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Lintner's Dividend Partial Adjustment Model on Aggregate Data. The Case of the Warsaw Stock Exchange

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Abstract

The partial adjustment model developed by Lintner, which assumes that the dividend paid for year t *is dependent on net profit in year* t *and on the dividend paid in year* $t - 1$*, and used to assess the dividend policy of individual companies as well as entire markets and their sectors, is most often estimated on the basis of data from selected companies. Additionally, estimations of the model typically only consider observations in which a dividend payment was recorded. Because this selection is not random, it limits the possibility of correctly assessing the dividend policy implemented in the analyzed markets. Therefore, the article hypothesizes that the dividend policy of a given market will be better described by the Lintner model estimated on the aggregate sums of payments and profits of all companies paying dividends than by one estimated on the panel data of selected companies. The hypothesis was verified using models estimated with aggregate data from the Warsaw Stock Exchange for the years 1992–2024. The source of information on dividends and profits was resolutions of the Ordinary (or, much less often, Extraordinary) General Meetings of Shareholders, adopted by all companies that paid at least one dividend during while listed on the Warsaw Stock Exchange.*

Keywords: Lintner's dividend partial adjustment model; dividend and profit aggregate data; instrumental variable method; Warsaw Stock Exchange

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Introduction

The model of partial dividend adjustments developed by Lintner (1956) is one of the basic tools for analyzing and forecasting companies' dividend decisions. It is a linear, dynamic autoregressive model assuming that the dividend paid for year t is dependent on the net profit (income) in year t and on the dividend paid in year $t - 1$. It describes the behavior of company management boards (or shareholders controlling companies) in that their payment decisions on only partially take into account changes in achieved financial results. Companies make further partial changes in the value of dividends in the following years. This policy of "partial adjustments" leads to the stabilization of dividend payments and minimizes adverse reactions from shareholders (Lintner 1956, 100). The model allows for the estimation of two parameters characterizing the dividend policy pursued by companies: the target dividend payout ratio and the dividend speed of adjustment to future profits. According to Lintner's assumptions, the value of the speed of adjustment should be low, which means a slow, long-term adjustment of dividends to profits.

Since Lintner's work, the model has been estimated primarily on individual firm data (pooled cross section or panel). The Lintner model has rarely been estimated on aggregated data. According to Marsh and Merton (1987, 4), "the relative lack of research on aggregate-dividend behavior

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is perhaps not surprising since many of the more interesting issues surrounding dividend policy are likely to be firm specific." However, analysts and investors also need information about the dividend policy of the entire market and its selected sectors, and models estimated on data from the select companies do not always accurately describe the entire market. While few such studies exist globally, there is no such research for the Warsaw Stock Exchange (WSE).

According to Leithner and Zimmermann (1993, 102), another reason for the low interest in estimating the Lintner model on aggregates may be that, "unlike for the US, European aggregate stock market data, particularly dividends, are not readily available and must be collected from different sources and archives."

Therefore, the article hypothesizes that the dividend policy of a given market will be better described by the Lintner model estimated on the aggregate sums of payments and profits of all companies paying dividends than by one estimated on the panel data of selected companies.

This article presents the results of the estimation of the Lintner model on aggregate data from the WSE as whole and separately for the Banks and Insurance sector and the Other companies sector. The source of information on dividends and profits was resolutions of Ordinary (or, much less often, Extraordinary) General Meetings of Shareholders, adopted by all companies that paid at least one dividend while listed on the WSE. Between 1992 and 2024, 481 companies (i.e., 69.1% of all companies ever listed on the WSE) made 3141 dividend payments. The payments made for each year and the profits earned in that same year were added together, and their values were converted into 2024 prices to obtain a series of aggregate data. The resulting series served as the basis for the estimation of the Lintner's models (with different definitions of income adopted, as well as a division into sectors). The method of instrumental variables (IV) was used for the estimation.

The structure of the paper is as follows. Section 1 presents the literature review. Section 2 describes problems related to the estimation of the Lintner model on individual data. Section 3 describes the methodology used in the study, including the analytical approach and data characteristics. Section 4 presents the results of the research and a discussion. The article ends with conclusions.

1 The literature review

Lintner (1956, 109), using observations of dividend payments and profits from a panel of companies from 1918 to 1941 (excluding 1936 and 1937, when there was an administrative ban on dividend payments), estimated two models differing in the definition of profit:

(1) $D = 352{,}3 + 0{,}700D_{-1} + 0{,}150P_w$ with profits adjusted for inventory gains, and

(2) $D = 160{,}0 + 0{,}788D_{-1} + 0{,}145P_n$ when profits were unadjusted.

