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Tax cooperation, royalty payments, and profit shifting: Empirical evidence from new EU member states

We study the extent of profit shifting in the European Union using novel data on intellectual property payments from post-2004 EU member states. First, verify the claim that there is profit shifting via the royalty payments channel from the "low tax" group of the EU members. Second, we estimate the effect of the transposition of the Anti-Tax Avoidance Directive (DAC1 or Directive 2011/16) on intra-EU profit shifting. Our results demonstrate that even the "low tax" group of EU members experiences substantial profit shifting even after adopting the aforementioned tax cooperation regulations.

JEL: F42, F55, H26

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1. Introduction

According to the most recent estimates of Tørsløv, Wier and Zucman (2023), approximately 36% of all multinational profits are shifted to tax heavens. The instruments for that are plentiful: transfer of ownership, manipulation of intangible assets, abusive transfer pricing, royalty payments and so on. In an effort to minimize corporate tax base erosion, there has been a significant (and ongoing) increase in the tax competition[1] across the world. Even within the European Union (EU), the gap in statuary corporate income tax rates has shrunk by approximately 30%[2] when comparing post-2004 to the pre-2004 EU members (and the EFTA members) over past two decades. In spite of this, the current estimates[3] of international profit shifting continue to report substantial losses in tax revenues.

In response to the observed revenue losses, the EU has launched an unprecedented experiment in international tax cooperation by introducing the European Council Directive 2011/16[4] (EUR-Lex, 2011). Between 2010 and 2019, there have been four major waves that introduced various norms and regulations[5] targeted at combating profit shifting within the bloc. At the same time, there has been an ongoing debate on the topic of CIT rate harmonization[6] between pre-2004 and post-2004 members to achieve an even playing economic field, as historically, the CIT rates of post-2004 members have been significantly lower (see Table A4

[1] There is plenty of empirical evidence that multinational firms respond to changes in the tax rate, see Grubert and Mutti (1991, 2000), Altshuler et al. (2001), Altshuler and Hubbard (2001), Mutti and Ohrn (2019), de Mooij and Ederveen (2003, 2008). Most recently, however, Fuest, Hugger and Neumeier (2022) report that standard (or "headline") statuary rates do not play a role when it comes to profit sensitivity of MNEs using German firm data because tax competition takes place through instruments such as subsidies, patent boxes, and exemptions.

[2] Table A4 in Appendix provides detailed computations.

[3] Garcia-Bernardo and Jansky (2024) report these estimates in Table A.13 of their paper, the current estimates of revenue losses are somewhere between 90 and 312 US billion per annum (data scope: 2013-2019).

[4] Also known as Anti-Tax Avoidance Directive or Directive on Administrative Cooperation (DAC).

[5] For example, norms related to the (i) exchange of information regarding taxpayers, their incomes, assets, or taxes paid; (ii) the exchange of information on tax decisions having a potential transnational effect (tax rulings and advance pricing arrangements), (iii) the joint participation in administrative inquiries, and (iv) the provision of assistance in the notification of taxpayers on decisions or instruments regarding their tax liabilities (European Commission, 2019).

[6] There are a number of concerns when it comes to the existence of vastly different corporate income taxes within the EU. First, it prompts competition between governments to attract mobile forms of investment by offering lower corporate tax rates or special regimes favouring certain business activities. Second, firms can exploit such differences to engage in perfect tax planning to reduce tax bills. Third, as was noted earlier, location of multinational affiliates is impacted by the corporate tax rate. Lastly, some firms may find it difficult to structure their operations efficiently as a result of having to deal with different national tax systems. The EU's Code of Conduct Group on business taxation has been functioning for well over 25 years to serve as a place of discussion between the EU members on the aforementioned issues. Bond et al. (2000) provide an excellent introduction to this debate.

of Appendix). Such harmonization would require both member groups to somewhat match their domestic CIT rates between each other. More specifically, post-2004 members will likely have to raise their CIT rates. However, is there really any rationale in doing that?

