R E P O R T

Measuring IPR infringements in the internal market

Development of a new approach to estimating the impact of infringements on sales

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Executive summary

Counterfeiting is not a new phenomenon. For centuries, artists or inventors have seen their creations and products copied without their permission. However, it is with the trends of globalisation, the integration of markets and the rise of the Internet economy in recent decades that violations of Intellectual Property Rights (IPRs) have become more widespread. Easy access to computers, Internet and other technological developments facilitate duplication of designs, labels, logos, packaging and documentation with speed, accuracy and relative anonymity.

IPRs refer to protections granted to firms and/or individuals who are the creators of ideas, products, or methods that allow the creators/inventors a period of time in which they can earn exclusive returns on these intangible and tangible products as a way of rewarding them for the risky investment they initially made. Counterfeiting these products or sharing creative content without permission of the creators infringes upon these intellectual property rights. We distinguish two types of infringements: counterfeiting of physical products and unauthorised use of protected content (UUPC), which is commonly referred to as piracy.

It is argued that 'victims' of counterfeiting and UUPC could face considerable economic, health and safety impacts. Many of these will impact the IPR holders, for example if consumers purchase these counterfeited or pirated substitutes instead of the legitimate products. In turn for consumers, their health or safety may be compromised. Some argue on the other hand that some forms of IPR infringements may even have positive externalities.

There is no shortage of estimates of the extent of IPR infringements, and there is some empirical evidence of negative impacts of these infringements in specific sectors. However, most of these efforts lack a transparent methodology, suffer from serious methodological or data limitations or are funded by stakeholders in the debate. This means that the resulting estimates must be heavily caveated and qualified, putting into question the extent to which they are useful to governments and firms trying to understand and tackle the phenomenon. Without objective and reliable estimates of the extent of IPR violations it is difficult to debate these claims.

Given the intensity of these debates, an objective and evidence-based approach towards measuring the scale and impact of the phenomenon has become more important than ever. This study was set up to assist the European Commission in the development of a methodology that would quantify the scope, scale and impact of IPR infringements on the European economy in the Internal Market. This study is the first stage in an attempt to continuously assess the problem and to develop evidence-based policies in the area of intellectual property rights. In this report we offer the "building blocks" for a methodology that is consistent, robust, feasible and reliable in measuring the size of counterfeiting and UUPC. Further testing of the methodology is recommended in multiple industry sectors to better understand the scope and scale of the

problem before it is possible to move to the next stage, which would involve assessing the impact of counterfeiting and UUPC on industries, government and public health or safety.

In this report we aim to address a number of research questions that help to achieve this goal.

What can we learn from previous efforts about the drivers and impacts of IPR infringements?

In order to develop a theoretical basis for a method to estimate the extent of IPR infringements, it is important to understand the factors that encourage suppliers to offer products that are in violation of these rights or drive consumers to buy them. Some of these drivers of supply and demand of counterfeit products or UUPC are summarised in the table below.

Macro-level drivers of supply	Macro-level drivers of demand
• The growing prevalence of digital and networked technologies	• Social acceptance to buy products that violate intellectual property rights
• The globalization of trade, the growing importance of international brands	• Limited availability of authentic goods
• The presence of large integrated markets supporting free trade	• The high price of authentic goods
• Low or weak enforcement of penalties targeting violators of IPR infringements	• The rising quality of counterfeit goods.
• The growing presence and involvement of organized crime in the production and distribution of counterfeited and pirated goods	
• Industry-specific factors.	

The production or consumption of products that infringe IPRs could have important implications for rights' holders, consumers, governments, employees, etc. There have been a number of attempts to estimate the variety of impacts, using different methodologies. They range from an annual $ 77.5bn in lost tax revenues in the G20 to 120,085 jobs lost in the motion picture industry. By offering a sample of these estimates, this report provides an indication of the variation in attempts and some indicative empirical evidence for the breadth of the effects of IPR infringements and their order of magnitude.

The validity and reliability of these estimates have been extensively challenged in previous studies. Either they tend to lack the necessary transparency or, when rigorously describing their methodologies, they have been criticized for some of their assumptions. Given the poor understanding of the extent of IPR infringements in the internal market, which is a necessary basis for estimating their effects, we focus in this study on developing an approach to measure trends in counterfeit and UUPC markets.

What are the strengths and weaknesses of existing methodologies that have been applied to measure the scope, size and impact of IPR infringements?