In the first model, the target dividend payout ratio was 50.0% and the speed of adjustment ratio was 30.0%, while in the second model, the ratios were 68.4% and 21.2%, respectively.

The positive values of the constant term confirm the tendency of the analyzed companies to gradually increase their payouts.

The model proposed by Lintner has gained wide recognition among financial theorists and practitioners, and for almost 70 years, the results of its estimates for different periods, different companies, and financial markets in various countries have been published. Over time, the Lintner model was modified by expanding it with other variables (Fama and Babiak 1968; Fama and French 2002), introducing other indicators (e.g., cash flow, operating profit) instead of net profit, and, above all, by analyzing a growing number of companies and transitioning from the pooled cross-section approach to the panel approach. The estimation of Lintner models based on panel data has dominated this field of research up to the present day.

Fernau and Hirsch (2019), based on 99 papers published between 1957 and 2016 in which 979 dividend smoothing coefficients were estimated, conducted a regressive meta-analysis of Lintner's models. The obtained values came from models describing different company activities, periods, countries, and were estimated using various econometric methods. Companies listed in the USA

had an average estimated speed of adjustment between 32.2% and 34.3%. The authors also found that using the Generalized Method of Moments (GMM), the average speed of adjustment for non-financial companies was higher at 46.4%.

Kowerski (2024) analyzed the results of Lintner model estimations included in 24 articles published between 1968 and 2020. The analysis indicates that the speed of adjustment is significantly lower (*t*-Student test) in the USA (29.1%) and in the countries of the "old EU" (36.4%) than in developing markets (66.8%). This means that companies from developed markets are better able to meet Lintner's assumption of a long-term, gradual adjustment of dividends to changing earnings. In the case of companies from emerging markets, short-term changes in profits more often determine dividend payments. On the other hand, the target dividend payout ratio in these three groups of countries does not differ significantly (ranging from 39.5% to 47.1%).

According to Wójcikowska and Wójcikowski (2008, 321), the first attempt to test the Lintner model on the Polish capital market was made by Paliwoda (1997). Wójcikowska and Wójcikowski used data from companies listed on the WSE from 2001–2005 that paid dividends for at least two consecutive years, excluding banks. As a result of the research, it was determined that the Lintner model best describes companies without a strategic investor, and describes weaker companies with a dominant private or corporate shareholding. The best fit and significance were shown by models based on net profit.

Kowerski and Wypych (2016) conducted research on the impact of the shareholding structure of companies on the Polish capital market on dividend levels. The survey was conducted on companies listed on the main market and the alternative market (New-Connect) that regularly paid dividends in the years 2012–2016. Observations on companies that paid dividends despite incurring losses were excluded, resulting in 307 observations from 71 companies. The estimated target dividend payout ratio for all companies was 52.8%. Companies controlled by strategic investors had the highest target ratio (76.8%), followed by companies with a dispersed shareholding structure 52.5%, companies controlled by the government and local governments 51.3%, companies controlled by groups of individual investors 47.1%, and companies controlled by financial institutions 36.1%.

Kowerski (2024), using an unbalanced panel of 1509 observations from 112 domestic companies (excluding banks) listed on WSE, estimated Litner models using the Hackman procedure. The sample included companies that, at the end of 2019, were part of the WIG20, mWIG40, and sWIG80 indices, and had been listed for at least three years, and entered the WSE in 1998 or later. In these models, target dividend ratios ranged from 46,4% to 47,4% and the speed of adjustment from 62,2% to 63,8%.

The author has not been able to find any papers presenting the results of the estimation on aggregate data of the model according to the formula proposed by Lintner. However, inspired by Lintner's partial adjustment dividend model, Marsh and Merton (1987) proposed an error correction model that differs slightly from Lintner's model. This model allows for the estimation of the speed of adjustment and target dividend-capitalization ratio,[1], but calculating the target dividend payout ratio requires data from outside the model. Unlike Lintner, Marsh and Merton used stock prices instead of profits, which they believe embody rational predictions of firms' future net cash flows and thus permanent earnings. For them, the variables to be investigated on the aggregate level are therefore dividends and market capitalization in nominal values. They estimated the model using annual aggregate data from companies listed on the NYSE index over the period 1926–1981. The parameter on the lagged percentage capitalization change is positive and significant at the 0.05 level, which, in the authors' opinion, "is consistent with the hypothesis that the market capitalization is a good indicator of permanent earnings and that managers systematically change dividends in response to an unanticipated change in permanent earnings" (Marsh and Merton 1987, 22). The speed of adjustment is insignificant, which at best suggests that a substantial period of time is required for the dividend-capitalization ratio to converge to its steady-state distribution.