According to the so-called New Economic Geography (NEG) models, tax competition for a mobile factor such as capital or entrepreneurs is different in NEG settings compared to standard tax competition models based on neoclassical assumptions of perfect competition and constant returns to scale (Andersson and Forslid, 2003).[7] The agglomeration rent, which accrues to the mobile factor in the core regions can be taxed (Baldwin and Krugman, 2004). Moreover, a tax differential between the core and the peripheral regions can be maintained (Baldwin et al., 2005). Furthermore, recent empirical studies show that new EU member states already have optimal tax schemes and raising CIT rates would have an adverse effect on capital accumulation, the rate of economic growth and the speed of convergence with the old EU member states (Cieślik and Turgut, 2021).

Therefore, the main goal of this paper is twofold. First, we investigate whenever there is substantial evidence to support the claim that there is indeed profit shifting via the royalty payments channel from the "low tax" group of the EU members. The logic behind our approach is simple, as firms strategically locate intangible assets (patents, licenses, or trademarks) in European tax havens, their affiliates will pay royalties to use these intangibles and "shift profits" to low-tax jurisdictions. Second, we estimate the effect of the implementation of tax cooperation provisions introduced in the first wave of the aforementioned Council Directive (DAC1) on the royalty payments channel. As we show in the paper, even the "low tax" group of EU members experiences substantial profit shifting even after adopting the aforementioned tax cooperation regulations. Therefore, in our view, upward changes in the CIT rates would likely amplify this process even further.

Our empirical analysis proceeds in two steps. First, we study the exact transposition timing of the aforementioned provisions into members' legislation. Second, we employ a formal panel data analysis on cross-country intellectual property royalty payments and foreign direct investment positions between the new EU members of Bulgaria, Croatia, Czechia, Hungary, Lithuania, Poland, Romania, Slovenia and the rest of the EU and the EFTA for 2010-2019. This

[7] See, for example, Zodrow and Mieszkowski (1986) for a typical analysis of the tax structure in standard neoclassical tax competition models. The surveys of the neoclassical literature on tax competition can be found in Bucovetsky and Wilson (1991), Wilson (1999), and Borck (2003).

allows us to verify whether the newly introduced regulations were effective in preventing (or at least limiting the extent of) profit shifting between the post-2004 members and tax-favourable destinations such as Cyprus, Ireland, the Netherlands, etc.

Our main findings can be summarized as follows. First, we demonstrate that there was a significant decrease in the total value of royalty payments related to the first leg of conducted transactions that coincided with the complete implementation of DAC1 provisions. Second, we show that most of this reduction is related to country pairs, where the receiving destination was either Cyprus or Ireland. Third, we find that this decrease in value was only temporary. We offer two main explanations regarding the observed disruption. The first is that firms had to readjust the first leg of their profit shifting scheme and come up with another destination for such payments. The second is that firms started to rely less on IP payments as a tool for profit shifting during the early months after DAC1 transposition.

This paper contributes to the growing body of empirical literature related to the study of transnational profit shifting that includes Keen, Perry and de Mooij (2014), Crivelli, de Mooij and Keen (2016), Clausing (2016), Johansson et al. (2017), Bolwjin, Casella and Rigo (2018), Cobham and Janský (2018), Pavel and Tepperová (2021), Bratta, Santomartino and Acciari. (2021), Fuest et al. (2022), Wier and Zucman (2022), Tørsløv et al. (2023), Garcia-Bernardo and Janský (2024), and others. The closest studies to ours are: Keen et al. (2014), Fuest et al. (2022), and Tørsløv et al. (2023). We briefly discuss these studies below before summarizing our contribution to this strand of the literature.

Keen et al. (2014) document extremely disproportional FDI stocks in four EU tax havens: Luxembourg, the Netherlands, Cyprus, and Ireland. They emphasize potential risks of regional tax coordination, where participating countries can be vulnerable to tax pressures from other (non-member) jurisdictions. Subsequently, Fuest et al. (2022) find that the overwhelming majority of tax haven profits of German multinationals are reported in European tax havens like Switzerland, Ireland, and the Netherlands. More recently, Tørsløv et al. (2023) estimate that most profits shifted out of the EU is done initially to EU tax havens, where half of the profits shifted out end up in non-EU tax havens such as Bermuda, the British Virgin Islands, etc. They also point out that the governments of high-tax EU members appear to be the main losers of profit shifting.

