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Time efficiency as a measure of court performance: evidence from the Court of Justice of the European Union

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Abstract
This work proposes an alternative measure of court performance, namely, time efficiency, which is equal to the length of a verdict divided by the time needed to resolve the case. Using the data of resolved judgments of the Court of Justice of the European Union (CJEU) from 1954 to 2017, we show that, first, backlog causes time efficiency to fall using a vector autoregression model (VAR), and, second, the lowest value of time efficiency coincides with the establishment of the General Court in 1989. We argue with evidence that the improvement of time efficiency since 1989 was a result of the reform of the CJEU.

Keywords Court productivity · Court of Justice of the European Union · Judicial speed · Verdict length · Quantitative approach

JEL Classification C23 · D24 · K41 · O52

1 Introduction

In recent years economists have become increasingly interested in court performance and the impact of staffing and workload on judicial decision-making. While some scholars attest to a positive relationship between judicial resources and court productivity (Djankov et al., 2003; Mitsopoulos & Pelagidis, 2010; Rosales-López, 2008) others show exactly the contrary. Advocates of the endogenous productivity hypothesis of judges argue that a higher number of files on the court docket will motivate judges to increase their efficiency in resolving cases (Beenstock &

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Haitovsky, 2004; Dimitrova-Grajzl et al., 2012). Critics have pointed to missing variables in their theories, most notably judicial and institutional constraints (de Oliveira Gomes et al., 2016; Jonski & Mankowski, 2014). Bielen et al. (2018) found that backlog negatively impact litigation rates but only in highly litigious countries. Along with this criticism one can plausibly argue that where judicial output grows with increasing backlog, it can only do so at the expense of another attribute given resources are scarce. Although some hints and clues partially explaining this divergence were advanced in the literature, a unified theoretical and empirical effort is necessary to illuminate the fundamentals of performance of courts and judges.

The performance of court systems is of great interest to public administrations everywhere, all the more so given pressures on reducing public spending. The balancing of several variables, from demand for quick dispute resolution to the necessary staffing levels, is the key to judicial management and court system planning (Engel & Weinshall, 2020; Voigt, 2016). Dysfunctional and arbitrary judiciaries have proven to have serious economic consequences for growth and businesses. In many countries in the world, courts accumulate a large backlog of cases with the consequence of increasing delay, which downstream impacts negatively on both litigants and public trust in the judiciary (Cabrillo & Fitzpatrick, 2008). Dilatory judicial proceedings increase uncertainty among economic actors and thus impede economic activity. This problem has received widespread attention in international fora such as the European Union (EU), Council of Europe, Organisation for Economic Co-operation and Development (OECD) and World Bank, all of which have urged action to combat judicial delay and improve the efficiency of court systems (Marciano et al., 2019; Falavigna et al., 2015; Henisz, 2000; Weder, 1995).

The trade-off between quality and quantity in the context of judicial output has received scholarly attention in the past. Measuring quality has presented serious difficulties, however. Rosales-López (2008) attempted to use reversal rate to proxy judgement quality and did not find that higher performance courts (in terms of number of resolutions) were associated with higher reversal rate, showing that quantity and quality may not be engaged in a trade-off relationship. Using the percent of decisions appealed as a measure of judgement quality, Coviello et al. (2015) found that task juggling, working on more trials at once, did not adversely impact the quality of the decision. Grajzl and Silwal (2020) used the numbers of appealed, partially overturned, and fully overturned cases in Nepal as measures of judicial quality and found no evidence supporting a quantity-quality trade-off. Their paper also provides a careful discussion of the limitations of these quality measures. So far, evidence supporting no quantity-quality trade-off are more abundant and accepted (see another example by Dimitrova-Grajzl et al. (2016)).

In light of the problems posed by measuring quality of judgments, we propose to turn to time efficiency, defined as the rate of technical transformation from time to verdict, whereas we do not claim that length implies quality. This work attempts to explore a new research avenue that relies on easily accessible information (verdict length and judicial speed) and validates its usefulness using data on the Court of Justice of the European Union (CJEU). In an analytical model that begins with an equation of judgments, we establish time efficiency (in its simplest form, it is length divided by time spent on the case) as a function of backlog and resources

and hypothesize that backlog negatively impacts on time efficiency while resources improve it. To empirically analyse the effects, we first estimate the time efficiency for each year from 1956 to 2017 using data from cases submitted to the CJEU, and then regress the estimated coefficients on backlog and resources in a time-series analysis.

We have several interesting findings from the empirical analysis. First, the relationship between the time needed to resolve a case (a judgement) and verdict length is robustly positive. The relationship supports a technical transformation between both measures and thus the correlation can be considered as a measure of time efficiency. Second, results from autoregressive and vector autoregressive regression indicate that backlog has a negative impact on time efficiency, but the amount of resources does not significantly influence time efficiency. Third, our proposed time efficiency measure can be a useful indicator showing a need for court reform. In a structural break analysis, we show that the relationship between length and time needed to deliver a judgement followed a U-shaped evolution over the years and the strongest reversal of the trend is found at 1989 when the General Court was established. This interesting finding supports the argument that the establishment of the General Court improved the court performance of the Court of Justice. This work proposes a new research approach to studying judge or court performance that focuses on time efficiency in terms of verdict length per unit of time.

The paper proceeds as the following. The next section describes the structure of the Court of Justice of the European Union and discusses its own struggle with court performance. Section 3 presents a simple model of court performance and the empirical approach we adopt to study the impacts of resources and backlog. Section 4 describes and visualizes our data. The results of the regression analysis are presented in Section 5. The last section provides a discussion of our results and concludes the paper.

2 A brief description of the Court of Justice of the European Union

The CJEU is one of the most well-known international courts in the world and a chief actor in the process of European integration since the latter's beginning. Reflecting the most advanced state of European integration among regional integration organizations worldwide, the term "supranational" might be more appropriate than "international", as the Court was set up from the start to partially mimick domestic courts (Valentine, 1955). Despite several changes to its official name, the Court is in continuous operation since December 1952 when it opened for business at the villa Vauban in Luxembourg as the Court of Justice of the European Coal and Steel Community. Although the Court has since relocated into premises many times larger (villa Vauban is now an art museum), and undergone changes commensurate with the expansion of European integration, the point of origin for all

successive institutional developments is late 1952, which makes it one of the oldest EU institutions.[1]

Both the composition of the Court and potential avenues for reaching it have changed considerably since its establishment. The Court started off with less than fifty staff members and seven judges. Nowadays it has over 1500 staff and 74 judges divided across two levels of jurisdiction, the Court of Justice (the highest, traditional instance) and the General Court (a first instance court). The legal structure determining what pathways are available for a case to reach the Court has also changed over time, albeit less drastically. In the following paragraphs we introduce briefly the main features of the Court's composition and provide an exposé of the four most important judicial procedures which generate 95% of the Court's caseload.

2.1 Composition

What is nowadays referred to as the Court of Justice of the European Union consists in fact of two courts: the Court of Justice and the General Court. The Court of Justice is the court longest in existence and it has always occupied the highest position in the EU judicial hierarchy. The General Court was established in 1989 in response to mounting caseload as the Court of First Instance. A third, specialized court called the Civil Service Tribunal existed between 2005 and 2016; its workload has now been transferred to the General Court which has additionally had its number of judges raised from 28 to 56 to tackle increasing case delay.

Judges are appointed for a renewable term of 6 years by consensus of the Member States. The latter have never blocked the appointment of any judge, although a new committee which vets each judge's credentials (behind closed doors) was established following the Lisbon Treaty revision in 2010. The committee's in theory non-binding recommendations regarding appointments have so far been always respected. The CJEU moreover includes so-called Advocates-General who draft opinions on important cases; in a majority of cases the Court follows these opinions in its judgments.

