# Antitrust: Have We Gone Too Far?

The Relationship between Competition Law Stringency and Welfare

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**Abstract**

Theoretically, competition law is meant to increase welfare through stimulating competition. While a number of studies provide evidence to support this, this paper presents counterevidence. With the use of a recently created comprehensive index, no significant relationship whatsoever is found between competition law stringency and welfare, both in the form of economic development and human development, which adds a health and education dimension to the economic dimension. Increasing the strictness of an antitrust regime might not lead to a significant decrease in anticompetitive actions that harm welfare. However, competition law stringency does seem to have a positive effect on educational attainment and life expectancy, which gets stronger over time. While the former relationship is strictly linear, the latter appears to be inverse U-shaped. Just like competition law stringency, competition law quality also doesn't appear to influence GDP, but it does have a positive relationship with human development. Possibly, competition law quality positively influences the other dimensions of human development enough to overcome the insignificant effect on the economic dimension.

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# List of Abbreviations

ALI             Antitrust Law Index

CLI             Competition Law Index

CPI             Competition Policy Index

EI              Education Index

GDP             Gross Domestic Product

GNI             Gross National Income

HDI             Human Development Index

II              Income Index

LEI             Life Expectancy Index

UNDP            United Nations Development Programme

# 1. Introduction

Antitrust laws aim to protect (fair) competition between companies for the consumers' benefit by ensuring trade remains unrestrained. This results in lower prices, more alternatives, greater innovation and higher-quality products. Hence, antitrust laws should add to (consumer) welfare.[1]

Most economists recognize competition policy as a substantial contributor to the improvement of nations' welfare,[2] but others say that competition can yield suboptimal results[3] or even that antitrust laws should be abolished because they threaten the core elements of competition.[4] It could be that competition law to a certain extent is beneficial for society but more and more antitrust measures might not always be good.

Whether this is the case, is empirically researched in this study by answering the following question: ***What is the relationship between the stringency of competition law and welfare?*** The hypothesized answer is that there is a quadratic relationship that is inverted U-shaped. This means that antitrust measures are initially beneficial but they have diminishing marginal returns. Then there is a certain level of competition law strictness for which welfare is maximized, but a further increase has negative effects on welfare.

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[1] Stucke 2013, p. 165-167.
[2] Hüschelrath 2008.
[3] Stucke 2013.
[4] Younkins 2000.

To research this question, firstly, some key terms need to be clarified. Section 2 explains why competition and competition law are important and why human development, along with GDP, are the forms of welfare that are researched. In section 3, with the help of some empirical studies, hypotheses surrounding the effects of competition law stringency are created. Section 4 follows with a description of the methodology that is used to answer the main research question and of the data that is used. Subsequently, the results of the analysis are presented in section 5. Lastly, section 6 rounds up with a conclusion.

## 2. Theoretical Framework

Before any analysis can be performed, some concepts and definitions need to be explained. This section clarifies in sections 2.1 and 2.2 what competition and competition law entail and why they are important for society. It also has to be determined in what way society is influenced. In other words, societal welfare needs to be defined. This is done in section 2.3.

### 2.1. Competition

The classical concept of competition is a dynamic one in which individual sellers try to undersell and individual buyers try to outbid their rivals in the market, which forces prices to a cost-covering level.[5] Adam Smith's interpretation of this is that individuals are led by an invisible hand in the form of market prices. Sellers are obliged to set lower prices in order to attract customer demand or otherwise be dispelled from the market. This way, competition makes sure individuals increase social welfare by acting in their own interest.[6]

Later, the neoclassical static model of perfect competition developed. Instead of looking at how the market equilibrium is reached dynamically, it considers the properties of the equilibrium itself. Such a perfectly competitive market is considered to have the following characteristics. Firstly, a large number of producers operate on the market. They decide individually on their actions and are unable to influence their rivals' actions

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[5] Van den Bergh, Camesasca & Giannaccari 2017, p. 41; McNulty 1968, p. 647.
[6] Van den Bergh, Camesasca & Giannaccari 2017, p. 41-42; Smith 1776, p. 127-128.

and the market price due to a lack of market power. Secondly, there must be no barriers to enter or exit the market. Thirdly, there must be perfect and complete information, so that all parties can take the decisions that are optimal for themselves. Fourthly, goods and services must be homogenous. Consumers decide only on price from which producer they buy. Lastly, transaction costs must be zero, which means that products can be exchanged without any costs which ensures that the goods end up in the place where they are valued the most.[7]

If all these requirements are met, the perfectly competitive market equilibrium is Pareto-efficient, meaning that the welfare of one actor cannot be increased further without decreasing the welfare of another. Therefore, this market equilibrium is considered to be optimal from an economic welfare perspective. Economic welfare can be split in consumer welfare, which represents the difference between the market price and the consumers' willingness to pay, and producer welfare, which is the difference between the market price and the marginal production costs.[8]

Regardless of the form of the concept of competition, both the classical and neoclassical economists agree that competition is desirable and that distortions decrease efficiency and social welfare. Adam Smith acknowledged that producers could collude together to raise prices in detriment to consumers and that there was a need for a legal framework

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[7] Van den Bergh, Camesasca & Giannaccari 2017, p. 45-48.
[8] Van den Bergh, Camesasca & Giannaccari 2017, p. 47-48.

that guarantees freedom of competition.[9] The neoclassical economists proposed another problem, namely that of a monopoly. In this case, there is only one seller instead of many, and due to its market power or certain advantages that pose as entry barriers, it is also not challenged by (possible) new entrants. This results in the monopolist having the ability to set prices instead of taking them. Prices are raised which in turn leads to lower demand and thus to an inefficient allocation of resources because the consumers' wishes are not fully satisfied. A part of the consumer surplus is redistributed to the monopolist but a part of it is lost completely, because consumers purchase less of the product. This deadweight loss represents a loss in societal welfare. Furthermore, monopolists don't have the same incentive to minimize production costs as firms in a competitive market nor to keep innovation, product quality and product variation levels high. Additionally, the efforts firms take to become a monopolist are also costly. This is called rent-seeking.[10]

All these examples of welfare-decreasing distortions in the competitive process provide a strong argument for the design and implementation of a welfare-improving competition law.[11] This is exactly why most countries in the world have introduced competition law to some extent.

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[9] Van den Bergh, Camesasca & Giannaccari 2017, p. 42-44; Smith 1776, p. 127-128.
[10] Van den Bergh, Camesasca & Giannaccari 2017, p. 48-51.
[11] Van den Bergh, Camesasca & Giannaccari 2017, p 49.

## 2.2. Competition Law

Antitrust laws aim to protect (fair) competition between companies for the consumers'
benefit by ensuring trade remains unrestrained and no firm can become a coercive
monopolist that could charge higher prices and leave consumers with fewer choices,
which lowers consumer welfare.[12] Competition, on the other hand, results in lower
prices, more alternatives, greater innovation and higher-quality products and services.[13]
Hence, antitrust laws should add to welfare.[14] The main areas that antitrust laws see to
are cartels or collusions and other anticompetitive practices (like price-fixing
conspiracies), market dominance (e.g. predatory pricing to achieve or maintain
monopoly power and exclude others from the market), mergers (that are likely to
reduce the competitive nature of the market in question) and state aid to companies.[15]

### 2.2.1. Goals of Competition Law

The general aim of all competition policy regimes is to protect (fair and efficient)
competition between companies to the consumers' benefit.[16] However, there are
differences in how antitrust authorities interpret this and in the goals they try to
accomplish. For instance, many economists think that the maximization of total social
welfare is the goal, but consumer welfare is often found to be more important than the
welfare of companies, which means that maximizing consumer surplus and choice are

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[12] Van den Bergh, Camesasca & Giannaccari 2017, p. 48-49.
[13] Stucke 2013, p. 165-167.
[14] Van den Bergh, Camesasca & Giannaccari 2017, p. 49-52.
[15] European Commission 2019a.
[16] Van den Bergh, Camesasca & Giannaccari 2017, p. 48-49.

the most important things.[17] Other goals include ensuring economic freedom, ensuring

a level playing field for all enterprises, stimulating innovation, promoting international

competitiveness and achieving market integration (especially in Europe). The aims differ

per region and change throughout time and they can include both economic and

political objectives. All antitrust regimes do have in common that they try to maximize

some sort of welfare, whether this is total social welfare or only consumer welfare.[18]

### 2.2.2. Elements of an Antitrust Regime

Competition law is needed to protect the competitive process, but this is not the only

important aspect of an impactful antitrust regime.[19] There is also not one ideal way to

describe which elements such a regime requires. Bradford and Chilton make a

distinction between two categories. The first captures the ability of the competition

authority to regulate competition. This encompasses the provisions on who is enabled

to enforce the laws and the accompanying limits, including the availability of remedies

or private litigation. The second category is the substance of the law. This entails the

substantive rules that regulate competition and it consists of three sub-categories of

rules, which are rules surrounding merger control, abuse of a dominant position and

anticompetitive agreements.[20]

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[17] Buccirossi, Ciari, Duso, Spagnolo & Vitale 2011, p. 168; Kaplow & Shavell 2002; Motta 2004; Buccirossi 2008; Never & Röller 2005.
[18] Van den Bergh, Camesasca & Giannaccari 2017, p. 139-167.
[19] Bradford & Chilton 2018.
[20] Bradford & Chilton 2018.

A more elaborate view on the elements of an efficient antitrust regime is provided by Buccirossi, Ciari, Duso, Spagnolo and Vitale. They describe indicators of the quality of competition policy, which measure its deterrence properties. With competition policy, they mean the antitrust legislation, including the merger control provisions and its enforcement, that puts into force a set of prohibitions and obligations that firms must comply with to ensure that competition is not reduced or altered, together with an array of tools for policing and punishing any violation. All these components are features of an antitrust regime.[21]

It seems clear that any antitrust regime is made up from a number of important elements that range from written law to institutional settings and enforcement.

## 2.3.   Welfare

Now that it is established that competition and competition law aim to increase welfare in one form or another, it is still necessary to define welfare itself. If we take welfare in its entirety (i.e. consumer welfare + producer welfare), the question is how to measure it. One variable that is often used to describe welfare is the Gross Domestic Product (GDP) of a country, since this says something about economic development. Nevertheless, using GDP as representative of welfare does not come without limitations. For instance, GDP not include other factors of overall welfare like the income

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[21] Buccirossi, Ciari, Duso, Spagnolo & Vitale 2011, p. 168-169.

distribution in a country,[22] environmental damage,[23] the merits of household and other unpaid work,[24] opportunities to get good education and healthcare.[25]

Recently, the Human Development Index (HDI) has become a more popular indicator of welfare. The HDI includes three key dimensions of welfare, which are the standard of living dimension, the education dimension and the health dimension. The first is represented by Gross National Income per capita, which is very similar to GDP in the sense that it also says something about a country's economic state. The second consists of both the mean years and the expected years of schooling. To describe the health level in a country, life expectancy at birth is used. Together, these three dimensions set up a more complete picture of welfare than just GDP does.[26]

All in all, both GDP and human development are used as standard of welfare in this study, with the latter being the more encompassing measure.

