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The economic cost of IPR infringement in toys and games

Quantification of infringement in Manufacture of toys and games (NACE 32.40)

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Executive Summary

The European Observatory on infringements of Intellectual Property Rights (the Observatory) was created to improve the understanding of the role of Intellectual Property and of the negative consequences of IPR infringements.

In a study carried out with the European Patent Office[1], the Office for Harmonization in the Internal Market (OHIM), acting through the Observatory, estimated that approximately 39% of total economic activity and 26% of all employment in the EU is directly generated by IPR-intensive industries, with a further 9% of jobs in the EU arising from purchases of goods and services from other industries by IPR-intensive industries.

Perceptions and behaviours of European citizens regarding Intellectual Property and counterfeiting and piracy[2] were also assessed as part of an EU-wide survey. This survey revealed that although citizens recognise the value of IP in principle, they tend to justify their infringements as a consequence of individual circumstances as opposed to the recognition of the principle.

The Observatory has now embarked on an effort to complete the picture by assessing the economic impact of counterfeiting and piracy.

This exercise is challenging from a methodological perspective, as it attempts to shed light on a phenomenon that by its very nature is not directly observable. To pave the way towards quantification of the scope, scale and impact of IPR infringements in the European Union, as identified in its mandate, the Observatory has developed a step by step approach to evaluate the negative impact of counterfeiting and its consequences for legitimate businesses, governments and consumers, and ultimately society as a whole.

Several IP right intensive industries whose products are known or thought to be subject of counterfeiting have been selected. This report presents the results of the fourth sectorial study, covering games and toys[3]. Registered Intellectual property rights are widely used in this sector. The EPO/OHIM study revealed that patents were used extensively, whilst amongst the industries which used trade marks and designs intensively, the sector ranked 8th for trade marks and 11th for designs.

1 - “Intellectual Property Rights intensive industries; contribution to economic performance and employment in the European Union”, OHIM/EPO, September 2013.

2 - “European citizens and intellectual property: perception, awareness and behaviour”, OHIM, November 2013.

3 - Games and toys analysed here, comprises the four digit NACE code 3240. NACE is the official classification of economic activity used by Eurostat, the statistical office of the EU.

It is estimated that legitimate industry loses approximately 1.4 billion euros of revenue annually due to the presence of counterfeit games and toys in the EU marketplace, corresponding to 12.3% of the sector's sales.

These lost sales translate into direct employment losses of approximately 6,150 jobs. This figure does not take account of the effect of imports, since in those cases the associated employment impacts occur outside of the EU. Estimated employment losses in the EU therefore relate to goods produced and consumed within the EU.

If we add the knock-on effects on other industries and on government revenue, when both direct and indirect effects are considered, counterfeiting in this sector causes approximately 2.3 billion euros of lost sales to the EU economy, which in turn leads to employment losses of 13,168 and a loss of 370 million euros in government revenue.

It is important to note that in contrast to the first two reports, the impacts of counterfeiting for games and toys refers only to manufacturing and so does not include wholesale and retail trade[4]. For that reason, the absolute numbers in this report cannot be directly compared to those previously presented for cosmetics and personal care and for clothing and footwear.

4 - The reason is that the data provided by Eurostat does not distinguish between retail sales of toys and games and retail sales of other goods which are not part of this NACE code. It is therefore not possible to calculate the trade margins for toys and games.

1. Introduction

A major problem which has hindered the effective enforcement of Intellectual Property Rights (IPR) in the EU is related to a lack of knowledge in relation to the precise scope, scale and impact of IPR infringements. Many attempts to quantify the scale of counterfeiting and its consequences for businesses, consumers and society as a whole have suffered from the absence of a consensual and consistent methodology for collecting and analysing data on counterfeiting and piracy across various sectors. Different approaches have been used, such as surveys, mystery shopping, monitoring of online activities, making it all the more difficult to aggregate information for the whole economy. The very nature of the phenomenon under investigation makes it extremely challenging to quantify reliably, as obtaining comprehensive data for a hidden and secretive activity is by necessity difficult.

These challenges have in turn hindered the tasks of those involved in enforcing IP rights and in charge of establishing precise priorities, programmes and targets for enforcement, as they limit the possibilities to design more focused as well as evidence-based public awareness campaigns.

To help overcome these challenges while taking full account of methodological constraints, the Observatory developed a specific approach that has so far been applied to the Cosmetics and Personal Care, Clothing, Footwear and Accessories, and the Sports Goods sectors.

In the present report the Observatory focuses its attention on the sector officially labelled Manufacture of games and toys by Eurostat. This sector covers different products, such as:

- **manufacture of dolls and doll garments, parts and accessories**
- **manufacture of action figures**
- **manufacture of toy animals**
- **manufacture of toy musical instruments**
- **manufacture of playing cards**
- **manufacture of board games and similar games**
- **manufacture of electronic games: chess etc.**
- **manufacture of reduced-size (“scale”) models and similar recreational models,**
- **electrical trains, construction sets etc.**
- **manufacture of coin-operated games, billiards, special tables for casino games, etc.**
- **manufacture of articles for funfair, table or parlour games**
- **manufacture of wheeled toys designed to be ridden, including plastic bicycles and tricycles**
- **manufacture of puzzles and similar articles**

Video games consoles, software for video game consoles or bicycles are not included in NACE class 3240.

