
The Software Alliance
BSA
Competitive Advantage
The Economic Impact of Properly Licensed Software
INSEAD
The Business School for the World®

# Contents

# Executive Summary

Software is an essential tool of production in every sector of the modern economy. Enterprises of all sorts rely on it to design products, provide services, communicate with customers, and manage operations. But software contributes considerably more value to national economies if it is properly licensed than it does if it is pirated.

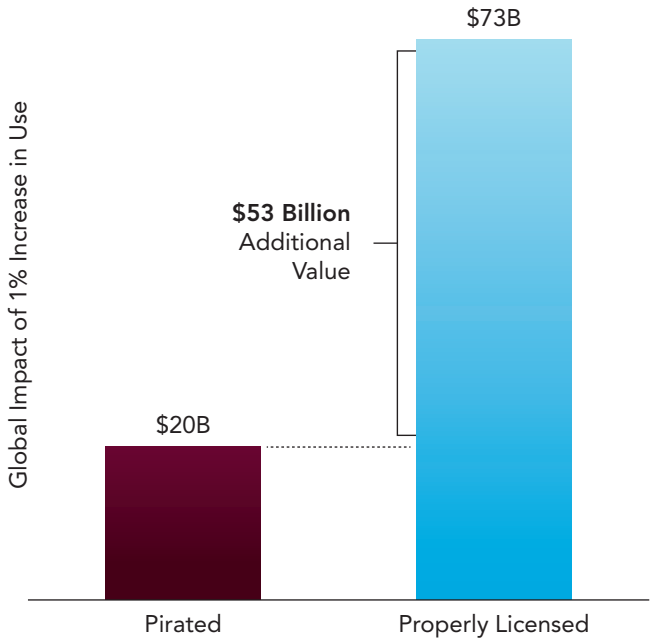
Indeed, properly licensed software has a positive impact on national economic activity that is more than three times the impact of pirated software, according to a new study from BSA | The Software Alliance. And the additional economic value associated with lawful software use is especially pronounced in developing markets: Every dollar invested in properly licensed software in low-income countries yields an astounding $437 in additional national production, on average.

These are among the findings of an analysis conducted for BSA by INSEAD, one of the world's most prominent business schools and respected research institutions. Drawing on data from 95 countries, the study confirms that increasing use of properly licensed software in a national market corresponds to substantial positive gains in gross domestic product (GDP). It also reveals that licensed software has a greater economic stimulus effect than pirated software.

Among the study's findings:

- Increasing licensed PC software use by 1 percent globally would inject $73 billion into the world economy. By contrast, increasing the use of pirated PC software by 1 percent would add only $20 billion to the global economy — meaning there is a $53 billion advantage associated with use of properly licensed software. (See figure 1.)

**Figure 1.** Economic Impact of Properly Licensed Software vs. Pirated Software




- On a dollar-for-dollar basis, low-income countries have the most to gain from increasing their use of legitimate software — a $437 return on every dollar invested, compared to $35 for every dollar's worth of pirated software put into use in the market.
- While the economic gains from using properly licensed software over pirated software is greatest in lower-income countries, it is significant in middle- and higher-income countries, too. There, the national return on every dollar invested in genuine software is $140 and $117, respectively.

The enterprise-level performance and reliability dividends of properly licensed software are well documented — it reduces exposure to security risks and malfunctions, and provides greater operational efficiency than pirated or counterfeit software.

But this study shows that properly licensed software is not just good for business; it is also a more important driver of national economic growth than pirated software. Governments therefore should take every opportunity to promote lawful software use. They should put in place strong laws and enforcement mechanisms to protect intellectual property rights, and they should raise public awareness of the risks associated with software piracy and the benefits of managing software assets carefully.

# The Value of Properly Licensed Software

It is well established that software includes features and services that generate value for enterprises. It creates operating efficiencies that enhance productivity. It facilitates communication within companies and between companies and customers, and makes enterprises around the world more agile and better able to exploit new market opportunities. Software is a fundamental building block of business operations today and a valuable intangible asset for governments, companies and organizations.

Fully licensed software, in particular, improves effectiveness and efficiencies in enterprises by reducing exposure to viruses and other security vulnerabilities, meaning fewer system malfunctions, downtime, and IT repair costs.[1] This is because licensed software comes with value-added services that provide access to upgrades, patches, and manufacturer support such as training and problem resolution.

Capturing these efficiencies on a daily basis delivers operational and financial gains that help firms reduce costs and drive further investment. They are the ingredients for more production and national economic growth, as shown in figure 2.

## Macroeconomic Analysis

This study seeks to quantify, at the national level, the economic value derived from the productivity gains and operational efficiencies that enterprises achieve with software. To that end, researchers at INSEAD employed a production function model (see figure 3), which relates changes in various economic inputs — such as labor, physical capital, or PC software — to national output. A production function determines the "elasticities" of national production (GDP) associated with each of these variables — that is, the extent to which changes in each input correlate with changes in GDP.