[22] US Bureau of Foreign and Domestic Commerce, US Seventy-Third Congress & Kuznets 1934.
[23] Van den Bergh 2010; Gertner 2010.
[24] Nussbaum 2013.
[25] Drèze & Sen 2013.
[26] Jahan 2016; UNDP 2016.

# 3. Expected Relationships Between Competition Law Stringency and Welfare

In this chapter, the set out theories are combined with empirical studies to form a set of hypotheses regarding the relationships between competition law stringency and welfare. In section 3.1, specifically the expected relation between competition law stringency and GDP is made clear. In section 3.2, the other two dimensions of human development, health and education, are also taken into consideration to form an expectation about the association between competition law stringency and human development.

## 3.1. Competition Law Stringency and GDP

The first study of interest is that of Nicholson, who creates his own Antitrust Law Index (ALI) by assigning binomial scores for the presence of particular competition laws in a jurisdiction and aggregates these points. Three broad dimensions of competition policy are incorporated, which are regime structure, merger policy and anticompetitive practices.[27] Nicholson argues that there might be a relationship between the wealth of a country and the competition law regime's extensiveness, because an economically developed country has more resources available for competition law institutions and enforcement. To test this theory, Nicholson regresses his ALI against GNP (which is a measure of economic development, similar to GDP) and finds a statistically significant

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[27] Nicholson 2004, p. 12-16.

non-linear relationship with the shape of an U, which means that very poor and very rich countries have more competition laws on the books, while middle-income countries have fewer.[28]

Another study finds that having an antitrust regime positively affects economic development (i.e. GDP per capita) and economic growth. Interestingly, this effect increases over time, which makes sense since it might take some time before an antitrust institution is fully established, has performed investigations and has made decisions. However, just looking at the effects of the presence of an antitrust regime doesn't say anything about the effectiveness of the system. In a second model, Petersen uses Nicholson's ALI, which does measure the scope of different competition law regimes, and finds that increasing antitrust law stringency has a weakly significant positive effect on economic development.[29]

Unlike Nicholson, who looks only at the presence of key competition law rules, Buccirossi et al. construct an index of competition law quality by scoring its provisions against a benchmark of generally agreed-upon best practices. Best-practice means here those provisions that deter all welfare-harming market actions. In other words, welfare is maximized when all best practices are implemented. The awarded scores are used to make up the Competition Policy Index (CPI), which is based on provisions that concern antitrust infringements and mergers, and on institutional and enforcement features

[28] Nicholson 2004, p. 16-17.
[29] Petersen 2011.

across all anticompetitive actions.[30] The findings are that the average CPI ranges between 0.45 and 0.52 during the researched time period of 1995-2005.[31] This implies that jurisdictions didn't even come close to having an optimal antitrust regime and that moving towards these best practices would bring about an increase in welfare.

Next, Buccirossi, Ciari, Duso, Spagnolo and Vitale use the CPI to examine the relationship between competition policy quality and total factor productivity, which is the growth in production that is not caused by growth in inputs of labor and capital. They find a positive significant effect.[32] While this provides support for the argument that competition policy creates benefits to the long-term performance of a country's economy by increasing the deterrence of anticompetitive actions, the authors acknowledge that these benefits should be compared with the costs of enforcing competition laws.[33] This is important because welfare increases with the level of deterrence up to the point when it turns into over-deterrence, which means that the added benefits of deterrence are outweighed by the extra costs of strengthening the institutional and enforcement features. Alas, the authors did not have access to sufficiently precise and encompassing cost estimates in order to perform such an analysis. Therefore, the CPI is an imperfect measure to determine whether countries' competition law provisions are optimal.

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[30] Buccirossi et al. 2011, p. 168-173.
[31] Buccirossi, et al. 2011, p. 199.
[32] Buccirossi, Ciari, Duso, Spagnolo & Vitale 2012a.
[33] Buccirossi et al. 2012a, p. 22.

Despite some flaws in the discussed analyses, they all show that competition law is positively linked to GDP and welfare. However, more competition law or even more competition in itself might not always be desirable. Competition could yield suboptimal results in particular situations,[34] antitrust laws could lead to the protection of inefficient competitors and harm consumers[35] and as explained above, even if increasing the amount or quality of competition laws has benefits, it also comes with costs. This all suggests that there is an overall optimal level of competition law and that any further augmentation would reduce welfare. Therefore, the main hypothesis **(I)** of this research is: ***the relationship between the stringency of competition law and welfare in the form of GDP is inverted U-shaped***.

One way to research this hypothesis is to compare the benefits of antitrust law with the costs that come with its enforcement, which is what Hüschelrath does for the United States and the Netherlands. The benefits are measured by estimating the sizes of the deadweight losses that occur due to monopolized industries. In the US, the conservative estimate of the yearly deadweight losses amounts to $6 billion and the average estimate is $156 billion.[36] These benefits have to be compared to the total antitrust enforcement costs which are calculated to be $2.126 billion, which is clearly less than the estimated deadweight losses.[37] However, all these estimations are rough. A number of antitrust

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[34] Stucke 2013.
[35] Younkins 2000.
[36] Hüschelrath 2008, p. 26.
[37] Hüschelrath 2008, p. 23-25.

scholars believe that the costs of deterring beneficial activities are much larger, but on the other hand, benefits are also likely to be substantially greater since the decrease in rent-seeking activities and the deterrence effect of disadvantageous activities should be added to the evaded deadweight losses. Thus, it does seem likely that the aggregate benefits outweigh the aggregate costs in the US.[38]

Regarding the situation in the Netherlands on an aggregate level, the estimated total costs amount to €52-70 million annually.[39] While no attempt is made to estimate the aggregate benefits, a look can be taken at the individual case of the Dutch Nuon-Reliant merger. In this case, the deadweight loss was 'only' €1.7 million.[40] Based on this, Hüschelrath reaches the conclusion that these benefits do not cover the antitrust enforcement costs.[41] However, it doesn't make sense to compare the benefits of an individual case to the aggregated enforcement costs. The study also contains estimations of the costs per case, which amount to a maximum of €1.32 million.[42] The €1.7 million benefit was therefore larger than the costs in this individual case.

In conclusion, according to this study, it is likely that the benefits of antitrust enforcement are larger than its costs. Even if that is ture, it can still be that there is a quadratic relationship between competition law and welfare but that the found

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[38] Hüschelrath 2008, p. 26-28.
[39] Hüschelrath 2008, p. 29-32.
[40] Hüschelrath 2008, p. 32-33.
[41] Hüschelrath 2008, p. 36.
[42] Hüschelrath 2008, p. 31.

datapoints are on the upward part of the inversed U and that the optimal level of enforcement is not yet reached.

In this regard, another portion of the study of Buccirossi et al. is interesting. Even though they don't have data on enforcement costs, they still perform a short analysis on whether the relationship between competition policy quality (i.e. the CPI) and productivity growth is quadratic. When one takes into account that increasing competition law quality always comes with added costs, and that there is probably a point where the marginal costs of extra quality outweigh the marginal benefits, then by estimating a quadratic regression model with welfare as dependent variable, one can determine this optimal point and show whether jurisdictions have already passed it, without having the need for actual data on costs. If a certain level of CPI lies after the optimal point, this implies that the extra costs are greater than the extra benefits and welfare decreases.

When estimating the quadratic relationship, Buccirossi et al. find that the linear term is negative and that the quadratic term is positive. This implies that the relationship is actually U-shaped instead of inverted U-shaped. However, since both terms are insignificant, this suggests that the relationship between the CPI and productivity growth is not quadratic at all. They conclude that the data refuse such specification. Interestingly, they do state that over the entire range of the CPI datapoints they are in

the increasing part of the estimated U-shaped relationship.[43] This again could mean that the real relationship is in fact inverted U-shaped but due to the data being only on the increasing part, the analysis is unable to show this. Because of this possibility, hypothesis **(I)** remains unchanged.

## 3.2. Competition Law Stringency and Human Development

The previously discussed studies looked at the effects of competition law stringency or quality on GDP but as explained in section 2, the HDI is a more encompassing measure of welfare since it adds a health and educational dimension to the standard of living dimension that GDP represents. However, in order for the effect of any competition law index on HDI to be different from the effect on GDP, competition law also has to influence either overall health or the level of education in a country.

As explained before, ensuring competition increases innovation. This is especially important in the healthcare sector since citizens need new and affordable treatments. The European Commission acknowledges that effective competition is key to stimulate healthcare companies to invest in developing such treatments. Therefore, the European Commission monitors business practices in the pharmaceutical, health services and medical devices markets in order to protect effective competition and it also prevents mergers that are likely to harm competition in the healthcare sector.[44] Competition law appears to have successfully ensured price competition, higher levels of quality and

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[43] Buccirossi, Ciari, Duso, Spagnolo & Vitale 2012b, p. 23.
[44] European Commission 2019b.

choice for consumers in the healthcare sector,[45] implying that consumer and overall welfare have improved from a health perspective. Therefore, hypothesis **(II)** reads: ***more stringent competition law has a significant relationship with health***.

Effective competition is also useful in the (higher) education sector. It helps to ensure that the fees charged are reasonable and provide value for money, to provide more choice, to encourage innovation in training programs, to support the continual improvement of teaching and of the student's experience, and to allow ambitious, high-quality providers of education to develop their 'services' and grow their businesses in line with customer demands.[46] Regardless of these positive effects of competition, a link between competition law and the education dimension of welfare is not that straightforward since schools and universities are often public and are therefore controlled or heavily regulated by the government, rendering concerns of anticompetitive actions low. However, enrollment in private schools and universities has been on the rise and is currently around 17% for primary education,[47] 26.5% for secondary education[48] and 33% for higher education.[49] Besides, public institutions are also not beyond the reach of competition law. There have been situations where both private and public educational institutions have engaged in anticompetitive collusion by fixing prices,[50] which is an infringement of article 101 TFEU. Educational institutions can

[45] Sage, Hyman & Greenberg 2003.
[46] Department for Business, Innovation and Skills 2013, p. 7.
[47] World Bank 2018a.
[48] World Bank 2018b.
[49] Levy 2018.
[50] Gideon 2017, p. 76-78; Office of Fair Trading 2006; Autoriteit Consument & Markt 2011, 2012.

also be subject to merger control[51] or hold a dominant position for specialized subjects and subsequently abuse that dominance, hence infringing article 102 TFEU.[52]

All in all, even though most educational institutions are of a public nature, a considerable amount is also private. Furthermore, public educational institutions are subject to competition law as well. Hence, competition law is expected to stimulate competition in the educational sector and thus improve educational outcomes. Therefore, hypothesis **(III)** is: ***more stringent competition law has a significant relationship with education***.