Judges and Advocates-General are aided in every-day work by the registry, which manages the administrative aspects of case handling, and law clerks working in chambers of the respective court members (Krenn, 2018; Zheng, 2017). Judges can also draw on institutional resources, notably research services, which provide on-demand support. Both the Court of Justice and the General Court elect their own President—with the former leading the hierarchy—who are responsible for representing the institution externally and managing key aspects of judicial work, such as case allocation, internally.

[1] The core institutions of the European Coal and Steel Community—the High Authority (nowadays the Commission), the Council (composed of the Member States) and the Assembly (nowadays the European Parliament) began operation during the autumn of 1952, after the establishing Treaty of Paris entered into force on 23 July 1952.

2.2 Judicial procedures

The primary role envisaged for the Court in the institutional framework of the Coal and Steel Community was to control the decisions of the executive body, the High Authority (the Commission), when these were disputed by the Member States or affected private parties.[2] This pathway to the Court is called the "annulment procedure", because the plaintiff aims to annul a decision of an EU institution. The procedure was modelled upon the French system of administrative law review (Koopmans, 1991).[3] It has persisted in similar forms since, with the main change relating rather to the increasing number of issue areas in which EU institutions– not only the Commission—render decisions.[4]

The Treaty of Rome, signed in 1957, brought about many institutional changes, notably by expanding the policy remit of the nascent EU beyond coal and steel. But the most important change for the CJEU concerned the introduction of a new judicial procedure.[5] Article 177 (now Article 267 TFEU) enabled national courts in the Member States to refer questions about EU law to the CJEU. Although the procedure was not used during the first two and a half years it had been in force, it has since become the main source of the CJEU's workload and in qualitative terms one of the most important interfaces through which European (legal) integration transpires (Rasmussen, 2014; Weiler, 1994; Alter, 1998; Dyevre et al., 2020). Despite the fact that the Treaty more or less obliges national courts whose judgments cannot be appealed to send preliminary references to Luxembourg, in practice a host of other factors impede the uniform application of EU law in the Member States (Lampach & Dyevre, 2020).

Third, the EU legal system has since its inception provided for the possibility to prosecute Member States which fail to respect EU law obligations.[6] Next to the Court the key actor in this procedure—called "infringement proceedings"—is the Commission. The Commission is charged with monitoring—and if necessary, enforcing, via the Court—Member State compliance with EU law. As a result, the caseload flowing through this judicial avenue is going to largely depend on the Commission priorities and strategic behaviour and to a lesser extent on the compliance record of the Member State (Fjelstul & Carrubba, 2018).

Fourth, the EU judiciary has since the beginning been in charge of adjudicating actions concerning civil service matters. Typically these cases involve an EU civil servant complaining about their employment conditions with one of the EU institutions. From a broader political or economic perspective, this line of cases is therefore among the qualitatively less important, albeit considerable in number. Originally,

[2] See Articles 33 and 37 of the Treaty establishing the European Coal and Steel Community.

[3] French influence is felt more generally at the Court, seeing as it is also its main working language.

[4] See Article 263 of the Treaty on the Functioning of the European Union (TFEU).

[5] A rudimentary and vague allusion to a similar procedure was already included in Article 41 of the Treaty establishing the European Coal and Steel Community.

[6] Originally Article 88 of the ECSC Treaty; now Article 258 TFEU. The Treaty of Rome (Article 169) adjusted this procedure in 1958 by shifting the burden of initiating a court case from the Member State on the Commission and by allocating the power to impose financial penalties to the Court.

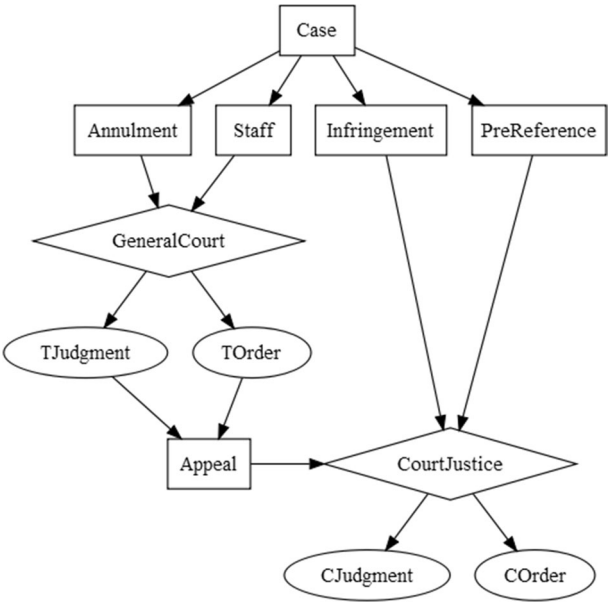

Fig. 1 Types of cases and judicial outcomes. *Note* Other judicial procedures are excluded from the flowchart due to their relatively rare application. In addition, in a limited number of annulment cases (those which are inter-institutional) the dispute goes directly in front of the Court of Justice

the Court of Jus- tice alone was in charge of dealing with civil service cases; later the bulk of this responsibility was transferred to the Court of First Instance (now the General Court) after which a specialized court, the Civil Service Tribunal, was set up to ease the burden on the Court of Justice and the General Court. Following a major reform in 2016, the Civil Service Tribunal was disbanded and the General Court is back in charge of staff cases. Figure 1 illustrates the main workflow of the CJEU.

Although there is a myriad of other judicial procedures—such as third-party proceedings or applications for interim relief—these are used relatively rarely compared to the four main types of cases outlined already. With the exception of opinions on the conclusion of international agreements, which can be requested by EU institutions, the outcomes of these other types of cases are generally also less consequential than the main procedures. Moreover, a common procedural measure involves the joining of several cases together for the purposes of judicial deliberation and/or issuing a single judgment.

In the majority of cases CJEU judges choose between deciding a case by a judgment or by an order. Both are similar in form but orders are typically much shorter and less time-intensive. Case files which are discontinued or otherwise manifestly unworthy can be closed by an order with as few as two sentences. Judgments, on the other hand, should engender fully-fledged resolutions of disputes, albeit they, too, can vary from a few pages to several hundred depending on case and judicial discretion. Most cases filed at the first instance—i.e. with the General Court—can

subsequently be appealed on points of law to the Court of Justice which can confirm or overturn the original decision. The decisions of the Court of Justice cannot be appealed before any other court, similarly to the Supreme Court of the United States. Unlike the SCOTUS, however, the Court of Justice—nor the General Court—can select cases for which it will render judgments. This lack of direct docket controlling power makes the CJEU a more representative object of inquiry, as the vast majority of domestic and international courts must dispose of all cases put in front of them.

2.3 Delays and reforms

One reason the EU judiciary offers an appropriate ground to test our theory of economic performance are the organizational interventions the CJEU attracted due to increasing delays. The original single-instance system was transformed into a two-tiered one in 1989 with insiders describing the growing backlog and delay as "unmanageable" (Jacqué & Weiler, 1990; Kennedy, 1989; Slynn, 1988; van Ginderachter, 1989). The causes and potential consequences discussed are not difficult to guess: the EU was expanding both geographically and in terms of policy remit, in particular with a possible deluge of internal market laws on the horizon at the dawn (1985) of the Single European Act agenda (Easson, 1989; Schermers, 1988). A chief concern was that an increasing length of proceedings would discourage national courts from submitting preliminary references which even today are critical to the practical application of EU law in the Member States.[7] Conversely, it was hoped that a separate first-instance court dealing with fact-heavy cases could improve the quality of decisions (Slynn, 1988; van Ginderachter, 1989), which according to some was already falling at the time (Jacqué & Weiler, 1990).