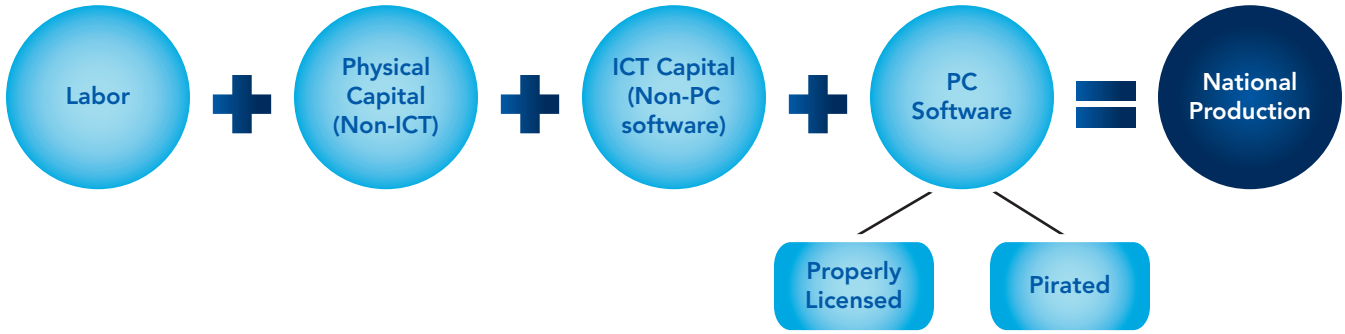
Drawing on data from 95 countries that together represent more than 96 percent of the global economy, INSEAD's analysis shows the difference in the economic impact of a 1 percent change in the use of legal or pirated software in a given market.

The analysis finds that, in high-income countries, properly licensed software is associated with an elasticity of 0.13 percent, meaning that a 1 percent increase in licensed software use would result in a 0.13 percent increase in GDP, on average. In middle- and low-income

**Figure 2.** The Software Value Chain


[1] See: Harrison Group (2011), *Genuine Microsoft Products vs. Pirated Counterparts*, www.microsoft.com. Users of genuine software enjoy better performance and reliability than users of counterfeit or pirated software. For example, users of genuine software enjoyed significantly faster boot times, print times, and loading times for documents and websites.

**Figure 3.** The Inputs of National Production, Including Software




countries, the associated benefits are 0.06 and 0.07 percent respectively, as shown in table 1.[2]

The greater absolute benefit of increasing licensed software use in higher-income countries is largely due to their heavier reliance on software tools for economic production.

The impact of pirated software use is less clear. Across all countries studied, it is associated with an elasticity of between 0 and 0.03 percent — at most. There is too much variability in the results to confirm the results more precisely than that.[3]

**Table 1.** The Impact of a 1 Percent Increase in Software Use on GDP

| Licensed Software | Elasticity |
|---|---|
| High-Income Countries | 0.13% |
| Middle-Income Countries | 0.06% |
| Low-Income Countries | 0.07% |
| **Unlicensed Software** | **Elasticity** |
| All Countries | 0 to 0.03% |

## GDP Benefit

Extrapolating from the elasticities associated with software, the study shows the GDP benefit of increasing legitimate software use by 1 percent varies from country to country. For example, increasing use of properly licensed software by 1 percent would add $20 billion to the US economy, $7.6 billion to the Japanese economy, and $1.2 billion to the Indian economy.

Globally, a 1 percent increase in properly licensed software use would add $73 billion to world economic output, compared to $20 billion for a similar increase in unlicensed software use.[4] The difference — $53 billion — is the additional economic value created by investing in fully licensed software instead of pirated software.

This added value exists across every market covered in the study. Table 2 shows the 20 countries with the most to gain from increasing their use of properly licensed software.

[2] Countries are categorized using the World Bank income group classification: low- and lower-middle incomes are combined in the low income category; upper-middle-income in the middle-income category; and high-income in the high-income category.

[3] All other inputs in the model are statistically significant within a 95 percent confidence level.

[4] Applying the upper limit elasticity of 0.03% for pirated software and income level-specific elasticities for licensed software.

**Table 2.** Additional Economic Value Derived from a 1 Percent Increase in the Use of Properly Licensed Software, Instead of Pirated Software

| | Country | Additional Economic Value |
|---|---|---|
| 1. | United States | $15.1B |
| 2. | Japan | $5.9B |
| 3. | Germany | $3.6B |
| 4. | France | $2.8B |
| 5. | United Kingdom | $2.4B |
| 6. | China | $2.2B |
| 7. | Italy | $2.2B |
| 8. | Canada | $1.7B |
| 9. | Spain | $1.5B |
| 10. | Australia | $1.4B |

| | Country | Additional Economic Value |
|---|---|---|
| 11. | South Korea | $1.1B |
| 12. | Netherlands | $836M |
| 13. | Brazil | $743M |
| 14. | India | $739M |
| 15. | Switzerland | $636M |
| 16. | Saudi Arabia | $577M |
| 17. | Russia | $557M |
| 18. | Sweden | $538M |
| 19. | Poland | $515M |
| 20. | Belgium | $512M |

## GDP Return on Investment

Another way to assess the value of software to national economies is to calculate the return on investment (ROI) in GDP from spending on software[5] — or the additional GDP created by each extra dollar invested in software. Again, properly licensed software delivers a consistently higher return than pirated software.

While the preceding analysis of overall GDP benefit finds that higher-income markets have the most to gain by increasing spending on legal software, it is emerging economies that see the greatest returns on a dollar-for-dollar basis.

A one-dollar investment in fully licensed software is associated with an average return of $437 in additional GDP for low-income countries, compared to $140 for middle-income countries and $117 for high-income countries. The outsized benefit in low-income countries is because the value of the stock of properly licensed software represents a much lower proportion of overall GDP in these countries, so every extra dollar spent on licensed software has a greater marginal impact. In other words, the greatest immediate economic gains to be created by lawful software use are in emerging markets where licensed software use is lowest.