To sum up the three formulated hypotheses, more stringent competition law is expected to have a significant relation with GDP, health and education. Furthermore, the relationship between more stringent competition law and welfare is expected to be inverted U-shaped, whether welfare is defined as being just GDP or as human development. This leads to the final hypothesis **(IV)**: ***the relationship between the stringency of competition law and welfare in the form of human development is inverted U-shaped***.

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[51] Gideon, p. 93.
[52] Gideon, p. 87.

# 4. Data & Methodology

This chapter starts by discussing the main explanatory variable, the dependent variables and the used control variables in section 4.1. The methodology of the research is then presented in section 4.2.

## 4.1. Data

### 4.1.1. Competition Law Index

Mainly, the recently created Competition Law Index (CLI) is used, which measures the stringency of competition regulation around the world from 1889 to 2010. The index quantifies and aggregates the key elements of the competition authority, including available remedies and the option of private enforcement, and of the substantive law provisions regarding anticompetitive agreements, abuses of dominance and merger control.[53] The CLI quantifies these features for each jurisdiction in each year since the country first introduced its competition law.[54] Hence, the CLI is similar to Nicholson's ALI. However, this latter index covers 'just' 52 jurisdictions and it focuses on the year 2003 only,[55] making the CLI much more comprehensive.

The elements of the CLI are first categorized in the Antitrust Index and Substance Index separately and then combined to form the overall CLI.[56] This way, the CLI reflects the view that both the substantive laws and the likelihood of detection and subsequent

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[53] Bradford & Chilton 2018, p. 6-7.
[54] Bradford & Chilton 2018, p. 2.
[55] Nicholson 2004.
[56] A full list of variables that make up the CLI and its sub-indices can be found in Appendix A.

consequences are critical components of the regulation of anticompetitive behavior.[57]

Each element has its own respective weighted score.[58] After all the scores are added up, they are normalized. If a country does not have any competition statute in place in a given year, it gets a score of 0, and it gets a score of 1 if it had the most stringent legal system possible.[59]

The CLI does come with a pair of limitations. Firstly, regarding the authority category, the CLI does not take into account the resources or efforts countries put into enforcing their competition laws. Even though countries may have strict law on the books, if there is no effort in enforcing the law, the stringency of the country's competition law might be overstated when looking at just the black letter law. However, the composers of the CLI state that focusing on the law on the books was the only way to build a comprehensive dataset of competition policies around the world, because enforcement data is difficult, if not impossible, to obtain for a large number of countries and years.[60] Secondly, the authors elect not to follow indexes that attempt to measure the quality of competition law, like the CPI. Even though they admit that quality of the law is important, they focus on the law's stringency because it is not easy to objectively measure quality, they didn't want to rely on competition authorities' own perceptions of the quality of their regimes and they did not want to assume that there is one 'optimal

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[57] Bradford & Chilton 2018, p. 9-16; Becker 1968; Goldsmith & Posner 2005; McAdams 2015; Buccirossi et al. 2011.
[58] Bradford & Chilton 2018, p. 6.
[59] Bradford & Chilton 2018, p. 17.
[60] Bradford & Chilton 2018, p. 5.

law' that applies for all jurisdictions across every time period. However, they feel like the CLI and the quality indexes complement each other in a valuable way.[61] The differences and complementarity between the CLI and the CPI are exactly the reasons why researching the relationship between competition policy and welfare using the CLI is valuable even though this relation has already been researched by Buccirossi et al. using the CPI.

The dataset contains data from 123 countries that had a competition law in place by 2010.[62] Despite this, the dataset contains a couple of errors. Firstly, a number of countries have a CLI of 0 for all years even though they should at least have a competition law in place in 2010, according to the previous statement. So, either these are mistakes in the dataset or the statement from the authors is wrong. In the second scenario, the data would still be interesting when comparing different countries, but since Fixed Effects Models are used, these data are of no relevance because there is no variation in competition law stringency in these countries over time. Therefore, these data have been dropped. Secondly, for some countries, the CLI suddenly gets a value of 0 even though their competition law was still in place. This means that there is just a gap in the data. For this reason, these countries have also been dropped. For each country, all competition laws are included starting from the year when their first competition law was adopted, which goes as far back as 1889 for Canada, whose competition statute is

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[61] Bradford & Chilton 2018, p. 34.
[62] Bradford & Chilton 2018, p. 2-3.

considered to be the first comprehensive competition regime in the world. This means that the data ranges from 1889 to 2010. [63] However, for a number of countries, the data only goes as far back as 1992. Therefore, some analyses only use the years 1992-2010 while others use data from further back as well.

### 4.1.2. Dependent Variables

Regarding the outcome variables,[64] the main one is the HDI, which is created by the United Nations Development Programme (UNDP) to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country instead of economic output alone. The HDI consists of three indices which are all also used as dependent variables. The Life Expectancy Index (LEI) is assessed by life expectancy at birth, the Education Index (EI) is measured by both mean of years of schooling for adults aged 25 years and over, and expected years of schooling for children of school entering age. The Income Index (II) is measured by the logarithm of GNI per capita to reflect the diminishing importance of income with increasing GNI. The scores for the three HDI dimension indices are then aggregated into a composite index using geometric mean.[65] The UNDP started to assemble the HDI in 1990. This restricts the time component of the analysis. Since the HDI data is from 1990 onwards and the CLI is available for all countries from 1992 to 2010, the years 1992-2010 are researched. This also goes for the Income, Life Expectancy and Education Indices.

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[63] Bradford & Chilton 2018, p. 3.
[64] Appendix B gives a full list of used variables, their definitions and finding places.
[65] UNDP 2016, 2019.

Data on countries' GDP goes as far back as 1960. That means that the analysis with GDP as dependent variable can be more extensive than the ones with the HDI and its sub-indices as outcomes. This analysis will range from 1960 to 2010, since the end is still capped off by the availability of the CLI.

### 4.1.3. Control Variables

An extensive set of control variables is used in the regression analyses in order to minimize omitted variable bias. Known factors that influence GDP include the accumulation of both physical capital (i.e. gross fixed capital formation) and human capital (i.e. mean number of years of schooling), population growth, expenditure on research and development, inflation (both its level and variability), general government final consumption expenditure, access to funding for capital accumulation in the form of credit provided by deposit money banks to the private sector, liquid liabilities to GDP and international trade. Lastly, economic output is also said to depend on the value of economic output in the previous period. The reasoning is that poorer economies develop at faster rates than richer economies and that all economies converge to its country-specific steady state level of per capita income at some point in time.[66]

Regarding human development, it is found that public provisions in health and education play an important role. Secondly, political indicators like the quality of governance, political stability and corruption have an influence as well, just like

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[66] Bassanini & Scarpetta, 2001.

economic variables of international trade and financial development.[67] Measures that represent financial development are private credit of money provided by banks to the private sector and liquid liabilities to GDP. The former indicates the access to funding for capital accumulation while the latter shows the monetization of the financial system.[68] Lastly, variables of social exclusion, which are income inequality, poverty and unemployment, are found to be affecting human development.[69]

Whereas GDP and human development are national indicators, health and education are mostly personal issues. Since this study only includes analyses on the national level, a difference has to be made between the determinants that affect individual health and level of education and those that influence societal health and educational attainment. Regarding health and life expectancy, societal health depends both on the health system in a country and the economic development of a country. Following several studies, the main factor that represents the health system is public expenditure on health and factors that proxy for the level of economic development are (public expenditure on) education, GDP per capita, income inequality, subsidies and other transfers, poverty and unemployment.[70] Therefore, these variables are included as controls in the life expectancy models.

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[67] Christoforou 2010; Ranis, Stewart & Ramirez 2000.
[68] Lawrence & Longjam, 2003.
[69] Christoforou, 2010; Ranis, Stewart & Ramirez 2000.
[70] Lee, 2018; Kim & Kawachi, 2006.

The demand for education is influenced by individual factors like sex and health status, by household factors like household income per capita and the level of education of the household lead, and by national determinants like the quality of education and the level of public infrastructure. This doesn't only hold for higher levels of education, but also for primary schooling, since attending primary school is not as ordinary in developing countries as it is in developed countries. This is due to both a lack of money and bad infrastructure which makes it hard for children to even get to school.[71] The lack of funds is captured in the model by the variables GDP per capita, poverty, unemployment and subsidies and other transfers, and since there is no clear direct measure available that represents the quality of infrastructure, the gross fixed capital formation is used. This is a commonly accepted representative.[72] Since there is also no clear-cut measure of educational quality available, public expenditure on education is used as a proxy. Lastly, students' health is important for them to go to school. Especially improving children's health makes it more likely that they enrol in primary education.[73] Therefore, public spending on health is also included in the models.

Alas, a number of control variables only go back until around 1990 or they contain some or a lot of missing data points. Multiple imputation is used in order to deal with this problem. However, since multiple imputation cannot reliably be performed for variables that have no data points, all countries that had any control variable without data points

[71] Sánchez & Sbrana 2009; Simkins 2005; Suryadarma & Suryahadi 2010.
[72] Joshi, Lazatin & Flaminiano 2017.
[73] Sánchez & Sbrana 2009.

have been dropped, which results in the remainder of 79 countries. For the analysis for the years 1992-2010 this is an adequate solution, but for the regressions with GDP as dependent variable for the years 1960-2010, using multiple imputation means that for a number of control variables, data are estimated for the 30 years before the first available datapoint, which makes this estimation method less reliable. So, additional to this analysis, the effect of the CLI on GDP is also researched using just the data from the years 1992-2010. Lastly, multiple imputation has only been used for the control variables and not for any of the dependent or main explanatory variables.

## 4.2. Methodology

The research question aims at discovering whether the relationship between competition law stringency and total welfare is a positive linear one or whether it has an inverse U-shape. In order for this relationship to have the latter form, an important assumption has to be made, which is that the increase in competition law stringency has benefits in the sense that it deters companies from engaging in welfare-harming actions, but that it also comes with costs. If at some point the extra costs start to outweigh the extra benefits, the relationship is reverse U-shaped and a socially optimal point for competition law stringency exists.