The approach in this study aims to estimate the scale of two major impacts of counterfeiting which cover the direct and indirect costs to industry and the wider costs to government and society.

1) Direct costs to industry

The costs to industry are mainly comprised of lost sales due to counterfeiting. Estimation of lost sales is therefore a necessary first step, both because it constitutes a major economic consequence in itself and because it drives other consequences, for example loss of public fiscal revenue.

The methodology builds on an adaptation of an approach developed for the European Commission[5] so that it can be used on a sectorial level rather than on a firm level which proved very difficult to apply in practice.

Variations in a sector's sales are analysed using statistical techniques which allow the researcher to relate them to economic and social factors and thereby estimate the amount of sales lost by rights holders due to counterfeiting.

Loss of sales also leads to loss of employment in the affected sector, which can be derived from European statistical data on employment for the sector in question.

2) Indirect effects of counterfeiting

In addition to the direct loss of sales in the identified sector, there are also impacts on other sectors of the EU economy. These indirect effects are a result of the fact that the different sectors of the economy buy goods and services from each other for use in their production processes. If one sector's sales are reduced because of counterfeiting, then this sector will also buy fewer goods and services from its suppliers, causing sales declines and corresponding employment effects in other sectors.

3) Impacts on Public Finances

Since the activity in question is illegal, it is likely that those engaged in manufacture of counterfeit goods do not pay taxes on the resulting revenues and incomes. Therefore, an additional impact of counterfeiting is the resulting losses of tax revenue by government, specifically income taxes and social contributions, corporate taxes, and indirect taxes such as excise taxes or VAT.

In order to approximate these costs, several relationships are estimated. The methodology is fully explained in the Appendices and is briefly outlined below.

Step 1: Estimation of lost sales due to counterfeiting

Predicted sales of the sector are generated and compared with actual sales in each country, as reported in official statistics. The difference can then be explained by socio-economic factors such as growth in gross disposable income or GDP per capita, or the exchange rate of the Euro. In addition, factors related to counterfeiting are considered, such as the behaviour of consumers, and the characteristics of the country's markets and its legal and regulatory

5 - RAND (2012): Measuring IPR infringements in the internal market. Report prepared for the European Commission

environments[6]. The difference between forecast and actual sales is analysed in order to extract the effect of counterfeited consumption on legitimate sales.

Step 2: Translation of lost sales into lost jobs and lost public revenue

Since the legitimate industry sells less than it would have sold in the absence of counterfeiting, it also employs fewer workers. Data from Eurostat on employment in these sectors is used to estimate the employment lost related to the reduction of legitimate business as a result of lost sales due to counterfeiting.

In addition to the direct loss of sales in the sector being analysed, there are also indirect impacts on other sectors as this sector will also buy fewer goods and services from its suppliers, causing sales declines and corresponding employment effects in other sectors.

Furthermore, the reduced economic activity in the private sector has an impact on government revenue as well, essentially tax revenue such as VAT, household income tax and tax on company profits, but also social security contributions.

It should be noted that the indirect effects of sales lost due to counterfeiting only include losses in sectors that provide inputs to manufacture of legal products in the EU. Possible positive effects of inputs provided for production of illicit goods that could be manufactured inside or outside the EU, are ignored in this study. In other words, the indirect effect calculated is a gross effect that does not take into account the long-term effect of sales displacement from legal to illegal producers. The net employment effect could therefore be smaller than the gross effect calculated here.

Similarly, while illicit activities do not generate the same levels of tax revenue as legal activities, to the extent that sales of counterfeits happen in the legitimate sales channels, some amount of direct and indirect taxes are levied on these products, and so the net reduction in government revenue may be smaller than the gross effect calculated here.

Unfortunately, data currently available do not allow for calculation of these net effects with any degree of accuracy.

The next section presents the main findings of the study.

6 - Perception of corruption by citizens from Eurobarometer and the Worldwide Governance Indicator from the World Bank are used in this study

2. Impact of counterfeiting in the Games and Toys Sector

The starting point is the estimation of consumption of these products by country. Based on official data from Eurostat on production and intra and extra EU trade, total consumption of games and toys for the EU 28 countries at producer prices (without wholesale and retail trade margins) totalled 10.6 billion euros in 2012[7].

Information on wholesale and retail trade of games and toys cannot be obtained from official statistics, so estimation of consumption for these products is at producers prices and thus does not include the value of trade margins paid to distributors and retailers.

In the same year, there were approximately 53 thousand people employed in the games and toys manufacturing sector.