The respite, if any, was temporary and by 2000 the talk was of a "crumbling judicial system" due to the rising backlog and delay (Rasmussen, 2000; Turner & Muñoz, 1999). After years of deliberation and two Treaty reforms, the EU opted to establish a third court in 2005, the Civil Service Tribunal (Lavranos, 2005).[8] The General Court, in particular, was by then seriously struggling to juggle the fact-heavy competition cases with the sheer number of other cases, including staff complaints, while the duration of the sacrosanct preliminary ruling procedure kept increasing. An amendment to the EU constitutional framework led to the addition of a specialized tribunal to the existing judicial architecture. The choice of staff cases as the subject matter of the specialization was facilitated by the perception that this area of law did not directly affect the Member States—the key principals in the EU political system—but was rather internal in nature (Butler, 2020).

[7] Underlining the practical relevance of our theoretical lens, some national judges' preferences over the speed-length continuum were later revealed when they were quoted as willing to accept slower replies from the Court of Justice as long as a high level of quality was maintained (Turner & Muñoz, 1999, p. 91).

[8] Interestingly, a staff tribunal was deemed desirable by the Council as early as 1974 (Schermers, 1988, p. 542).

Nonetheless, the Civil Service Tribunal itself was sacrificed in the negotiations of the latest judicial reform as part of a political compromise that saw the number of General Court judges double and its agenda reabsorb staff disputes. This 2015 reform was described as both "radical" and "questionable" (Alemanno & Pech, 2017; Sarmiento, 2017) but it again came on the back of concerns about the effectiveness of the EU judiciary (Hadrousek & Smolek, 2015; van der Woude, 2012). It was prompted by excessively delayed competition cases in which a group of plaintiffs successfully sued the General Court for taking too long to render decisions, resulting in several damages awards (Ovádek, 2017). We are not yet able to observe the full impact of this organizational intervention but it attests to the continuing pertinence of concerns about delay and their non-negligible political salience.

A common theme running through the preceding storyline is that none of the interventions was accompanied by a rigorous econometric analysis of judicial performance (Alemanno & Pech, 2017). This provides further justification to supplant existing narratives with a theoretically informed inquiry of court data. That efficiency requires a solid information base was confirmed by a recent audit of the CJEU conducted by the Court of Auditors (a dedicated EU auditing institution) (European Court of Auditors, 2017). Limitations owing to document secrecy and data availability constrained the auditors' examination to less than 3000 cases. Our macro analysis of the CJEU's resource constraints and backlog speaks directly to observers interested in the Court's overall economic performance, in addition to providing a testing ground for our theoretical model.

3 Formal model

Our analysis begins with a simplified relationship between the number of judgements and the total time needed to make those judgements. In our analysis, various factors are abstracted while we try to capture the reality as much as possible. We define the relationship in an equation, acknowledging that the equation may not completely describe the actual constraints facing judges.

The number of judgements a judge makes is denoted by J and the total available time for judgements is T. For each judgement, the judge is required to deliver a verdict, which has a length of L. For simplicity, we assume all verdicts are of the same length in the consideration or maximization process of a judge, and thus L is also the average length of verdicts. To produce such a verdict, the judge transforms time into verdict facing an efficiency coefficient Θ. The coefficient governs the rate of technical transformation of time into actual outputs in terms of "words". It is natural to assume that longer is the verdict more time is required. The simplest version of the relationship between number of judgments and the time needed is:

$$J = \frac{\Theta T}{L} \tag{1}$$

In words, the judge faces a time efficiency constraint that limits his or her ability to transform available time into verdicts. The longer the verdicts are, the fewer judgements a judge is able to make. A larger efficiency coefficient allows the judge to be more productive and deliver more judgements. The coefficient captures any factors that help or hinder how judges utilize their scarce time, such as administrative burdens that judges bear, support from secretaries, and support from information technology. Time efficiency, though presented as an exogenous constraint so far, is a constrained and maximized choice. Otherwise, this measure of court performance is useless as judges could meaninglessly improve "time efficiency" by stuffing the verdict. Time efficiency is not the ultimate objective that judges attempt to maximize but a measure of performance that reveals judges' maximization behaviors under constraints. We will come back to discuss the maximization process later in this section.

The efficiency coefficient can be further disintegrated into tangible factors and intangible ones. Tangible factors can be measured by monetary expenditures that are spent on staff, information technology and other overhead fixed assets. Intangible factors include administrative pressure, political pressure and backlog pressure. Backlog imposes pressure on judges and diverts judges' attention. Leaving a case idle may also induce additional (opportunity) costs. Although in theory a judge can always deal with one case at a time, in practice judges may have to multitask and thus backlog would negatively influence the time efficiency. We modify the equation as the following:

$$J = \frac{T}{L}\frac{\theta R^{\alpha}}{B^{\beta}} \tag{2}$$

where $\Theta = \theta R^{\alpha}/B^{\beta}$. Resource factor, denoted by R, and backlog, denoted by B, enter into the equation together with their corresponding transformation coefficients $\alpha > 0$ and $\beta > 0$. More resources are supposed to improve time efficiency and a heavier backlog tends to worsen time efficiency.

We rearrange Eq. (2) as the following:

$$\frac{T}{J} \equiv t = L\frac{1}{\theta}\frac{B^{\beta}}{R^{\alpha}} \rightarrow \frac{L}{t} = \theta\frac{R^{\alpha}}{B^{\beta}} \tag{3}$$

where t is the average time needed to resolve a case (a judgement). The ratio of average length to average time is thus equal to time efficiency, which can be interpreted as the rate of technical transformation of time into verdict. To measure time efficiency, researchers need only two pieces of information: verdict length and the time needed to resolve the case. To proceed, we propose the following estimation approach.

First, using case-level data we estimate the following equation:

$$L_i = \Theta_s t_i + \varepsilon_i \tag{4}$$

for case i that was submitted in year s. The equation will produce an estimate of Θ per year. Readers may notice that by dividing length by time to resolution and averaging across cases of a year it suffices to give an estimate of Θ. However, we expect

some other factors, such as the procedure of the case, to influence the time efficiency of a case. We will present both methods. First, we compute the verdict length per day spent on each case and average them across cases of the same year. Second, we employ ordinary least squares (OLS) to estimate Θ of each year during the sample period along with some case-level features. The advantage of using length per day as a measure of time efficiency is that the information is almost always available as long as the texts of judgments are publicly accessible. The disadvantage is that the heterogeneity among cases is not controlled for in the computation of the time efficiency. To precisely understand the correlation between time and length, a multivariate regression analysis that takes into account case features is preferred.

Next, we regress the obtained estimates from the first step on resources and backlog using year-level data:

$$ln(\Theta_s) = c + \alpha ln(R_s) - \beta ln(B_s) + u_s \tag{5}$$

Equation (4) does not aim at identifying a causal effect from time to length but only the rate of technical transformation. Therefore, even if reverse causality is an issue, OLS will adequately do so. To estimate the impacts of resources and backlog is less straightforward since past and expected efficiency will impact the resources assigned to judges and the clearance speed of backlog. We will first present an autoregressive analysis and then resort to a vector autoregression (VAR) to study any causal effects.

