Agnieszka Teterycz[1], Anna Białek-Jaworska[1]*, Michał Woźniak[1], Monika Piosik[2]

[1] *Uniwersytet Warszawski, Wydział Nauk Ekonomicznych*
   AT: agnieszka.teterycz1@gmail.com, https://orcid.org/0000-0002-4346-6746
   ABJ: abialek@wne.uw.edu.pl, https://orcid.org/0000-0003-4520-8916
   MW: mj.wozniak9@uw.edu.pl, https://orcid.org/0000-0001-7313-864X

[2] *Szkoła Główna Handlowa, Warszawa*
   MP: mp64054@doktorant.sgh.waw.pl, https://orcid.org/0000-0003-2885-5927

* corresponding author

Do gaming companies benefit from the IP Box tax rate? Multinational, Polish and Wielkopolskie voivodeship perspective

Abstract: This article aims to verify the impact of the reduced IP Box tax rate on the revenues of gaming companies and Gibrat's Law stating that firm growth is independent of a company's size. The dynamic panel-data models estimated in this article using GMM, FE panel data and OLS methods were created based on data of 673 companies from 11 countries. We show that small gaming firms are growing faster than their larger rivals. Thus, we reject Gibrat's Law. We did not find evidence that IP Box supports the firm's growth except for the Wielkopolskie Voivodeship. More chances for IP Box's (reduced to 5% income tax rate being in force in Poland since 2019) effects are given to firms with more remarkable and dynamic changes in capital intensity, intangibility and inventory. The gaming industry in Wielkopolska benefits more from IP Box than the rest of Poland.

Key words: IP Box, gaming sector, companies growth

Introduction

The global gaming industry has grown rapidly in recent years. However, it is characterised by a remarkably short lifetime, and most mobile games' downloads peak during the service's early period. Acquiring as many users as possible immediately after the launch and retaining these users, therefore, becomes very important for mobile game sales (Nam, Kim 2020). The structure of classic games comprises four stages: development or production, commercialisation or pub-

lishing, distribution, and customer engagement (Aleem et al. 2016), while the mobile game ecosystem consists of three stages – creation, delivery and use. Developers produce a game, game publishers distribute it on mobile app platforms, i.e., Google Play and Apple's App Store, and finally, users download and enjoy the game (Feijoo et al. 2012). Nowadays, the most popular mobile games are experience goods. This is because although users expect to experience fantasies, feelings, and fun by playing them (Holbrook, Hirschman 1982, Schmitt 1999), they do not recognise their real value until they experience it (Shapiro et al. 1998). Thus, one of the critical properties of mobile games as an experience good is that the information a user can obtain is very limited until the game is released and downloaded. Their choice to download depends on their expectations. This implies that the users' information-seeking behaviour before experiencing the mobile game and the game publishers' market strategy should significantly influence the mobile game's sales (Nam, Kim 2020). The gaming sector solely in Poland is also constantly growing by 30% year-on-year (YoY) growth in 2016–2019 (PARP 2021).

Over the last 20 years, 14 out of 27 European countries have applied IP Box regimes to enable firms to cut the tax rate on income earned from successful innovation (Lester 2021) emerging from various forms of intellectual property (Evers et al. 2015, Merrill 2016). Because multinational enterprises have more opportunities to reap tax benefits than domestic firms (Karkinsky, Riedel 2012). Koethenbuerger et al. (2018), Bornemann et al. (2020), Karkinsky and Riedel (2012), and Chen et al. (2019) examine how the IP Box affects locations of intangible assets or R&D, cross-border payments and reported income. Bradley et al. (2015), Evers et al. (2015), Mohnen et al. (2017), Chen et al. (2019), and Haufler and Schindler (2020) find that IP Box boosts firms' innovative activities and investments in R&D. But Gaessler et al. (2021) provided evidence that IP Box negatively impacts local invention and R&D when there is no requirement for further development but insignificant otherwise. Therefore, learnt by experience, OECD introduced the Base Erosion and Profit Shifting (BEPS) restrictions. Results obtained by Gaessler et al. (2021) call into question whether the IP box is an effective instrument for encouraging innovation in a country rather than simply preventing or facilitating the shifting of corporate income to low-tax jurisdictions. However, nexus rules reduce firms' incentives for acquiring developed intangibles and, by extension, reduce the number of Mergers and Acquisition activity as it requires actual action in exchange for tax benefits (Lester 2021), among others, in Poland.

In Poland, IP Box (lower – amounting to a 5% tax rate for income obtained from qualified intellectual property rights) has been available since the beginning of 2019. Under certain conditions (mainly through developing copyrighted software – one of the qualified IP rights), IP Box can be applied by companies producing and developing software in the gaming sector (Prokurat 2020). The number of IP Box taxpayers since 2019 in Wielkopolskie Voivodeship is significantly growing, much more among Personal Income Tax (PIT) taxpayers than Corporate Income Tax (CIT) taxpayers. Due to the construction of the Nexus ratio, the

Polish IP Box regime supports taxpayers who conduct the R&D works leading to developing the qualified IP by themselves. It can be stated that this tax preference helps to develop the internal companies' creativity, operations and products. The gaming sector links ICT with the art and creative industry. Therefore it is vital to notice the relationship between creativity and the possibility of (innovative) idea implementation. Firstly the ability to produce creative ideas is more common than the actual implementation of innovations (West 2002). Dissanayake et al. (2018) suggest that creativity and innovations are firmly integrated, but creativity does not guarantee (the victorious) implementation of the idea. Synergies between creative and technological activities in the gaming industry can influence innovation leading to the development of the whole region (Stolarick et al. 2006). IP Box tax regime has the advantage that the entities benefiting from it have already succeeded in their R&D process. It means that the solutions they have developed were already patented and commercialised. Examining the gaming companies benefiting from IP Box allows checking the trends observed within efficient and successful entities whose creativity is already successfully monetised. Because the literature review in Section 4 shows that empirical evidence and theoretical expectations give no clear picture of how the various factors influence the relationship between firm size and growth, we aim to check if Gibrat's law holds in the gaming industry. Therefore this paper analyses the impact of IP Box on the computer games sector growth.