This paper innovates with respect to the aforementioned studies by i) conducting a systematic policy intervention study with respect to one of identified profit shifting channels (i.e. royalty payments), and ii) providing novel cross-country evidence on the extent of intra-EU profit shifting using the perspective of post-2004 members. Second, we also contribute to the literature that explores the role of intangible assets which includes studies such as Dischinger and Riedel (2011), Taylor, Richardson and Lanis (2015), Bryan, Rafferty and Wigan (2017). In particular, we refer to the empirical analysis of Dischinger and Riedel (2011) who identify a strong association between location of multinational affiliates in low tax jurisdictions and placement of intangible assets in the EU. We employ this nexus to study patterns of royalty payments that occur between post-2004 members and the rest of the EU and the EFTA.

The paper is structured as follows. Section 2 describes policy intervention timing and economic data. Section 3 reports the results. Section 4 concludes with policy recommendations.

2. Methodology and Data

In this section we first outline methodology used to recover the exact transposition timing of tax cooperation provisions across the studied EU member states. Then, we describe variables of interest used in the paper's analysis together with stylized evidence connected to outgoing royalty payments and foreign direct investment (FDI).

2.1 Transposition timing

Below, we summarize our findings related to the study of when various anti-profit shifting and tax cooperation provisions have been transposed into national legislation across the new EU member states. In 2019, the European Commission (2019) has launched a systematic evaluation study of administrative cooperation across multiple waves of legal provisions introduced between 2010-2019 that targeted transnational profit shifting and taxation cooperation within the EU, in Table 1, we briefly describe content of each wave. As can be seen, even the initial transposition of DAC1 carried significant changes to how members request and exchange information in the area of taxation. Whereas further waves deepened this cooperation with a focus on ownership (DAC2), tax rulings and transfer pricing (DAC3), and multinational firms (DAC4).

Table 1. Brief contents of Directives introduced between 2010-2019.

Directive	Scope
DAC1[a)] (Directive 2011/16)	Foundation for administrative cooperation in the area of taxation. Standardizes the exchange of information on request within the EU.
DAC2 (Directive 2014/107)	Introduction of requirements for financial institutions to report information about account holders in other EU states. Resulting in ownership transparency of assets and income held in other members.
DAC3 (Directive 2015/2376)	Introduction of an automatic exchange of information on tax rulings and advance price arrangements related to transfer pricing.
DAC4 (Directive 2016/881)	Introduction of country-by-country reporting for large multinational enterprises, requiring detailed reporting on the allocation of income, taxes paid, and economic activity among countries.

[a)] Introduced in two stages: initial transposition of the directive's text and setup of data exchange system.
Source: own elaboration based on European Commission (2019).

Next, Table 2 details the exact timing we are able to retrieve from the aforementioned evaluation study. In cases, where it is unclear when exactly the implementation was finished, we list an approximate time interval that is confined to two years. There is an overlap in timing between DAC1 and DAC2 provisions related to the exchange of financial information for the 2015 year across few member states (Estonia, Slovenia), however, most of the studied members have implemented DAC2 at a much later stage. Additionally, further provisions have been implemented in a staggered manner between 2016-2018 and included regulations related to OECD BEPS Action 5 (DAC3) and further administrative cooperation (DAC4). Because of this overlapping nature of implementation, we chose the timing related transposition of DAC1 regulations to perform our policy intervention study.

Table 3 breaks down the two-stage implementation of DAC1: first, the initial transposition of the Directive's text into national legislation and second, the implementation of the automatic exchange of information on incomes and assets gained or held abroad by non-

resident taxpayers (the so-called AEOI provisions). As can be seen, the majority of the new member states (except Estonia) have successfully transposed DAC1 by the end of 2016.

Table 2. DAC1-DAC4 implementation timing across new member states.