In order to find out what the empirical relationship is, a set of regression models are used. More specifically, panel analyses are performed for 79 countries for either 19 or 51 years. The following general regression is estimated:

**(\*)**      $Y_{i,t} = \alpha_i + \beta_1 {}^* CLI_{i,t} + \beta_2 {}^* X_{i,t} + \varepsilon_{i,t}$

In which $Y_i$, represents a certain outcome (i.e. either GDP, the HDI or one of its sub-indices), *CLI* represents either the aggregated Competition Law Index or the set of different sub-indices which are authority, substance, mergers, dominance and anticompetitive agreements. $\alpha_i$ is a country fixed effects estimator and $X_{i,t}$ is a vector of control variables.

This regression assumes a linear relationship between competition law stringency and welfare, which is what is assumed or found in most empirical research. However, in this paper, the hypothesis is that this regression is misspecified in its functional form and that the true form is inverse U-shaped. To test this, a quadratic regression estimation is needed:

**(\*\*)** $\quad Y_{i,t} = \alpha_i + \beta_1 * CLI_{i,t} + \beta_2 * CLI_{i,t}^2 + \beta_3 * X_{i,t} + \varepsilon_{i,t}$

As stated, both equations contain a country fixed effects estimator, because it can be that certain historical, cultural or institutional features of a country explain both the level of stringency of the country's competition law and the levels of economic output and human development, which would create an endogeneity problem if these are not included in the models. These country-specific and time-invariant factors are captured by the country fixed effects estimator. This means that the regressions are Fixed Effects Models, which in turn means that only within-country variation is examined. Since the used dataset shows rich variation in competition law stringency within countries over time, this is not a problem. Even in the data that is used for the regressions based on the years 1992-2010, there is significant within variation. Not only did a number of countries introduce their competition law within this time span, which implies a big jump in the index, countries have adjusted their antitrust regime during this time period as well,

mostly by making it stricter but sometimes also by making it less stringent. As said before, the dataset also contains countries with a CLI of 0 for all years, which are of no relevance in a Fixed Effects Model, and are therefore dropped.

A possible issue in these estimations is put forward by Nicholson. According to him, wealthier countries have better developed institutional features of competition law because more resources are available.[74] Therefore, it could be that GDP or human development actually influence competition law stringency instead of the other way around. This problem of possible reverse causality is dealt with by estimating distributed lag models with lagged variables of the CLI. Since these lagged values precede the dependent variable in time, it says something about the direction of the relationship. According to Petersen, the effects of competition law on economic development actually need time to establish. The lagged CLI values also show whether this holds up. Petersen finds that ten years after its introduction, the effect of an antitrust institution on economic growth per capita is more than 50% stronger than three years after its introduction.[75] It seems that a time period of 10 years is warranted. Therefore, lagged values of up to 10 years are included in the models.

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[74] Nicholson 2004, p. 17.
[75] Petersen 2011, p. 20.

# 5. Results

The main results of the linear and quadratic regressions with the different dependent variables are discussed in section 5.1. In order to compare the results to those of Buccirossi et al, the regressions are repeated with the CPI replacing the CLI. Next, in 5.2, the CLI is split into its different categories to examine which provisions drive the relationships. In section 5.3, distributed lag models are estimated to see whether it takes more time to establish an effect and if there is an effect, if it becomes stronger over time, in accordance with the findings of Petersen.[76] Lastly, the direction of the relationships are examined in section 5.4 to see if it is indeed the CLI that affects the outcome variables, or whether it's the other way around, like Nicholson suggests to be the case with economic development.[77]

## 5.1. Main Results

The results of the different models are discussed per outcome variable, starting with GDP. The first interesting finding to look at is the correlation between GDP and the CLI, which is 0.33 and thus implies only a moderate connection. The first model **(1)**,[78] which is based on the years 1960-2010, shows a positive significant relationship between the CLI and GDP, whereas regression **(3),** based on the years 1992-2010, shows an insignificant negative relation. For both sets of years, the quadratic equations **(2)** and **(4)** show a negative linear term and a positive quadratic term, which would suggest an

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[76] Petersen 2011.
[77] Nicholson 2004.
[78] See Table 1.

U-shaped relationship, but since all coefficients are insignificant, there is no evidence that the relationship between GDP and the CLI is quadratic. This is similar to Buccirossi et al.'s findings regarding the CPI.[79] Dissimilar and unexpected is the insignificant coefficient of the CLI in model **(3)**. This is also somewhat contradictory to the findings of Petersen.[80] Although Petersen did find a significant positive relationship between the presence of an antitrust regime and GDP, the effect of Nicholson's ALI on economic development is only significant at the 10% level. Furthermore, the ALI was not even included in the estimation with growth per capita as outcome variable.[81] Regarding the research of Buccirossi et al., they find a positive relationship between their CPI and total factor productivity (which doesn't differ that much from GDP), but their set-up and dataset are very different from this paper. They research 22 industries across 12 countries over an 11 year period,[82] whereas this study focuses on 79 countries over a time span of 19 or 51 years. Another possible explanation for the divergent findings is the inherent difference between the CLI and the CPI, since the former measures the stringency of competition law and the latter the quality of competition law. It is therefore interesting to see what the results would be if the CLI is replaced by the CPI in the performed regressions.[83] Interestingly, the linear regression **(5)** shows an insignificant (and negative) association between the CPI and GDP, which completely

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[79] Buccirossi et al. 2012a.
[80] Petersen 2011.
[81] Nicholson 2004.
[82] Buccirossi et al. 2012a.
[83] Using the CPI does mean that the dataset automatically gets restricted to the 12 countries and 11 years (1995-2005) that Buccirossi et al. used, resulting in a total of only 116 observations.

contradicts the findings of Buccirossi et al.[84] The results of the quadratic estimation **(6)** do correspond, since it shows an U-shaped relationship, although it is surprising that both the linear and quadratic term are significant at the 10% level. However, since it's only at the 10% level, this is no real evidence for a quadratic relationship. The only conclusion that can be drawn here is that using their CPI in a different set-up with a different estimation method and different data leads to different results.

Based on these findings, there is some evidence for a (positive) significant relationship between the CLI and GDP but also evidence against it. It is not easy to say which of the regressions is more likely to hold the actual answer. Estimation **(1)** is based on a lot more data but this includes the multiple imputed datapoints for control variables for the 30 years before the first available datapoint. This, in my opinion, makes this estimation less reliable than regression **(3)**, which might be based on fewer years, but it uses data from 79 countries over a time span of 19 years, which is still quite extensive. If this is the better model, this would imply that there is no significant relationship between competition law stringency and GDP, which in a way corresponds to the finding of the insignificant association between the CPI and GDP in model **(5)**.

This also means that the relationship between the stringency of competition law and welfare in the form of GDP is not only not inverted U-shaped and that hypothesis **(I)** has to be rejected, but according to these results, any significant relationship is non-existent.

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[84] Buccirossi et al. 2012.

**Table 1**: Estimates of the effect of competition law stringency and quality on GDP

| GDP | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Constant | -319.05 | -299.62 | -2042.60** | -2041.07** | -19433.38 | -9102.90 |
| | (209.17) | (210.09) | (798.54) | (800.68) | (13793.21) | (15063.69) |
| CLI | 307.58** | -66.31 | -81.82 | -117.84 | | |
| | (142.25) | (414.29) | (366.54) | (1086.65) | | |
| $CLI^2$ | | 505.33 | | 44.68 | | |
| | | (525.70) | | (1268.89) | | |
| CPI | | | | | -3900.75 | -73972.60* |
| | | | | | (6945.10) | (40533.25) |
| $CPI^2$ | | | | | | 79614.13* |
| | | | | | | (45743.93) |
| | | | | | | |
| F-Stat | 9605.66 | 8896.51 | 993.16 | 920.10 | 35.96 | . |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | . |

Regressions (1) and (2) are based on the years 1960-2010, (3) and (4) on 1992-2010 and (5) and (6) on 1995-2005.

All regressions include country-specific fixed effects and the controls mentioned in section 4.1.3.

Standard errors are in parentheses. Probabilities are in brackets.

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.[85]

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[85] These general specifications hold for all regressions and tables, unless otherwise specified.

So, how can this insignificant relation be explained since it contradicts previous findings? Remember that, according to Hüschelrath, the yearly average deadweight loss in the US amounts to $156 billion. If this deadweight loss is prevented by competition law against the estimated costs of $2.126 billion, this seems like a significant increase in GDP. Even if the costs of deterring beneficial activities are much higher, it still appears likely that the benefits significantly outweigh the costs since rent-seeking and other disadvantageous activities might also be deterred to a larger extent.[86] One thing that Hüschelrath hasn't considered is that this scenario implies that all monopolies are actually prevented and that no deadweight losses remain. This seems very unlikely since no antitrust regime is perfect and there will always be companies that abuse their market power, collude or perform other anticompetitive actions. The question is how effective the antitrust regimes are in practice. Better institutional and enforcement features don't guarantee significantly better results which means that it could be possible that competition law does not increase welfare (at least in the form of GDP) in a significant way. Even so, competition law is still important to create fairness in the competitive environment and to protect consumers. Hüschelrath estimates that overcharges and redistribution effects are much larger than deadweight losses.[87] It would be interesting to empirically study the relationship between the CLI and CPI on one side and these overcharges and redistribution effects on the other side.

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[86] Hüschelrath 2008.
[87] Hüschelrath 2008.

Regarding the Income Index, its correlation with the CLI amounts to -0.03. This isn't only very small, but also negative. This corresponds with regression **(7)**, which shows a negative and insignificant relation.[88] There is also no significant quadratic relationship to be found in regression **(8)**. These results don't change when the CLI is replaced by the CPI in regressions **(9)** and **(10)**. These results are quite in line with the findings regarding the GDP regressions, which seems logical since the II is based on GNI, which is similar to GDP. However, it is strange that the found correlation is negative. Maybe this can be explained by the difference between GNI and GDP. GNI is basically equal to the GDP of a country plus what the residents of that country earn abroad and minus what foreigners earn in this country. This includes wages, returns on investments and dividends from shareholdings. If we connect this to competition policy, we have to notice that one of the goals of antitrust is to prevent exclusionary behavior. This means that competition laws bring about more competition and more market players, which results in more available jobs and an overall improvement of the competitive position and business climate of the country. This leads to more foreign workers and businesses entering the country and less domestic workers and businesses getting their income abroad. Hence, more income flows out of the country and less flows into the country, which lowers GNI relative to GDP. That might explain why higher levels of competition law stringency have a negative correlation with GNI but a positive one with GDP.

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[88] See Table 2.