1. Also called the "dividend yield ratio." This indicator does not appear in the Lintner model but is a commonly used metric for evaluating dividend policy.

Leithner and Zimmermann (1993) estimated the model proposed by Marsh and Merton on aggregate data in real values for Switzerland and Germany for the years 1959–1986, for the USA from 1959–1987, Great Britain from 1962–1986, and for France from 1963–1987. The parameter on the variable describing the capitalization is insignificant only for the USA. The speed of adjustment is significant for Germany, Great Britain, and France, but not for Switzerland and the United States, which in the latter case confirms the results obtained by Marsh and Merton. Target dividend payout ratios estimated using data from outside the model amounted to: 21% in Switzerland, 50% in Germany, 63% in Great Britain, 64% in France, and 79% in the USA.

It is also worth noting the work of Shiller (1981), who used the relationship between aggregate values of dividends and market capitalization to verify the hypothesis that that stock prices are the present value of their future dividends.

2 Problems related to the estimation of the Lintner model on individual data and the hypothesis of the article

It is very rare for the panel Lintner model to be estimated on the basis of data from all companies listed on a given market. It is usually estimated on data from selected companies, and quite often, the selection is limited by the availability of data.

Thus, the question arises: are the selected companies representative of the entire market? Even if the data came from all companies, it should be noted (a point rarely made by researchers) that in the Lintner model, only observations in which dividend payments were recorded should be taken into account. The introduction of observations with "zero payouts" causes an increase in the value of the smoothing ratio (Larkin, Leary, and Michaely 2017, 5), which confirms Lintner's hypothesis of a gradual adjustment of dividends to profits but has little to do with reality.[2] There are relatively few companies that systematically pay dividends over a longer period (especially in small markets). In such a situation, the authors of many works assume that the sample should only include companies that have made at least a certain number of payments, with the required number varying widely from two to five (most often) and as high as twenty (Kowerski 2024). However, the authors do not explain their reasoning. This type of approach makes it very difficult to compare the results obtained and also undermines the assumption of sample representativeness. At this point, it is worth quoting Leary and Michaely (2011, 3212): "We recognize that this is clearly not a random sample from the universe of firms . . . which naturally limits our analysis (and the scope of our implications) to the subpopulation of dividend-paying firms."

Selecting only observations with dividend payments for the study is not random, and such a sample is not representative of the entire population – this is the problem of sample self-selection bias. Kowerski (2024) proposed solving this problem for panel data by estimating the Lintner model as the outcome equation in Heckman's two-equation model.

Bearing in mind the above, it seems that the dividend policy implemented on the analyzed market and/or its submarkets will be better described by the Lintner model estimated on the sums of payouts and profits of all companies paying dividends (i.e., aggregate data) than by one estimated on panel data of selected companies. This is the basic hypothesis of this article.

3 Methodology

3.1 Lintner model

Lintner (1956, 107–109) conducted interviews with the boards of directors (3 to 5 people) of 28 selected companies regarding their dividend policies, which allowed him to formulate the following conclusions regarding the dividend strategies of American companies:

- maintaining long-term target (*ideal*) dividend payment ratios

2. Paradoxically, models estimated on data predominantly from "non-paying" companies would best meet the assumptions of the Lintner model.

- recognizing that for company owners, a rational, stable dividend payment ratio is more important than the level of dividends paid
- altering dividends to follow long-term changes in the level of net profit, gradually adjusting to it (*dividend smoothing*) and short-term changes in profits do not affect the dividend payment
- showing reluctance by company managers to make decisions to increase the dividend payout ratios, as well as a reluctance to reduce them

This conservatism makes "dividend policy sticky." And this, in turn, causes the management boards to change dividends in a given year, only partially taking into account changes in the financial results obtained. Further partial changes in dividends will be carried out in the following years. This policy of "partial adjustments" leads to the stabilization of dividend payments and minimizes adverse reactions from shareholders (Lintner 1956, 100).

The above conclusions led Lintner to propose a dividends partial adjustment model of the form

$$D_t = \alpha_0 + \alpha_1 D_{t-1} + \alpha_2 P_t + \varepsilon_t, \tag{3}$$

where:
D_t — dividend paid for year t,
P_t — profit in year t, and
ε_t — random components.

The model formulated in this way is in fact a linear dynamic model — Autoregressive Distributed Lag ARDL(1,0,1) model, also called the Koyck model (Welfe 2008, 165). We will call this model the "classic Lintner model."