Country	DAC1	DAC2	DAC3	DAC4
	Final implementation		Including OECD BEPS	
Bulgaria	2015	2015	2018	2017
Czechia	2015	NT	2017	2017
Croatia	2015	2017-2018	2017	2017
Estonia	2018	2017-2018	2017	2017
Hungary	2015	2017-2018	2017	2017
Latvia	2015	2017-2018	2016	2017
Lithuania	2015	2015	2016	2017
Poland	2016	2018	2017	2017
Romania	2015	2017-2018	2016	2017
Slovakia	2016	2017-2018	2016	2017
Slovenia	2015	2015	2016	2017

Note: NT stands for not transposed at the moment when the evaluation was conducted.
Source: European Commission (2019).

Table 3. Two-stage DAC1 implementation timing across new member states.

Country	DAC1 transposition	AEOI provisions	Final implementation
Bulgaria	2012	2015	2015
Croatia	2012	2015	2015
Czechia	2013	2015	2015
Estonia	2012	2018	2018
Hungary	2013	2015	2015
Latvia	2013-2014	2015	2015
Lithuania	2012	2015	2015
Poland	2013-2014	2016	2016
Romania	2012	2015	2015
Slovakia	2012	2016	2016

Slovenia	2013	2015	2015

Source: European Commission (2019).

2.2 Variables of interest

This subsection describes the data employed in the paper. As we are interested in quantification of the potential effect of DAC1 implementation on cross-country profit shifting activities within the EU as represented by the royalty payments toward countries suspected of allowing aggressive tax planning we obtain information on intra-EU intellectual property (IP) royalty payments (current EUR mln) between the new member states and the rest of the block plus EFTA from Eurostat (2024) for years 2010-2019. Our sample contains the following reporting economies: Bulgaria, Croatia, Czechia, Hungary, Lithuania, Poland, Romania, and Slovenia.[8] Due to missing or incomplete data the following members are not included: Estonia, Latvia, and Slovakia. Payment data are then converted into USD using average annual rates.[9] Figure A1 (Appendix) visualizes annualized IP payments for the studied economies in the sample. We also collect information on inward FDI equity holdings (current USD mln) from International Monetary Fund (2024) for the aforementioned economies that we use as: *i)* control for the relative economic size and *ii)* potential proxy for profit shifting akin to IP payments data.

The tables below describe various stylized facts related to the total value of intra-EU intellectual property royalty transactions (Tables 4, 5, 6). Table 4 details top ten pairs with the highest nominal values. Table 5 reports transactions with destinations that feature favourable tax environments.[10] Table 6 shows the largest IP/FDI ratios across our panel. As can be seen from Table 4, most of the observed transaction value occurs between Poland and three economies: the United Kingdom, Germany, and Switzerland. When it comes to transactions with tax favorable destinations, the majority of high-value transactions are observed between Czechia, Poland and the Netherlands. Moreover, in terms of IP/FDI ratio, we observe a substantial value of IP payments outgoing from Croatia and Slovenia into Ireland despite the fact that Irish-registered entities hold very little of equity in the studied economies. We believe that the listed facts across the abovementioned tables point out the existence of profit shifting from the post-2004 EU members.

[8] Table A1 in Appendix provides additional details on our country sample.
[9] See Table A2 in Appendix for details.
[10] Refers to Cyprus, Ireland, Luxembourg, the Netherlands, and Malta.

It is important to note that our data have the following limitations. First, we are only able to observe the first "leg" of the payment and geographical location of its immediate receiver. Despite this, we think that our results serve as a relatively decent approximation as most profit shifting out of the EU is done initially to EU tax havens and only later to tax havens located outside the EU (Fuest et al., 2022; Tørsløv et al., 2023). Second, the fact that our data are intra-EU without inclusion of additional information regarding the outgoing IP payments outside of the EU.[11]

Table 4. IP payments (top ten transactions, 2010-2019, USD mln)

payer and recipient pair		year	annual value of royalty payments
Hungary	United Kingdom	2015	623.22
Poland	Germany	2018	593.61
Poland	Germany	2019	562.13
Poland	Switzerland	2014	554.09
Poland	Germany	2011	519.91
Poland	Germany	2012	506.86
Poland	United Kingdom	2019	504.58
Poland	Germany	2017	489.61
Poland	Switzerland	2017	483.02
Poland	United Kingdom	2019	481.84

Source: Eurostat (2024).