The advantage of using properly licensed software is also evident when comparing its ROI to the ROI of using pirated software, as shown in table 3. In high-income countries, one dollar invested in legitimate software delivers nearly three times the return in national production as a dollar's worth of pirated software. In middle-income countries, the return is five times higher, and in low-income countries the return for properly licensed software is a staggering 12 times higher than the ROI for pirated software.

Table 4 estimates the GDP Benefit and ROI associated with properly licensed and pirated software across each of the 95 countries included in the study.[6]

**Table 3.** Return on Investment from Software

| | ROI: Properly Licensed Software | ROI: Pirated Software | ROI: Difference in Economic Value |
|---|---|---|---|
| High-Income Countries | $117 | $42 | $75 |
| Middle-Income Countries | $140 | $28 | $112 |
| Low-Income Countries | $437 | $35 | $402 |

[5] GDP Benefit ($) / $ value of 1% current SW market = ROI per SW $

[6] Estimates of national gains are calculated using the average elasticity for each country's income group. To the extent that a country's elasticity deviates from the average, actual gains may vary.

**Table 4.** Estimated National Economic Impact of Increased Use of Properly Licensed Software vs. Pirated Software

### GDP Benefit (From a 1 Percent Increase in Software Use)

| Country | Properly Licensed Software ($US M) | Pirated Software ($US M) | Value Difference ($US M) |
|---|---|---|---|
| United States | 19,622 | 4,528 | **15,094** |
| Japan | 7,627 | 1,760 | **5,867** |
| Germany | 4,642 | 1,071 | **3,571** |
| France | 3,605 | 832 | **2,773** |
| United Kingdom | 3,161 | 729 | **2,432** |
| China | 4,391 | 2,196 | **2,196** |
| Italy | 2,853 | 658 | **2,195** |
| Canada | 2,257 | 521 | **1,736** |
| Spain | 1,938 | 447 | **1,491** |
| Australia | 1,783 | 412 | **1,372** |
| South Korea | 1,451 | 335 | **1,116** |
| Netherlands | 1,087 | 251 | **836** |
| Brazil | 1,486 | 743 | **743** |
| India | 1,294 | 554 | **739** |
| Switzerland | 826 | 191 | **636** |
| Saudi Arabia | 750 | 173 | **577** |
| Russia | 1,115 | 557 | **557** |
| Sweden | 700 | 161 | **538** |
| Poland | 669 | 154 | **514** |
| Belgium | 665 | 153 | **512** |
| Norway | 632 | 146 | **486** |
| Austria | 544 | 126 | **419** |
| United Arab Emirates | 468 | 108 | **360** |
| Mexico | 693 | 347 | **347** |
| Indonesia | 593 | 254 | **339** |
| Denmark | 432 | 100 | **333** |
| Greece | 388 | 90 | **299** |
| Finland | 346 | 80 | **266** |
| Hong Kong | 317 | 73 | **244** |
| Israel | 316 | 73 | **243** |
| Singapore | 312 | 72 | **240** |
| Portugal | 309 | 71 | **238** |
| Turkey | 464 | 232 | **232** |
| Ireland | 283 | 65 | **217** |
| Czech Republic | 280 | 65 | **215** |

### GDP Return on Investment (From $1 of Properly Licensed or Pirated Software)

| Country | Properly Licensed Software ($US) | Pirated Software ($US) | Value Difference ($US) |
|---|---|---|---|
| Zimbabwe | 1,992 | 74 | **1,918** |
| Zambia | 2,042 | 192 | **1,849** |
| Yemen | 1,275 | 68 | **1,207** |
| Cameroon | 967 | 85 | **882** |
| Algeria | 716 | 68 | **648** |
| Bangladesh | 474 | 23 | **451** |
| Cote d'Ivoire | 449 | 45 | **404** |
| Kuwait | 459 | 74 | **385** |
| Azerbaijan | 380 | 28 | **352** |
| Oman | 405 | 60 | **346** |
| Senegal | 394 | 48 | **346** |
| Albania | 389 | 65 | **324** |
| Pakistan | 327 | 23 | **304** |
| Qatar | 363 | 84 | **279** |
| Nigeria | 300 | 28 | **272** |
| Iraq | 288 | 20 | **268** |
| Kazakhstan | 288 | 45 | **242** |
| Sri Lanka | 253 | 21 | **232** |
| Indonesia | 248 | 17 | **231** |
| Venezuela | 208 | 14 | **194** |
| Armenia | 202 | 12 | **191** |
| Georgia | 196 | 8 | **187** |
| Greece | 177 | 26 | **151** |
| China | 165 | 25 | **140** |
| Saudi Arabia | 174 | 39 | **135** |
| Tunisia | 154 | 27 | **127** |
| Bahrain | 152 | 30 | **122** |
| Cyprus | 156 | 39 | **117** |
| Morocco | 150 | 33 | **117** |
| Egypt | 146 | 40 | **106** |
| Bosnia | 140 | 36 | **104** |
| Italy | 135 | 34 | **102** |
| Croatia | 126 | 26 | **101** |
| Turkey | 144 | 44 | **100** |
| Bolivia | 109 | 12 | **97** |