Equation (3) allows for the estimation of the long-term multiplier, which in this model is called the target dividend payout ratio:

$$\text{TDPR} = \frac{\alpha_2}{1 - \alpha_1} \cdot 100\% \tag{4}$$

and the short-term multiplier α_1, which in this model is called the dividend smoothing ratio.

Meanwhile, the expression

$$\text{SOA} = (1 - \alpha_1) \cdot 100\% \tag{5}$$

is the speed of adjustment ratio.

In order to meet the assumptions of the Lintner model, the values of the estimated parameters α_1 and α_2 should be proper fractions, where $\alpha_2 < 1 - \alpha_1$. Partial adjustment is confirmed by low values of the speed of adjustment ratio (SOA), i.e., high values of the smoothing ratio. A positive value of the constant reflects a greater reluctance to reduce rather than increase dividends, which may be a specific expression of the tendency to gradually increase of payments (Lintner 1956, 107).

3.2 Data

The source of information on dividends paid and net profits are resolutions of Ordinary and (less often) Extraordinary General Meetings adopted while companies were listed on the WSE. If in a given year, in addition to the ordinary dividend, the company also paid an extraordinary dividend on the basis of a resolution of the Extraordinary General Meeting, the values of both payments were added together so that, in the presented research, each company could make one payment during the year. This also applies to advance payments which, despite being paid in the previous year, were included in the dividend of the current year, as their payment was approved by a resolution adopted in the current year. In the case of companies for which the fiscal year was different from the calendar year, dividend payments for a given year were classified as coming from companies whose fiscal year covered part of the previous year and a maximum of half of the current year (e.g., from July 1 of the previous year to June 30 of the current year). If the financial period exceeded June 30 of the current year, the dividend was assigned to the following year.

Dividends are most often paid out of the net profit for the last fiscal year. However, according to Article 348 § 1 of the Commercial Companies Code (Act of 15 September 2000)[3], the amount to

3. See: Ustawa z dnia 15 września 2000 r. — Kodeks spółek handlowych. DzU z 2000 r. nr 94 poz. 1037.

be distributed among shareholders may not exceed the net profit for the last fiscal year, increased by undistributed profits from previous years and by amounts transferred from supplementary and reserve capital created from profit (retained earnings) that may be used for dividend payments. The amount should be reduced by uncovered losses, the value of own shares acquired by the company, and by the amounts that, according to the law or the company statute, should be allocated from the profit for the last fiscal year to supplementary and/or reserve capital.

This means that the size of the dividend depends not only on the net profit in the last fiscal year, but also on the company's financial results and the disposition of profits in previous years. The growing number of payments made from sources other than the net profit of the last fiscal year is a trend on the WSE. This affects the value of the dividend payout ratio. When a company pays a dividend from retained earnings, the dividend-to-net profit for the last fiscal year ratio no longer functions as a simple ratio: the numerator is no longer part of the denominator and may take on values greater than 100%. If the company paying the dividend has incurred a loss in the last year, the ratio takes on a negative value, which makes interpretation impossible.

Kowerski (2014, 192–193) proposed a solution to this problem by introducing the category of "distributed profits." If the dividend is paid only from the net profit for the last fiscal year, the distributed profits are equal to the net profit for the last fiscal year. If the company allocates other sources of financing to the dividend in addition to (or instead of) the net profit for the last year, the to be distributed profits are the sum of the net profit for the last fiscal year and any retained earnings that were allocated to the dividend. In the case of a company that incurred losses in the last fiscal year, the distributed profits are equal to the retained earnings that were allocated for dividends. With this understanding of profit, the dividend payout ratio takes on values from 0% to 100%, with the value reaching 100% when the company pays out all net profit for the last fiscal year or pays a dividend despite a loss. The dividend payout ratio calculated in the proposed way is lower than, and at most equal to, the dividend-to-net profit ratio for the last fiscal year.

Between 1992 and 2024, 481 companies, i.e., 69.1% of companies ever listed on the WSE Main Market, paid at least one dividend. A total of 3431 payments were made.[4] But only 9 companies (1.3% of those ever listed) have paid dividends continuously for at least 20 years. There were 58 companies that paid continuously for at least 10 years, but the value of their payments was greater than a quarter of total payments (25.4%). Of the total number of payments, 80 were made despite losses incurred in the previous year. Thirty payments were made entirely from retained earnings, despite the fact that the company did not record a loss. In addition, in the case of 431 dividend payments, dividends came from both net profit for the last year and retained earnings. The companies made 2600 payments only from the profit for the last year.