[11] Summary statistics for our dataset are available in Table A3 (Appendix).

Table 5. IP payments with profit shifting partners (top ten transactions, 2010-2019, USD mln).

payer and recipient pair		year	annual value of royalty payments
Czechia	Netherlands	2018	360.96
Czechia	Netherlands	2019	323.33
Poland	Netherlands	2019	321.42
Poland	Netherlands	2018	265.85
Poland	Netherlands	2011	244.29
Poland	Netherlands	2010	239.18
Poland	Netherlands	2013	233.29
Czechia	Netherlands	2017	225.48
Poland	Netherlands	2017	221.08
Czechia	Netherlands	2016	220.75

Source: Eurostat (2024).

Table 6. IP/FDI ratios (top ten transactions by ratio, 2010-2019, USD mln)

payer and recipient pair		year	annual value of royalty payments	annual value of inward FDI equity	payment/FDI ratio
Slovenia	Ireland	2010	115.74	0.30	376.13
Slovenia	Ireland	2011	117.20	0.36	318.15
Croatia	Ireland	2016	56.43	0.24	230.62
Slovenia	Romania	2014	15.41	0.08	178.81
Slovenia	Bulgaria	2012	1.41	0.01	75.60
Croatia	Ireland	2019	77.25	1.36	56.63
Slovenia	Romania	2013	9.83	0.26	36.55
Slovenia	Ireland	2012	131.44	5.72	22.94
Croatia	Ireland	2018	64.98	4.37	14.86
Slovenia	Ireland	2013	60.05	5.30	11.32

Source: Eurostat (2024), International Monetary Fund (2024).

3. Empirical results

This section contains our empirical results. We proceed in two parts: first, we describe the econometric approach, and second, describe the estimation results.

3.1 Econometric approach

To quantify the potential effect of DAC1 implementation on cross-country profit shifting activities, we run the following OLS regressions with individual fixed effects at the country level:[12]

$$y_{ij,t} = \beta_1 \left[DAC1_{\ i,t} \times PS_j \right] + \beta_2 DAC1_{\ i,t} + \beta_X X_{i,t} + \mu_{j,t} + \varepsilon_{i,t} \qquad (1)$$

where $y_{ij,t}$ is either of three measures: *i)* log of charges paid for the use of IP rights from country i to country j in year t, *ii)* log of inward FDI from country j to country i in year t, *iii)* ratio between charges paid for the use of IP rights and inward FDI between countries i and j in year t; $DAC1_{\ t}$ is a dummy taking unity if country i has implemented regulations related to DAC1 in year t and zero otherwise[13]; PS_j is a dummy taking unity if country j is associated with transnational profit shifting and zero otherwise; in some regressions, where we use IP payments, we include additional controls for economic size $X_{i,t}$ such as log of inward FDI or ratio between payments and FDI; all baseline regressions feature partner-year fixed effects $\mu_{j,t}$.

We proceed in three steps. First, we estimate equation (1) on our panel using the three different dependent variables described in the previous subsection. Then, we change the specification to include reporter-year and partner-year fixed effects to account for potential multilateral resistance terms across the studied sample of economies. Finally, we break down our panel into subsamples to see which exact destinations have seen a substantial decrease in the overall value of IP payments.

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[12] Estimation of equation (1) requires the specification to include both interaction terms separately together with the interaction itself. As we employ partner-year fixed effects $\mu_{j,t}$, the PS_j term is collinear with these fixed effects and is not included in (1). We also check potential cross-sectional (and panel) pairwise correlations between the log of IP payments and the interaction term, we do not obtain any results that point out to the presence of very high correlation (see Table B1 in Appendix).

[13] To account for the presence of EFTA members in the sample as recipients, we put $DAC1_{i,t}$ equal to zero in EU-EFTA pairs.