The research includes three perspectives: international, national and regional, concerning the Wielkopolskie voivodeship. Six hundred seventy-three gaming companies from 11 countries were analysed, including 68 Polish and 28 companies from Wielkopolska. The data covers the period from 2010 to 2019 for the global analysis and from 2008 to 2021 for one country's study. We tested whether Gibrath's law, which says that the growth of an enterprise is independent of its size, applies to the computer games sector. The analysis was carried out by estimating the dynamic panel models using the Arellano-Bover/Blundell-Bond estimator of the system GMM method, the Arellano-Bond estimator of the GMM, fixed-effects panel data estimation and OLS. All the models' estimates aim to check whether the IP Box affects the firm growth; this is an increase in revenues from sales in the analysed companies. We paid particular attention to the relationship between IP Box and companies' growth in Poland and Wielkopolskie voivodeship. Moreover, we have checked whether companies from Wielkopolska are developing faster than the companies in Poland.

The paper is structured as follows. Section 2 describes the gaming sector. Next, Section 3 takes a closer look at the subject of the IP Box regime. Section 4 covers the literature review and develops hypotheses. In Section 5, we describe the data used and the research design. We present our results in Section 6 and conclude in Section 7.

Gaming sector

The game development process can last for years because this sector is characterised by cyclical seasonality of several years (ca. eight years). We can differentiate 7 phases of the game development process, including (1) planning, (2) pre-production, (3) production, (4) testing, (5) pre-launch, (6) launch, and (7) post-production (Pickell 2019). The way how the game is developed forces high investment and expenses in between short periods when the revenues of the company are high (new release). This is a typical business model in this sector; however, the producers operate in a subscription or frequently realised games' add-ons system.

The data prove that the gaming sector is constantly growing. Mainly online games are getting more and more popular. PwC's Global Entertainment & Media Outlook 2020–2024 Report shows the estimated annual growth rate (CAGR) between 3.9% and 11% from 2019 to 2024 in the gaming sector among the 11 analysed countries. Our research sample covers the primary European markets with the highest comparable to Poland gaming industry sales (Germany, the UK, France, Italy, Spain, Poland, Belgium, and the Czech Republic). Moreover, it includes all three countries where software intellectual property rights are protected (Japan, South Korea, and the USA). Furthermore, Newzoo (2020) highlights that these countries generate the highest revenue globally. Figure 1 shows the revenues of the gaming sector in each of the studied countries in 2020.
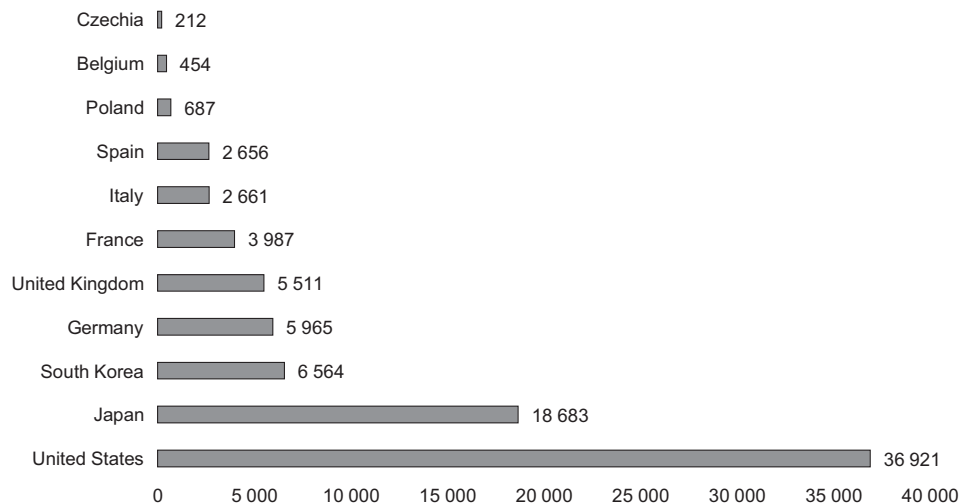
Fig. 1. The revenues in the gaming sector in 2020 (USD M)
Source: own elaboration based on Newzoo Top 10 Countries/Markets by Game Revenues (2020).

According to The game industry of Poland – Report 2021 issued by the Polish Agency of Enterprise Development (PARP) in August 2021, there were around 470 active game producers and publishers in Poland. The sector's revenue in 2020 amounted to EUR 969 M. It is estimated that the annual number of new

releases is higher than 600 games (PARP 2021, p. 7). In this article, we do consider the game industry as a set of game-producing and developing companies. The data show that such companies in Poland generate almost 96% of their revenues from export. However, we can also differentiate the Polish game market, dominated chiefly by foreign game titles imported to the country. The report states that Poland's total employment in the game industry amounts to 12,110 workers (25% of them are women). It is estimated that the employment growth rate is 24% YoY (PARP 2021, p. 8). Regarding sales revenues, the YoY growth of the industry equals nearly 30% (between 2016–2019) and even further accelerated in 2020. Among companies listed on the Warsaw Stock Exchange, 73% have reported an increase in revenues in 2020 (PARP 2021, p. 10). The biggest Polish gaming producer is CD Projekt Red S.A, and this company reported revenues that amounted to almost half of the yearly revenues of the whole sector (e.g. in 2016 and 2020).

Many Polish game producers make efforts to take over the longest possible fragment of the game development cycle to have as much control over the process as possible and, at the same time, derive the greatest potential profit from the production of games. However, it must be clearly indicated that no company in Poland would succeed while doing it all alone. Even CD Projekt, which, thanks to the GOG.com store, part of the sale to the end customer is carried out internally, must collaborate with international digital distribution stores (e.g. steam) (KPT 2020, p. 39).