3.1 Co-determination of speed and length

Judges in practice do not maximize time efficiency. Instead, the number of judgements and their judicial quality are the most mentioned and studied performance measures in courts. This section attempts to complete the picture by a utility maximization exercise. Suppose a judge maximizes the following utility function:

$$U = u(J(L), Q(L)) \tag{6}$$

A judges obtains utility from delivering judgements, J, and the average quality of those judgements, Q. Assume that the utility function is strictly concave in both J and Q. As we illustrated above, the number of judgements is a function of average length L. The quality of a judgement is also dependent on its length. Quality is a vague concept and we do not attempt to clearly define it. As long as length and quality are positively correlated, even if only locally over some ranges of length, the judge will pin down a value of length that corresponds to a quality level that maximize the utility. Therefore, we assume that $\partial Q^2/\partial^2 L < 0$ and $\partial Q/\partial L > 0$ for $L \in \left[0, \overline{L}\right]$, where $\overline{L}$ is sufficiently large value (to ensure interior solution).

The first-order condition for an interior equilibrium choice of length is:

$$u_J \frac{\partial J}{\partial L} + u_Q \frac{\partial Q}{\partial L} = 0 \tag{7}$$

One could see that the marginal quality of length must be positive in an equilibrium. That implies that the judge must stop at a point where the marginal quality is increasing. In other words, the judge will not work until additional quality is completely exhausted. Moreover, as long as marginal quality of length becomes negative beyond a certain point, the judge cannot always improve quality by extending the verdict. We do not require length and quality to be always positively correlated to validate our analytical model. By equalizing marginal cost and marginal benefit, the judge decides the average length of judgements and the number of judgements at the same time. By Eq. (3), the judge also determines the judicial speed of the judgements. Time efficiency, or the rate of technical transformation of time into verdict length, is thus an outcome of a maximization process subject to both exogenous constraints and judges' preferences over quantity and quality.

By substituting Eq. (2) into the Eq. (7), one can compute the following comparative statics:

$$\frac{\partial L^*}{\partial R};\frac{\partial L^*}{\partial B};\frac{\partial t^*}{\partial R};\frac{\partial t^*}{\partial B}$$

However, their signs depend on the relative magnitudes of different components. This work bypasses this struggle by focusing on time efficiency, or the rate of technical transformation of time into length. By merging the two variables into one, as in Eq. (3), we have one variable less to solve in the system of equations and we obtain two unambiguous comparative statics. In our analysis, the focus will be the following two hypotheses: backlog worsens time efficiency and resources improve it.

4 Data

4.1 Description of the data

We build a dataset comprising the entire universe of cases decided by the CJEU since its inception (1953–2018, n = 37,538). Contrary to existing datasets (e.g. Dyevre et al., 2020; Pavone & Kelemen, 2019), which focus either on a single procedure, period or only include judgments, ours attempts to paint the full picture of the Court's workload at any point in time during its existence. We source all data from publicly available information on CJEU cases.[9]

Throughout the analysis, variables are sorted into the submission year of the case. As a case may last for years, we can also sort the variables into the decision year of the case. As we aim to study the impacts of backlog and resources, we argue that the submission year of a case is more appropriate unit for summarizing information because the constraints of the submission year are more influential in the subsequent process than those of the decision year.

[9] The raw information is available on the websites of the CJEU and the EU's law portal: https://curia.europa.eu and https://eur-lex.europa.eu. The data can be obtained through a dedicated R package (Ovádek, 2021).

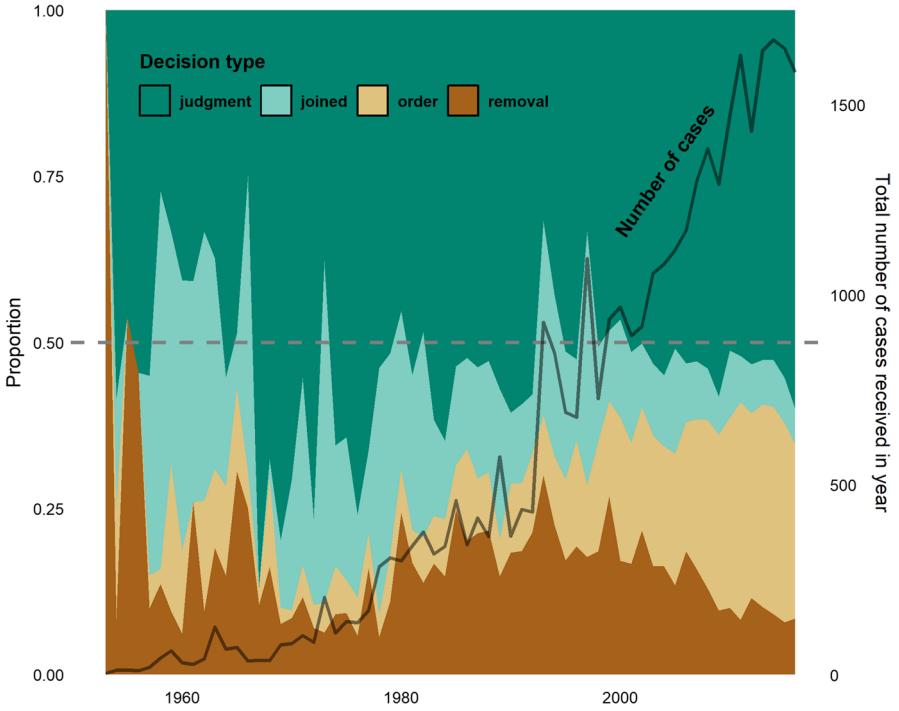

Fig. 2 Share of different decision types and total number of cases (1953–2017). *Note* The year axis measures the year when a case was filed. The left axis shows the proportion of the various types of decisions (colored area), while the right axis shows the total number of cases received in a year (dark line)

As mentioned previously, each case can be closed by either an order or a judgment. Nonetheless, we identify additional variation in decision type: a case can be removed by an order from the docket with minimal justification or it can be joined with other similar cases. Removals occur for example when a case is with- drawn by the plaintiff but also when the Court deems it overwhelmingly inadequate to warrant deliberation. As removals are usually imposed extraneously by virtue of the parties or the national court discontinuing proceedings, they do not comply with the usual speed-length relationship. On the one hand, removals are extremely short as a result—merely acknowledging the withdrawal of the case. Joined cases refer to those cases sharing a verdict of another case. We exclude removals, joined cases, and unresolved cases from the following analysis. Figure 2 plots the proportion of each decision type over time, as well as the total number of cases received in each year.[10]

We measure length of decisions by the log of count of words and judicial speed by the minus of the log of the days to decision. We compute the court-specific

[10] Apart from removing some types of decisions, we also drop a small number of cases for which we are unable to obtain the corresponding text. Even if we can impute the length of the verdict and also the date of submission, we decide to remove them from the sample as we will rely on the text to measure the case complexity that may drive the speed and the length of the verdict together.

