,. I have found only one application of this type of method, in *Molnár et al.* [2007], who analyse competition in a market with differentiated products, the market for residential financial products.[32] The paper estimates the own and cross-price elasticity for various specifications, and uses these to calculate optimal margins using the general model of competition for the supply side. The margins observed in the market are then compared to the equilibrium outcomes of two specific models of competition (Bertrand-competition and collusion). The paper thus effectively measures market power on the specific markets, and finds that the level of competition is quite low in the markets for most financial products; even the hypothesis of collusion cannot be rejected.

There are a few more examples for demand estimation beased on discrete choices: *Crawford and Molnár* [2008] analyse the effects of advertisements on the demand (and its elasticity) for Hungarian mobile telephone services, while *Tánczos and Török* [2007] present an application in the area of transportation economics by modelling the flow of traffic between Budapest and Győr.[33] *Koltay* [2012*a*] studies the German market, estimating the effect on consumer choices of the introduction of an eco-friendly brand in the market for hygiene products. He investigates how the results conform to various theoretical models describing the demand for common goods.

Analysing the supply side

Although they do not, in a strict sense, concern the relationship between prices (or some other performance indicator) and market structure or market behaviour, it is still worth discussing studies estimating production and cost functions, as well as production efficiences. The empirical methods employed typically seek to explain some output variable (production, cost, or productivity indicator) using the level of various inputs (or their price). The estimated equation is typically derived from the first order conditions of the firm's (or industry's) profit maximisation problem. There are only a handful of such papers in Hungary: *Reiff et al.* [2002] estimate production functions and various productivity indicators at an industry level, while *Bisztray et al.* [2010] estimate firms' energy efficiency in the case of water utilities.

[32] *Paizs* [2009] also estimates a structural model, however, he estimates the reaction functions of a specific theoretical model of competition, and not the equations for optimal behavioural in a discrete choice model. Furthermore, the paper estimates a model for the competition between European countries in determining excise taxes, which is a cross-market interaction.

[33] *Édes et al.* [2011] provide a general survey of the empirical methods for analysing substitutability between modes of transport.

CONCLUSION

This paper set out to survey Hungarian empirical IO analyses from the past decade, and also draw attention to the diversity of empirical methods that can be applied. The groups into which the methods have been sorted do not represent a ranking of quality: while it is true in general that more detailed databases enable the use of more complex empirical methods, this does not mean that the results will be more reliable (and especially not that they will be more easy to interpret in practice). Therefore it is important to be familiar with the various empirical methods, their advantages and their limitations, and to interpret the available facts according to several methods, if possible. This can be considered a type of robustness check.[34] I have shown several cases where relatively standard (reduced form) econometric methods were sufficient to conduct empirical analyses which could effectively assist in rejecting or verifying various hypotheses important in competition policy and regulation.

Surveying the Hungarian studies in empirical IO we can also draw the interesting conclusion that the majority of the authors is not or not only an academic. This confirms the common supposition that these studies are typically connected to practical application, and also that it is in institutions that are not foremost research facilities that authors encounter topics and databases which can be used to produce scientifically sound results. Four such institutions can be identified: the Regional Centre for Energy Policy Research (REKK), Infrapont Economic Consulting, the Hungarian Competition Authority (GVH) and the Central Bank of Hungary (MNB). We can only hope that these institutions can continue their scientific work, and that access to databases will improve so that in the future, research facilities can also focus more on modern empirical industrial organisation.

[34] As one of the reviewers of this paper aptly commented: "An empirical model is like the Hungarian language. It can be used to tell the truth, but also to lie."

REFERENCES

Ashenfelter, O.–Ashmore, D.–Baker, J.–Gleason, S.–Hosken, D. [2006]: Empirical methods in merger analysis: Econometric analysis of pricing in FTC v. Staples. International Journal of the Economics of Business, Vol. 13, pp. 265–79.

Bakucs L. Z.–Fertő I. [2009]: Marketing and Pricing Dynamics in the Presence of Structural Breaks. The Hungarian Pork Market. Journal of International Food and Agribusiness Marketing, Vol. 21, pp. 116–133.

Békés, G.–Harasztosi, P. [2013]: Agglomeration Premium and Trading Activity of Firms. Regional Science and Urban Economics, Vol. 43, pp. 51–64.

Békés, G.–Koren, M.–Zsohár, P. [2011]: Geographical pricing of retail petrol prices. MTA KTI Working Papers, MT-DP-2011/30.

Békés, G.–Muraközy, B. [2012]: Temporary Trade and Heterogenous Firms. Journal of International Economics, Vol. 87, pp. 232–246.

Berry, S.–Reiss, P. [2007]: Empirical models of entry and market structure. In: *Armstrong, M.–Porter R.* (ed.): Handbook of Industrial Organization, Vol. 3, North Holland, pp. 1845–1886.