We identified nearly 250 publications addressing the issues relevant for this study, 80 of which were analysed in detail. We focused on studies that provided original attempts to quantitatively estimate the scope, size or effects of counterfeiting and/or UUPC, in any geographical area, and for one or more products. For each source we assessed the robustness and suitability of the methodological approach for the purpose of our study. We have drawn a number of lessons from this review:

- **Proxy indicators are needed to assess the magnitude of illicit markets.** In illicit markets, it is not possible to observe either demand or supply of counterfeits and UUPC directly. This means that proxy indicators, i.e. indirect measures that approximate or represent the real phenomena will be required to estimate their production, trade and consumption. Moreover, it will be necessary to triangulate information from alternative approaches and sources. Not all proxy indicators are equally suitable to provide reliable estimates.

- **Data sources are primarily based on consumer surveys and seizures.** Most data sources for estimating the size of these markets draw largely on self-reported information from consumers and suppliers as well as law enforcement data on known seizures and law suits. Some efforts use these data sources in conjunction with information obtained through more sophisticated, but resource-intensive approaches such as mystery shopping or sting operations.

- **There is little convergence on methodology in counterfeiting literature.** While numerous attempts to approximate the scale of counterfeiting have been made, there has been little convergence on a preferred methodology that can be broadly applied across industry sectors: innovation in methods and forms of collecting data continue to evolve. Furthermore it is often difficult to assess the quality of specific studies, as there is little transparency in assumptions and data values or sources; often for good reasons.

- **There is more convergence in the literature on copyright infringements.** Most approaches focus on "online piracy" these days. The absence of tangible goods has fundamental consequences for the distribution channels of UUPC. Estimates for these copyright infringements typically utilise survey methods and download or Internet traffic statistics. However, there is lack of clarity and consistency in how extrapolations to specific markets or countries are performed, in large part because the literature has not yet reached consensus on what drives copyright infringements.

- **Much work is needed around consumers' substitution rates.** There is still considerable uncertainty about the extent to which consumers substitute legitimate products and for those that violate IPR. Assumptions on the substitution rate depend on the consumers' knowledge and assessment of the quality. These often vary considerably by product and/or they remain unknown.

- **Methods for extrapolating to other markets or countries lack clarity.** More serious consideration regarding how to aggregate findings for specific products across countries needs to be considered in light of the nuances of the different product markets. As it is likely to be unfeasible to collect empirical data on all products and all geographical areas, some aggregation will be required. However, regional and market-specificities may make extrapolation based on general assumptions across countries and product types not reasonable or reliable.

- **Reliability and rigour may need priority over coverage.** There seems to be scope for sacrificing coverage of products targeted by counterfeiters for reliability and in terms of developing a model that works for specific products, at least to start with. This is because the hidden nature of these markets requires that significant effort and learning is required when trying to measure these phenomena in a meaningful way across countries and product groups.

- **The literature reveals a preference for "market-based" approaches.** Many studies focus on lost sales to legitimate IPR holders. This can be considered as a proxy of the market size for

counterfeiting and UUPC, but also represents a first-order effect. Clarifying the distinction between size and effects from a conceptual perspective is not a crucial question for future efforts in this field. However, from a practical standpoint our review suggests that lost sales, measured in terms of quantities or revenues, are a sensible outcome to consider when estimating the size of counterfeiting and piracy using a "market-based" approach.

- **A first-cut quantitative analysis of impacts may not require complicated methodologies.** Given the current state of knowledge, studying the impact of counterfeiting and UUPC does not require sophisticated econometric techniques. The linear regressions found in the literature so far are a good starting point provided that the right interpretation is attached to them. The biggest challenge remains in obtaining reliable measures of the magnitude of counterfeiting and UUPC.

What does this mean for the development of a methodology to be applied by the European Commission to estimate the scale of IPR infringements in the internal market?

We conclude that there is no reliable or accepted method for estimating the size of counterfeiting and UUPC that is feasible for the purposes of producing annual measures for all the affected products or markets and in all countries. While different approaches, such as consumer surveys or mystery shopping, can provide useful insights towards understanding specific aspects of these markets, it appears there is no one-size-fits-all solution available.

A market-based approach to estimate lost sales to rights' holders seems a sensible approach to proxy the market for IPR infringements in the EU and as a first-order estimate of the effects. While lost sales or revenues only partially represent the potential impacts of infringements, it is a first step in developing a monitoring system for the measurement of other impacts more broadly (e.g. on innovation, growth and competitiveness, creativity and culture, public health and safety, employment, environment, tax revenues and crime).