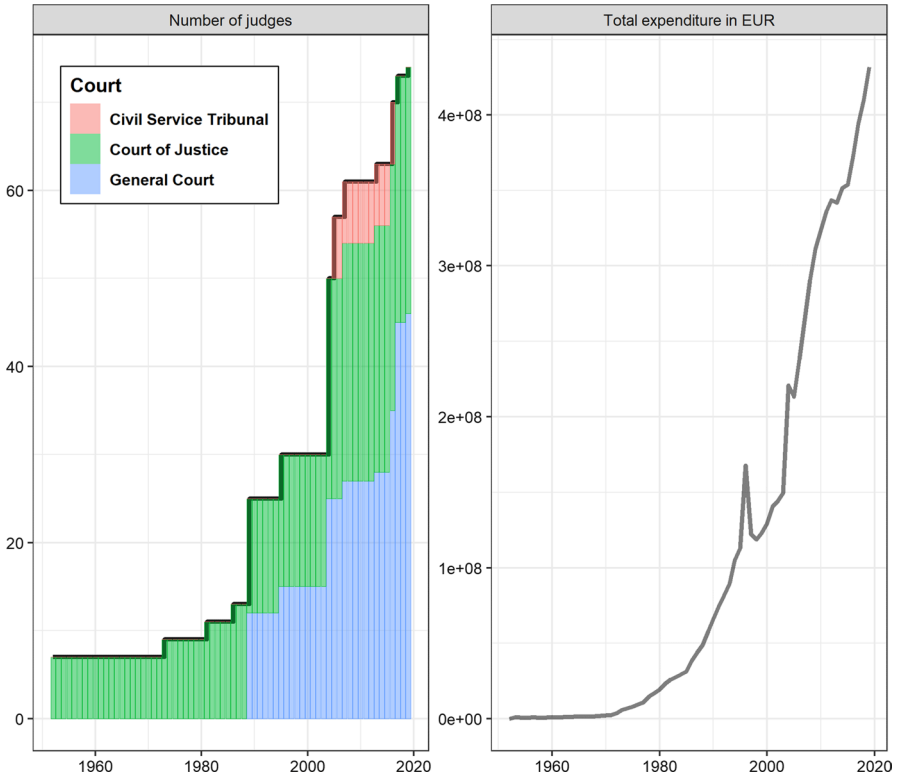

Fig. 3 Number of Judges and Expenditures in EURO of CJEU by year (1952–2019). *Note* Prior to the introduction of the euro the amounts were expressed in terms of the European Currency Unit (ECU)

backlog on the date of each decision by counting all outstanding cases, and then divide them equally to judges of each court. Besides, we compute the yearly expenditure per judge (not court-specific) and include in the regressions its log-transformation. By doing this, we roughly measure the backlog pressure on judges while considering the resources allocated to each judge. We further compute the number of new cases received, the number of cases resolved and the backlog at each moment in time so that we can measure the caseload pressure right at the moment a new case is presented to the Court.[11] Although the number of cases closed per day increases over time, the backlog (additive sum of open cases) has been growing for decades and started to decrease only in recent years.

On the input side we collected information on the budget of the CJEU and the number of sitting judges, both reported at the year level. Budgetary information is taken from the official accounts of the EU at the moment when the final amount of expenditure is definitively closed (two years after the budgetary year), with the exception of 2018 and 2019 for which we use intermediate projections. Figure 3

[11] The computation of backlog considers also cases without texts.

Table 1 Summary statistics of some variables

	Mean	SD	Min	Max
Length (no of words)	3585	1569	36	5770
Time (days)	579	265	40	3954
Appeal	0.0812	0.2732	0	1
Competition	0.090	0.286	0	1

shows the number of judges and the total amout of expenditure over the lifespan of CJEU. Similarly to the budget, the number of judges has also been steadily increasing over the years. Judges were added at various junctions rather than on a year-by-year basis, notably when the EU expanded its membership or when a new court was created.

Our analysis focuses on judgements and orders and opinions are dropped. The main reason is that judgements are revolved cases but orders (2871 cases) and opinions (24 cases) are not necessarily closed cases. The process of delivering and the efforts spent on orders and opinions may be substantially different. As our model considers judges' efforts in revolving a case, we drop orders and opinions from the sample to maintain logical consistency of the model and the empirical analysis.

In the effective sample used for estimation we constrain the time period to 1954–2017 (by submission year), as many cases submitted in 2018 and 2019 have not yet been decided. Finally, we end up with a trimmed sample of 11,549 resolved judgements. Table 1 reports some summary statistics.

5 Regression analysis

5.1 Estimating time efficiency

The first step is to estimate the time efficiency of each year using case-level data. First, we compute the length to time ratio of each case and average across cases of the same year. Second, we estimate the time efficiency by the following regression for judgement i that was submitted in year s:

$$L_i = \Theta_s t_i + \sum_g^G \gamma_g c_i + \varepsilon_i \tag{8}$$

where c_i contains procedure fixed effects, appeal dummy variable and competition dummy variable.[12] Figure 4 shows the estimates and their 95% confidence intervals, together with the arithmetic means of length per day. The shapes of the estimates of OLS and the arithmetic means are very similar. The estimated time efficiency coefficients experienced a period of volatile variations between 1954 and 1970, but

[12] The regression output is skipped. R-squared = 0.8979; number of observations = 11,549.

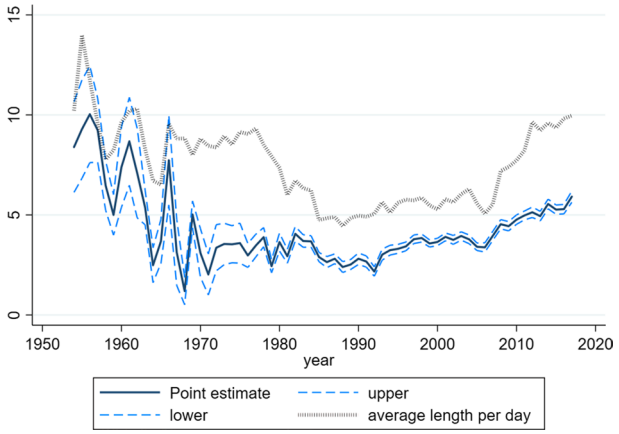

Fig. 4 Estimates of time efficiency with 95% CIs

then seemed stabilized. The coefficients follow obvious trends rather than flucutate erratically, except in the early years when cases were few, indicating that the relationship between verdict length and time needed to revolve a case is considerably stable. Such a stable relationship between length and time hints that the relationship is worth deeper research.

5.2 Decompose the time efficiency

The second step is to decompose the time efficiency coefficient and identify the impacts of backlog and resources using year-level data. We have the information of three variables (time efficiency coefficient, backlog and total expenditure) from 1954 to 2017 (64 observations). Figure 5 illustrates the backlog and resources per judge over the period. Expenditure per judge had reached 10 (in natural log-scale) in the 1990s and was falling since then. Backlog per judge had been rising since the establishment of the Court of Justice and reached roughly 4 (in natural log-scale) in the 1980s before falling towards 2017.

We recall Eq. (5) here:

$$ln(\Theta_s) = c + \alpha ln(R_s) - \beta ln(B_s) + u_s$$

We first check if the three variables are stationary before we put them into autoregressive (AR) and vector autoregressive (VAR) regressions. Table 2 reports the results of the augmented Dicker-Fuller tests.

As expenditure per judge is non-stationary, we replace it with the first-differenced expenditure. The arithmetic mean of length per day is marginally unit-root.[13] Partial autocorrelation graph (not shown here) suggests that AR(1) can sufficiently

[13] Results using average length per day are shown in the Appendix for comparison. We keep it at level even the test cannot reject that it is a unit-root process for the purpose of a consistent comparison.

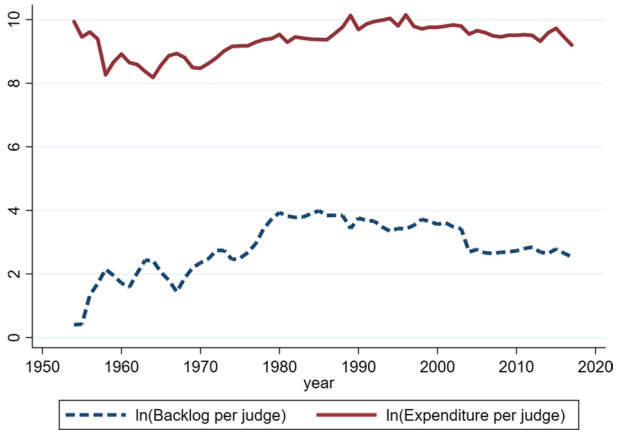

Fig. 5 Backlog and resources per judge in log-scale

Table 2 Dickey-Fuller test results

Augmented Dickey-Fuller test	Time efficiency (OLS) (Lag = 1)	Time efficiency (arithmetic mean) (Lag = 1)	Backlog per judge (Lag = 0)	Expenditure per judge (Lag = 0)	FD Expenditure per judge (Lag = 0)
Z(t)	− 3.46	− 2.542	− 3.124	− .214	− 8.777
p value	0.0091	0.1055	0.0248	0.2014	0.0000

capture autocorrelation. Yet, we also provide the results of no lag and AR(2) for comparison in Table 3. Based on the AR(1) result, backlog has a negative impact on time efficiency, but the amount of resources is not significantly correlated with time efficiency.