**Table 2**: Estimates of the effect of competition law stringency and quality on the II

| II | (7) | (8) | (9) | (10) |
|---|---|---|---|---|
| *Constant* | -10.26 | -10.55 | 0.04* | 0.04* |
| | (11.48) | (11.53) | (0.02) | (0.02) |
| *CLI* | -5.78 | -1.64 | | |
| | (5.64) | (16.57) | | |
| *CLI²* | | -5.16 | | |
| | | (19.40) | | |
| *CPI* | | | -0.01 | 0.01 |
| | | | (0.01) | (0.04) |
| *CPI²* | | | | -0.01 |
| | | | | (0.04) |
| | | | | |
| *F-Stat* | 35.55 | 32.85 | 271.81 | . |
| | [0.00] | [0.00] | [0.00] | . |

Regressions (7) and (8) are based on the years 1992-2010 and regressions (9) and (10) on the years 1995-2005.

Now, let's move on to the Life Expectancy Index. The correlation between the CLI and the LEI is 0.31 which signifies a moderate association and the results of the analysis coincide with hypothesis **(II)** that more stringent competition law has a significant relationship with health since the coefficient of the CLI is positive and significant in model **(11)**.[89] According to the quadratic model **(12)**, there is even a significant inverse U-shaped relationship. However, since the coefficient of the quadratic term is smaller than the coefficient of the linear term and all the used indexes have a value between 0 and 1, the quadratic term can never be larger than the linear term. For instance, if the

[89] See Table 3.

CLI is increased from its minimum value of 0 to its maximum value of 1, this leads to an increase of 0.11 points on the LEI through the linear term and to a decrease of $0.09*1^2$ = 0.09 through the quadratic term, which means that there is still an overall increase. The maximum point of the inverse U lies somewhere beyond CLI levels of 1, which the CLI is unable to attain. This means that all values of the CLI lie on the upward portion of the curve and that any increase in CLI is beneficial for life expectancy. There also appears to be a positive significant relationship between competition law quality and the LEI, although only a linear one, which follows from the CPI models **(13)** and **(14)**. The difference might be due to the inherent distinction between the CLI as a measure of competition law stringency and the CPI as a measure of competition law quality or due to the use of different subsets of data for the CLI and CPI regressions.

**Table 3**: Estimates of the effect of competition law stringency and quality on life expectancy

| LEI | (11) | (12) | (13) | (14) |
|---|---|---|---|---|
| Constant | 0.66*** | 0.65*** | 0.71*** | 0.74*** |
|  | (0.02) | (0.02) | (0.01) | (0.03) |
| CLI | 0.04*** | 0.11*** |  |  |
|  | (0.00) | (0.01) |  |  |
| CLI² |  | -0.09*** |  |  |
|  |  | (0.01) |  |  |
| CPI |  |  | 0.06*** | -0.10 |
|  |  |  | (0.01) | (0.11) |
| CPI² |  |  |  | 0.17 |
|  |  |  |  | (0.12) |
|  |  |  |  |  |
| F-Stat | 48.28 | 48.95 | 29.44 | 27.87 |
|  | [0.00] | [0.00] | [0.00] | [0.00] |

Regressions (11) and (12) are based on the years 1992-2010 and regressions (13) and (14) on the years 1995-2005.

Next up is the relationship between competition law stringency and education, which is expected to be significant and positive, as formulated in hypothesis **(III)**. Both the correlation of 0.45 and the empirical analysis are in alignment with this hypothesis. In both the linear model **(15)** and the quadratic model **(16)** the CLI has a positive and significant coefficient, although the quadratic term is insignificant in the latter estimation.[90] This implies that more competition law stringency indeed leads to higher levels of educational attainment and that this relationship is linear. It's possible that the results don't show a significant inverse U-relationship if the used datapoints are purely located on the upward section and the optimal level is not yet reached. But since the dataset contains the maximum value of the CLI and therefore also includes any 'optimal value', the analysis should have shown a significant quadratic relation if this were the true relationship.

Curiously, there are no real significant relationships between the CPI and educational attainment, as can be seen in regressions **(17)** and **(18)**. This discrepancy might be because of the essential differences between the CLI and CPI or due to the use of alternate datasets.

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[90] See Table 4.

**Table 4**: Estimates of the effect of competition law stringency and quality on education

| EI | (15) | (16) | (17) | (18) |
|---|---|---|---|---|
| Constant | 0.50*** | 0.50*** | 0.79*** | 0.65*** |
| | (0.01) | (0.01) | (0.10) | (0.13) |
| CLI | 0.11*** | 0.08*** | | |
| | (0.01) | (0.02) | | |
| $CLI^2$ | | 0.03 | | |
| | | (0.03) | | |
| CPI | | | 0.08 | 0.70* |
| | | | (0.05) | (0.41) |
| $CPI^2$ | | | | -0.68 |
| | | | | (0.44) |
| | | | | |
| F-Stat | 83.68 | 76.73 | 12.03 | 11.08 |
| | [0.00] | [0.00] | [0.00] | [0.00] |

Regressions (15) and (16) are based on the years 1992-2010 and regressions (17) and (18) on the years 1995-2005.

Lastly, the association between the CLI and human development is examined. Interestingly, the correlation between the CLI and the HDI is negative, just like between the CLI and the II, and takes the value of -0.01, which suggests a very weak relation. Regressions **(19)** and **(20)** support this since there is no significant linear or quadratic relationship,[91] which means that hypothesis **(IV)** has to be rejected. This sounds a bit illogical at first instance because competition law stringency appears to significantly improve two of the three factors that make up the HDI. However, it could be that the insignificant negative effect on the II drags down the positive significant effects on the

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[91] See Table 5.

Life Expectancy and Education Indices in the statistical analysis, resulting in an aggregate insignificant effect on the HDI. To see if there is any truth to this conjecture, three indices have been constructed by using the three components of the HDI. Each index is calculated in the same way as the HDI but is based on only two of the three elements of the HDI. Thus, we get the Life Expectancy-Education Index, the Education-Income Index and the Income-Life Expectancy Index. When the HDI is replaced as the dependent variable by these three indices, the trio of regressions show a significant positive relationship between the CLI and the Life Expectancy-Education Index and an insignificant negative relationship between the CLI and the other two created indices.[92] These results support the idea that it is the relationship between the CLI and the II that renders the association between competition law stringency and the HDI insignificant.

Regarding the CPI models **(21)** and **(22)**, there appears to be at least a significant linear relationship between competition law quality and the HDI and possibly an inverse U-shaped relationship, but the evidence for this latter relationship is weak since the quadratic term in model **(22)** is significant at only the 10% level. The found significant linear relationship is a bit unexpected since the CPI only showed to have a significant effect on life expectancy. However, maybe this effect is strong enough to compensate for the insignificant relationships between the CPI and the Income and Education Indices. When the same procedure is performed as with the CLI and the HDI is replaced by the Life Expectancy-Education, Education-Income and Income-Life Expectancy

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[92] Results not shown.

Indices, the results are that the CPI has a positive significant relationship with all three indices, which underpins the found significant association between the CPI and the HDI.

Just like before, the differing results between the CLI and CPI models could be caused by the use of a different part of the dataset or by the innate characteristics of the two variables.

**Table 5**: Estimates of the effect of competition law stringency and quality on the HDI

| HDI | (19) | (20) | (21) | (22) |
|---|---|---|---|---|
| Constant | 3.82 | 3.48 | 0.63*** | 0.56*** |
| | (6.24) | (6.23) | (0.03) | (0.05) |
| CLI | -0.16 | 4.36 | | |
| | (2.78) | (8.62) | | |
| $CLI^2$ | | -5.55 | | |
| | | (10.04) | | |
| CPI | | | 0.08*** | 0.40** |
| | | | (0.02) | (0.18) |
| $CPI^2$ | | | | -0.35* |
| | | | | (0.20) |
| | | | | |
| F-Stat | 0.27 | 0.27 | 13.69 | 13.80 |
| | [1.00] | [1.00] | [0.00] | [0.00] |

Regressions (19) and (20) are based on the years 1992-2010 and regressions (21) and (22) on the years 1995-2005.

## 5.2. Categories of Competition Law

As mentioned in section 4.1.1, the overall CLI can be split into the Authority Index and the Substance Index. In turn, the latter consists of three indices that represent the three major categories of competition rules, which are anticompetitive agreements, abuse of dominance and merger control. This means that the relationships between the dependent variables and competition law stringency can be examined in more depth by replacing the CLI in the regressions with its sub-indices.[93] First, the CLI is split into its two main sub-indices and next, the Substance Index is further divided.[94]

The previous estimations show that the CLI only has a significant effect on GDP in the model based on the years 1960-2010. This seems to be due to the substantive competition rules since only the Substance Index shows significance. When the Substance Index is further split, the Anticompetitive Index is insignificant and the Dominance and Mergers Indices are significant at the 10% level. These latter two probably cause the significance of the Substance Index in the previous model. However, there are still no significant relations to be found in the models based on the years 1992-2010.

Up until this point, the II didn't appear to have a significant relationship with competition law stringency, which doesn't change when we look at the different categories. Only the Authority Index is significant at the 10% level.

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[93] No quadratic relationships are examined here.
[94] See Table 6 and Table 7 in Appendix C.

Regarding the variables that did show to have a significant relationship with the CLI, which are the LEI and the EI, they also have significant relationships with the CLI's sub-indices. Only the coefficient of the Authority Index in the Life Expectancy model is significant at only the 10% level. The rest is highly significant. When the Substance Index is split, the weakly significant Antitrust Index in the Life Expectancy model becomes insignificant, and the driver of the significance of the Substance Index seems to be the Anticompetitive Index. The other two are insignificant. Regarding the EI, the Authority Index stays significant and the Dominance and Merger Indices are also significant, whereas the Anticompetitive Index is not.

Lastly, the HDI does not show any significant association with any of the authority and substance provisions, which supports the finding that human development is unrelated to competition law stringency.

## 5.3. Distributed Lag Models

In this section, lagged values of the CLI are added to the models in steps in order to check two things. Firstly, it could be that the consequences of a change in competition law stringency need some time to come into force. In that case, there can still be a significant relation between the CLI and the dependent variables even though the relationship between the current values is insignificant, like with GDP,[95] the II and the HDI. Secondly, for the significant effects that have already been found, the aim is to see whether the

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[95] In the model based on the years 1992-2010.

effect becomes stronger over time, just like Petersen concludes. To recall, he finds that the effect of establishing an antitrust regime on economic growth per capita is 50% stronger ten years after its introduction than after three years. Therefore, lagged values of up to 10 years are included in the models. First, only a 1-year lag is included, followed by a 2-year lag, then a 5-year lag and lastly a 10-year lag.[96]

Regarding the models with GDP as outcome variable, only the 10-year lag has a positive significant effect and this is only in model **(26)** based on the years 1960-2010 and not in the model based on the years 1992-2010.[97] This finding adds to the evidence that there is no significant relationship whatsoever between competition law stringency and GDP. Basically the same result is found for both the II and the HDI, where not a single lagged value is statistically significant.[98] This means that for the dependent variables that showed an insignificant relationship with the current value of the CLI in the previous section, there are also no significant relations with the past values of the CLI. Hence, there is no evidence for the theory that the effects need more time to become established but there is evidence for the theory that there is no significant relationship at all between competition law stringency on one side and GDP, the II and the HDI on the other side.