3.2 Estimation results

Table 7 details our baseline results regarding the impact of DAC1 on outgoing intra-EU IP payments from the studied member states. Columns (1)-(3) report results based on the log of charges paid for the use of IP rights (P), which allows the interpretation of the estimated coefficient on the interaction term as a semi-elasticity. There are three different specifications: (1) no extra market size control, then (2) log of inward FDI, and (3) IP/FDI ratio. Overall, we find a negative and highly significant coefficient on the interaction term of -1.818 (or -181%), suggesting that there was a substantial year-to-year decrease in the total value of IP payments at the time of DAC1 final implementation between the studied EU member states and favourable tax destinations. When we include additional market size controls, the estimated coefficient ranges between -1.656 and -1.674. Further, when use log of inward FDI (F) and ratio between IP payment and FDI (R), we do not obtain any significant estimates for the interaction term.

In Table 8, we check the stability of our baseline results by including reporter-year and partner-year fixed effects to account for potential endogeneity of estimates related to the omission of multilateral resistance terms that exist between the economies. Our estimates remain quantitatively similar to what is listed in Table 6. Additionally, we also test the inclusion of Switzerland to our sample of profit shifting partners, the results remain the same to Table 8 (see Appendix Table B4).

Next, we study the three most important intra-EU destinations that are frequently associated with tax favourable environment: Cyprus, Ireland, and the Netherlands. Tables 9, 10, and 11 showcase our results. To ensure that the studied subsample is not contaminated, we drop other profit shifting destinations and only compare that one particular destination in question (e.g. Cyprus) against only genuine partner economies. In particular, we find that the initial result depicted in Table 6 is driven by the reduction in the value of IP payments related to Cyprus (between -234% and -248% at 1% significance) and Ireland (-127% and -153% at 5% significance). In addition, we divide profit shifting destinations into two groups (pre-2004 and post-2004 members) and repeat the exercise (see Tables B2 and B3 in Appendix). We again find negative and significant effects in both groups. However, the post-2004 group (Cyprus and Malta) appear to have a much larger reduction that pre-2004 one (Ireland, the Netherlands, and Luxembourg).

What can be driving these results? We offer two explanations. First, it is that firms had to readjust the first leg of their profit shifting scheme and come up with another destination for such payments. The would be in line with the results reported in recent studies of Fuest et al. (2022) and Tørsløv et al. (2023) that emphasize the importance of that "first leg payment" when it comes to profits shifted within the EU. Another, more normative explanation, could be that firms started to rely less on IP payments as a tool for profit shifting at least within the EU. The former explanation can be supported by the observation we can draw from Poland-Cyprus or Poland-Ireland pairs (top of Figure A2 and Figure A3). As can be seen, outgoing royalty payments from Poland to Cyprus or Ireland see a substantial decrease during the DAC1 implementation. The latter explanation can possibly be true in Slovenia-Ireland pair, where payments to Ireland have seen a significant and permanent decline during the transposition of DAC1.

All in all, the obtained results indicate that there was a significant decrease in the overall value of IP payments related to the first leg of conducted transactions that coincided with the complete implementation of DAC1 provisions across the studied EU member states. On the other hand, we do not find any notable changes related to foreign equity holdings or their ratio.

Table 7. Impact of DAC1 on outgoing intra-EU IP payments from new member states, all profit shifting destinations.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t$	-1.157***	-0.698***	-1.302***	0.0359	-1.810***
	(0.294)	(0.256)	(0.321)	(0.0339)	(0.377)
PS_j	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
$DAC1_t \times PS_j$	-1.818***	-1.656***	-1.674***	0.0770	0.227
	(0.527)	(0.486)	(0.543)	(0.228)	(0.569)
F		0.414***			
		(0.0539)			
R			0.00650***		
			(0.00214)		
N	1839	1711	1711	2166	2166
R^2	0.572	0.673	0.546	0.130	0.506