Backlog and amount of resources are very likey endogenously determined. Low time efficiency piles up cases and backlog induces injections of new resources. The interconnected nature of the three variables suggests that VAR model may be more relevant than AR(1). Following the insight from the Dickey-Fuller test and the AR(1) results, we focus on a VAR with one lag, as shown in Table 4.[14] In such a reduced-form VAR, we are required to impose a restriction in order to identify potential causal relationships. As we have not provided a theory to fix the relationships between variables, we resort to orthogonal impulse responses. However, the resulting impulse-response analysis is sensitive to the order of variables. We expect that time efficiency is the least exogenous variable among the three and is thus put at the end of the order following the usual practice. The order between backlog and resources is however undetermined. We thus provide two sets of impulse-response graphs showing two different orders as a robustness check.

[14] The BIC of VAR(2) is 0.9925 and that of VAR(3) is 1.1428.

Table 3 Autoregressive Regression

Dep. Variable: Estimated time efficiency coefficient	(1) OLS	(2) AR(1)	(3) AR(2)
ln(Backlog)	− 0.2689***	− 0.2626***	− 0.2626***
	(0.0626)	(0.0932)	(0.0969)
ln(D.Resource)	− 0.2105	− 0.0649	− 0.0644
	(0.2703)	(0.2471)	(0.2468)
AR(1)		0.4247***	0.4235***
		(0.0795)	(0.0800)
AR(2)			0.0031
			(0.1110)
Constant	2.1362***	2.1255***	2.126***
	(0.1564)	(0.2294)	(0.2466)
Sigma	0.3203	0.2915	0.2914
	(0.0210)	(0.0190)	(0.0239)
Observations	63	63	63
Log-likelihood	− 17.66	− 11.82	− 11.82
BIC	51.90	44.36	48.50

***significant at 1% level; **significant at 5% level; *significant at 1% level. Standard deviations are provided in parentheses

Table 4 VAR regression with 1 lag

VAR(1)	(1) Backlog	(2) Resources	(3) Time efficiency
Lag backlog	0.8642***	0.0011	− 0.1242**
	(0.0445)	(0.0435)	(0.0564)
Lag resources	− 0.1115	− 0.1616	0.0406
	(0.1232)	(0.1203)	(0.1560)
Lag time efficiency	− 0.0452	− 0.1838**	0.4502***
	(0.0908)	(0.0886)	(0.1150)
R-squared	0.9001	0.1006	0.4110
No. of observations	62	62	62
Overall BIC	0.8216		

***significant at 1% level; **significant at 5% level; *significant at 1% level. Standard deviations are provided in parentheses. All the eigenvalues lie inside the unit circle so that the VAR satisfies the stability condition

Roughly speaking, the two sets of impulse-response functions are very similar, shown in Fig. 6, except that Model 1 produces smaller standard deviations and confidence intervals for the causal relationship from resources to time efficiency. Nevertheless, the effect is statistically insignificant. The causal impact from backlog to time efficiency is robust and statistically significant across both. The effect amounts to approximately 0.4 percent two years after a 10 percent increase in backlog.

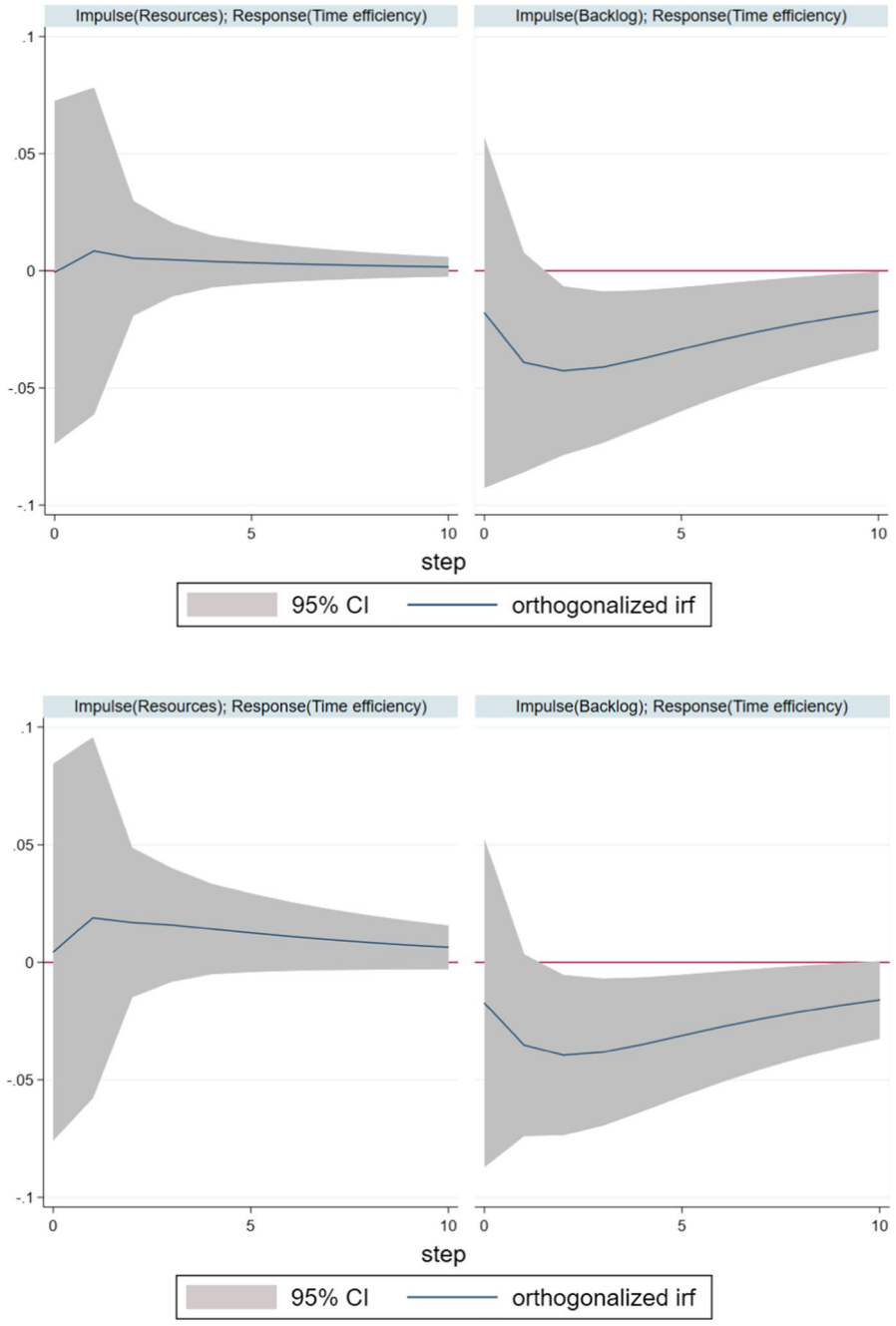

Fig. 6 Orthogonalized Impulse-Response Functions. *Note* At the top (Model 1), the order of the variables in the VAR is (backlog, resources, time efficiency). On the bottom (Model 2), the order is (resources, backlog, time efficiency). Bootstrapped (500 times) standard errors are used to construct the confidence intervals