## GDP Benefit
## (From a 1 Percent Increase in Software Use)

| Country | Properly Licensed Software ($US M) | Pirated Software ($US M) | Value Difference ($US M) |
|---|---|---|---|
| Kuwait | 230 | 53 | **177** |
| Qatar | 225 | 52 | **173** |
| New Zealand | 185 | 43 | **142** |
| Hungary | 182 | 42 | **140** |
| Argentina | 268 | 134 | **134** |
| South Africa | 245 | 123 | **123** |
| Thailand | 207 | 104 | **104** |
| Colombia | 199 | 100 | **100** |
| Slovakia | 125 | 29 | **96** |
| Venezuela | 190 | 95 | **95** |
| Nigeria | 165 | 71 | **94** |
| Egypt | 161 | 69 | **92** |
| Philippines | 157 | 67 | **90** |
| Malaysia | 167 | 84 | **84** |
| Pakistan | 148 | 63 | **84** |
| Chile | 149 | 75 | **75** |
| Oman | 93 | 22 | **72** |
| Ukraine | 116 | 50 | **66** |
| Croatia | 83 | 19 | **64** |
| Luxembourg | 77 | 18 | **60** |
| Algeria | 113 | 57 | **57** |
| Kazakhstan | 112 | 56 | **56** |
| Romania | 108 | 54 | **54** |
| Peru | 106 | 53 | **53** |
| Slovenia | 64 | 15 | **50** |
| Vietnam | 87 | 37 | **50** |
| Iraq | 81 | 35 | **46** |
| Bangladesh | 77 | 33 | **44** |
| Morocco | 70 | 30 | **40** |
| Cyprus | 32 | 7 | **25** |
| Sri Lanka | 41 | 18 | **24** |
| Bahrain | 30 | 7 | **23** |
| Estonia | 29 | 7 | **22** |
| Ecuador | 40 | 20 | **20** |
| Azerbaijan | 38 | 19 | **19** |
| Guatemala | 33 | 14 | **19** |
| Dominican Republic | 33 | 17 | **17** |

## GDP Return on Investment
## (From $1 of Properly Licensed or Pirated Software)

| Country | Properly Licensed Software ($US) | Pirated Software ($US) | Value Difference ($US) |
|---|---|---|---|
| Poland | 122 | 25 | **97** |
| Dominican Republic | 114 | 18 | **96** |
| Guatemala | 106 | 12 | **94** |
| Moldova | 98 | 5 | **93** |
| Philippines | 109 | 20 | **89** |
| Spain | 125 | 37 | **88** |
| Kenya | 98 | 12 | **86** |
| Malta | 125 | 38 | **86** |
| Ukraine | 94 | 8 | **86** |
| Vietnam | 94 | 9 | **84** |
| Estonia | 106 | 27 | **80** |
| Slovakia | 122 | 42 | **80** |
| United Arab Emirates | 132 | 52 | **80** |
| Peru | 103 | 25 | **78** |
| Slovenia | 108 | 29 | **78** |
| South Korea | 119 | 41 | **78** |
| Iceland | 99 | 25 | **74** |
| Ecuador | 93 | 22 | **71** |
| Hong Kong | 103 | 32 | **71** |
| Argentina | 91 | 20 | **70** |
| Romania | 89 | 26 | **63** |
| Hungary | 88 | 29 | **59** |
| India | 75 | 19 | **56** |
| Ireland | 101 | 45 | **56** |
| Portugal | 84 | 29 | **55** |
| Uruguay | 70 | 16 | **54** |
| Thailand | 63 | 12 | **50** |
| Jordan | 77 | 28 | **49** |
| France | 77 | 30 | **47** |
| Mexico | 74 | 28 | **46** |
| Chile | 61 | 20 | **42** |
| Colombia | 76 | 34 | **42** |
| Russia | 59 | 17 | **42** |
| Bulgaria | 56 | 16 | **40** |
| Czech Republic | 70 | 30 | **40** |
| Lithuania | 68 | 29 | **39** |
| Israel | 74 | 38 | **36** |

## GDP Benefit
## (From a 1 Percent Increase in Software Use)

| Country | Properly Licensed Software ($US M) | Pirated Software ($US M) | Value Difference ($US M) |
|---|---|---|---|
| Bulgaria | 32 | 16 | **16** |
| Iceland | 18 | 4 | **14** |
| Tunisia | 28 | 14 | **14** |
| Uruguay | 28 | 14 | **14** |
| Yemen | 24 | 10 | **14** |
| Kenya | 24 | 10 | **13** |
| Lithuania | 26 | 13 | **13** |
| Costa Rica | 25 | 12 | **12** |
| Bolivia | 17 | 7 | **10** |
| Cameroon | 18 | 8 | **10** |
| Cote d'Ivoire | 17 | 7 | **10** |
| Jordan | 17 | 9 | **9** |
| Malta | 12 | 3 | **9** |
| Latvia | 17 | 9 | **9** |
| Zambia | 13 | 6 | **8** |
| Georgia | 10 | 4 | **6** |
| Senegal | 10 | 4 | **6** |
| Bosnia | 11 | 5 | **5** |
| Albania | 8 | 4 | **4** |
| Armenia | 7 | 3 | **4** |
| Zimbabwe | 7 | 3 | **4** |
| FYROM | 6 | 3 | **3** |
| Moldova | 5 | 2 | **3** |
| **Worldwide Total** | **$73 billion** | **$20 billion** | **$53 billion** |