The value of dividends paid in the years 1992–2024 amounted to PLN 483.8 billion in 2024 prices, of which PLN 56.2 billion (11.6%) came from retained earnings. Loss-making companies paid dividends worth PLN 8.0 billion (1.6%).

The vast majority of studies do not take into account companies from the financial sector, assuming that their independence in making dividend decisions is limited by public financial supervision institutions. This also applies to Polish banks and insurance companies, which receive individual recommendations regarding the possibility and level of dividend payments.[5] Therefore, the Lintner models were estimated separately for the Banks and Insurance sector and the Other companies sector which in most studies is referred to as "Industrial companies."

Between 1992 and 2024, companies from the Banks and Insurance sector paid dividends worth PLN 207.8 billion, and Industrial companies paid out dividends worth PLN 276.0 billion. Noteworthy is the low value of payments made by banks and insurance companies in 2009, which was

4. The number of payouts is the sum of the annual payouts of the companies. In fact, a larger number of payments were made to shareholder accounts, resulting from separate payments of ordinary and extraordinary dividends, partial dividend payments in the form of advances, or payments in installments applied by some companies.

5. The recommendations contain the conditions that banks and insurance companies must meet in order to pay out a portion of the net profit for the last fiscal year, they also govern the use of retained earnings. In March 2020, the Polish Financial Supervision Authority issued a recommendation that, in connection with the COVID-19 pandemic, banks and insurance companies, regardless of the measures already taken in this regard, should retain all profit generated in previous years. All banks and insurance companies listed on the WSE complied with these expectations.

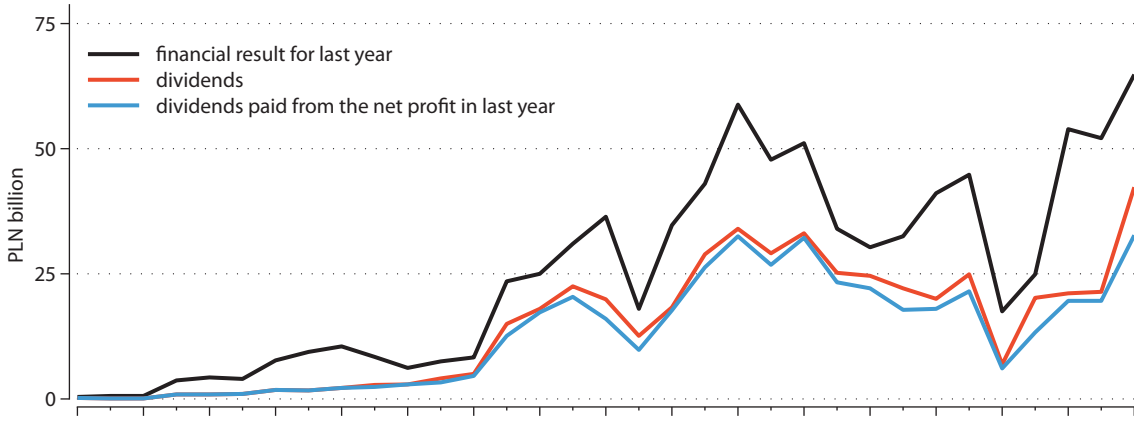

Figure 1. Changes in the value of the financial results and dividends paid in the years 1992–2024

Source: Author's own elaboration.

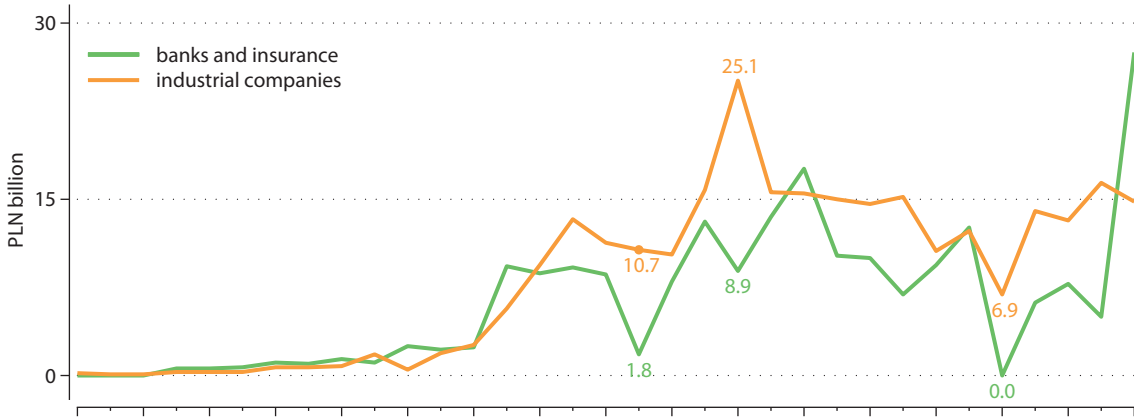

Figure 1. Changes in the value of dividends paid by sector, 1992–2024

Source: Author's own elaboration.

a consequence of the global financial crisis, and the lack of payments in 2020, which resulted from an administrative ban (although formulated as a recommendation) by the Polish Financial Supervision Authority (PFSA). The particularly large payout in 2024 (almost twice as high as that of other companies) is the result of the PFSA allowing the payment of retained profits, which can be considered as a "recovery" from the COVID-19 pandemic.