Note: All results with partner-year fixed effects, country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8. Impact of DAC1 on outgoing intra-EU intellectual property payments from new member states, all profit shifting destinations, robustness.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t \times PS_j$	-1.755***	-1.607***	-1.625***	0.0777	0.202
	(0.503)	(0.470)	(0.514)	(0.223)	(0.532)
F		0.294***			
		(0.0506)			
R			0.00828***		
			(0.00170)		
N	1836	1709	1709	2166	2166
R^2	0.752	0.799	0.762	0.168	0.701

Note: All results include $DAC1_t$ dummy, reporter-year, partner-year fixed effects, and country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9. Impact of DAC1 on outgoing intra-EU IP payments from new member states, Cyprus and genuine destinations only.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t$	-1.157***	-0.663***	-1.302***	0.0359	-1.810***
	(0.295)	(0.252)	(0.322)	(0.0340)	(0.378)
CYP_j	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
$DAC1_t \times CYP_j$	-2.485***	-2.390***	-2.340***	-0.0521	-0.170
	(0.790)	(0.706)	(0.803)	(0.0340)	(0.830)
F		0.439***			
		(0.0539)			
R			0.0121***		
			(0.00402)		
N	1570	1445	1445	1850	1850
R^2	0.580	0.693	0.554	0.167	0.503

Note: All results with partner-year fixed effects, country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10. Impact of DAC1 on outgoing intra-EU IP payments from new member states, Netherlands and genuine destinations only.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t$	-1.157***	-0.662***	-1.302***	0.0359	-1.810***
	(0.295)	(0.252)	(0.322)	(0.0340)	(0.378)
NED_j	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
$DAC1_t \times NED_j$	-0.498	-0.262	-0.353	-0.0355	0.147
	(0.660)	(0.458)	(0.675)	(0.0340)	(0.635)
F		0.439***			
		(0.0532)			
R			0.0121***		
			(0.00402)		
N	1577	1450	1450	1849	1849
R^2	0.608	0.718	0.582	0.167	0.526

Note: All results with partner-year fixed effects, country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 11. Impact of DAC1 on outgoing intra-EU IP payments from new member states, Ireland and genuine destinations only.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t$	-1.157***	-0.754***	-1.302***	0.0359	-1.810***
	(0.295)	(0.256)	(0.322)	(0.0340)	(0.378)
IRE_j	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
$DAC1_t \times IRE_j$	-1.279**	-1.534**	-1.138+	0.565	1.418
	(0.640)	(0.737)	(0.654)	(1.002)	(1.059)
F		0.376***			
		(0.0564)			
R			0.00650***		
			(0.00215)		
N	1577	1452	1452	1851	1851
R^2	0.600	0.684	0.575	0.129	0.484

Note: All results with partner-year fixed effects, country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4. Conclusion

This paper provided empirical estimates related to the initial implementation of the Anti-Tax Avoidance Directive on intra-EU profit shifting from the new member states as approximated by the outgoing IP royalty payments toward countries suspected of allowing aggressive tax planning such as Cyprus or Ireland. Our results demonstrated that that there was a significant decrease in the overall value of IP payments related to the first leg of conducted transactions that coincided with the complete implementation of DAC1 provisions some time between 2015 and 2018. Most of the reduction has occurred in country pairs with Cyprus and Ireland, while some reduction has happened with Ireland. We also find that the observed reduction has been temporary as outgoing royalty payments between Poland and Cyprus has been on a steady recovery post-2016.

Before proceeding to policy recommendations, we would like to mention the key limitations of the empirical approach undertaken in this paper. First, we are only able to observe

the first leg of the payment and its immediate receiver. As profit shifting usually occurs in a "ping-pong" fashion, this is a significant limitation of the performed analysis. Despite this, we think we are able to provide a relatively complete picture as most of profit shifting out of the EU usually first occurs in one of the EU's tax havens. Second, we were unable to use the available data for the three small EU economies of Estonia, Latvia, and Slovakia due to incomplete and missing payment records. Third, because of the intra-EU scope of this study, we have to ignore possible payments going outside of the EU. This is dictated by the fact that there is very little information on IP royalty payments occurring between the EU members and the rest of the world that's reported in Eurostat. Finally, despite the fact that we are able to recover the exact timing of when various anti profit shifting and tax cooperation provisions have been transposed into national legislation, we are only able to perform a systematic event study for the initial two-step transposition of DAC1 due to the overlapping nature of later tax cooperation incentives (DAC2-DAC4).