## GDP Return on Investment
## (From $1 of Properly Licensed or Pirated Software)

| Country | Properly Licensed Software ($US) | Pirated Software ($US) | Value Difference ($US) |
|---|---|---|---|
| Latvia | 62 | 26 | **36** |
| Costa Rica | 55 | 20 | **35** |
| Brazil | 59 | 26 | **33** |
| Singapore | 60 | 28 | **32** |
| Norway | 81 | 50 | **30** |
| Canada | 73 | 46 | **28** |
| Germany | 72 | 47 | **25** |
| Netherlands | 62 | 39 | **23** |
| Belgium | 83 | 61 | **22** |
| FYROM | 54 | 14 | **22** |
| United Kingdom | 57 | 38 | **20** |
| Malaysia | 31 | 13 | **18** |
| Denmark | 62 | 45 | **17** |
| Finland | 55 | 38 | **17** |
| Australia | 70 | 54 | **16** |
| Austria | 72 | 56 | **16** |
| Switzerland | 54 | 37 | **16** |
| Japan | 108 | 94 | **14** |
| Sweden | 48 | 35 | **13** |
| New Zealand | 53 | 43 | **10** |
| Luxembourg | 59 | 54 | **5** |
| South Africa | 23 | 22 | **2** |
| United States | 47 | 46 | **1** |

# Conclusion

Properly licensed software can be an economic engine, creating significant value for enterprises and national economies alike. And the benefits of licensed software — both for firms and national production — are likely to increase with developments in cloud computing as it is made easier and more cost-efficient for businesses of all sizes to opt in to value-added services delivered over the Internet.

Pirated software, on the other hand, is associated with a host of risks. It puts end users in legal jeopardy, and it exposes them to virus infections and security breaches. More broadly, as shown in this analysis, it produces less value than licensed software for national economies.

For governments looking at ways to increase economic growth, the implication is that lowering software piracy and increasing use of properly licensed software is an effective way to stimulate innovation, promote firm success, and generate economic returns.

# BSA Blueprint for Reducing Software Piracy

## Increase Public Education and Awareness

Reducing software piracy requires a fundamental shift in public attitudes toward software and IP. Public education is critical, therefore, to increase awareness of the importance of managing software assets and respecting creative works through compliance with software licensing. Experience has shown that public-private awareness campaigns about piracy and the value of IP can be extremely effective. In addition, support for industry-led initiatives to promote the business practice of managing and optimizing software purchases, utilization, and maintenance — a process known as software asset management (SAM) — can help governments, businesses, and other organizations derive greater value from software assets by optimizing their use of licensed applications and reducing piracy. For example, BSA offers a suite of certification programs in standards-based SAM for individual professionals, entire organizations, and auditors.

## Modernize IP Laws to Account for New Innovations

Around the world, copyright and other intellectual property laws have lagged behind the pace of technology innovation. With the advent of cloud computing and the proliferation of networked mobile devices, policymakers should modernize protections for software and other copyrighted materials. This effort should include vigorous enforcement actions — including against online piracy — and modernization of underlying copyright laws, for example through implementation of World Intellectual Property Organization (WIPO) copyright treaties.

## Step Up Enforcement with Dedicated Resources

Too often, software theft is not considered a serious crime and penalties for convicted offenders are too low to provide effective deterrence. Countries can elevate their enforcement of intellectual property by:

- Creating specialized IP enforcement units at the national and local level and providing dedicated resources to investigate and prosecute IP theft;
- Increasing cross-border cooperation among police and other enforcement agencies to improve coordination for law enforcement in multiple countries;
- Supporting the training of law enforcement and judiciary officials (including establishing specialized IP courts where appropriate) and providing better technical assistance to ensure that the people on the front lines of piracy enforcement are equipped with the tools they need to deal with the changing nature of IP theft; and
- Fulfilling their obligations under the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) by adopting and implementing laws that meet international norms for civil and criminal IP rights protection. IP laws also should provide for clear protection and energetic enforcement against misappropriation and infringement of new software innovations, such as cloud computing technologies.

## Lead by Example

Governments are the largest users of software in the world. They should demonstrate leadership by ensuring they are using only fully licensed software in their own operations. They should also implement SAM programs and promote the use of legal software in state-owned enterprises, and among all contractors and suppliers.

# Methodology

*Competitive Advantage: The Economic Impact of Properly Licensed Software,* published by BSA | The Software Alliance, is a sophisticated statistical analysis of economic data across a heterogeneous mix of 95 countries representing 96 percent of global gross domestic product (GDP).

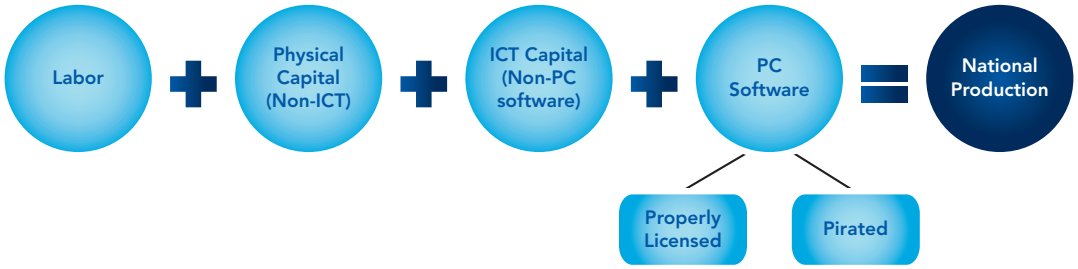
To conduct the research, INSEAD, one of the world's leading business schools and research institutions, utilized an established macroeconomic approach known as a *production function model* to analyze the changes in national output (GDP) that result from changes in various economic inputs. A production function is used to determine the *elasticities* in GDP associated with those inputs — that is, the responsiveness of GDP to a given change in a particular variable.