Wielkopolskie voivodship (north-western region of Poland) is divided into four cities with poviat rights, 31 poviats and 226 communes, with the seat of local government authorities in the city of Poznań. In 2020 it was inhabited by about 3.5 million people (GUS 2020). Wielkopolskie is the second voivodeship in the country in terms of area and third in terms of population. In 2022 37 gaming companies were operating in this region (Polski GameDev 2022). These companies produce all types of games, including PCs, mobile web browsers, consoles and VR games. Wielkopolska, as well as other Polish Regions, have dedicated IT/ICT clusters established to connect and cooperate with local authorities, scientific and research units and business representatives to popularize and develop initiatives based on modern ICT technologies (e.g. Wielkopolski Klaster Teleinformatyczny, Klaster Wzgórza Nowych Technologii – Nt Hills, Klaster Firm Informatycznych ICT Pomorze Zachodnie, Multiklaster – Stowarzyszenie Klaster Multimediów i Systemów Informacyjnych or Alternatywny Klaster Informatyczny) (Klaster IT 2022). In creative sectors such as gaming – clusters can play a vital role. Research on US video game clusters showed that the factors contributing to developing them and entrepreneurship in the gaming sector are the following: concentration of human creativity in arts and technology in a strict localisation, cross-fertilisation of industries and public policy (Pillon, Tremblay 2013).

Clusters of companies contribute to the formation of technological spillovers that lead to innovations, which impact the development of the entire region, which cooperates with each other in a given field in our gaming sector (Stolarick et al. 2006).

IP Box regime

IP Box tax regime allows reducing the tax rate subject to the income from intellectual property rights (Evers et al. 2015, Merrill 2016). This tax regime is called a back-end preference, meaning that companies benefit from it at the end of their R&D process cycle (successful commercialisation of the developed innovative results is needed) (Lester 2021). It is crucial to note that the IP Box regime should be constructed in line with the Modified Nexus Approach proposed by OECD within BEPS (Base Erosion and Profit Shifting) rules (OECD 2015). Therefore, it is necessary to avoid unfair tax competition between countries.

Considering the introduction of the IP Box in the USA, it was noted that the region with the higher patent growth also had a higher job growth rate. Implementing IP Box would encourage manufacturing companies to return to the country and conduct their operations in the local market (Knight, Maragani 2013). They pointed out, however, that the R&D activities leading to obtaining patents should be done in-country to allow the US to benefit from introducing the IP Box regime. According to Caramina (2022), the Italian IP Box regime system was initially aimed to attract companies to retain in the country and relocate to Italy their activities connected with the development of intangible assets. Due to the construction of the Nexus ratio, the IP Box regime in Poland also prefers internal R&D activity leading to developing the qualified IP right. The taxpayer could purchase only the partial results of R&D works on the market; it is impossible to benefit from IP Box while only purchasing the complete solution subject to IP protection.

Nevertheless, governments can decide on the type of intellectual property income subject to the IP Box tax rate. They choose between patents, trademarks, software innovations etc. – catalogue proposed by OECD. However, software (computer programs) is subject to intellectual protection only in very few countries. Of the 11 analysed countries, Japan, the USA, South Korea, the Czech Republic, and Germany have not introduced the IP Box regime. In the first three non-European countries, software patent protection is allowed by law. However, it is crucial to mark that in Europe, the software is not patentable. The preferential tax rate varies from 4.44% to nearly 14% of IP-related income in the European countries we analyse. For example, implementing the Innovation Box in Belgium decreased the marginal effective tax rate of 1.88% on marginal R&D investments (Evers et al. 2015), and the effective tax rate decreased by 7.2% to 7.9% when developing intellectual property (Bornemann et al. 2020). Still, MNEs receive more tax benefits from the IP Box than domestic companies. The summary of the IP Box rate in the analysed countries that have introduced the regime is presented in Table 1. In Poland IP Box tax regime has been in force since January 2019; under this regulation, the reduced tax rate equals 5%. Qualified IP rights in Poland include: (1) patent; (2) protection right for a utility model; (3) the right to register an industrial design; (4) right in registration of integrated circuit topography; (5) additional protection right for a patent for a medicinal product or a plant protection product; (6) the right to register a medicinal prod-

Table 1. IP Box in European Countries

Country	Year	IP Qualifying Assets		IP Box (%)	Statutory tax rate (%)
		Patents	Software		
France	2000	x	x	10	28
Belgium	2007	x	x	4.44	29
Spain	2008	x	x	10	25
UK	2013	x	–	10	19
Italy	2015	x	x	13.95	24
Poland	2019	x	x	5	19

Source: OECD Dataset Intellectual Property Regimes (2019); Tax Foundation Report: Patent Box Regimes in Europe (2020); KPMG Corporate Tax Rate (2021).

uct and an authorised veterinary medicinal product admitted to trading; (7) the exclusive right referred to in the Act of June 26, 2003, on the legal protection of plant varieties; and (7) copyright to a computer program.

The income subject to the IP Box tax rate is obtained from qualified IP (in line with the IP Box tax regulations) and multiplied by the Nexus formula (defined in the PIT and CIT Acts). In Poland, companies from the IT sector are highly interested in IP Box taxation due to the last qualified IP right category – copyright to the computer program. In 2019, there were 1,924 IP Box taxpayers, and the amount of IP tax paid by them accounts for PLN 46 million (the average tax paid is PLN ca. 24,000 per taxpayer). Comparing this data with the content of the individual tax rulings issued by the Polish tax Authorities, we may suppose that the vast majority of taxpayers using IP Box come from the IT sector. Table 2 shows

Table 2. IP Box taxpayers and the tax paid (PLN M) in Poland (2019–2020)

Year	CIT IP Box taxpayers		PIT IP Box taxpayers	
	Number	total tax paid (in millions PLN)	Number	total tax paid (in millions PLN)
2019	65	24	1 859	22
2020	104	55	4 520	54

Source: own elaboration based on data from the Ministry of Finance of Poland.