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[96] All tables belonging to this section can be found in Appendix D.
[97] See Table 8 and Table 9.
[98] See Table 10 for the II and Table 13 for the HDI.

When it comes to the LEI and the EI, the current CLI did show a positive significant relationship with those. This significance is still present in the distributed lag models, with the only exception being the 2-year lag model **(36)** with the LEI as outcome variable.[99] Additionally, in each model, at least the lag that goes the furthest back in the past is highly statistically significant. When longer lags are added, some of the shorter lags become insignificant but others remain significant, implying that the effects of changes in the competition law stringency affect life expectancy and educational attainment for quite some time. The effects of longer lags are even greater than those of shorter lags, similar to Petersen's findings.[100] The effect of a change in competition law stringency on both life expectancy and educational attainment is about three times stronger after ten years than after two years and about forty percent stronger after ten years than after five years.[101]

All in all, there doesn't appear to be any significant relationship between competition law stringency and GDP, the II and the HDI, but there is evidence that competition law stringency has a positive significant effect on both life expectancy and educational attainment, which gets stronger over time.

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[99] See Table 11 for the LEI and Table 12 for the EI.
[100] Petersen 2011.
[101] Based on the exact results.

## 5.4. Direction of the Relationships

So far, the empirical results suggest that competition law stringency does not influence GDP, the II and the HDI and it does increase life expectancy and educational attainment. However, it could still be that significant relationships exist. Nicholson, for instance, finds a significant positive effect of GNP on his ALI and his explanation is that wealthier countries have more resources available to improve its institutional features of competition law.[102] Since wealth is also a part of human development, this reverse relation could also exist between the HDI and competition law stringency. This is examined by running regressions with the CLI as dependent variable. Since it is unclear which factors all influence the stringency of a country's competition law, only regressions without control variables are estimated. Therefore, all found results should be taken with a grain of salt, since any found significant relationship could disappear when sound control variables are included. This also happened with the GDP models. Without control variables, the CLI has a positive significant effect on GDP as well as the longest lagged value of CLI in the different distributed lag models, which implies that competition law stringency stimulates GDP, but the significance of these effects disappears in almost all models when controls are added.[103]

With this in mind, let's discuss the findings.[104] Firstly, when the CLI acts as the dependent variable, current GDP is significant and positive in almost all models as well as the last

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[102] Nicholson 2004.
[103] See Table 14 for the regressions of GDP on the CLI without control variables.
[104] All tables for this section can be found in Appendix E.

lag in the 5-year and 10-year distributed lag models. However, in the 1-year and 2-year distributed lag models, no lags are significant.[105] This implies that in the long run, GDP might influence competition law stringency.

Secondly, the CLI never has a positive effect on the II, regardless of whether control variables are included in the models or not. However, the other way around, the 5-year and 10-year lag of the II have a positive significant effect on the CLI,[106] which strengthens the evidence a bit for the theory that more economic wealth leads to higher levels of competition law stringency in the long run.

Thirdly, the CLI and its (longer) lagged values appear to have a positive effect on both the LEI and the EI in both the models with and without controls. When the roles are reversed, the results change in one major way. Even though these indices and their (longer) lagged values show statistical significance, the longer significant lagged values have a positive effect, while the shorter ones have a negative sign.[107] If these indices in fact would influence competition law stringency, we would expect there to be no difference in the sign of the coefficients of the different lags. Therefore, it seems more likely that competition law stringency influences life expectancy and educational attainment than the other way around.

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[105] See Table 15.
[106] See Table 16.
[107] See Tables 17 and 18.

Finally, in both the models with control variables and without, none of the current or lagged values of the CLI have a significant effect on the HDI. Interestingly, the 5-year lagged value of the HDI does have a significant effect on the CLI in both the 5-year and 10-year distributed lag models.[108] In both cases, this effect is negative. A possible explanation is that countries with higher levels of human development don't care that much about increasing welfare through competition law as the citizens are already doing well. However, this effect might disappear or become different if solid control variables are added.

In conclusion, there is some evidence that higher levels of economic development lead to an increase in competition law stringency in the long run, which is in line with Nicholson's findings and this might be because these countries have more resources available to improve the antitrust regime.[109] However, human development, which includes economic development, shows some negative relationship with competition law stringency. This might be because the higher overall well-being of the population renders an increase in welfare through competition law unnecessary or not worthwhile, even though more resources are available. Higher levels of health and education appear to have an ambiguous effect on competition law stringency, since some significant effects are positive while others are negative. In the end, these results should be looked at with skepticism since there are no control variables present in the models.

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[108] See Table 19.
[109] Nicholson 2004.

## 6. Conclusion

The general aim of competition law is to prevent and stop anticompetitive actions and to promote competition. In doing so, an antitrust regime is supposed to increase overall or consumer welfare. Multiple researchers have found a positive significant linear association between competition law stringency and economic development. However, the possibility of a quadratic relationship is not often considered, even though an increase in competition law could induce more costs than benefits at some point. Also, the effects on other forms of welfare than GDP have not been studied. In this paper, these two issues are researched by combining them into the question what the relationship is between competition law stringency and welfare, both in the form of GDP and human development, which adds a health and education dimension to the measure of economic well-being.

The results of the analyses suggest that there is actually no significant relationship at all. Competition law stringency only seems to have a significant effect on life expectancy and educational attainment, which gets stronger over time. The positive effect on life expectancy appears to be driven by the substantive rules regarding anticompetitive agreements, while the effect on educational attainment seems to be powered through both the provisions on the authority to regulate competition and the substantive rules regarding abuses of dominance and mergers.

Even though the associations with these two human development dimensions are significant, the insignificant relation with the income dimension probably renders the aggregate effect on human development insignificant. The lack of a relationship between competition law stringency and GDP contradicts previous findings. However,

an antitrust regime expansion only increases welfare significantly if it effectively diminishes anticompetitive behavior in practice. Maybe it's just the case that it doesn't do that enough, which would explain the differences between the empirical findings of this paper and the theory. The different results of this research as compared to the other empirical studies can also be explained. Firstly, Nicholson finds a positive relation between competition law stringency and GNP, but the analysis in this paper is much more comprehensive and the results are therefore likely to be closer to the true relationship. Secondly, Petersen might have found significant effect on competition law stringency, but this is only weakly significant, which means that the results aren't really different after all.

Lastly, Buccirossi et al. find a positive significant association between competition law quality and GDP, but since their CPI doesn't measure stringency, it's inherently different from the CLI used in this research. Therefore, the analyses have also been performed using the CPI, which also leads to the result that there is no significant relationship with economic development. This is opposite to Buccirossi et al.'s conclusion. An explanation for this could be that different research methods and datasets are utilized. Interestingly, the CPI does show a positive significant relationship with human development. Possibly, competition law quality positively influences the other dimensions of human development enough to overcome the insignificant effect on the income dimension.

Lastly, there is some minor evidence that higher levels of economic development increase competition law stringency in the long run, which could be due to the country having more resources available to improve the antitrust regime. Furthermore, higher levels of health and education appear to have an ambiguous effect on competition law

stringency and higher levels of human development actually lead to a decrease in competition law stringency. This might be because the higher overall well-being of the population renders an increase in welfare through competition law unnecessary. However, these results should be doubted since no control variables are included in these models.

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# Appendix A: Elements of the CLI

**Figure 1:** The elements that make up the CLI and its four sub-indices

| Authority | | Abuse of Dominance | |
|---|---|---|---|
| Private Right of Action | 1 | General Prohibition | 2 |
| Fines | 1 | Market Access | 0.25 |
| Imprisonment | 1 | Tying | 0.25 |
| Divestitures | 1 | Discounts | 0.25 |
| Damages | 1 | Unfair Pricing | 0.25 |
| Extraterritoriality | 1 | Discriminatory Pricing | 0.25 |
| Industry Exemptions | −0.5 | Predatory Pricing | 0.25 |
| Enterprise Exemptions—Categorical | −0.5 | Retail Price Maintenance | 0.25 |
| | | Other Abusive Acts | 0.25 |
| | | Efficiency Defense | −0.5 |
| | | Public Interest Defense | −0.5 |

| Merger Control | | Anticompetitive Agreements | |
|---|---|---|---|
| Pre-merger Notification | 1 | Price fixing | 0.5 |
| Mandatory Notification | 1 | Market Sharing | 0.5 |
| Substantive Assessment: Economic | 1 | Output Limitations | 0.5 |
| Substantive Assessment: Public Interest | 1 | Bid Rigging | 0.5 |
| Efficiency Defense | −0.5 | Tying | 0.5 |
| Failing Firm Defense | −0.5 | Exclusive Dealing | 0.5 |
| Public Interest Defense | −0.5 | Resale Price Maintenance | 0.5 |
| | | Eliminate Competitors | 0.5 |
| | | Efficiency Defense | −0.5 |
| | | Public Interest Defense | −0.5 |

**Source**: Bradford & Chilton 2018, p. 10.

## Appendix B: List of Used Variables

*Competition Law Index:* overall index that aggregates the key elements of the competition authority and the substance of competition law in a country. The index ranges between 0 and 1.[110] Data on the CLI and its sub-indices are received by email from Professor Chilton.

*Authority Index:* captures the provisions on who can enforce the competition laws and their limits, including available remedies and the option of private enforcement. The index ranges between 0 and 1.[111]

*Substance Index:* captures the substantive rules that regulate competition, which include the three sub-categories of rules: anticompetitive agreements, abuses of dominance and merger control. The index ranges between 0 and 1.[112]

*Anticompetitive Agreements Index:* captures the substantive rules regarding anticompetitive agreements. The index ranges between 0 and 1.[113]

*Abuse of Dominance Index:* captures the substantive rules regarding abuses of dominance. The index ranges between 0 and 1.[114]

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[110] Chilton & Bradford 2018.
[111] Chilton & Bradford 2018.
[112] Chilton & Bradford 2018.
[113] Chilton & Bradford 2018.
[114] Chilton & Bradford 2018.