In 2012 the most significant producer of games and toys in the EU was Germany, accounting for 40% (2.7 billion euros) of total production and net exports of more than 1 billion euros.

The industry is comprised of 5,200 enterprises in the EU28, with an average of 10.2 workers per firm. Of these companies, 99% are SMEs of which 90% (or 4,644 companies) are micro enterprises (fewer than 10 workers) employing 8 thousand persons. In Germany however, about 77% of companies are micro enterprises and the average number of persons employed per enterprise is more than double the EU average (26.8 workers). This is mainly due to the presence of seven large companies employing, on average, more than 950 persons.

These statistics underline the pre-dominance of small companies in the manufacture of games and toys across the EU.

7 - In 2012, EU production amounted to 6.4 billion euros. Net imports from third countries were 4.2 billion euros, leaving 10.6 billion euros (at producer prices) for consumption in the EU.

Case study – Magia Borras

Educa Borrás, based in Barcelona, can trace its roots back more than 120 years. The company manufactures a range of toys and games in its two plants in Barcelona and Alicante, respectively, employing about 200 people.

The company's most emblematic product is Juego de Magia Borras, a "magic box" launched in 1933 and known to several generations of children in Spain and elsewhere. Even though the box has evolved over the years, the packaging has emphasized the word "Magia" since 1956 and has maintained the current form, a black box with the word MAGIA in yellow letters with red framing, and the word BORRAS underneath, since 1993. The trade mark Magia Borras is protected in NICE class 28 in Spain, in the EU, and in 54 other countries.

In November 2004, an employee of Educa Borrás, while visiting a toy store in Barcelona, was surprised by seeing the Magia Borras box priced at 4.90 euros, about 10 euros less than the normal selling price. After calling the company to make sure that the distributor had purchased the game at the usual price, the employee looked more closely at the product and noticed that the box labelled "Magia Funny" instead of "Magia Borras".

It became obvious that Magia Funny was a copy. The design of the box was faithfully reproduced, as were the components of the game inside the box. The only indication that this was not the genuine product was the substitution of "Funny" for "Borras" on the box. The counterfeits were imported from China.

Clearly if even an employee of the company, who is intimately familiar with the product, can be confused by the copy, the likelihood that an average consumer mistakes the fake for the genuine article is quite high. Even in cases where the consumer knows the usual selling price and therefore realises that this must be a copy, in many cases she would choose to buy the counterfeit in order to save money, on the assumption that the contents are equivalent.

However, the equivalence of the contents is only apparent. The copied components are of inferior quality, making it impossible to perform some of the magic tricks. The consumer has thus been doubly cheated: the product is counterfeit and it does not perform as the original.

The company has no way of knowing how many "Magic Funny" boxes were sold before its employee discovered the fraud. However, the very same day, representatives of Educa Borrás appeared in court with the counterfeit product and successfully enforced the company's trade mark. The judge ordered immediate cessation of sales and removal from the market of any unsold stock of the infringing products, thus limiting further damages to the company. The importer of the fake box was also ordered to pay the sum of 14486 euros.

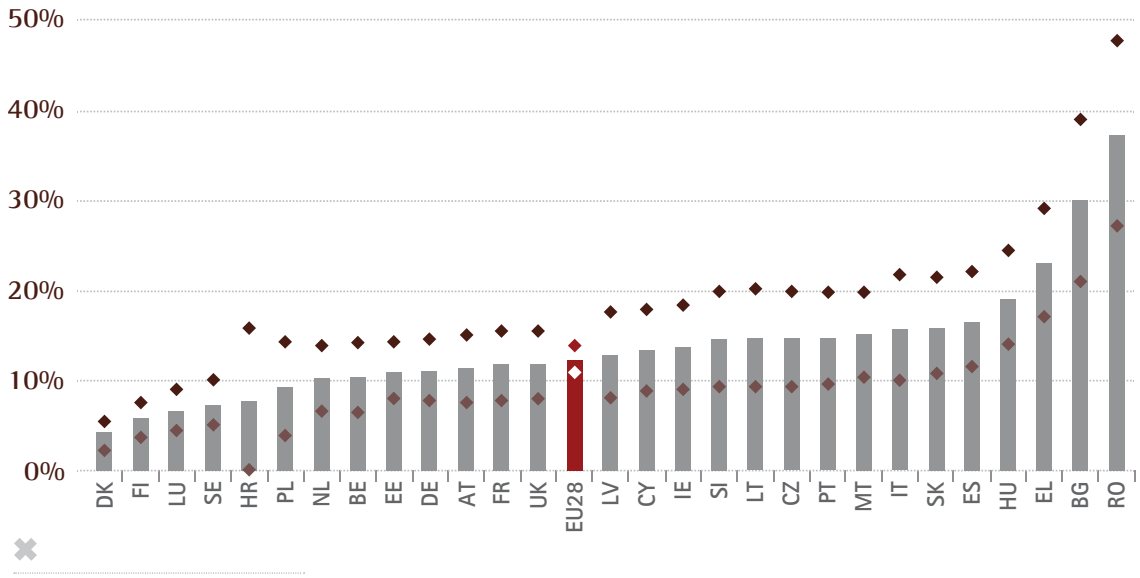
Despite this success, counterfeit Educa Borrás products continue to be discovered from time to time.