Table 3. Number of active protection rights in Poland in 2019 and 2020

Number of protection rights	2019	2020
Patents for inventions	18,336	18,731
European patents	73,638	83,800
Protection rights for a utility model	3,623	3,931
Rights from registration of industrial design	8,368	8,500
Additional protection rights for medicinal products and plant protection products	234	287
Integrated circuits topography	47	49

Source: own elaboration based on the Annual Reports of the Patent Office of the Republic of Poland issued in 2019 and 2020.

the data concerning the popularity of IP Box in Poland between 2019 and 2020 among PIT and CIT taxpayers.

However, the potential of the IP Box regime in Poland is much higher, which is proved by the data from the Polish Patent Office presented in Table 3.

Hypothesis development

Gibrat's law of proportionate effect predicts that firm growth is independent of its size (Gibrat 1931). Most models defining firm size changes assume Gibrat's law of proportional change. In its simplest form, Gibrat's law states that the probability distributions of the growth rate of a firm's size are independent random variables with the same distribution (Kwaśnicki 2004, p. 2). However, there is research which argues with Gibrat's law. It has been proved that smaller firms are characterised by higher growth rates than larger firms (Audretsch et al. 1999). This is especially visible for innovative companies (Calvo 2006).

On the contrary, considering that economics of scale affect the production process, large firms should have an advantage and grow faster than small firms. On the other hand, Audretsch and Elston (2010) proved the positive correlation between a company's size and growth rate (cross-industry study in Germany). It suggests that Gibrat's law should be more likely to hold in the innovative sectors. In addition, it is worth-notice that multi-plant companies tend to have greater financial backing than single-plant firms, which can positively influence their growth rates (Geroski, Gugler 2004, Fagiolo, Luzzi 2006). The research also confirmed the positive impact of clustering and knowledge spillovers on companies' growth rates (Park et al. 2010).

Since the empirical evidence and theoretical expectations provided above give no clear picture of how the various factors influence the relationship between firm size and growth, we aim to check if Gibrat's law holds in the gaming industry. Our research is the first that analyses this issue in the gaming industry, characterised by no liquidity constraints, high competitiveness in the digital economy and various access to the IP Box advantages. We state the hypothesis:

H1: *Gaming company growth is independent of its size.*

This article also aims to examine whether Innovation Box regimes are efficient in supporting the growth of gaming companies, particularly in the Polish market. Tax incentives tend to support companies by increasing the money (free cash flows) that can be reinvested in line with the companies' needs. A lower IP Box tax rate, being a back-end solution, helps gain higher sales revenues from the commercialisation of innovative solutions and therefore enables higher R&D investments in the future. According to the literature, corporate productivity growth positively correlates with R&D expenditures (Minasian 1962, 1969). The value added for the company increases when the innovation process is successfully finished.

On the other hand, regarding R&D expenditures, they include both the positive and negative results of conducted R&D activity. R&D returns are very high,

even hundreds to thousands per cent. Their development bounded with the increased productivity caused by R&D activity may result in lower prices. This change will affect companies' sales revenues (Minasian 1969).

Moving strictly to the gaming sector, the extra money they obtain via the IP Box tax rate can be used to positively influence the production capacity or revenue growth of existing products that have entered the market. However, the efficiency of IP Box depends on the companies' decision on how to spend the extra money. For example, this tax incentive may become inefficient if used for payouts such as dividends or higher salaries. To find out what are the results of introducing IP Box in the gaming sector, we have stated the following hypothesis:

H2: *IP Box positively influences the revenue growth rate of gaming companies.*

And to strictly discover how the situation looks like in the Wielkopolskie voivodeship, we added hypothesis no. 3, which allows comparing this region to the rest of the country.

H3: *The companies from the gaming sector in Wielkopolskie voivodeship grow faster than the gaming companies from other regions of Poland.*

Research design

Our research sample covers the international gaming market of leading European countries (Belgium, Czech Republic, France, Germany, Italy, Poland, Spain and the UK), Japan, South Korea, and the USA. We use financial, employment and ownership data from 2011 to 2019 retrieved from the Orbis database and KPMG Reports for international study and from 2008 to 2021 for the regional research dedicated to Poland. Five analysed countries (Czech Republic, Germany, Japan, South Korea, and the USA) did not introduce the IP Box regulations. South Korea and the USA have tax regulations concerning R&D and intellectual property activities, but it is crucial to mention that they differ significantly from the European IP Box tax regimes. Table 4 presents definitions of variables.

Table 4. Definitions of variables

Variable	Definition
	Dependent variables:
Revenue_Growth	$ln(Revenue_t) - ln(Revenue_{t-1})$
Ln_Sales	$ln(Sales_t)$
	Test variables:
Lagged dependent variable	$ln(Sales_{t-8})$ $Revenue\_Growth_{t-1}$
IP_BOX	A binary variable indicating when IP Box has been implemented equals 1 – for the year of introducing IP Box and after, and 0 – otherwise
Wielkopolska	Binary variable indicating when the company is located in Wielkopolska voivodeship equals 1, and 0 – otherwise

Variable	Definition
Did	Interaction of IP_BOX time dummy variable and Wielkopolska binary variable
	Control variables:
Capital intensity	$\dfrac{\textit{Tangible fixed assets}}{\textit{Total assets}}$
Intangibility	$\dfrac{\textit{Intangible fixed assets}}{\textit{Total assets}}$
Inventory	$\dfrac{\textit{Current assets}}{\textit{Total assets}}$
Leverage	$\dfrac{\textit{Long-term debt}}{\textit{Total assets}}$
Size	$ln\,(\textit{Total Assets})$
MNE	Binary variable indicating if a firm has foreign shareholders that equals 1 – if the firm's foreign shareholders have more than 50% share in equity, and 0 – otherwise
ROA	$\dfrac{\textit{Profit (Loss) before interest and tax}}{\textit{Total assets}}$
Employees	$ln\,(\textit{Number of employees})$
STR	Statutory Tax Rate
Kaufmann	Average of six sub-index of the Worldwide Governance Indicators that rank countries concerning six aspects of good governance: Voice and Accountability, Political Stability and Violence, Government Effectiveness, Rule of Law, and Control of Corruption.
Ownership	Categorical variable indicating the type of ownership structure that consists of 15 levels: Bank; Corporate; Hedge fund; Employees, managers, directors; Financial company; Private equity firms; Public (listed companies); Venture capital; Insurance company; Foundation; Research Institute; Self-ownership; One or more named individuals or families; Other unnamed shareholders aggregated, Mutual and pension fund nominee trust trustee; Public authority state government

Source: own elaboration.