In this article, the classic Lintner models of the form (3) were estimated using the annual value of dividends paid from 1992–2024 (in 2024 prices), both in total and divided into two sectors: Banks and Insurance and Industrial Companies. Taking into account two global events that impacted the level of payouts (as shown by the analysis of time series from the 20th century): the global financial crisis, which resulted in a decline in payouts in 2009, and the COVID-19 pandemic, which resulted in a drastic decline in payouts in 2020, the following model was also estimated:

$$D_t = \alpha_0 + \alpha_1 D_{t-1} + \alpha_2 P_t + \alpha_3 \mathrm{COVID} + \alpha_4 \mathrm{GLOB} + \varepsilon_t, \tag{6}$$

where:

D_t — annual aggregate value of dividends paid (total and by sector) at 2024 prices for year t (in millions of PLN),

P_t — annual aggregate net financial result, i.e. the balance of net profits and losses (total and by sector) in prices 2024 in year t (in millions of PLN) or annual aggregate distributed profits (total and by sector) at 2024 prices in the year t (in millions of PLN),

GLOB — variable describing the impact of the global financial crisis on dividend decisions and taking a value of 1 in 2009 and a value of 0 in other years, and

COVID — variable describing the impact of the pandemic on dividend decisions and assuming the value of 1 in 2020 and 0 in other years.

3.3 Estimation method

Due to their autoregressive nature, the models were estimated using the instrumental variables method. In this method, the problem of selecting variables — instruments — is very difficult and does not yet have a single, clear solution. A good instrument is a variable that is correlated with the variable for which we need the instrument but is not correlated with the random component of the estimated equation. In the context of time series, lagged observations are usually used as instruments. As there is often autocorrelation in time series, this means that the instrument will be correlated with the explanatory variable. Assuming that the random component is not autocorrelated, the instrument will not be correlated with it (Koop 2011, 178). Therefore, D_{t-2} has been introduced as one of the instruments for D_{t-1}. Since the variable is dependent on a predetermined variable (and thus uncorrelated with the random component) P_t, it can be assumed that the variable D_{t-1} will also be correlated with the variables P_{t-1} and P_{t-2}, which become subsequent instrumental variables (Maddala 2006, 652). On the other hand, based on the assumption that the instruments should reflect both the situation inside the company and in its environment, three macroeconomic variables were assumed as instrumental variables: annual inflation and unemployment rates and their lags by one and two years, as well as the annual rate of return from the WIG index at the end of the year.

It was assumed that the estimated models should meet five conditions:

- stationarity of the dependent variables, verified by the KPSS test
- validity of all adopted instruments, verified by the Sargan test
- absence of heteroscedasticity in the random components, verified by the Pesaran-Taylor test
- absence of autocorrelation in the random components, verified by the first-order Godfrey's test for autocorrelation
- significance of all parameters (except the constant), verified by the *t*-Student test

A significance level of 0.05 was used as a criterion for inference. If more models met the above criteria, the one with the highest value of the adjusted coefficient of determination was selected for the analysis. Models with a lower value of the adjusted coefficient of determination were used for comparative analyses.

The calculations started from the 1994–2024 series (due to lags, they are shorter by two years). If the model did not meet the criteria, the oldest observation (year 1994) was removed and the model was estimated on a series that was one year shorter until the correct model was obtained.

The calculations were performed using the GRETL software (see: Kufel 2011).

4 Results of the research and discussion

The estimated target payout ratios and speed of adjustment ratios depend on the sources of dividend funding and are therefore not fully comparable.

After rejecting the observations from the years 1992–1997, the models of total dividends in relation to both financial results and distributed profits estimated on the data from the years 1998–2024 fulfill all the quality criteria and have the highest value of the adjusted coefficient of determination — these are the best models.