Bishop, S.–Walker, M. [2010]: The Economics of EC Competition Law: Concepts, Application and Measurement. Sweet & Maxwell, London.

Bisztray, M.–Kis, A.–Muraközy, B.–Ungvári, G. [2010]: Energy Efficiency Analysis of Water and Wastewater Utilities Based on the IBNET Database, Regional Centre for Energy Policy Research Working Paper.

Bölcskei, V. [2010]: A review of the demand models of telephone services – with special regard to estimating substitution between land and mobile services. Economic Review, Vol. 57. No. 6, pp. 517–535.

Bresnahan, T. F. [1989]: Empirical studies of industries with market power. In: *Schmalensee, R.–Willig, R.* (ed.): Handbook of Industrial Organization, Vol. 2, North Holland, pp. 1011–1057.

Brown, D.–Earle, J.–Telegdy, Á. [2006]: The Productivity Effects of Privatization: Longitudinal Estimates from Hungary, Romania, Russia and Ukraine, Journal of Political Economy, Vol. 114, pp. 61–99.

Crawford, G.–Molnár, J. [2008]: The Empirical Consequences of Advertising Content in the Hungarian Mobile Phone Market. Manuscript, http://www2.warwick.ac.uk/fac/soc/economics/staff/academic/crawford/research/adcontent.pdf.

Csorba, G. [2008]: A fúziókontroll módszertanáról: Dominancia- vagy versenyhatásteszt? [On the assessment criteria in merger analysis: Dominance vs Significant Lessening of Competition test] In: *Valentiny Pál–Kiss Ferenc László* (eds.): Verseny és szabályozás, 2007. [Competition and Regulation, 2007], Institute of Economics, Hungarian Academy of Sciences, Budapest, pp. 96–110.

Csorba, G.–Koltay G.–Farkas, D. [2011]: Separating the ex post effects of mergers: an analysis of structural changes on the Hungarian retail gasoline market. MTA KTI Working Papers, MT-DP-2011/18.

Davis, P.–Garces, E. [2010]: Quantitative Techniques for Competition and Antitrust Analysis. Princeton University Press, Princeton.

Doraszelski, U.–Pakes, A. [2007]. Framework for Applied Dynamic Analysis in IO. In: *Armstrong, M.–Porter R.* (ed.): Handbook of Industrial Organization, Vol. 3, North Holland, pp. 1887–1966.

Édes, B.–Bölcskei, V.–Lőrincz, L.–Nagy, P.–Pápai, Z. [2010]: A vezetékes és mobil távbeszélő szolgáltatások közötti helyettesítés vizsgálata [An examination of substitution between fixed and mobile telephone services]. In: *Valentiny Pál–Kiss Ferenc László–Nagy Csongor István* (eds.): Verseny és szabályozás, 2009. [Competition and Regulation, 2009] Institute of Economics, Hungarian Academy of Sciences, Budapest, pp. 204–242.

Édes, B.–Micski, J.–Pápai, Z. [2011]: Kereslet és intermodális helyettesítés a távolsági közlekedésben. [Demand and intermodal substitution in long distance transport]. Infrapontpaper. http://www.infrapont.hu/dokumentumok/Intermod%e1lis%20helyettes%edt%e9s_Infrapont_2011.pdf.

Einav, L.–Levin, J. [2010]: Empirical Industrial Organization: A Progress Report, Journal of Economic Perspectives, Vol. 24, pp. 145–162.

Farkas, D.–Csorba, G.–Koltay, G. [2009]: Prices and concentration on the Hungarian retail market for motor fuels. Economic Review, Vol. 56, No. 12, pp. 1088–1109.

Fertő, I. [2009]: Labour Market Adjustment and Intra-Industry Trade: The Effects of Association on the Hungarian Food Industry. Journal of Agricultural Economics, Vol. 60. No. 3, pp. 668–681.

Halpern, L.–Muraközy, B. [2012]: A verseny és a K + F összefüggései – elméleti megközelítések és számszerű eredmények [The relationship between competition and R&D – theoretical approaches and quantitative results]. In: *Valentiny Pál–Kiss Ferenc László–Nagy Csongor István* (eds.): Verseny és szabályozás, 2011 [Competition and Regulation, 2011] Institute of Economics – Centre for Economic and Regional Studies, Hungarian Academy of Sciences, Budapest, pp. 13–37.

Horváth, Á.–Kiss, H. J.–McLean, A. [2013]: How does an Increase in Energy Efficiency Affect Housing Prices? A Case Study of a Renovation. ELTINGA Working Paper Series, No. 2.

Imbens, G.–Wooldridge, J. [2009], Recent Developments in the Econometrics of Program Evaluation. Journal of Economic Literature, Vol. 47, pp. 5–86.