What would be the characteristics and data requirements of such a methodology?

We propose and test a new methodology for estimating lost sales motivated by economic theory that has been applied to specific industries in a few instances. We propose to use firm forecasts combined with information in the literature on country level measures related to counterfeiting to understand counterfeiting trends. Our key insight is that the relationship between these country level measures and unexpected differences between firm forecasts and sales provides us a proxy for estimating trends in IPR violations.

The methodology we develop to estimate the size of the market for counterfeit goods is a supply-side approach making use of economic theories of monopolistic competition and differentiable goods. Counterfeiters are more attracted to markets where firms are able to extract some monopoly rents. This can either be due to product differentiation or because it is a true oligopoly. Our approach attempts to exploit this feature in its empirical strategy to estimate the size of the market.

The idea is to estimate from legitimate producers the post-hoc amount of "unmet demand" that they experience and use that as a proxy for total counterfeit products sold. We presume that rights holders who are targeted by counterfeiters are able to calculate this amount as the residual of their forecasted demand for their products net actual units sold.

If a leading firm in an oligopoly market is unable to sell the predicted quantity it projects, it is typically due to an unexpected shock that is observable after the fact, such as a shock in the

supply chain, poorly received advertising campaign, or even a financial crisis or earthquake that impacts the overall economy. Once these factors are taken into account, the revised predicted quantities look a lot more like the volumes actually sold. However, sometimes the revised projection still cannot account for the difference between revised forecasted sale and actual sales.

This unexplained unfulfilled demand, our model presumes, is due at least in part to IPR infringements. A statistical model then attempts to identify the portion of unexplained unfulfilled demand that is highly correlated with factors that drive IPR infringements of a particular product in a particular country. These factors may include: the rule of law, control of corruption, level of tourism, access to broadband Internet or government effectiveness. This approach implies a two-stage regression based on the steps outlined in the box below.

A two-staged approach to estimate sales lost due to IPR infringement

1) **First stage**: identify unexplained error
   a. Based on forecasts of quantities of specific products that firms expected to sell in a given time period, calculate the difference between the forecast and real quantities sold;
   b. Identify any "observable" reasons for "error";
   c. Remaining difference is the unexplained forecast error.
2) **Second stage**: estimate proportion of unexplained error that is caused by IPR infringements
   a. Collect indicators on observable factors for a specific year that have been identified in the literature as related to consumption and supply of products that infringe IPRs. These may include legal (e.g. rule of law), economic (e.g. international tourism) or technological (e.g. broad Internet access) factors;
   b. Correlate unexplained error to those second stage regression factors;
   c. Generate an estimate of the amount of unexplained forecasting error that can be predicted by supply and demand factors of IPR infringements.

The approach requires firm forecast data on products that are subject to IPR infringements, as well as the actual items sold in different countries. The first stage regression requires retrospective information on observable product-, firm- and/or market-specific factors that explain the error. These may include data on competitors' sales, GDP growth, consumer trust, foreign exchange rates, etc. The second stage regression requires annual descriptive statistics on factors related to IPR infringements in specific countries.

What does application of this methodology teach us about the scale and impacts of IPR infringements in the internal market?

This new methodology has been empirically tested using confidential data made available to us by a multinational technology firm producing consumer goods targeted by counterfeiters. Preliminary evidence suggests that the proposed alternative two-step methodology may be a fruitful avenue forward for monitoring trends in the overall size of counterfeit markets, particularly the internal market. In the pilot test, the model struggles with estimating large infrequent outliers, which are overwhelmingly geminated from a single market outside of Europe(China). When these outliers are removed the model generates estimates that are broadly

consistent with those generated by the firm. The trend in the models excluding China are boadly consistent with the trends observed from the firm's approach (general decline from 2006-2008, rise during 2009-2011), but year-to year the RAND model deviates from the firm's trend. Without information from the firm regarding the statistical uncertainty in their estimate, it is not possible to know if these year-to-year deviations are statistically meaningful but give pause regarding the ability of the model to reliably predict short term fluctuations in counterfeiting. A more thorough and careful assessment of the model, which would include data from additional firms, other products, and a longer time period, is required before it can be determined if the methodology reliably predicts long or short-term fluctuations. Also, it would be preferable to compare the results of the RAND model to observations that are exclusively based on an industry gold standard, such as mystery shopping. In the current application, the firm used a hybrid approach involving mystery shopping and modelling for generating estimates of counterfeiting that makes it difficult to ascertain the extent to which deviations in the firm data reflect real differences or some modeling variability.