Based on country-level consumption data, the difference between forecast sales and actual sales has been estimated for each country (Appendix A), and analysed using statistical methods (Appendix B), relating the sales shortfall to factors (called variables in economic parlance) such as:

- **GDP growth** rate and the **Euro exchange rate** (socio-economic variables);
- the percentage of the population thinking that the problem of **corruption is widespread** as reflected in the Eurobarometer on corruption[8], and the growth rate of the **World Bank Index of Rule of Law**[9] (variables related to counterfeiting).

The resulting estimates of lost sales due to counterfeiting for all Member States are shown in the figure below. This is the **direct impact** of counterfeiting discussed above, although as noted, for this sector, due to limited available information, we only consider the impacts on the manufacturing industry, as opposed to wider considerations incorporating the wholesale and retail trade sectors.

For each country, the bar indicates the impact of counterfeiting on the sector, expressed as a percentage of sales, while the diamonds indicate the 95% confidence interval of that estimate[10]. The figures represent an annual average for the 6 years 2007-2012.



8 - According to WCO (2012), "the predominance of the informal economy is then associated with corruption and the degree of regulation..." So, to the extent that counterfeiting is part of the informal economy, a measure of corruption could be considered explanatory for counterfeiting.

9 - The Rule of Law index captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

10 - The 95% confidence interval is a statistical calculation which means that there is a 95% probability that the true figure lies between the lower and upper bounds of that interval. For example, for the EU as a whole, the estimated percentage of lost sales is 12.3%, with a 95% probability that the true percentage lies between 10.8% and 13.9%, as shown in the table below.

For the EU as a whole[11], the estimated total counterfeiting effect amounts to 12.3% of consumption (1.4 billion euros). This is a direct estimate of sales lost by legitimate toys and games manufacturers in the EU each year due to counterfeiting.

Since the legitimate industry sells less than it would have in the absence of counterfeiting, it also employs fewer workers[12]. Data from Eurostat on sectorial employment-to-sales ratios are used to estimate the corresponding employment lost in the legitimate games and toys sector due to counterfeiting, resulting in a total of 6,150 lost jobs across the EU.

11 - The estimation was performed using data from 20 Member States, as these countries account for 95% of the total consumption of the EU28. It is reasonable to apply the resulting coefficients to the remaining eight Member States for which data on the dependent variable was not available.

12 - The total lost sales figure of 1.4 billion euros is not used to calculate employment impacts, since 551 million euros of this total is attributable to imports. Therefore, the figure used to estimate employment impacts within the EU is 865 million euros, representing the difference between estimated total lost sales and imports.

Country-level estimates of lost sales, including 95% confidence intervals, expressed both as a percentage of total sales and in million euros, are shown in the table below:

	Lower 95%	Average	Upper 95%	Lost sales (million Euro)
AUSTRIA	7.6	11.3	15.0	49
BELGIUM	6.3	10.2	14.1	21
BULGARIA	20.7	29.8	38.9	16
CYPRUS	8.7	13.2	17.7	5
CZECH REPUBLIC	9.1	14.5	19.9	24
GERMANY	7.4	10.9	14.4	327
DENMARK	2.9	4.1	5.3	6
ESTONIA	6.9	10.6	14.3	2
GREECE	16.9	22.9	29.0	25
SPAIN	11.1	16.6	22.0	167
FINLAND	3.7	5.5	7.4	6
FRANCE	7.7	11.6	15.4	168
CROATIA	0.0	7.8	15.6	4
HUNGARY	13.8	19.0	24.3	11
IRELAND	9.0	13.6	18.2	26
ITALY	9.9	15.6	21.4	201
LITHUANIA	9.0	14.5	19.9	3
LUXEMBOURG	4.2	6.6	8.9	3
LATVIA	7.9	12.7	17.5	4
MALTA	10.3	14.9	19.6	2
NETHERLANDS	6.7	10.2	13.8	26
POLAND	3.9	9.0	14.2	32
PORTUGAL	9.4	14.5	19.6	23
ROMANIA	27.0	37.2	47.4	41
SWEDEN	4.8	7.4	10.1	12
SLOVENIA	9.2	14.4	19.7	4
SLOVAKIA	10.4	15.9	21.3	5
UNITED KINGDOM	7.8	11.6	15.4	213
EU28	**10.8**	**12.3**	**13.9**	**1,427**

The biggest absolute impacts are found in Germany, Italy, France, and Spain. These four countries account for 60% of the total lost sales in the EU due to counterfeiting.

Employment losses arising from lost sales (6,150 jobs), relate to countries where the products are manufactured, not where they are sold. The table below shows the eight countries with the highest employment losses, accounting for 77% of the EU total job loss.