Kézdi, G. (ed.) [2012]: In Focus. Evaluation of active labour market programs. In: *Fazekas Károly–Kézdi Gábor* (ed.): The Hungarian Labour Market, 2012. Institute of Economics – Centre for Economic and Regional Studies Hungarian Academy of Sciences & National Employment Non-profit Public Company Ltd. Budapest.

Kézdi, G.–Csorba, G. [2012]: Estimating consumer lock-in effects from firm-level data. Journal of Industry, Competition and Trade, November, http://link.springer.com/article/10.1007%2Fs10842-012-0149-2.

Koltay, G. [2012*a*]: How much does your environment matter? Estimating the effect of the Blauer Engel eco-label. European Association for Research in Industrial Economics, 39th Annual Conference, September 2–4, Rome.

Koltay, G. [2012*b*]: Not an average story: Asymmetric price transmission in the Hungarian gasoline retail market. 18th International Panel Data Conference, July 5–6, Paris.

Lőrincz, L.–Nagy, P. [2010]: Switching costs in telecommunications: Conclusions from a Hungarian survey. In: *Falch, M.–Markendahl, J.* (ed.): Promoting New Telecom Infrastructures: Markets, Policies and Pricing, Edward Elgar, Cheltenham, UK–Northampton, MA, pp. 175–193.Molnár, J.–Nagy, M.–Horváth, Cs. [2007]: A Structural Empirical

Analysis of Retail Banking Competition: the Case of Hungary. MNB Working Papers, 2007/1.

Muraköz, B. [2010]: Ökonometriai módszerek a vezetékes és mobiltávközlési szolgáltatások helyettesítésének vizsgálatára [Econometric methods for measuring the substation between fixed and mobile telecommunication services]. In: *Valentiny Pál–Kiss Ferenc László–Nagy Csongor István* (eds.): Verseny és szabályozás, 2009. [Competition and Regulation, 2009], Institute of Economics, Hungarian Academy of Sciences, Budapest, pp. 171–203.

Nagy, P.–Pápai, Z.–Muraköz, B.–Micski, J. [2012]: A vezetékes telefonszolgáltatás rugalmasságának vizsgálata a piacmeghatározás empirikus megalapozása céljából [Study on the elasticity of demand for fixed telephone services supporting empirical market definition]. Nemzeti Média- és Hírközlési Hatóság HF/25000–9/2012. számú határozatának II. Függeléke, http://nmhh.hu/dokumentum/153976/1es_piac_hatterv_ii_fuggelek_uzleti_titkot_nem_tartalmazo_valtozat.pdf.

Nevo, A.–Whinston, M. [2010]: Taking the dogma out of econometrics: Structural modeling and credible inference. The Journal of Economic Perspectives, Vol. 24, pp. 69–81.

Paizs, L. [2009]: Fiscal competition on the market for diesel fuel in the European Union. Economic Review, Vol. 56. No. 3, pp. 216–238.

Pápai, Z.–Lőrincz, L.–Édes, B. [2011]: Triple play as a separate market? Empirical findings and consequences to broadband market definition. International Telecommunications Society (ITS) 22nd European Regional ITS Conference, Budapest.

Popovics, P. A.–Tóth, J. [2006]: Price transmission and asymmetric price development in the vertical structure. Economic Review, Vol. 53. No. 4, pp. 349–364.

Reiff, Á.–Sugár, A.–Surányi, É. [2002]: Productive efficiency in the Hungarian industry. Hungarian Statistical Review, Vol. 7, pp. 45–74.

Schmalensee, R. [1989]: Inter-industry studies of structure and performance. In: *Schmalensee, R.–Willig, R.* (ed.): Handbook of Industrial Organization, Vol. 2. North Holland, pp. 951–1009.

Szolnoki, P.–Tóth, A. I. [2008]: Szolgáltatóváltás a magyar lakossági árampiacon 2008-ban [Switching in the Hungarian electricity market in 2008]. In: *Valentiny Pál–Kiss Ferenc László* (eds.): Verseny és szabályozás, 2007. [Competition and Regulation, 2007], Institute of Economics, Hungarian Academy of Sciences, Budapest, pp. 197–227.

Tánczos, L.–Török, Á. [2007]: Közúti közlekedési módválasztás modellezése Budapest és Győr között [Modelling individual choice in passenger travel between Budapest and Győr]. Közlekedéstudományi Szemle, Vol. 57, pp. 220–226.

Weinberg, M. [2011]: More Evidence on the Performance of Merger Simulations. American Economic Review, Vol. 101, pp. 51–55.

Werden, G.–Froeb, L. [1993]: Correlation, causality, and all that jazz: The inherent shortcomings of price tests for antitrust market delineation. Review of Industrial Organization, Vol. 8, pp. 329–353.