Although the ratios calculated on the basis of the models estimated on all payments in the years 1998–2024 are acceptable, only the dividend versus distributed profits model shows a causal relationship: it "links" the cause (all possible sources of dividend payment: net profit in the last year and retained profits) to the effect (dividend paid for the last year). Therefore, in further analyses, models in which the measure of income is the distributed profits will be used. The target payout ratio estimated in this model is 55.7% and the speed of adjustment ratio is 72.6%. This may mean that companies listed on the WSE are less likely than companies in developed markets to meet Lintner's assumption of a long-term, gradual adjustment of dividends to changing profits. Much more often, dividend payments are determined by short-term changes in profits.

Models were also estimated on the basis of data from which payments made despite losses and payments made only from retained profits despite a realized net profit were removed. The best model was estimated on data from 1999–2024 and was characterized by a 3-percentage-point lower

Table 1. Estimated best Lintner models (classic and with the impact of the COVID-19 pandemic)

		Dividend versus financial result 1998–2024		Dividend versus distributed profits 1998–2024		Dividend versus distributed profits 2000–2024			
Parameter/test	**Null hypothesis**	**value of parameter/ statistics**	***p*-value**	**value of parameter/ statistics**	***p*-value**	**value of parameter/ statistics**	***p*-value**	**value of parameter/ statistics**	***p*-value**
α_0	Parameter equals 0	−69.2816	0.9613	−212.1180	0.8665	369.7910	0.7799	412.2310	0.7588
α_1	Parameter equals 0	0.3316	0.0132	0.2739	0.0079	0.2853	0.0057	0.2339	0.0394
α_2	Parameter equals 0	0.4091	0.0001	0.4042	<0.0001	0.3969	<0.0001	0.4105	<0.0001
α_3	Parameter equals 0					−9319.60	0.0215		
Coefficient of determination R^2		0.8641		0.9014		0.9008		0.8874	
Adjusted R^2		0.8528		0.8932		0.8866		0.8772	
KPSS test	Dependent variable is stationary	0.1344	0.0780	0.1344	0.0780	0.1195	>0.1000	0.1195	>0.1000
Sargan test	All instruments are valid	14.2300	0.0760	14.6578	0.0662	13.5411	0.0600	14.2666	0.0751
Pesaran-Taylor test	No heteroscedasticity of random components	1.8208	0.0686	1.8090	0.0705	1.6034	0.1088	1.6021	0.1091
Godfrey test	No autocorrelation of random components	2.1405	0.1570	0.0184	0.8933	0.0468	0.8309	0.0062	0.9380
TDPR (%)		61.21		55.66		55.54		53.58	
SOA (%)		66.84		72.61		71.47		76.61	

Source: Author's own calculations.

of speed adjustment ratio compared to the model estimated for all payments. This may mean that payouts despite losses and payouts from retained earnings despite a realized net profit limit the assumptions of the Lintner model.

Table 2. Comparison of model estimation results: dividend versus distributed profits, 1999–2024

Model	The sign and significance of constant parameter (α_0)	Target dividend payout ratio (%)	Speed of adjustment ratio (%)	Adjusted coefficient of determination
Excluding payments made despite losses and payments made entirely from retained earnings, despite the company had not recorded a loss	– insignificant	55.94	71.22	0.8911
With all payments	– insignificant	55.22	74.70	0.8863

Source: Author's own calculations.

In order to determine the impact of unpredictable global crises on the dividend target ratio and the speed of adjustment ratio, Lintner models were estimated, extended with the GLOB and COVID variables. The parameters on the GLOB variable for all sub-periods turned out to be statistically insignificant[6], which means that in the longer term the decline in payments in 2009 did not have a significant impact on dividend payments by companies listed on the WSE. On the other hand, the best Lintner model extended with the COVID variable turned out to be the model estimated for the years 2000–2024. The value of the parameter for the COVID variable was −9319.6, which means that the epidemic resulted in a reduction in payments in 2020 by PLN 9319.6 million in 2024 prices. To assess the impact of COVID on dividend policy ratios, the classic Lintner model for the years 2000–2024 was also estimated. The target dividend payout ratio calculated on the basis of the classic model is 2 percentage points lower than in the extended model, while the speed of adjustment ratio is more than 5 percentage points higher than in the extended model. This means that the COVID pandemic caused a reduction in the target dividend payout ratio and an acceleration of the adjustment of dividends to future distributed profits, and thus contradicted the assumptions of the theory formulated by Lintner.

Lintner's models were also estimated separately for the Banks and Insurance and Industrial companies sectors. In the case of Banks and Insurance sector, the parameters on the one-year lagged dividend for all sub-periods turned out to be statistically insignificant. This means that this sector does not meet the assumptions of the Lintner model, and dividend paid for year t depends only on the distributed profits in year t. This is confirmed by a very high speed of adjustment (more than 80%). In their dividend policy, companies in this sector are not guided by Lintner's assumption of a long-term, gradual adjustment of dividends to changing profits. Much more often, dividend payments are determined by short-term changes in profits.