Lost employment	Persons employed	%
GERMANY	1,563	11.8
UNITED KINGDOM	623	12.0
ITALY	518	14.4
POLAND	506	14.2
SPAIN	498	13.7
HUNGARY	351	16.5
BULGARIA	334	18.8
FRANCE	327	11.8
EU28	6,150	12.4

Direct employment impacts are calculated at the country level by estimating lost sales by that country's toys and games manufacturing sector across the entire EU market. For example, the direct sales lost by German industry as a result of counterfeiting are estimated by adding sales lost in Germany to German sales lost in other EU countries. The latter total is calculated from the differing counterfeiting rates prevalent within each of the Member States.

Consequently, whilst Germany's lost sales figures are below those of the EU average, employment losses are somewhat higher, given German industry's reliance on both domestic and EU markets.

Indirect impact

In addition to the direct loss of sales in the games and toys sector, there are also impacts on other sectors of the EU economy, as the sector suffering lost sales due to counterfeiting will also buy fewer goods and services from its suppliers, causing sales declines and corresponding employment effects in other sectors.

To assess this indirect impact, data from Eurostat[13] is used to calculate how much the games and toys sector buys in the EU from other sectors in order to produce what it delivers[14].

Final demand for games and toys, as estimated in this report, includes imported goods and not only the value of EU production. Analysis of these import figures reveals that on balance the EU is a net importer of games and toys from countries outside of the EU. Employment and indirect effects arising from these imports occur outside of the EU and therefore are not included in our calculations. Consequently, of the total lost sales figure of 1.4 billion euros, only the value of domestic production (865 million euros) is used to generate indirect impacts[15].

13 - Input-Output Tables (IOT) published by Eurostat provide the structure of input requirements for the production of a certain level of final demand acknowledging whether the origin of these inputs are either domestic or imported.

14 - The input-output tables are provided by Eurostat at division level (2 digit NACE level) or aggregation of divisions instead of class level (4 digit level). This means that for calculating the impact of the sales reduction in 32.40 NACE class, it is necessary to use the structure of 'Furniture and other manufactured goods' industry (NACE 31-32).

15 - On the other hand, this report only estimates the effect on sales of the games and toys sector within the EU marketplace. So, to the extent that counterfeiting products in non-EU markets displace exports of legitimate EU manufacturers, there is a further employment loss in the EU which is not captured here.

Total direct and indirect effects in the EU of lost sales due to counterfeiting as an annual average for the period 2007-2012 amounts to 2.3 billion euros.

Thus, beyond the direct effects on the sectors involved in the production of games and toys of 1.4 billion euros, a further 850 million euros is lost in other sectors of the economy due to counterfeiting. This is the *indirect* effect of counterfeiting[16].

Turning to employment, if we add losses in the supplier sectors to the direct employment loss in the manufacture of games and toys, the total employment loss resulting from counterfeiting of games and toys in the EU is estimated at 13,168.

Finally, the reduced economic activity in the legitimate private sector has an impact on government revenue as well[17]. If we accept this assumption, the lost taxes that sales of games and toys valued at 1.4 billion euros would have generated can be calculated, as well as the tax revenues corresponding to the total (direct + indirect) loss of 2.3 billion euros calculated above.

The three main types of tax considered are[18]: Value Added Tax (VAT), taxes on household income, and taxes on the income or profits of companies.

1) **The lost VAT is estimated on the basis of household consumption of direct lost sales in games and toys (1.4 billion euros)[19], accounting for 202 million euros.**

2) **The lost household income tax, estimated on the basis of the share of wages generated by employment lost to total wages, considering direct and indirect effects on employment, amounts to 70 million euros.**

3) **The lost tax on corporate profits is estimated from the share of direct and indirect costs to industry and amounts to 29 million euros.**

In addition, social security contributions linked to the direct and indirect employment losses are also estimated. Social security contributions data by industry are available in Eurostat, so that social security contributions per employee in each industry can be used to calculate lost contributions as a consequence of counterfeiting. These lost social security contributions amount to 68 million euros.

16 - As mentioned in Section 1, this calculation assumes that the counterfeit products are produced outside of the EU. If they are (partly) produced inside the EU, then the impact would be less than shown in the table since those illicit producers would presumably source some of their inputs from EU producers.

17 - According to WIPO (2010) and OECD (2008), most of the empirical work assumes that counterfeiting occurs in informal markets that usually do not generate tax revenues.

18 - National Accounts tax aggregates are published by Eurostat and provide information on total payments for these three taxes to all levels of government.

19 - VAT generated by indirect effects is not estimated because inputs are intermediate uses that in general do not pay VAT.

> The total loss of government revenue (household income taxes and social security contributions, corporate income taxes and VAT) can be roughly estimated at 370 million euros.