*Merger Control Index:* captures the substantive rules regarding mergers. The index ranges between 0 and 1.[115]

*Competition Policy Index:* overall index that scores the key features of a competition policy regime against a benchmark of generally agreed-upon best practices. The index ranges between 0 and 1.[116]

*GDP:* per capita in current U.S. dollars.[117]

*Human Development Index:* summary measure of achievements in three key dimensions of human development which are a long and healthy life, access to and a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions which are the Income Index, Life Expectancy Index and Education Index. The index ranges between 0 and 1.[118]

*Income Index:* represents to what extent people have a decent standard of living. It is based on GNI per capita. The index ranges between 0 and 1.[119]

*Life Expectancy Index:* represents to what extent people live a long and healthy life. The index is based on the life expectancy at. The index ranges between 0 and 1.[120]

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[115] Chilton & Bradford 2018.
[116] Burrirossi, Ciari, Duso, Spagnolo & Vitale 2011, 2014.
[117] World Bank 2018c.
[118] Jahan 2016; UNDP 2016, 2017a.
[119] UNDP 2016, 2017b.
[120] UNDP 2016, 2017c.

*Education Index:* represents to what extent people have access to knowledge. The index is based on mean years of schooling and expected years of schooling. For each of these, an index is calculated. Then the arithmetic mean of the two resulting indexes is taken to create the Education Index. The index ranges between 0 and 1.[121]

*Life Expectancy-Education Index:* geometric mean of the Life Expectancy Index and the Education Index. The index ranges between 0 and 1.[122]

*Education-Income Index:* geometric mean of the Education Index and the Income Index. The index ranges between 0 and 1.[123]

*Income-Life Expectancy Index:* geometric mean of the Income Index and the Life Expectancy Index. The index ranges between 0 and 1.[124]

*Gross fixed capital formation:* investments in physical capital which includes land improvements; plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.[125]

*Mean years of schooling*: average years of schooling of residents in a country.[126]

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[121] UNDP 2016, 2017d.
[122] UNDP 2016, 2017c, 2017d.
[123] UNDP 2016, 2017b, 2017d.
[124] UNDP 2016, 2017b, 2017c.
[125] World Bank 2017a.
[126] UNDP 2016, 2017e.

*Population growth:* difference in the population in two consecutive years. Calculated by using the total population aged 15-64.[127]

*Total R&D expenditure:* as percentage of GDP.[128]

*Inflation:* measured by the consumer price index which reflects the annual percentage change in the cost of a basket of goods and services to the average consumer.[129]

*Inflation variability:* the standard deviation of inflation estimated as a centered three-year moving-average.[130]

*Government consumption expenditure:* includes all government current expenditures for purchases of goods and services, and most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.[131]

*International trade:* sum of exports and imports of goods and services as share of GDP.[132]

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[127] World Bank 2017b.
[128] World Bank 2016a.
[129] World Bank 2017c.
[130] World Bank 2017c.
[131] World Bank 2017d.
[132] World Bank 2017e.

*Credit provided by banks:* the financial resources provided to the private sector by domestic money banks as a share of GDP. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits.[133]

*Liquid liabilities to GDP:* liquid liabilities as percentage of GDP. Liquid liabilities are also known as M3. They are the sum of currency and deposits in the central bank (M0), transferable deposits and electronic currency (M1), time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements (M2), traveler's checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents.[134]

*Public health expenditure:* domestic general government health expenditure as percentage of GDP.[135]

*Public education expenditure:* total government expenditure on education as percentage of GDP.[136]

*Subsidies and other transfers:* as percentage of total public expenditure.[137]

*Poverty:* percentage of the population living on less than the international poverty line of $1.90 per day (at 2011 international prices), as set by the World Bank.[138]

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[133] World Bank 2018d.
[134] World Bank 2018d.
[135] World Bank 2015.
[136] World Bank 2018e.
[137] World Bank 2017f.
[138] World Bank 2016b, 2017h.

***Income inequality:*** the GINI index measures the extent to which the income distribution among individuals or households in an economy deviates from a perfectly equal distribution. A value of 0 implies perfect equality and 100 implies perfect inequality.[139]

***Unemployment:*** share of the labor force that is without work but available for and seeking employment.[140]

***Corruption:*** captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Estimates range from -2.5 to 2.5.[141]

***Political stability:*** measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Estimates range from -2.5 to 2.5.[142]

***Quality of governance:*** average of two indicators: (i) voice and accountability (captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media) and (ii) government effectiveness (perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies). Estimates range from -2.5 to 2.5.[143]

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[139] World Bank 2017g.
[140] World Bank 2017i.
[141] World Bank 2018f.
[142] World Bank 2018f.
[143] World Bank 2018f.

# Appendix C: Categories of Competition Law

**Table 6**: Estimates of the effects of authority and substance of law on the dependent variables

|  | (23) | (24) | (25) | (26) | (27) | (28) |
|---|---|---|---|---|---|---|
| *Constant* | -294.18 | -1968.29*** | -8.46 | 0.66*** | 0.50*** | 3.51 |
|  | (209.84) | (798.65) | (11.53) | (0.02) | (0.01) | (6.27) |
| *Authority Index* | -230.39 | -751.86 | -15.05* | 0.01* | 0.02** | 3.00 |
|  | (224.09) | (514.81) | (7.92) | (0.01) | (0.01) | (3.98) |
| *Substance Index* | 535.28** | 699.66 | 9.89 | 0.03*** | 0.09*** | -3.27 |
|  | (221.26) | (519.00) | (8.08) | (0.01) | (0.01) | (4.05) |
|  |  |  |  |  |  |  |
| *F-Stat* | 8897.71 | 922.41 | 33.12 | 46.92 | 79.28 | 0.29 |
|  | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [1.00] |

Regressions (23) and (24) have GDP as dependent variable but (23) is based on the years 1960-2010 and (24) on the years 1992-2010. The dependent variables of regressions (25), (26), (27) and (28) are respectively the II, the LEI, the EI and the HDI.

**Table 7**: Estimates of the effects of all competition law categories on the dependent variables

|  | (29) | (30) | (31) | (32) | (33) | (34) |
|---|---|---|---|---|---|---|
| *Constant* | -347.80* | -1994.43** | -10.98 | 0.66*** | 0.49*** | 3.34 |
|  | (210.46) | (802.65) | (11.57) | (0.02) | (0.01) | (6.32) |
| *Authority Index* | -169.28 | -764.50 | -16.24* | 0.01 | 0.02** | 3.29 |
|  | (242.07) | (541.18) | (8.32) | (0.01) | (0.01) | (4.18) |
| *Anticompetitive Actions* | -233.53 | 33.68 | 12.78 | 0.03*** | -0.00 | -6.41 |
|  | (236.80) | (516.64) | (7.97) | (0.01) | (0.01) | (4.03) |
| *Abuse of Dominance* | 391.74* | 428.93 | 2.51 | 0.00 | 0.05*** | 2.32 |
|  | (213.88) | (451.74) | (6.95) | (0.01) | (0.01) | (3.50) |
| *Mergers* | 319.16* | 260.39 | -4.33 | 0.01 | 0.05*** | 0.19 |
|  | (165.84) | (371.78) | (5.76) | (0.00) | (0.01) | (2.87) |
|  |  |  |  |  |  |  |
| *F-Stat* | 7752.12 | 804.37 | 29.02 | 43.06 | 69.06 | 0.33 |
|  | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [1.00] |

Regressions (29) and (30) have GDP as dependent variable but (29) is based on the years 1960-2010 and (30) on the years 1992-2010. The dependent variables of regressions (31), (32), (33) and (34) are respectively the II, the LEI, the EI and the HDI.

# Appendix D: Distributed Lag Models

**Table 8**: Estimates of the effects of the lagged values of the CLI on GDP for the years 1960-2010

| GDP | (35) | (36) | (37) | (38) |
|-----|------|------|------|------|
| Constant | -318.03 | -311.84 | -282.12 | -190.29 |
| | (209.20) | (215.85) | (235.87) | (284.91) |
| CLI | 188.06 | 205.76 | 231.41 | 295.11 |
| | (343.96) | (364.51) | (383.48) | (417.84) |
| 1-Year Lag | 130.91 | -22.41 | -59.72 | -34.05 |
| | (343.01) | (487.25) | (529.43) | (572.13) |
| 2-Year Lag | | 138.58 | -69.82 | -53.99 |
| | | (350.74) | (433.14) | (469.04) |
| 5-Year Lag | | | 303.82 | -43.42 |
| | | | (241.20) | (307.06) |
| 10-Year Lag | | | | 502.74** |
| | | | | (245.57) |
| | | | | |
| F-Statistic | 8891.25 | 7932.62 | 6475.65 | 4547.16 |
| | [0.00] | [0.00] | [0.00] | [0.00] |

**Table 9**: Estimates of the effects of the lagged values of the CLI on GDP for the years 1992-2010

| GDP | (39) | (40) | (41) | (42) |
|---|---|---|---|---|
| Constant | -2046.94** | -2092.05*** | -2122.34** | -1893.16** |
| | (800.39) | (811.88) | (852.79) | (917.30) |
| CLI | -42.41 | -57.48 | -117.97 | -25.23 |
| | (581.98) | (614.36) | (631.90) | (675.15) |
| 1-Year Lag | -47.48 | -20.38 | -170.89 | -148.95 |
| | (542.78) | (756.72) | (801.75) | (843.20) |
| 2-Year Lag | | -38.13 | 156.38 | 136.03 |
| | | (547.65) | (644.98) | (674.82) |
| 5-Year Lag | | | 29.33 | -142.60 |
| | | | (370.93) | (438.45) |
| 10-Year Lag | | | | 342.62 |
| | | | | (370.51) |
| | | | | |
| F-Statistic | 920.01 | 849.35 | 773.23 | 678.42 |
| | [0.00] | [0.00] | [0.00] | [0.00] |

**Table 10**: Estimates of the effects of the lagged values of the CLI on the II

| II | (43) | (44) | (45) | (46) |
|---|---|---|---|---|
| Constant | -10.92 | -10.86 | -16.72 | -19.56 |
| | (11.52) | (11.74) | (12.54) | (13.51) |
| CLI | -1.19 | -1.32 | -3.20 | -4.46 |
| | (8.98) | (9.53) | (9.80) | (10.52) |
| 1-Year Lag | -5.52 | -2.84 | -3.63 | -5.21 |
| | (8.42) | (11.74) | (12.45) | (13.14) |
| 2-Year Lag | | -3.76 | 0.80 | 0.87 |
| | | (8.41) | (10.03) | (10.54) |
| 5-Year Lag | | | -5.88 | -4.36 |
| | | | (5.75) | (6.83) |
| 10-Year Lag | | | | -3.95 |
| | | | | (5.78) |
| | | | | |
| F-Statistic | 32.85 | 30.85 | 28.77 | 25.89 |
| | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1992-2010.