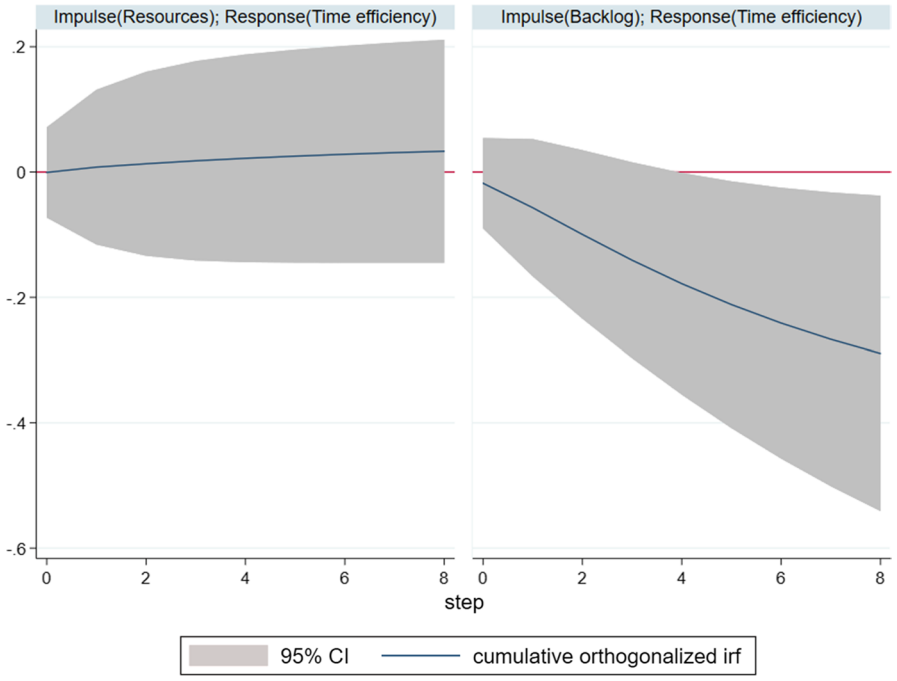

Fig. 7 Cumulative Orthogonalized Impulse-Response Functions. *Note* Only the result of Model 1 is provided

Figure 7 shows the cumulative orthogonalized impulse-response functions. The impact of a 10 percent increase in backlog is roughly 2 percent in four years and 3 percent in 8 years. In short, backlog has a negative impact on time efficiency but resources seem not to be correlated with time efficiency. Our attempt fails to support the resource hypothesis leading us to question our empirical strategy. Total expenditure is an objective measure of resources the CJEU have but may not be a relevant variable to explain time efficiency. The CJEU has been expanding fast and not all additional resources are directly spend on improving time efficiency in terms of delivering verdicts. It is very likely that a structural reform that alters the way a court approach a case produces a more substantial impact than merely raising its budget.

We provide the results using length per day as the measure of time efficiency instead of the estimated time efficiency in the Appendix.

5.3 Structural break analysis

By taking length per day and the estimated time efficiency coefficient as measures of court performance, we identify a very interesting phenomenon, as shown in Fig. 4. Time efficiency followed a downward trend since the establishment of the CJEU but experienced a consistent improvement since the early 1990s. The creation of the

General Court in 1989 might have induced a positive effect on court performance, seemingly vindicating the hopes of some observers (Slynn, 1988) more than the skepticism of others (Jacqué & Weiler, 1990). This section attempts to verify if we can confidently claim that the new court embarked a reversal of the trend of time efficiency.

The analysis relies on case-level information and take the length-to-time ratio as the time efficiency coefficient of a case. In fact we can also use the year-level data and the estimate of time efficiency of each year to study any reversal of trend, but such an analysis may not be very insightful as the sample size is relatively small.

In the following regressions, we have a reform indicator that has a value of one if the case was filed after the introduction of the new court, and zero otherwise. Moreover, we interact the reform indicator with a linear time trend that has been centred at the year of the reform. To understand the impact of the introduction of the General Court in 1989 on the performance of the Court of Justice, we limit the sample to the Court of Justice and study if the new court—modelled as a potential change in the linear time trend—would impact length-to-time ratio. Meanwhile, we drop those procedures (annulments, staff and others) that could have been taken up by the new court, so that the estimate is the impact of the reform on the cases that could only be taken up by the existing beneficiary court, the Court of Justice. This approach has two advantages. First, we avoid the problem that the estimated difference in the average performance would be simply due to a shift of burden. For example, we know for a fact that dozens of difficult competition cases were shifted from the Court of Justice to the General Court in the early 1990s, which would in itself precipitate a drop in the average delay at the former court. Second, by excluding overlapping procedures we are able to estimate the potential benefit of division of labour due to the reform. Moreover, we include backlog per judge and expenditure per judge in the regression. Any remaining effect of the reform is thus net of its positive impact on lessening backlog burden and the effect of more abundant resources. The sample size shrinks to 8,623 judgements.

We suppose that the break year is 1989 and regress case-level length per day on a reform indicator, a linear trend, the interaction between them, and other control variables as the following:

$$ln(\Theta_i) = \mu_1 Trend_s + \mu_2 Reform_s + \mu_3 Trend_s \times Reform_s + \sum_j^J \rho_j \boldsymbol{x}_i + v_i \qquad (9)$$

for judgement i that was filed in year s. Control variables $\boldsymbol{x}$ includes procedure fixed effects, appeal dummy, competition dummy, topic fixed effects, backlog per judge and expenditure per judge.[15] We then proceed to create 20 hypothetical break points, 10 years before 1989 and 10 years after 1989, and run the same regression but using a different hypothetical break point. In other words, we have 21 regressions and each of them assumes a different break year. Next, we collect the estimate

[15] Topic classification is obtained through a NLP topic modelling that assumes 10 distinctive topics. As the topics are not closely to the main theme of this work, we skip the explanation and the results of the topic classification.

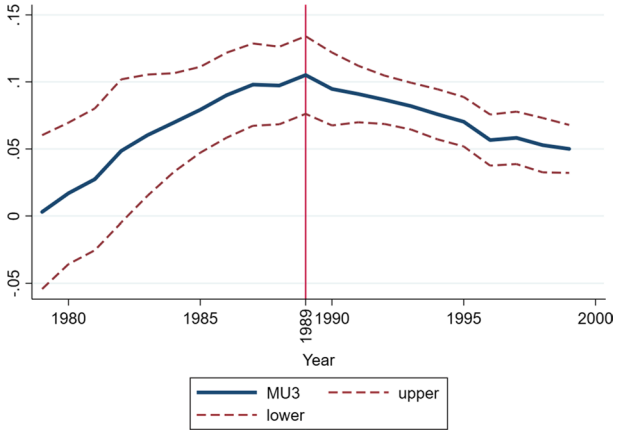

Fig. 8 Point estimates of MU3. *Note* In total 21 regressions are run and the estimates *of* μ_3 *are plotted against time*

of μ_3 from each regression. If the introduction of new court really changed the trend, the largest estimate should be found around the actual break point, i.e. 1989.

Skipping the regressions results of the 21 regressions, we report the estimates and their 95% confidence intervals in Fig. 8. The peak is found right at the year the General Court was established. The coefficient is positive, meaning that the trend turned upward. This result presents a strong evidence that the introduction of the General Court helped improved the time efficiency of the Court of Justice. Note that the effect is net of the impact of falling backlog (see Fig. 5). The reform not only expanded the CJEU and shared the burden of backlog among more judges but also induced some substantial improvements in the operation of the Court of Justice not captured by the variables we collected.