To check in H1 if Gibrat's law holds for the gaming industry in international institutional settings, we estimate the following model using ordinary least-squares (OLS).

$$Sales_{i,t} = \beta_0 + \beta_1 IP\_BOX_{c,t} + \beta_2 Sales_{i,t-8} + \beta_3 Controls_{i,t} + \beta_4 Controls_{c,t} + \varepsilon_{i,t} \quad (1)$$

The subscripts *i, c* and *t* denote firm, country, and year.

To address the H2 hypothesis, whether IP Box regimes are associated with the growth of companies in the gaming sector, we estimate models in eq. (2) where revenue growth captures incremental changes in value. In addition, we control *Size, Leverage, Employees, Intangibility, Capital Intensity, Inventory, MNE,* and ownership structure on a firm level and *STR, Patents,* and *Kaufmann* on a country level. The company's size *(Size)* assumes that larger firms that produce on a large

scale_are likely to have more innovative activity and benefit from economies of scale. However, *Leverage* is used to address the financial constraints of companies (Balsmeier et al. 2017, Hall et al. 2007), but also the opportunity to decrease the cost of capital in the case of public (listed) companies.

$$Revenue\_Growth_{i,t} = \beta_0 + \beta_1 IP\_BOX_{c,t} + \beta_3 Controls_{i,t} + \beta_4 Controls_{c,t} + \varepsilon_{i,t} \quad (2)$$

Models described by eq. (2) are estimated at the firm-country-year level using Arellano-Bond GMM (Arellano, Bond 1991) and fixed-effects (FE) panel data analysis estimators. Finally, models in eq. (3) and (4) are estimated using the two steps Blundell-Bond system GMM estimator dedicated to dynamic panel data (Blundell, Bond 1998) for the Polish subsample.

$$Revenue\_Growth_{i,t} = \beta_1 IP\_BOX_{i,t} + \beta_2 Wielkopolska_{i,t} + \beta_3 did_{i,t} + \beta_4 Controls_{i,t} +$$

$$\beta_5 time\_dummy_{i,t} + \beta_6 year_{i,t} + \upsilon_i + \varepsilon_{i,t} \quad (3)$$

$$ln\_Sales_{i,t} = \beta_1 IP\_BOX_{i,t} + \beta_2 Wielkopolska_{i,t} + \beta_3 did_{i,t} + \beta_4 Controls_{i,t} +$$

$$\beta_5 time\_dummy_{i,t} + \beta_6 year_{i,t} + \upsilon_i + \varepsilon_{i,t} \quad (4)$$

where: β_i – parameter, i – observation number, t – subsequent year, υ_i – panel-level effects, ε_{it} – independent and identically distributed effects.

Results

Based on Gibrat's equation estimation outcomes using the OLS approach provided in Table 5, we conclude that in the gaming industry, over the period 2012–

Table 5. Effect of IP Box on firm's growth – Gibrat's equation

	(1) OLS Sales	(2) OLS Sales	(3) OLS Sales	(4) OLS Sales	(5) OLS Sales	(6) OLS Sales
Sales in 2012 H1	0.9787***	0.9080***	0.9813***	0.9066***	0.9751***	0.9601***
	(0.0189)	(0.0249)	(0.0189)	(0.0245)	(0.0085)	(0.0099)
IP_BOX H2	–0.392***	–1.617***	–0.430***	–1.716***	0.0541	–0.554***
	(0.1317)	(0.3435)	(0.1351)	(0.3411)	(0.0795)	(0.2084)
MNE	0.0998	0.1238	0.2062	0.2332	0.1155	0.1324
	(0.1410)	(0.1392)	(0.1457)	(0.1424)	(0.0846)	(0.0854)
Capital_Intensity	0.0642	0.1827	–0.1331	0.09471	–0.0041	–0.0008
	(0.3244)	(0.3214)	(0.3351)	(0.3287)	(0.0206)	(0.0205)
Intangibility	0.0732	–0.02016	0.01961	–0.07036	–0.1264	–0.1137
	(0.2121)	(0.2111)	(0.2191)	(0.2159)	(0.1194)	(0.1203)

	(1) OLS Sales	(2) OLS Sales	(3) OLS Sales	(4) OLS Sales	(5) OLS Sales	(6) OLS Sales
Inventory	0.00002	0.00001	0.00002	0.00001	0.00002	0.00001
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Employees	0.0172	0.00094	0.00409	0.005024	0.0189	0.03131
	(0.0401)	(0.0431)	(0.04165)	(0.04418)	(0.0202)	(0.0215)
Leverage	−0.2501	−0.4242*	−0.2348	−0.4254*	−0.1723	−0.2013
	(0.2240)	(0.2243)	(0.2314)	(0.2293)	(0.1416)	(0.1444)
Size	0.0501	0.1317***	0.06022*	0.1481***	0.01443	0.0228**
	(0.0315)	(0.0366)	(0.03253)	(0.03731)	(0.0107)	(0.0112)
STR	2.435**	-8.5460	2.222*	4.974	2.445	6.018
	(1.1990)	(0.1816)	(1.242)	(0.1865)	(0.6708)	(0.1238)
Kaufmann	−0.4425**	1.046	−0.510***	−1.569	−0.465***	−1.267
	(0.1814)	(3.222)	(0.1884)	(3.305)	(0.1173)	(2.206)
Patents	−0.5606	−1.208**	−0.4476	−0.7716	0.0297	−0.4671
	(0.4233)	(0.6067)	(0.4413)	(0.6179)	(0.2484)	(0.3894)
Ownership_Effects	YES	YES	YES	YES	YES	YES
Corporate					0.2308***	0.2226***
					(0.0633)	(0.0646)
State-owned enterprises	−0.3726*		−0.576***	−0,4297**	0.6393***	0.5912***
	(0.2060)		(0.2128)	(0.2113)	(0.1976)	(0.1972)
Bank	0.7364***	0.6573**	0.6051**		0.3906**	0.3285*
	(0.2676)	(0.2641)	(0.2767)		(0.1699)	(0.1717)
Insurance_company					0.3511*	
					(0.2006)	
Self_ownership	−0.4361**	−0.4589**			−0.2726*	−0.3211**
	(0.2163)	(0.2140)			(0.1494)	(0.1538)
Family firms individuals				0.1890*		
				(0.1031)		
Unnamed shareholders	0.9356***	0.7670***	1.249***	0.9873***	0.5855***	0.5456***
	(0.2522)	(0.2527)	(0.2602)	(0.2588)	(0.1713)	(0.1739)
CountryxKaufmann	NO	YES	NO	YES	NO	YES
No. of observations	317	317	317	317	670	670
R2	0.9766	0.9791	0.9795	0.9821	0.9864	0.9864
F-statistic	341.3***	305.4***	391.9***	357.9***	1394***	1394***
RESET test (p-value)	6.2149 (0.002)	9.669 (0.000)	1.909 (0.15)	3.613 (0.03)	1.919 (0.15)	1.919 (0.15)
Breusch-Pagan test	39.866*	46.69*	44.59**	47.23*	83.88***	83.88***