The input variables included labor, physical capital, information and communications technology (ICT) capital, and PC software, as shown in the figure below. For the purposes of this analysis, PC software was extricated from the broader ICT capital variable and demarcated as licensed and pirated software in order to provide specificity in terms of the discrete GDP impacts associated with properly licensed and pirated software. The commercial values of licensed and pirated software serve as proxies for software use in the model.

The relationship between output and the various inputs, including software, is expressed by the following national production equation:

$$Q_{it} = A_{it}\, F\,(L_{it}, K_{it}, K^{IT}_{it}, X^{l}_{it}, X^{u}_{it})$$

**The Inputs of National Production**




**Data Sources for Elasticity Computations**

| | Variable | Description | Source |
|---|---|---|---|
| $Q_{it}$ | **National Production** | Aggregate level of GDP in each country (i) for year (t), expressed in USD | World Bank World Development Indicators |
| $L_{it}$ | **Labor** | Measurement of all people that are employed in each country (i) for year (t) | World Bank World Development Indicators |
| $K_{it}$ | **Physical Capital** | Stock of physical assets such as buildings, roads, bridges, airports, transport equipment and machinery in each country (i) for year (t) | Conference Board, Total Economy Database |
| $K^{IT}_{it}$ | **ICT Capital (Non-Software)** | Stock of computers, communications equipment *less commercial value of PC software* in each country (i) for year (t) | Conference Board, Total Economy Database<br>BSA Global Software Piracy Study |
| $X^{l}_{it}$ | **Software — Properly Licensed** | Commercial value of properly licensed PC software in each country (i) for year (t) | BSA Global Software Piracy Study |
| $X^{u}_{it}$ | **Software — Pirated** | Commercial value of pirated PC software in each country (i) for year (t) | BSA Global Software Piracy Study |
| $A_{it}$ | **Total Factor Productivity** | Increases in GDP that cannot be attributed to observed inputs in each country (i) for year (t); assumed to come from trends in technology and other evolving variables | |

The source data for each country covered an 8-year period from 2003–2010.

To compute the elasticities, the production function is converted into an additive linear empirical equation using the logarithmic form of a Cobb-Douglas function:

$$\text{Log } Q_{it} = a + b1\text{Log } (L_{it}) + b_2\text{Log}(K_{it}) + b_3\text{Log}(K^{IT}_{it}) + b_4\text{Log } (X^{I}_{it}) + b_5\text{Log}(X^{u}_{it}) + e_{it}$$

In this equation, *b1, b2, b3, b4* and *b5* are parameters to be estimated and represent the elasticities of output Q with respect to each input. The term $e_{it}$ represents an error term, or the amount by which the observed values of Q deviate from the estimated values as a result of characteristics in a country (such as different work ethics) that may affect national output but are not measured in the equation; and a is a constant term.

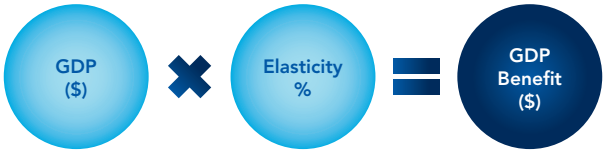
The equation is estimated using regression analysis with country fixed effects. The model finds that the highest elasticities are associated with employment (0.53 percent) and physical capital (0.24 percent), as those are the primary inputs of national production. The elasticity associated with IT capital is 0.06 percent. Licensed software is associated with a global average 0.06 percent increase in GDP and further segmented by income group category as outlined in this paper. Pirated software is associated with an increase of, at most, 0.03 percent in GDP. However, there is too much variability in the results for pirated software for the results to be statistically significant. Therefore, we can only confirm the elasticity associated with pirated software lies somewhere between 0 and 0.03 percent. All other inputs are statistically significant within a 95 percent confidence level.

Using the same source data, statistical analyses were carried out in order to check the robustness of the elasticity estimations. INSEAD calculated the estimation of the elasticities in absolute terms (the impacts of inputs on aggregate production), and in per-worker terms (the impacts of inputs on labor productivity). Both estimations give similar results and confirm the accuracy of the findings of this report.

## Converting Elasticity to GDP Benefit

Applying the elasticities determined by the model, the dollar values of the associated increases in GDP for properly licensed and pirated software use were computed using the following equations:

**GDP Benefit of a 1 Percent Increase in the Software Market**




**ROI of each $1 Increase in the Software Market**


For the purposes of this paper, the elasticity values were applied to GDP and software market data for the year 2011 (see appendix), which was the most current data available at the time the report was written.

## Computing the Additional Economic Value Derived from Properly Licensed Software

The difference between the GDP created by properly licensed and pirated software use is derived using the following equations:

**Additional Economic Value (in Terms of GDP Benefits)**


**Additional Economic Value (in Terms of ROI)**

# Appendix

## Supporting Data by Country

| | GDP 2011 ($US M) | Commercial Value of Properly Licensed Software, 2011 ($US M) | Commercial Value of Pirated Software, 2011 ($US M) | Piracy Rate 2011 |
|---|---|---|---|---|
| **High-Income Countries** | | | | |
| Australia | 1,371,764 | 2,554 | 763 | 23% |
| Austria | 418,484 | 757 | 226 | 23% |
| Bahrain* | 22,946 | 20 | 23 | 54% |
| Belgium | 511,533 | 798 | 252 | 24% |
| Canada | 1,736,051 | 3,085 | 1,141 | 27% |
| Croatia | 63,850 | 66 | 74 | 53% |
| Cyprus | 24,690 | 21 | 19 | 48% |
| Czech Republic | 215,215 | 397 | 214 | 35% |
| Denmark | 332,677 | 703 | 222 | 24% |
| Estonia | 22,185 | 27 | 25 | 48% |
| Finland | 266,071 | 630 | 210 | 25% |
| France | 2,773,032 | 4,689 | 2,754 | 37% |
| Germany | 3,570,556 | 6,447 | 2,265 | 26% |
| Greece | 298,734 | 219 | 343 | 61% |
| Hong Kong | 243,666 | 308 | 232 | 43% |
| Hungary | 140,029 | 206 | 143 | 41% |
| Iceland | 14,059 | 18 | 17 | 48% |
| Ireland | 217,275 | 280 | 144 | 34% |
| Israel | 242,929 | 427 | 192 | 31% |
| Italy | 2,194,750 | 2,107 | 1,945 | 48% |
| Japan | 5,867,155 | 7,054 | 1,875 | 21% |
| South Korea | 1,116,247 | 1,223 | 815 | 40% |
| Kuwait | 176,590 | 50 | 72 | 59% |
| Luxembourg | 59,475 | 132 | 33 | 20% |
| Malta | 8,887 | 9 | 7 | 43% |
| Netherlands | 836,257 | 1,741 | 644 | 27% |
| New Zealand* | 142,477 | 351 | 99 | 22% |
| Norway | 485,803 | 781 | 289 | 27% |
| Oman | 71,782 | 23 | 36 | 61% |
| Poland | 514,496 | 548 | 618 | 53% |
| Portugal | 237,522 | 368 | 245 | 40% |
| Qatar | 172,982 | 62 | 62 | 50% |
| Saudi Arabia | 576,824 | 431 | 449 | 51% |
| Singapore | 239,700 | 518 | 255 | 33% |

| | GDP 2011 ($US M) | Commercial Value of Properly Licensed Software, 2011 ($US M) | Commercial Value of Pirated Software, 2011 ($US M) | Piracy Rate 2011 |
|---|---|---|---|---|
| **High-Income Countries** | | | | |
| Slovakia | 95,994 | 102 | 68 | 40% |
| Slovenia | 49,539 | 60 | 51 | 46% |
| Spain | 1,490,810 | 1,548 | 1,216 | 44% |
| Sweden | 538,131 | 1,460 | 461 | 24% |
| Switzerland | 635,650 | 1,542 | 514 | 25% |
| United Arab Emirates | 360,245 | 354 | 208 | 37% |
| United Kingdom | 2,431,589 | 5,530 | 1,943 | 26% |
| United States | 15,094,000 | 41,664 | 9,773 | 19% |

* 2010 GDP used for Bahrain and New Zealand

| | GDP 2011 ($US M) | Commercial Value of Properly Licensed Software, 2011 ($US M) | Commercial Value of Pirated Software, 2011 ($US M) | Piracy Rate 2011 |
|---|---|---|---|---|
| **Middle-Income Countries** | | | | |
| Albania | 12,960 | 2 | 6 | 75% |
| Algeria | 188,681 | 16 | 83 | 84% |
| Argentina | 445,989 | 295 | 657 | 69% |
| Azerbaijan | 63,404 | 10 | 67 | 87% |
| Bosnia | 18,088 | 8 | 15 | 66% |
| Brazil | 2,476,652 | 2,526 | 2,848 | 53% |
| Bulgaria | 53,514 | 57 | 102 | 64% |
| Chile | 248,585 | 244 | 382 | 61% |
| China | 7,318,499 | 2,659 | 8,902 | 77% |
| Colombia | 331,655 | 262 | 295 | 53% |
| Costa Rica | 41,007 | 45 | 62 | 58% |
| Dominican Republic | 55,611 | 29 | 93 | 76% |
| Ecuador | 67,003 | 43 | 92 | 68% |
| Jordan | 28,840 | 22 | 31 | 58% |
| Kazakhstan | 186,198 | 39 | 123 | 76% |
| Latvia | 28,252 | 27 | 32 | 54% |
| Lithuania | 42,725 | 38 | 44 | 54% |
| FYROM | 10,165 | 11 | 22 | 66% |
| Malaysia | 278,671 | 538 | 657 | 55% |
| Mexico | 1,155,316 | 942 | 1,249 | 57% |
| Peru | 176,662 | 103 | 209 | 67% |
| Romania | 179,794 | 122 | 207 | 63% |
| Russia | 1,857,770 | 1,895 | 3,227 | 63% |

| | GDP 2011 ($US M) | Commercial Value of Properly Licensed Software, 2011 ($US M) | Commercial Value of Pirated Software, 2011 ($US M) | Piracy Rate 2011 |
|---|---|---|---|---|
| **Middle-Income Countries** | | | | |
| South Africa | 408,237 | 1,047 | 564 | 35% |
| Thailand | 345,649 | 331 | 852 | 72% |
| Tunisia | 45,864 | 18 | 51 | 74% |
| Turkey | 773,091 | 322 | 526 | 62% |
| Uruguay | 46,710 | 40 | 85 | 68% |
| Venezuela | 316,482 | 91 | 668 | 88% |