6 Conclusion

This work proposes a useful and easily observable indicator, the time efficiency coefficient, for measuring court performance. Focusing on numbers of judgments resolved, some scholars discovered a surprising result that the more burden judges bear the more productive they are. We argue that their results neglect other dimensions of judicial decision-making. Acknowledging that it is very difficult to measure the quality of a judgment, we propose to consider verdict length as a measure that helps reveal the quality and the rate of technical transformation between time and length, i.e. time efficiency, as a measure of court performance. We provide an analytical model that defines the relationships between time needed to resolve a case, verdict length, resources and backlog. In short, the analytical model shows that backlog worsens the time efficiency of a judge and resources improve it.

To estimate the time efficiency coefficient of the CJEU across the years, we first regress length on time and other case-level characteristics and obtain the time

efficiency coefficients for each year from 1954 to 2017. The estimates are then explained by backlog and resources in an AR(1) and a VAR(1) regression. We find robust evidence that backlog negatively impacts time efficiency while the amount of resources does not seem to be correlated with time efficiency. In addition, we present evidence suggesting that the establishment of the General Court in 1989 caused a positive and long-lasting improvement of time efficiency at the CJEU.

Appendix

AR(1) and VAR(1) using length per day as the dependent variable

The main text provides the AR(1) results using the estimated time efficient coefficients obtained from a case-level regression. The case-level regression captures the heterogeneity of cases within a year and thus produces a more precise correlation coefficients between length and time. However, it is not incorrect to simply take average length per day as a measure of time efficiency, which is handy and always observable in any courts given that the texts of judgements are publicly available.[16] We provide the AR(1) and VAR(1) results using average length per day as the dependent variable for comparison.

Tables 5, 6

Figures 9, 10

The impulse-response functions show a clearer picture: backlog has a negative impact on average length per day. On the other hand, resources significantly impact average length per day. This result is not found in the analysis using the estimated time efficiency.

[16] Their correlation is 0.7043.

Table 5 AR(1) using length per day as the dependent variable

Dep. variable: length per day	(1) OLS	(2) AR(1)	(3) AR(2)
ln(Backlog)	− 0.2645***	− 0.1961***	− 0.1967***
	(0.0392)	(0.0503)	(0.0505)
ln(D.Resource)	− 0.0135	− 0.0261	0.0260
	(0.1114)	(0.0568)	(0.0569)
AR(1)		0.8367***	0.8270***
		(0.0867)	(0.1324)
AR(2)			0.0114
			(0.1231)
Constant	2.7311***	2.5674***	2.5700***
	(0.1181)	(0.1468)	(0.1484)
Sigma	0.1714	0.1009	0.1009
	(0.0199)	(0.0109)	(0.0103)
Observations	63	63	63
Log-likelihood	21.72	54.50	54.50
BIC	− 26.86	− 88.28	− 88.15

***significant at 1% level; **significant at 5% level; *significant at 1% level. Standard deviations are provided in parentheses

Table 6 VAR(1) using length per day

VAR(1)	(1) ln(Backlog)	(2) ln (Resources)	(3) ln(Length per day)
Lag ln(Backlog)	0.9580***	0.0228	− 0.0653**
	(0.0571)	(0.0590)	(0.0259)
Lag ln(Resources)	− 0.1120	− 0.1231	0.0621
	(0.1190)	(0.1229)	(0.0541)
Lag ln(Length per day)	0.3107*	− 0.1041	0.7294***
	(0.1672)	(0.1726)	(0.0760)
R-squared	0.9050	0.0438	0.8436
No. of observations	62	62	62

***significant at 1% level; **significant at 5% level; *significant at 1% level. Standard deviations are provided in parentheses

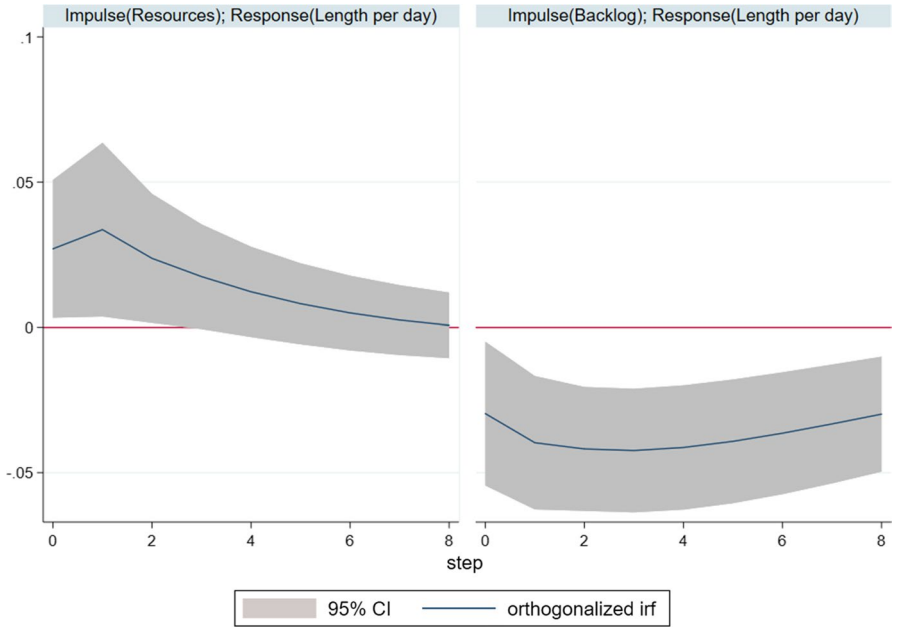

Fig. 9 Orthogonalized Impulse-response Functions (order: backlog, resources, time efficiency)

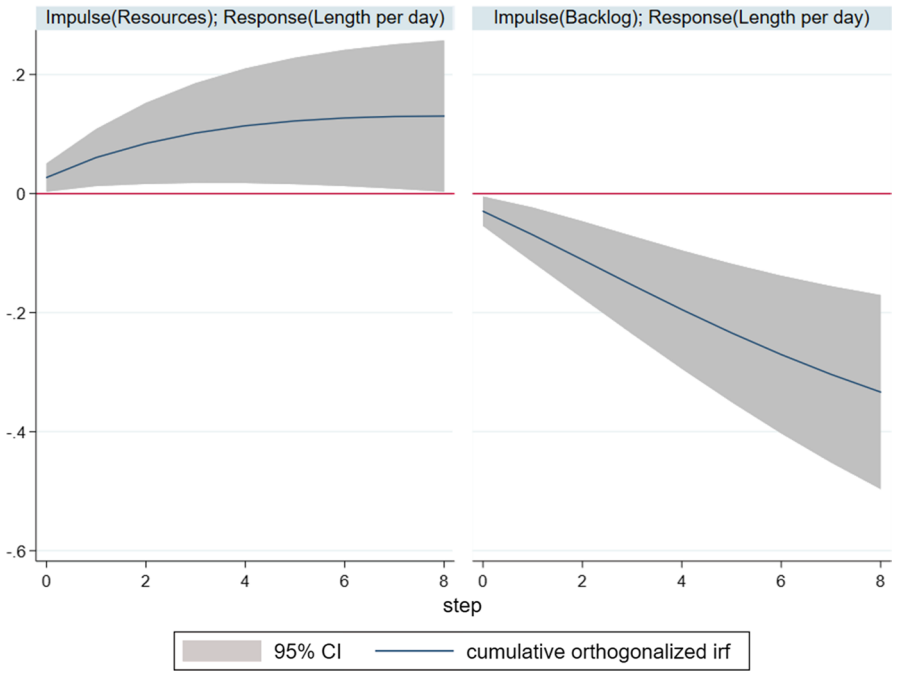

Fig. 10 Cumulative Orthogonalized impulse-response Fucntions

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Declarations

Conflicts of interest No conflicts of interest to declare.

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