3. Conclusions and Perspectives

The four studies attempting to quantify the scale and impact of IPR infringements in cosmetics and personal care, clothing and footwear, sports goods, and now toys and games, have provided coherent estimates of the size of the problem of counterfeiting for legitimate businesses and society in terms of lost sales, leading to lost jobs and loss of public revenue. These studies have used a common methodology and demonstrated the benefits from working in cooperation with stakeholders to take advantage of their knowledge of market conditions, while relying on harmonised European statistical data for the analysis.

These sectorial studies will be followed in the coming months by other similar studies covering additional sectors, applying the same methodology and combining it with knowledge from industry stakeholders. These sectors include medicines; tobacco; alcoholic beverages covering beer, wine and spirits; jewellery and watches; handbags and luggage; computers; and other sectors, depending on availability of data.

In parallel, the Observatory has embarked on a joint study with the Organization for Economic Cooperation and Development (OECD) to estimate the value of counterfeit goods in international trade, and on studies of infringements in the music, film and e-book industries, in this case with the support of the Joint Research Centre of the European Commission.

Taken together, these studies complement each other and will provide a complete and objective picture of the impact of IPR infringements in Europe, in order to help policy makers develop effective enforcement policies.

Appendix A: The first stage forecasting model

Employing the first stage of the two stage model as discussed earlier, we generate annual forecasts of consumption for each of the Member States. The process of producing the forecasts and estimating the impact of counterfeiting is depicted in the diagram below.

The simplest available comparable forecasts, across all member states, are produced via the use of ARIMA modelling. These models only use the past values of consumption to produce a forecast of future consumption. The forecast error, between the ARIMA forecast and observed sales, represents an estimate of the expected lost sales, notwithstanding adjustments for the impact of socio-economic factors.

The forecasting error is the difference between predicted and actual consumption and for the purposes of comparability is expressed as a proportion of actual consumption. For instance,

$$q_{it}^{*} = \frac{\hat{Y}_{it} - Y_{it}}{Y_{it}}$$

where Y_{it} is the consumption of games and toys in country i and year t (measured in euros) and $\hat{Y}_{it}$ is the forecast of Y_{it} obtained from the univariate model using consumption expenditure information up to and including the period t-1.

The relative error q_{it}^{*} measures the extent to which the forecasting model has predicted a higher or lower value (as a share of actual consumption) versus the actual level of consumption observed from the Eurostat data.

Step-wise forecasting errors for the six years from 2007 to 2012 are constructed for 20 Member States for which sufficient data is available.

The forecasting errors are presented in the following table. It is evident that these errors exhibit a large degree of variability, swinging from sizeable negative errors in the initial periods to similar positive magnitudes in 2008 and 2009. However, the forecasting errors are not interesting in themselves. The purpose of this study is not to produce a "good" forecast but rather to generate a set of relative forecasting errors which can then be quantitatively analysed to construct estimates of counterfeiting. Forecasts are produced using univariate models and using an automatic procedure, which ensures that they are comparable and "unpolluted" by a priori knowledge of factors influencing changes in demand.

RELATIVE ERRORS (%)	2007	2008	2009	2010	2011	2012
AUSTRIA	-34.1	4.1	5.0	-6.8	-6.0	1.1
BELGIUM	27.0	-2.1	5.4	-24.9	15.4	24.6
BULGARIA	-27.1	-19.6	89.3	-44.0	-20.1	-15.6
CYPRUS	-9.4	-8.9	11.8	-31.5	11.7	1.5
GERMANY	-14.6	-13.7	-2.8	-16.5	-2.5	-1.6
DENMARK	3.0	60.8	71.2	-62.3	-4.1	-19.9
ESTONIA	-28.7	62.5	12.5	-30.6	-2.1	-5.8
GREECE	-25.0	-22.5	28.2	16.8	39.2	NA
SPAIN	-8.5	6.8	31.0	-17.0	18.9	-0.8
FINLAND	-11.8	-8.7	1.6	-17.0	8.3	-4.0
FRANCE	-6.1	16.5	-5.9	-3.7	-3.8	3.7
HUNGARY	-19.0	31.3	NA	NA	NA	NA
ITALY	-29.3	18.4	18.5	-6.5	3.1	36.7
LATVIA	18.0	77.2	NA	NA	-20.3	-6.8
NETHERLANDS	1.4	NA	NA	NA	NA	NA
POLAND	-19.4	-21.6	31.8	-16.1	8.1	7.0
PORTUGAL	-1.6	10.6	4.0	0.2	-28.0	39.1
SWEDEN	-27.8	11.3	15.3	3.2	10.2	5.1
SLOVENIA	-40.0	31.2	21.9	41.6	NA	NA
UNITED KINGDOM	-7.1	15.7	11.4	-13.1	7.0	-2.7

The second part of the estimation process seeks to determine to what extent these forecast errors can be explained by economic and subsequently counterfeiting factors.

Appendix B: The second-stage econometric model

Counterfeiting might be one of a number of factors impacting on the level of legal sales of games and toys, but there are, as outlined earlier, a series of other economic factors which can explain the differential, such as variables related to the economic capacity of households, or consumer demographics (e.g. population growth) or any other driver of consumption expenditure.