| | GDP 2011 ($US M) | Commercial Value of Properly Licensed Software, 2011 ($US M) | Commercial Value of Pirated Software, 2011 ($US M) | Piracy Rate 2011 |
|---|---|---|---|---|
| **Low-Income Countries** | | | | |
| Armenia | 10,248 | 4 | 26 | 88% |
| Bangladesh | 110,612 | 16 | 147 | 90% |
| Bolivia | 24,427 | 16 | 59 | 79% |
| Cameroon | 25,465 | 2 | 9 | 83% |
| Cote d'Ivoire | 24,075 | 4 | 16 | 81% |
| Egypt | 229,531 | 110 | 172 | 61% |
| Georgia | 14,367 | 5 | 52 | 91% |
| Guatemala | 46,900 | 31 | 116 | 79% |
| India | 1,847,982 | 1,721 | 2,930 | 63% |
| Indonesia | 846,832 | 239 | 1,467 | 86% |
| Iraq | 115,388 | 28 | 172 | 86% |
| Kenya | 33,621 | 24 | 85 | 78% |
| Moldova | 7,000 | 5 | 45 | 90% |
| Morocco | 100,221 | 47 | 91 | 66% |
| Nigeria | 235,923 | 55 | 251 | 82% |
| Pakistan | 211,092 | 45 | 278 | 86% |
| Philippines | 224,754 | 145 | 338 | 70% |
| Senegal | 14,292 | 3 | 9 | 78% |
| Sri Lanka | 59,172 | 16 | 86 | 84% |
| Ukraine | 165,245 | 123 | 647 | 84% |
| Vietnam | 123,961 | 93 | 395 | 81% |
| Yemen | 33,758 | 2 | 15 | 89% |
| Zambia | 19,206 | 0.7 | 3 | 82% |
| Zimbabwe | 9,900 | 0.3 | 4 | 92% |
| **Worldwide Total** | **63,084,724** | | | |

# About BSA | The Software Alliance

BSA | The Software Alliance is the leading advocate for the global software industry before governments and in the international marketplace. It is an association of world-class companies that invest billions of dollars annually to create software solutions that spark the economy and improve modern life.

BSA serves as the world's premier anti-piracy organization and as a respected leader in shaping public policies that promote technology innovation and drive economic growth.

Through government relations, intellectual property enforcement and educational activities in dozens of countries around the world, BSA protects intellectual property and fosters innovation; works to open markets and ensure fair competition; and builds trust and confidence in information technology for consumers, businesses and governments alike.

## Protecting Intellectual Property & Fostering Innovation

Intellectual property rights — copyrights, patents and trademarks — provide the legal framework for creative enterprise, the bedrock of growing economies. They are also essential to commercial software development, which is the world's largest copyright industry.

By working with policymakers, leading enforcement actions and conducting public-education initiatives around the world, BSA ensures that respect for IPR pervades the global economy and society.

- **Championing Intellectual Property Rights:** BSA works with governments around the world to ensure intellectual property protections keep pace with new innovations in technology, such as cloud computing.
- **Curbing Software Theft:** BSA conducts vigorous enforcement programs around the world, helping its members guard against software theft by taking legal action against commercial, end-user license infringement, counterfeiting operations and Internet piracy.
- **Leading Industry Research:** BSA publishes the most authoritative global studies on piracy and its economic impact, illuminating the scope of the problem and helping shape national and international policy responses.
- **Educating the Public:** BSA educates consumers about harms associated with software piracy and offers groundbreaking tools and training programs to help organizations more effectively manage their software assets.

## Opening Markets & Ensuring Fair Competition

Open markets are essential to economic growth and prosperity. BSA expands market opportunities for the software industry by working with governments to break down trade barriers and eliminate discriminatory procurement preferences that stifle innovation by skewing competition.

- **Breaking Down Barriers to Growth:** BSA provides policymakers with information, expert analysis and industry insights to promote an open-markets agenda. These efforts include a special focus on the BRIC economies, which are the world's fastest-growing technology markets but also home to rampant piracy.

- **Promoting Technology Neutrality:** BSA encourages fair competition among technologies by promoting internationally recognized standards and unbiased IT-procurement policies for governments.
- **Supporting New Innovations:** BSA works with policymakers around the world to create conditions for new technologies, such as cloud computing, to flourish. In addition to collaborating on technology standards, this work involves elevating intellectual property protections, harmonizing international legal principles and addressing other challenges that are beyond the capability or jurisdiction of any one company or government.

## Building Trust & Confidence in Technology

Security and privacy undergird trust and confidence in information technology for consumers, businesses and governments. BSA promotes responsible data stewardship and facilitates acceptance and adoption of each new wave of innovation that transforms the technology marketplace and creates value for society.

- **Driving Public-Private Collaboration:** Drawing on the expertise of its members and productive working relationships with public officials, BSA serves as a knowledge center and catalyst to encourage cooperation and forge consensus among industry and governments.
- **Protecting Consumers:** As new technologies emerge, such as cloud computing, BSA and its members develop appropriate privacy and security standards and share their insights with policymakers and regulators.
- **Mapping Policy Solutions:** BSA has developed a global cybersecurity framework to guide governments in crafting policies that effectively deter and punish cybercrime, mitigate threats, inform and protect consumers, and respond to cyber incidents.

# About INSEAD eLab

As one of the world's leading and largest graduate business schools, INSEAD brings together people, cultures and ideas from around the world to change lives and transform organizations. eLab is INSEAD's center of excellence in the global knowledge economy. A key objective of INSEAD eLab is to strengthen links across academia, business leaders and policy makers by: drawing on a variety of global resources to develop research insights that are academically rigorous and relevant to private and public sector leaders.

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