Unfortunately, the preliminary assessment of the empirical model was substantially hampered because we were only able to complete a pilot test with one industry partner. The difficulty to recruit industry partners for data collection is in itself a shortcoming of the current approach, which will be discussed in further detail. Therefore, the evidence is incomplete and more piloting is needed to draw conclusions on the actual levels or trends in IPR infringements. Nonetheless there are a number of benefits associated with using this approach, should it be proven effective with additional data.

We therefore conclude based on the consistent evidence in the long run trends and statistical overlap of our level estimates and the firm's estimates in models excluding statistical outliers, that the RAND model has promise and should be more thoroughly tested and refined. The inability of the model to perform as well with outliers geminating largely from a single county is widely viewed as a major supplier of counterfeits is something that should be taken seriously, but should not condemn this approach until further testing of the model is undertaken for other firms and products (and compared to other firm estimates of counterfeit). It may be that the level of counterfeiting is so different for this single country an entirely different approach needs to be taken for it than from those countries that are generally smaller producers of counterfeits.

What are the benefits of this methodology in comparison to alternatives?
The RAND method has a number of advantages over and above approaches that have been applied in the past:

- **Cost-effectiveness.** The proposed methodology can be implemented at relatively low cost vis-à-vis other industry gold standard methods such as mystery shopping. It provides an economically feasible tool for government and regulatory agencies that need to monitor trends in counterfeiting or evaluate the effectiveness of alternative policies and interventions. For firms, this approach provides an alternative cost-effective means for filling in data gaps in other markets where the gold standard is not applied and does so in a way that is not sensitive to selection issues that can bias estimates using extrapolation methods from gold standard samples.
- **Flexibility.** The approach is relatively flexible and can be modified to meet unique aspects of specific products, firms or industries while still generating aggregated output that can be generalised across products, firms and industries to generate regional market or global

estimates of the level of counterfeiting. The flexibility comes about because of the two stage estimation process. In the first stage, a firm interested in understanding its own deviations from forecasts can customize the information in their first stage to be as firm- or product-specific as they like. In the second stage, the method is adaptable to the specificities of IPR infringements in market environments and for products.

- **Comparability.** The method enables a systematic comparison of counterfeiting effects across firms operating within the same market or in markets for similar products. This is because the same model is applied across firms, and hence any general market error that might exist in estimating counterfeiting more generally will not influence the relative effects of counterfeiting of one firm vis-à-vis other firms.

- **Replicability.** One of the main benefits of the method is its ability to be replicated for multiple products, in multiple countries and in consecutive years. Whilst the methodology, and its components – such as the second stage indicators – may be subject to change over time, it would be fairly straightforward to update the estimates retrospectively which would maintain comparability of the results over time. If the method will be improved or adjusted in the following years, the marginal extra costs of running the model retrospectively for preceding years are relatively low.

What are the challenges and limitations of this methodology; can they be tackled, and if so, how?

While preliminary evidence suggests that the RAND method does a good job at tracking the general trends reported by mystery shopping when China is excluded, a number of challenges remain. These need to be addressed or taken into account before the RAND method can be applied more broadly.

Challenges with using forecast data. The applicability of the method depends on the availability and quality of firm forecast data. There are various reasons why collecting firm forecast data may be difficult. There may be divergent business models (e.g. box office, DVD sales or broadcasting) in which sales are measured in different units (tickets, DVDs or broadcasting rights). Another concern relates to the extent to which firms incorporate counterfeiting into their forecast and whether or how this can be removed for use in a model. And related to this, some firms do not systematically generate forecasts but instead just use historical data to project trends going forward, which would inherently include influences of counterfeiting but in a fashion that is not discernible by the firm. Such issues represent a challenge for estimate of the level of forecasting systematically across markets, but assuming that such issues are firm specific and time persistent, they provide no threat to the ability of the methodology to predict trends or changes in trends of counterfeiting.