Having accounted for the influence of economic variables on the sales differential, we look to assess the extent to which counterfeiting variables, or relevant proxies, can explain the propensity to purchase fake games and toys. These variables might include measures of consumer and market characteristics, as well as the evolution of a country´s legal environment.

Combining the economic and counterfeiting variables allows us to specify a model, whose aim is to explain the aggregate differential (forecast errors) between expected and real sales. The model is specified in the following format.

$$q_{it}^{*} = \alpha * X_{it} + \beta * Z_{it} + \varepsilon_{it}$$

Where X_{it} is a matrix of explanatory economic variables unrelated to counterfeiting and Z_{it} a matrix of variables related to counterfeiting. Finally, ε_{it} is the remaining error.

Economic variables considered to have explanatory power, **unrelated to counterfeiting** include:

- Gross Disposable Income (GDI) of the household sector: per capita income and growth;
- GDP per capita and GDP growth;
- Population growth;
- Average age of the population;
- Population under 15 years old;
- Exchange rate of Euro vs. other EU currencies.

The second term of the equation, Z_{it}, contains the matrix of **variables thought to be related to counterfeiting**[20]. These variables include:

- Population at risk of poverty or social exclusion, as a share of total population and growth;
- Distribution of income by quartiles (including the share attributed to the lowest quartile and the ratio between the highest and lowest quartile);
- Gini coefficient (as a measure of income inequality);
- Variables selected from the Observatory's IP Perception study and from the Eurobarometer (including counterfeiting and corruption related variables);

[20] A list of factors affecting demand and consumption for counterfeit goods is available in OECD (2008).

- Corruption Perceptions Index, CPI (level and growth);
- Intellectual Property Right Index;
- Worldwide Governance Indicators (World Bank), covering Government effectiveness, regulatory quality, rule of law and control of corruption (level and growth);
- Sales in stalls and markets (from survey of trade enterprises);
- Internet purchases (as a percentage of population and growth).

Variables 1 to 4 in the list are considered to be consumer-related drivers of demand for counterfeiting. The population at risk of poverty, the share and concentration of income in quartiles of the household income distribution, along with the Gini coefficient are all variables that describe degrees of income inequality.

The variables considered for inclusion in the Z matrix from the IP Perception study and the Eurobarometer include; the percentage of the population that had bought counterfeit products intentionally or been misled into the purchase of counterfeit products and the percentage of the population that considered, in certain circumstances, buying counterfeit products to be acceptable.

Corruption variables considered for use in the Z matrix from the Eurobarometer survey include; the percentage of the population declaring that corruption is widespread, that it is in the business culture, that it is a major problem, and the percentage of the population that believed corruption had increased over the last three years.

Variables 5 to 7 in the list are considered to be drivers of counterfeiting related to institutional characteristics of each country.

The Corruption Perception Index (CPI) is published by Transparency International and measures how corrupt public sectors are seen to be by the public in each country. In this study the updated index is used as a time invariant variable with reference year 2012.

The Intellectual Property (IP) Rights Index used is published by Property Rights Alliance and measures the strength of protection accorded to IP. The 2010 index is used in this study and the same value is used in each country across the six years studied as a time invariant variable.

The Worldwide Governance Indicators reflect the perception of government effectiveness, regulatory quality, rule of law and corruption. They are published annually and range from 2.5 for favourable aspects of governance to -2.5 for poor. These indicators are considered as potential proxies for the perceived risk of buying or selling counterfeit goods, in much a similar way as considered in the 2010 WIPO study. These indices have a high and negative correlation with poverty indicators and with variables from the IP Perception study and Eurobarometer.

Finally, variables 8 and 9 reflect country market characteristics that might be related to counterfeiting.

Before commencing with estimation, it is clear that some of these variables will be correlated with each other. Such correlation is a possible sign of the existence of multicollinearity. If

correlated explanatory variables are included in the model, the estimated coefficients for these variables could be mistakenly considered as insignificant (small t-statistics), although possessing a high overall significance for the model, as measured by the F-Test. This situation can pose problems when trying to interpret the meaning and significance of parameter estimates and when testing the significance of other variables in the model specification.

For instance, per capita GDI of the household sector and per capita GDP are highly correlated. We therefore include in the model only those variables with the greatest explanatory power in order to avoid the problems described.

Having defined the model and acknowledged potential estimation issues (multicollinearity) we begin testing the specified model. Our first observation is that there is correlation between the residuals of the specified model and the variations in the sales differential, namely our dependent variable.

This relationship indicates that we might have a problem with heteroscedasticity, which implies that the variance of our estimated residuals is non-stable (variance stability is a key assumption behind the statistical validity of Ordinary Least Squares (OLS) method).

There are different solutions to this issue (discussed in Appendix C below), although on this occasion we employ Groupwise Two Stages Least Squares (2SLS) estimation to resolve the problem, since OLS estimators are not efficient in the presence of heteroscedasticity. This method assumes that each group (country) has a common variance.