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$
Source: own elaboration.

2019, revenue in small firms has grown more than in others. Therefore, all the models in Table 5 considered reject Gibrat's law. However, larger companies with higher assets (size variable) generate greater revenue. We also provide substantial evidence that IP Boxes didn't support revenue growth in the gaming industry.

These reject H2. More revenue is generated in countries with higher statutory tax rates and less governance quality, primarily by public companies with unnamed shareholders (substantial free float) or owned by banks.

Table 6 delivers the outcomes of testing hypothesis H2 using GMM dynamic panel data model (columns 1–3) and fixed-effects (FE) estimator (columns 4–5) for a narrower sample due to ETR restrictions. It provides evidence that implementing the Intellectual Property Box Regime negatively affects a gaming firm's revenue growth.

Table 6. Effect of IP Box on firm's growth

	(1) GMM	(2) GMM	(3) GMM	(4) FE	(5) FE
	Revenue_ Growth	Revenue_ Growth	Revenue_ Growth	Revenue_ Growth	Revenue_ Growth
IP_BOX H2	–0.3424**	–0.3032**	–0.2723*	–0.0980*	–0.1103*
	(0.1394)	(0.1373)	(0.1653)	(0.0526)	(0.0576)
L.Revenue_Growth H1	0.0232	0.0312	0.1155*		
	(0.0762)	(0.0710)	(0.0624)		
ROA				0.0059***	0.0059***
				(0.0016)	(0.0016)
MNE	–0.0659	–0.0583	–0.2110	–0.1915**	–0.1865*
	(0.0806)	(0.0782)	(0.1437)	(0.0949)	(0.0966)
Capital_Intensity	0.3526	0.3300	0.0618***	0.0011***	0.0010***
	(0.5561)	(0.5601)	(0.0152)	(0.0003)	(0.0002)
L.Capital_Intensity	0.1356	0.0957	0.0038		
	(0.5902)	(0.5908)	(0.0044)		
Intangibility	–0.0298	–0.0227	–0.2895	–0.2659	–0.2348
	(0.4276)	(0.4209)	(0.2051)	(0.2103)	(0.2065)
Inventory	–0.0003***	–0.0003***	–0.0003***	–0.00004***	–0.0001***
	(0.00002)	(0.00002)	(0.00003)	(0.00001)	(0.00001)
L.Inventory	0.00006***	0.00006***	0.00004		
	(0.00002)	(0.00002)	(0.00003)		
Employees	0.00262	0.01953	0.1176	–0.1336**	–0.1295**
	(0.0876)	(0.0860)	(0.0720)	(0.0531)	(0.0536)
Leverage	–0.1332	–0.1192	–0.0295	–0.1507	–0.1375
	(0.2007)	(0.1996)	(0.1782)	(0.1726)	(0.1748)
L.Leverage	0.1930	0.2213	0.2265*		
	(0.1737)	(0.1792)	(0.1302)		
Size	0.2859**	0.2828**	0.1580***	0.1952***	0.1892***
	(0.1204)	(0.1204)	(0.0324)	(0.0468)	(0.0454)
STR	–0.6509	–0.3057	–1.6550	–0.3757	–0.3333
	(1.0652)	(1.2359)	(1.2741)	(0.4135)	(0.5654)
Kaufmann	–0.5338		–0.12896	–0.1733	0.1987
	(0.3821)		(0.3366)	(0.2334)	(0.3127)
Patents	0.19997	0.3523	–0.0105	0.2376**	0.3508**
	(0.211)	(0.2465)	(0.3185)	(0.1140)	(0.1607)

	(1) GMM	(2) GMM	(3) GMM	(4) FE	(5) FE
	Revenue_ Growth	Revenue_ Growth	Revenue_ Growth	Revenue_ Growth	Revenue_ Growth
Ownership_Effects	YES	YES	YES	YES	YES
Corporate	–0.1072*	–0.1192*			
	(0.0635)	(0.0616)			
State-owned enterprises	0.2541*	0.2601*			
	(0.1471)	(0.1480)			
Financial_company		–0.1235*			
		(0.0735)			
Foundation_ research institute				–0.0718	–0.0814*
				(0.0437)	(0.0468)
Self_ownership				0.1063*	0.1448**
				(0.0608)	(0.0619)
Country x Kaufmann Effects	NO	YES	NO	NO	YES
Time Effects	YES	YES	YES		
Number of observations	1 380	1 380	4 038	2 261	2 261
Number of groups	360	360	673	360	360
R2				8%	10%
F-statistic				6.11***	4.85***
Hausman test				146.97***	114.37***
Breusch-Pagan test				798.94***	1282.8***
Sargan test	6.412 (0.27)	5.738 (0.33)	6.873 (0.23)		
Arellano-Bond AR(2)	0.541 (0.59)	0.455 (0.65)	–2.190 (0.03)		
Wald test	1683.58***	1955.09***	388.87***		
Wald test for time dummies	13.668**	11.237*	16.781**		

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$
Source: own elaboration.