**Table 11**: Estimates of the effects of the lagged values of the CLI on life expectancy

| LEI | (47) | (48) | (49) | (50) |
|---|---|---|---|---|
| Constant | 0.66*** | 0.66*** | 0.67*** | 0.67*** |
|  | (0.02) | (0.01) | (0.01) | (0.01) |
| CLI | 0.01** | 0.01 | 0.01** | 0.02*** |
|  | (0.01) | (0.01) | (0.01) | (0.01) |
| 1-Year | 0.03*** | 0.00 | -0.00 | 0.00 |
| Lag | (0.01) | (0.01) | (0.01) | (0.01) |
| 2-Year |  | 0.03*** | 0.01* | 0.01* |
| Lag |  | (0.01) | (0.01) | (0.01) |
| 5-Year |  |  | 0.04*** | 0.03*** |
| Lag |  |  | (0.00) | (0.00) |
| 10-Year |  |  |  | 0.04*** |
| Lag |  |  |  | (0.00) |
|  |  |  |  |  |
| F-Statistic | 47.76 | 48.38 | 57.40 | 63.57 |
|  | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1992-2010.

**Table 12**: Estimates of the effects of the lagged values of the CLI on education attainment

| EI | (51) | (52) | (53) | (54) |
|---|---|---|---|---|
| Constant | 0.50*** | 0.50*** | 0.50*** | 0.50*** |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| CLI | 0.04*** | 0.04*** | 0.05*** | 0.06*** |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| 1-Year Lag | 0.09*** | 0.00 | 0.00 | 0.00 |
| | (0.01) | (0.01) | (0.01) | (0.01) |
| 2-Year Lag | | 0.09*** | 0.03** | 0.03*** |
| | | (0.01) | (0.01) | (0.01) |
| 5-Year Lag | | | 0.09*** | 0.06*** |
| | | | (0.01) | (0.01) |
| 10-Year Lag | | | | 0.08*** |
| | | | | (0.00) |
| | | | | |
| F-Statistic | 84.14 | 87.71 | 108.41 | 132.93 |
| | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1992-2010.

**Table 13**: Estimates of the effects of the lagged values of the CLI on the HDI

| HDI | (55) | (56) | (57) | (58) |
|---|---|---|---|---|
| Constant | 3.86 | 3.96 | 4.05 | 3.85 |
| | (6.28) | (6.34) | (6.61) | (7.04) |
| CLI | -1.02 | -1.05 | -0.92 | -0.66 |
| | (4.62) | (4.82) | (4.96) | (5.33) |
| 1-Year | 1.00 | 4.14 | 4.92 | 5.39 |
| Lag | (4.35) | (5.98) | (6.30) | (6.67) |
| 2-Year | | -3.59 | -4.86 | -5.01 |
| Lag | | (4.38) | (5.07) | (5.34) |
| 5-Year | | | 0.51 | -0.63 |
| Lag | | | (2.93) | (3.52) |
| 10-Year | | | | 2.15 |
| Lag | | | | (2.88) |
| | | | | |
| F-Statistic | 0.26 | 0.28 | 0.29 | 0.31 |
| | [1.00] | [1.00] | [1.00] | [1.00] |

The regressions are based on the years 1992-2010.

# Appendix E: Direction of the Relationships

**Table 14**: Estimates of the effects of the lagged values of the CLI on GDP without controls

| GDP | (59) | (60) | (61) | (62) | (63) |
|---|---|---|---|---|---|
| Constant | 1616.25*** | 1536.00*** | 1520.88*** | 1571.64*** | 1677.82*** |
| | (300.48) | (307.35) | (312.66) | (327.83) | (360.94) |
| CLI | 15732.54*** | 7272.735*** | 6736.63*** | 6288.62*** | 5755.82*** |
| | (708.62) | (1965.678) | (2053.22) | (2089.20) | (2086.62) |
| 1-Year Lag | | 9108.96*** | 1290.00 | 544.03 | 1085.95 |
| | | (1961.87) | (2773.22) | (2906.59) | (2877.13) |
| 2-Year Lag | | | 8866.70*** | 1571.25 | 1180.61 |
| | | | (1995.80) | (2380.45) | (2361.99) |
| 5-Year Lag | | | | 10030.79*** | 2327.15 |
| | | | | (1306.21) | (1544.63) |
| 10-Year Lag | | | | | 11471.19*** |
| | | | | | (1208.96) |
| | | | | | |
| F-Statistic | 492.92 | 251.37 | 168.95 | 127.37 | 100.67 |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1960-2010 and are without control variables.

**Table 15**: Estimates of the effects of the lagged values of GDP on the CLI

| CLI | (64) | (65) | (66) | (67) | (68) |
|---|---|---|---|---|---|
| Constant | 0.30*** | 0.31*** | 0.31*** | 0.32*** | 0.34*** |
|  | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| GDP | 0.00*** | 0.00*** | 0.00*** | 0.00*** | 0.00 |
|  | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| 1-Year Lag |  | 0.00 | -0.00 | -0.00 | -0.00 |
|  |  | (0.00) | (0.00) | (0.00) | (0.00) |
| 2-Year Lag |  |  | 0.00 | -0.00 | -0.00 |
|  |  |  | (0.00) | (0.00) | (0.00) |
| 5-Year Lag |  |  |  | 0.00*** | 0.00 |
|  |  |  |  | (0.00) | (0.00) |
| 10-Year Lag |  |  |  |  | 0.00*** |
|  |  |  |  |  | (0.00) |
|  |  |  |  |  |  |
| F-Statistic | 492.92 | 238.21 | 152.79 | 102.73 | 69.85 |
|  | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1960-2010 and are without control variables.

**Table 16**: Estimates of the effects of the lagged values of the II on the CLI

| CLI | (69) | (70) | (71) | (72) | (73) |
|---|---|---|---|---|---|
| Constant | 0.53*** | 0.54*** | 0.55*** | -0.59*** | -0.45** |
|  | (0.00) | (0.00) | (0.00) | (0.12) | (0.18) |
| II | 0.00 | 0.00 | 0.00 | -0.00 | -0.00 |
|  | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| 1-Year Lag |  | 0.00 | 0.00 | 0.00 | 0.00 |
|  |  | (0.00) | (0.00) | (0.00) | (0.00) |
| 2-Year Lag |  |  | 0.00 | -0.00 | -0.00 |
|  |  |  | (0.00) | (0.00) | (0.00) |
| 5-Year Lag |  |  |  | 1.66*** | 0.72*** |
|  |  |  |  | (0.17) | (0.24) |
| 10-Year Lag |  |  |  |  | 0.79*** |
|  |  |  |  |  | (0.23) |
|  |  |  |  |  |  |
| F-Statistic | 0.02 | 0.01 | 0.02 | 23.66 | 6.60 |
|  | [0.89] | [0.99] | [1.00] | [0.00] | [0.00] |

The regressions are based on the years 1990-2010 and are without control variables.

**Table 17**: Estimates of the effects of the lagged values of the LEI on the CLI

| CLI | (74) | (75) | (76) | (77) | (78) |
|---|---|---|---|---|---|
| Constant | -1.37*** | -1.16*** | -1.27*** | -1.03*** | -1.11*** |
|  | (0.11) | (0.11) | (0.11) | (0.13) | (0.18) |
| LEI | 2.42*** | 8.93*** | 35.16*** | 18.10*** | 14.96*** |
|  | (0.14) | (1.22) | (3.72) | (4.04) | (4.00) |
| 1-Year Lag |  | -6.79*** | -62.52*** | -17.31* | -19.93** |
|  |  | (1.23) | (7.39) | (9.11) | (9.00) |
| 2-Year Lag |  |  | 29.65*** | -4.85 | 5.44 |
|  |  |  | (3.82) | (6.00) | (6.23) |
| 5-Year Lag |  |  |  | 6.10*** | -0.86 |
|  |  |  |  | (0.94) | (1.46) |
| 10-Year Lag |  |  |  |  | 2.58*** |
|  |  |  |  |  | (0.44) |
|  |  |  |  |  |  |
| F-Statistic | 300.80 | 150.35 | 101.46 | 48.70 | 25.77 |
|  | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1990-2010 and are without control variables.

**Table 18**: Estimates of the effects of the lagged values of the EI on the CLI

| CLI | (79) | (80) | (81) | (82) | (83) |
|---|---|---|---|---|---|
| Constant | -0.49*** | -0.41*** | -0.35*** | -0.13** | -0.01 |
| | (0.04) | (0.05) | (0.05) | (0.06) | (0.09) |
| EI | 1.62*** | 2.44*** | 1.77*** | 0.29 | 0.19 |
| | (0.07) | (0.44) | (0.45) | (0.47) | (0.45) |
| 1-Year Lag | | -0.95** | 0.42 | 0.76 | 0.61 |
| | | (0.44) | (0.69) | (0.68) | (0.62) |
| 2-Year Lag | | | -0.78* | -0.09 | 0.25 |
| | | | (0.44) | (0.55) | (0.53) |
| 5-Year Lag | | | | 0.15 | -0.61** |
| | | | | (0.21) | (0.29) |
| 10-Year Lag | | | | | 0.53*** |
| | | | | | (0.18) |
| | | | | | |
| F-Statistic | 518.43 | 216.68 | 119.78 | 41.65 | 12.09 |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |

The regressions are based on the years 1990-2010 and are without control variables.

**Table 19**: Estimates of the effects of the lagged values of the HDI on the CLI

| CLI | (84) | (85) | (86) | (87) | (88) |
|---|---|---|---|---|---|
| Constant | 0.53*** | 0.54*** | 0.55*** | -0.56*** | -0.37*** |
| | (0.00) | (0.00) | (0.00) | (0.09) | (0.14) |
| HDI | -0.00 | -0.00 | -0.00 | 1.57* | 1.64* |
| | (0.00) | (0.00) | (0.00) | (0.93) | (0.90) |
| 1-Year Lag | | -0.00 | -0.00 | 0.02 | 1.18 |
| | | (0.00) | (0.00) | (0.92) | (1.35) |
| 2-Year Lag | | | -0.00* | -0.00 | -0.39 |
| | | | (0.00) | (0.00) | (1.23) |
| 5-Year Lag | | | | -0.00** | -1.14** |
| | | | | (0.00) | (0.58) |
| 10-Year Lag | | | | | 0.00 |
| | | | | | (0.00) |
| | | | | | |
| F-Statistic | 1.57 | 1.10 | 1.01 | 42.38 | 13.03 |
| | [0.21] | [0.33] | [0.39] | [0.00] | [0.00] |

The regressions are based on the years 1990-2010 and are without control variables.