Model results

The specified model produces the following results[21]:

Variable	Coefficient	Standard Error	t Statistic	95% Confidence interval	
				Lower	Upper
Constant	-0.1180	0.0487	-2.4228**	-0.2146	-0.0214
GDP growth	-0.0146	0.0033	-4.4646 ***	-0.0210	-0.0081
Euro exchange rate growth	0.8021	0.1389	5.7735***	0.5265	1.0777
EB: corruption is widespread	0.1702	0.0712	2.3906 **	0.0290	0.3114
WB Index Rule of Law growth	-0.5341	0.1433	-3.7280***	-0.8183	-0.2500

R square = 54%
F statistic = 23.7 ***

* significant at 90% confidence level
** significant at 95% confidence level
*** significant at 99% confidence level

21 - All results of diagnostic tests are available on request.

The combination of economic and counterfeiting-related variables explains approximately 54% of the variation in the differential between expected and actual sales as calculated in the first stage of the estimation process.

Of the two economic variables, GDP growth has a negative coefficient, meaning that higher values of GDP growth are associated with smaller forecasting errors. On the other hand, the Euro exchange rate has a positive coefficient so that appreciation of the Euro against other currencies leads to higher forecasting errors in countries outside the euro zone.

The remaining two variables in the model relate to counterfeiting and cover the percentage of the population believing that the problem of corruption is widespread, as reflected in the 2013 Eurobarometer and the World Bank Index of Rule of Law growth rate.

The Eurobarometer variable is time invariant and its coefficient has a positive sign. This implies that a higher percentage of the population thinking that corruption is widespread, has a positive relationship with forecast errors estimated in the 1st stage. The World Bank Rule of Law Index growth variable has a negative coefficient, so that a higher value of this index corresponds to better governance and is related to smaller forecasting errors.

Having optimised this second stage specification for multicollinearity and heteroscedasticity we estimate the impact of counterfeiting via the following relationship;

$$C_{it}^{*} = \widehat{\beta_1} * Z_{1_i} + \widehat{\beta_2} * Z_{2_{it}}$$

Where C_{it}^{*} represents the sales lost due to counterfeiting in country i and year t (expressed as the fraction of the sector's actual sales), Z_{1_i} is the percentage of population that indicates that corruption is widespread, and $Z_{2_{it}}$ is the value of the World Bank Index of Rule of Law growth in that country and year[22]. The β's are the estimated coefficients from the table at the beginning of this section.

Interpretation of this specification is made on the following basis. For a country where 20% of the population declares that corruption is widespread and the average growth rate of Rule of Law index in 2007-2012 is -1%, the effect of counterfeiting on legitimate sales of games and toys is a sales decrease of 3.9% (0.1702*0.20 - 0.5341*(-0.01) = 0.0394).

22 - It should be noted that in this case, the value of Z_{1_i} is the same for all t since the variable is time-invariant during the period covered by this study.

Appendix C: Diagnostic tests for checking regression model assumptions

Checking the stability of coefficients

As the main objective of the model is to estimate the coefficients of the counterfeiting variables, it is clear that the characteristics of these coefficients should be investigated.
To check the stability of these coefficients, other explanatory variables were introduced into the 2nd stage model and different methods employed. The resulting estimated coefficients of the counterfeiting-related variables are presented in the following table.

	EB Corruption widespread	WB Rule of Law
1	0.1702	-0.5341
2	0.1457	-
3	-	-0.5025
4	-	-0.5050
5	0.1820	-0.5292
6	0.0758	-0.4400

As can be seen, the coefficients of variables related to counterfeiting remain stable even when explanatory variables are added or different methods of estimation are used. Such stability is a strong indication that the model is correctly specified.

Testing basic assumptions of regression model

One of the desired conditions for an econometric model is stability in the variance of its error term. This stability is referred to as homoscedasticity. Once a model is estimated, if the errors do not have a common variance, then it indicates the presence of heteroscedasticity. This is a problem that must be addressed, otherwise, the estimators using the most common regression method, Ordinary Least Squares (OLS), will be inefficient and the confidence intervals will be invalid.

Different tests were employed to detect the presence of heteroscedasticity (White Test and Breusch and Pagan Test) considering different specifications for residual variance (standard errors of the ARIMA forecasts and groupwise heteroscedasticity). Results from those tests suggested estimation of the 2nd stage model via Groupwise Two-Steps Least Squared (2SLS) method assuming a common variance by country that is estimated based on OLS residuals.

Finally, residuals of the 2SLS method were analysed to check compliance with the usual assumptions of regression models. The tests comprised a White test and residuals plots for heteroscedasticity; a tolerance analysis and Variance Inflation Factor (VIF) test for multicollinearity; and the Jarque-Vera test for normality of the residuals. Test results indicated that the residuals complied with regression assumptions, with the possible exception of normality[23].

23 - All results of diagnostic tests are available on request

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