Firms with higher ROA, capital intensity and size have a significantly higher growth rate in the FE models (4)–(5), particularly in more patenting countries. Although gaming companies reduce their tax rate and tax liabilities thanks to IP Box, the tax savings and free cash flows require time to materialise and increase their growth compared to their competitors from the countries with the highest revenue in the gaming industry. However, the parameter at the IP Box variable is significant and negative in all models in Table 6. It is caused at least partly by higher inventory that is increased by unsold games. Thus, we reject the H2 hypothesis. Although the total number of patent applications (*Patents*) at a country level positively influences revenue growth in FE models, their impact diminishes in GMM models.

Tables 7 and 8 focus on the Polish subsample. Based on the negative coefficient at the lagged *Revenue_growth* variable, we conclude that the small firms are growing faster than the big companies. So, Gibrat's law in the gaming sector in

Poland is not binding. Although IP Box negatively influences the revenue growth of gaming companies in Poland, its interaction with the Wielkopolskie voivodeship variable positively impacts their growth in the Wielkopolska region. Models (1)–(2) show that the companies from the Wielkopolskie voivodeship grow faster than in the rest of Poland. This gives us no basis to reject hypothesis H3. Considering dynamic effects, capital intensity, intangibility, and inventory limit the revenue's growth. Only revenues of firms with larger assets described by the *Size* variable grow faster than others.

Table 7. Effect of IP Box on firm's growth in Poland – system GMM

		(1)		(2)		(3)	
		system GMM Revenue_Growth		system GMM Revenue_Growth		system GMM Revenue_Growth	
L1.Revenue_Growth	H1	–0.0468	***	–0.0468	***	–0.0491	***
		(0.0078)		(0.0078)		(0.0084)	
IP_BOX	H2			–0.7004	***	–0.9972	***
				(0.1173)		(0.1382)	
Wielkopolska	H3	1.2647	***	1.2647	***	1.0179	
		(0.3615)		(0.3615)		(0.4018)	
did (Wielkopolska x IP_BOX)	H2					0.8087	**
						(0.3400)	
L1.did	H2					–0.7709	**
						(0.3425)	
Capital_intensity		5.2769	***	5.2769	***	4.9234	***
		(0.7934)		(0.7934)		(1.0147)	
L1.Capital_intensity		–12.6313	***	–12.6313	***	–13.5034	***
		(1.0054)		(1.0054)		(0.7277)	
Intangibility		2.9744	***	2.9744	***	2.8281	***
		(0.8542)		(0.8542)		(0.8664)	
L1.Intangibility		–9.3360	***	–9.3360	***	–9.1146	***
		(1.3513)		(1.3513)		(1.2939)	
Inventory		4.5580	***	4.5580	***	4.5061	***
		(0.4948)		(0.4948)		(0.4651)	
L1.Inventory		–10.1250	***	–10.1250	***	–9.8641	***
		(0.4830)		(0.4830)		(0.4745)	
Leverage		0.6402		0.6402		0.6329	
		(0.8879)		(0.8879)		(0.8080)	
L1.Leverage		–0.8850		–0.8850		–1.9206	
		(1.5045)		(1.5045)		(1.3963)	
Size		0.5486	***	0.5486	***	0.5463	***
		(0.0349)		(0.0349)		(0.0359)	
year 2010		1.7519	***	0.6580	*	0.8184	**
		(0.3661)		(0.3833)		(0.3759)	
year 2011		0.8922		–0.2022		–0.6350	
		(0.9801)		(0.9656)		(1.0233)	

	(1) system GMM Revenue_Growth		(2) system GMM Revenue_Growth		(3) system GMM Revenue_Growth	
year 2012	0.3804		–0.7146		–1.7059	
	(1.9309)		(1.9150)		(2.0703)	
year 2013	2.2665	***	1.1710	***	1.1885	***
	(0.1832)		(0.2227)		(0.2115)	
year 2014	2.3666	***	1.2706	***	1.3248	***
	(0.1762)		(0.2037)		(0.2146)	
year 2015	1.7076	***	0.6110	***	0.6523	***
	(0.1477)		(0.1778)		(0.1928)	
year 2016	1.8253	***	0.7282	***	0.7708	***
	(0.1904)		(0.1771)		(0.1600)	
year 2017	1.1450	***	0.0473		0.1147	
	(0.1712)		(0.1318)		(0.1400)	
year 2018	1.0982	***				
	(0.1781)					
year 2019	0.3983	**				
	(0.1812)					
year 2020			–0.3989	**	0.0216	
			(0.1812)		(0.1932)	
year 2021	–0.8347	***	–1.2341	***	–0.7959	***
	(0.2611)		(0.2386)		(0.2869)	
year	–0.0010	***	–0.0004	***	–0.0004	**
	(0.0001)		(0.0001)		(0.0002)	
Number of observ	816		816		816	
Number of groups	68		68		68	
Number of instr	97		97		99	
Sargan test	41.7611		41.7611		41.1913	
	0.9991		0.9991		0.9993	
Arellano-Bond test for zero autocorrelation in first-differenced errors						
AR(1)	–3.1976		–3.1976		–3.3172	
	0.0014		0.0014		0.0009	
AR(2)	1.5033		1.5033		0.98368	
	0.1328		0.1328		0.3253	

Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$
Source: own elaboration.