Since parameter on the variable D_{t-1} is statistically insignificant, the dividend model for year t versus distributed profits in year t for the years 1993–2024[7] was estimated with the Prais-Winsten method. The parameter on profit was 0.683, this can be interpreted to mean that the dividend payout ratio was 68.3%, while the adjusted coefficient of determination was 0.96, which confirms the very strong dependence of the dividend on the previous year's distributed profits. In the case of the Industrial companies sector, the model estimated for the years 1995–2024 turned out to be the best. It features a target dividend payout ratio of 42.7% and a speed of adjustment ratio of 56.0%. The model estimated for comparison purposes for the years 1998–2024 was characterized by a target ratio of 40.9%—i.e., it was 14.8 percentage points lower than the model estimated for all payouts, and the speed of adjustment ratio that was lower by 13.8 percentage points. Therefore,

6. The parameters were even positive for some subperiods. This, however, resulted from the failure to meet the coincidence principle (Hellwig 1976), because in these cases the Pearson linear correlation coefficients between the variables GLOB and D were negative.

7. The model estimated using the least squares method exhibited autocorrelation of the random components.

Table 3. Comparison of the results of estimation dividend models versus distributed profits for Banks and insurance sector and Industrial companies sector

		1995–2024				1998–2024			
		Industrial companies		Banks and insurance		Industrial companies		Banks and insurance	
Parameter/test	**Null hypothesis**	**value of parameter/ statistics**	***p*-value**	**value of parameter/ statistics**	***p*-value**	**value of parameter/ statistics**	***p*-value**	**value of parameter/ statistics**	***p*-value**
α_0	Parameter equals 0	730.2600	0.2623	−1809.1000	0.0055	1063.7700	0.2566	−2014.3400	0.0202
α_1	Parameter equals 0	0.4397	0.0006	0.0428	0.5458	0.4118	0.0023	0.0495	0.4960
α_2	Parameter equals 0	0.2393	0.0008	0.7552	<0.0001	0.2405	0.0017	0.7655	<0.0001
Coefficient of determination R^2		0.8742		0.9523		0.8467		0.9462	
Adjusted R^2		0.8649		0.9487		0.8339		0.9417	
KPSS test	Dependent variable is stationary	0.0779	>0.1000	0.0969	>0.1000	0.0892	>0.1000	0.1015	>0.1000
Sargan test	All instruments are valid	8.0669	0.4270	9.0135	0.3412	7.3631	0.4980	8.3771	0.3975
Pesaran-Taylor test	No heteroscedasticity of random components	1.0622	0.2882	0.4517	0.6515	0.5434	0.5869	0.3066	0.7592
Godfrey test	No autocorrelation of random components	0.0409	0.8414	1.5224	0.2283	0.0116	0.9150	1.3272	0.2611
TDPR (%)		42.71		78.90		40.89		80.54	
SOA (%)		56.03		84.07		58.82		95.05	

Source: Author's own calculations.

the Banks and Insurance sector is "responsible" for the high speed of adjustment in models estimated on all payments. This sector, as previously stated, does not meet the assumptions of the Lintner model.

Conclusions

In most studies based on panel data, Lintner's models were estimated on the basis of information from selected large and medium-sized companies, which could limit correct inferences about the dividend policy of the entire market or its individual sectors, and thus also about determining of the stage of development of a given market (developed vs. developing). The results of the estimation of Lintner's models based on the aggregated data of companies listed on the WSE, including the sums of the value of dividends paid and the corresponding sums of income over the longest possible time frames, seem to be much more accurate in this regard. This is confirmed by the estimation results of the Lintner's models for the WSE presented in this article.

The results also show that the assumptions of the Lintner model are not met by financial sector companies, which is commonly taken into account in studies based on panel data (as such companies are typically excluded). On the other hand, the speed of adjustment ratio for companies from the Industrial sector, estimated on the basis of aggregated data, is about 5–8 percentage points lower (depending on the model) than previously estimated on the basis of selected non-financial companies listed on the WSE (Kowerski 2014) and about 11 percentage points lower than the ratio for companies from developing markets (Mrzygłód et al. 2020). In the cited studies, the data came only from large and medium-sized companies, which means that the inclusion of small companies in this study causes a reduction in the target dividend payout ratio and the speed of adjustment ratio, which brings this sector closer to developed markets.

These results support the research hypothesis proposed in this paper.

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