Challenges with obtaining forecast and actual sales data. Although forecast data seemed to be available in many instances, firms were extremely reluctant to share the data. There are a number of salient reasons for this reluctance. For example, there is concern about the potential for the disclosure of commercially sensitive data. Firms seemed to be reluctant to be the first participant in the study from a given industry. Finally, it may be difficult for firms to collate forecasts from different products, as the forecasts may be conducted in a decentralised manner, at national or regional market level. Concerns such as these arose with the pilot firm which we worked with as well, but were easily resolved through direct communication and education on the need for specific information. One challenge that was raised by nonparticipants is the extent to which

firms may try to manipulate their forecasting error data before submitting them to be included in our model so as to influence estimates of the size of the market. While it is true that such strategic behaviour is possible, analytic diagnostics are available that could lead to its detection if the model is implemented for all targeted products within a sector. More importantly, such biases would not influence the reliability of the model in projecting trends in counterfeiting on the long run, provided that firms were persistent in their over-reporting over time.

Industry specific concerns. Any approach attempting to generate estimates of IPR infringements in a systematic way across multiple firms and industries is going to have to necessarily aggregate measurement issues to a level that will be far less precise and meaningful than if the assessment were being done for a single firm or industry. Some industries have specific characteristics that require serious consideration. Addressing these set of challenges directly is complicated and is likely impossible without actually working with the data, but the flexibility of the model suggests they may not be insurmountable. Estimates from the second stage model may, for example, be best obtained on an industry-by-industry basis, enabling for differential inclusion of specific second stage variables. Such an approach is feasible with this model as the aggregation of "units" counterfeited by market is done after estimation of the second stage model.

The applicability to unauthorised access to protected content (UUPC). On theoretical grounds, we do not reject the possibility that our methodology might offer sensible insights on the extent of UUPC. However, from an empirical perspective, UUPC industries and particularly those involving on-line content, have a number of specificities that may complicate the applicability of the model. While we have received some input on how to tailor our model, we have not been able to test it with actual data. Therefore, it is relevant to highlight the concerns and limitations, but it is too early to dismiss the RAND methodology for UUPC altogether.

What are the next steps that need to be taken in order to assist the European Commission in its ambition to measure the development of IPR infringements in the internal market on an annual basis?

The methodology described above is a first step towards developing a system to monitor trends of IPR infringements in the internal market. Prior to implementation, the feasibility and reasonableness of this approach will need to be tested and demonstrated across multiple firms and industries. For this to happen, a number of steps must be taken next.

Build trust and buy-in from the industry. A critical next step necessary to make any further progress on developing the methodology is to build trust and create buy-in from key industry leaders. We are actively engaging academic leaders to provide their perspectives on the approach. Furthermore, we encourage stakeholders to engage in discussions about the applicability of the approach to their markets. The fact that there are weaknesses in the approach is, by itself, not a limiting reason to stop further exploration of the method. Creating buy-in may require publication of non-technical explanations or presentations to the policy community and stakeholders.

Continued development of the methodology. The utility of the method for firms and policymakers can only be understood through its empirical testing using real world data from multiple firms. This should be a priority. It will be important to confirm the proof of concept by extending the pilot work in the near future with a selection of firms representing a broad range of products, including those related to online UUPC. Assuming that a core set of variables is found to be consistently useful for predicting unexplained forecasting error, then efforts can be

broadened to assess the reliability of the approach in more competitive markets. Statistical models can relatively easily account for unique factors that are time persistent by product line or firm using a statistical tool called fixed effects. Some of these factors may be easily addressed through statistical modelling rather than complicated data gathering tasks.

Possibility to tailor model to sector specificities. A key strength of the RAND methodology proposed is its flexibility to handle contemporaneously unique industry-, firm- and market-level factors. By extending a pilot to multiple product groups and industries, it will also be possible to consider the extent to which unique industry characteristics might impede the implementation of this approach. Much of the discussion has focused on the identification of common aggregate measures of IPR infringements at national level. But the RAND model could also be applied on a sector-by-sector basis, which would enable a more explicit consideration of sector-specific attributes.

Facilitating data delivery. The process involved in identifying the data required for this pilot, collating them in the correct format from the firm, and properly structuring it for estimation in the model has been relatively time consuming and cumbersome both for the researchers and firm representatives involved. There are several steps that can be undertaken to facilitate and accelerate this process: 1) A research team member needs to spend time with the firm to explain the approach, understand their forecasts and sales trends and how data describing those trends are captured by the firm; 2) Robust provisions, including signed data use agreements, are required for data protection; 3) A standardised template for data submission should be prepared to facilitate the delivery of data in a systematic way across all firms.