In Table 8, models (1)–(2) estimates show significant positive, lower than one, estimates of a parameter at the lagged sales variables, indicating that the smaller companies generate higher sales. Therefore, we reject the hypothesis of Gibrat's law (H1). The coefficient at the lagged IP Box variable in model (2) is significantly negative, showing that IP Box does not increase sales growth in gaming companies. Again, we reject H2. Although IP Box, a back-end preference,

generates profits for the companies when they start commercialising developed innovative solutions, the negative correlation may be a matter of the gaming sector or too short a time frame of data availability. A significant negative parameter at the *Wielkopolska* variable shows that companies from Wielkopolskie voivodeship sell less than the other Polish companies. Companies with higher assets, capital intensity, intangibility and inventory but less indebted in the previous period sell more.

Table 8. Effect of IP Box on firm's growth – Gibrat's equation for Polish subsample

		(1)		(2)	
		OLS Sales		OLS Sales	
L1.ln_Sales_	H1	0.0803	**	0.0841	**
		(0.0374)		(0.0379)	
L8.ln_Sales_	H1	0.0256	**	0.0304	***
		(0.0095)		(0.0076)	
L9.ln_Sales_		−0.0314	**		
		(0.0130)			
L1.IP_BOX	H2	−0.0814		−0.2716	**
		(0.1131)		(0.1271)	
Wielkopolska	H3	−0.6204	*	−0.6736	##
		(0.3758)		(0.4416)	
Capital_intensity		6.2086	**	5.6151	***
		(2.3507)		(0.7826)	
L1.Capital_intensity		1,2288		0.6509	
		(1.3422)		(0.7169)	
Intangibility		2.3061	***	3.2355	***
		(0.7909)		(0.5826)	
L1.Intangibility		−0.3549		−0.4266	
		(0.6630)		(0.5760)	
Inventory		2.8278	***	3.3670	***
		(0.5687)		(0.4500)	
L1.Inventory		−0.7733		−0.6464	
		(0.5002)		(0.5763)	
Leverage		−1.3244		0.1805	
		(1.5549)		(1.3500)	
L1.Leverage		−2.9842	***	−2.2577	***
		(0.9805)		(0.7984)	
Size		0.7819	***	0.7163	***
		(0.0407)		(0.0315)	
year 2016				0.1565	**
				(0.0718)	
year 2017		−0.0882		−0.0638	
		(0.0974)		(0.0718)	
year 2018		−0.0576		−0.1032	
		(0.0812)		(0.0708)	

	(1)	(2)
	OLS Sales	OLS Sales
year 2021	0.0354	0.1169
	(0.0912)	(0.0904)
year	0.0001	0.0002
	(0.0002)	(0.0002)
Number of observations	340	408
Number of groups	68	68
Number of instruments	60	70
Sargan test	36.3618	37.9181
	0.7161	0.9282
Arellano-Bond test for zero autocorrelation in first-differenced errors		
AR(1)	–1.7176	–2.0107
	0.0859	0.0444
AR(2)	1.1424	–0.5074
	0.2533	0.6118

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$; ## $p < 0.15$
Source: own elaboration.

Conclusion

This article analyses the development of the gaming sector from international, domestic and regional perspectives, focusing on the Wielkopolskie Voivodeship, showing the impact of the lower IP Box tax rate on the company's growth. Our study provides evidence that Gibrath's law is not binding in the gaming sector. It does not matter whether we consider the growth's dependence on the firm size from a multinational, Polish or regional (Wielkopolska voivodeship) perspective. Instead, our results confirm that small gaming producers and developers are growing faster than their larger rivals. Our findings are in line with Audretsch et al. (1999) and Calvo (2006) but contrary to Audretsch and Elston (2010), Geroski and Gugler (2004) and Fagiolo and Luzzi (2006). Our outcomes probably are due to more flexibility and less risk in developing games when supported by institutional owners, including banks, insurers and unnamed shareholders in the case of joint stock companies listed on the stock exchange. Unfortunately, we did not find evidence that IP Box supports the firm's growth except for the Wielkopolska region. However, gaming firms set in Wielkopolskie voivodeship sell less than their Polish competitors; therefore, it seems easier to boost revenue growth in this case. Our results align with Gaessler et al. (2021) but are opposite to Bradley et al. (2015), Evers et al. (2015), Mohnen et al. (2017), Chen et al. (2019), Haufler and Schindler (2020). It is due to gaming firms' business model that offers extraordinary growth in preordering and the first year of sale of the new game, IP Box's effects require time to influence firms' growth positively. More chances for these effects are given to firms with more remarkable and dynamic changes in capital intensity, intangibility and inventory.

Further research on the effect of IP Box on the gaming sector should consider the revenue growth of personal income (PIT) taxpayers that benefit from IP Box and their impact on economic growth in time and cross-regionally. Nevertheless, in the following years, when the relatively new IP Box legislation will be valid for 5-6 years, further research could also cover the spillover effects occurring in the gaming sector and leading to regional development. Future research, adding to Park et al. (2010), can check how clustering and knowledge spillovers impact companies' growth rates.

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Czy spółki sektora gier komputerowych odnoszą korzyści z IP Box? Perspektywa międzynarodowa, polska i województwa wielkopolskiego

Zarys treści: Celem artykułu jest weryfikacja wpływu obniżonej stawki podatkowej IP BOX na przychody spółek z branży gier komputerowych oraz prawa Gibrata stwierdzającego, że wzrost firmy jest niezależny od jej wielkości. Dynamiczne modele panelowe oszacowane metodą GMM, FE dla danych panelowych i MNK, opracowano na danych 673 spółek z 11 krajów. Wykazano, że małe firmy z branży gier komputerowych rosną szybciej niż ich więksi rywale. Tym samym odrzucono prawo Gibrata. Nie potwierdzono, że IP Box wspiera wzrost przedsiębiorstw z wyjątkiem województwa wielkopolskiego. Większe szanse na korzyści z IP Box (obniżona do 5% stawka podatku dochodowego obowiązująca w Polsce od 2019 r.) mają firmy o bardziej istotnych i dynamicznych zmianach kapitałochłonności, aktywów niematerialnych i zapasów. Branża gier wideo w Wielkopolsce odnosi większe korzyści z IP Box niż w pozostałej części Polski.

Słowa kluczowe: IP Box, sektor gier komputerowych, rozwój przedsiębiorstw