In terms of policy recommendations, we propose the following. First, further monitoring of data related to various interest and service payments toward non-EU countries suspected of allowing aggressive tax planning is required. Even at country-level this data can provide novel insights into the impact of tax cooperation on transnational profit shifting. Second, more effort has to be exerted in relation to the deoffshorization within the EU itself, as we have shown, EU tax havens have attracted significant amount of shifted profits from "low tax" EU members between 2010-2019.

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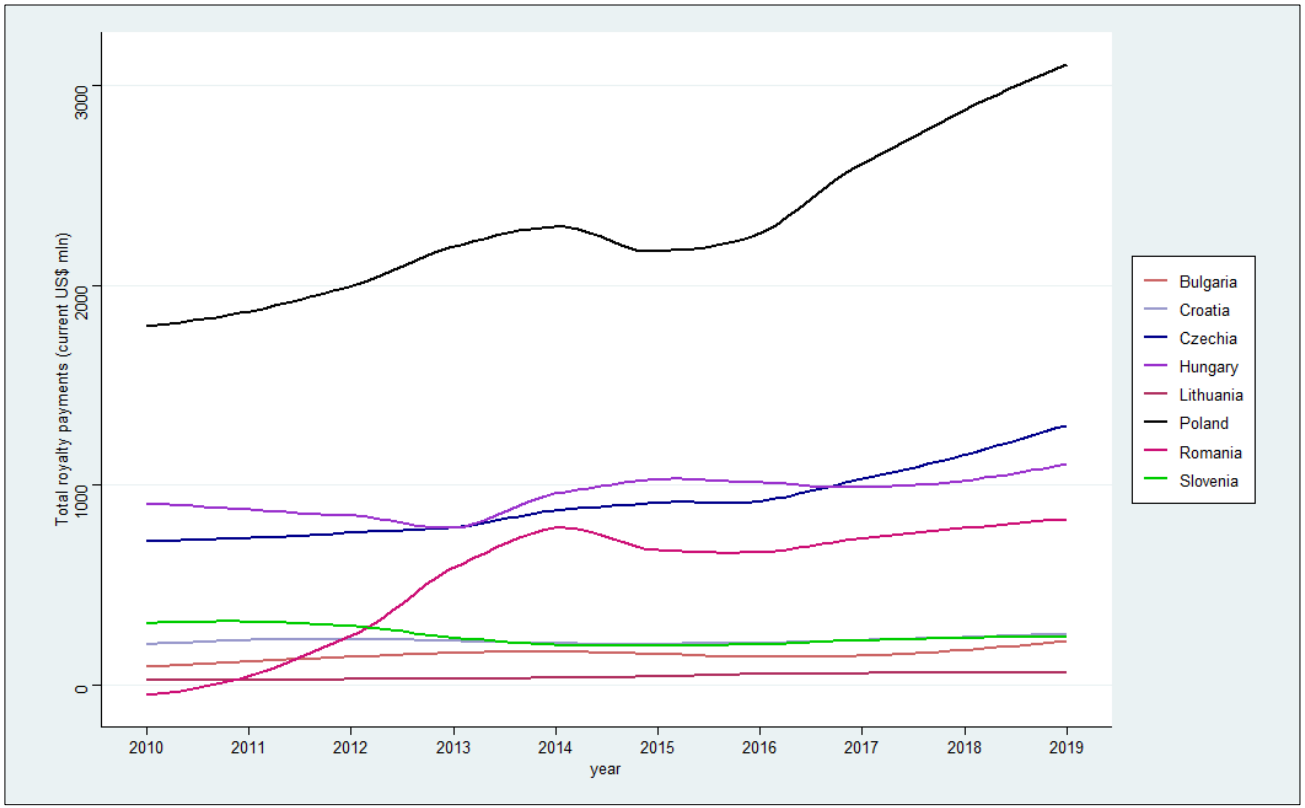
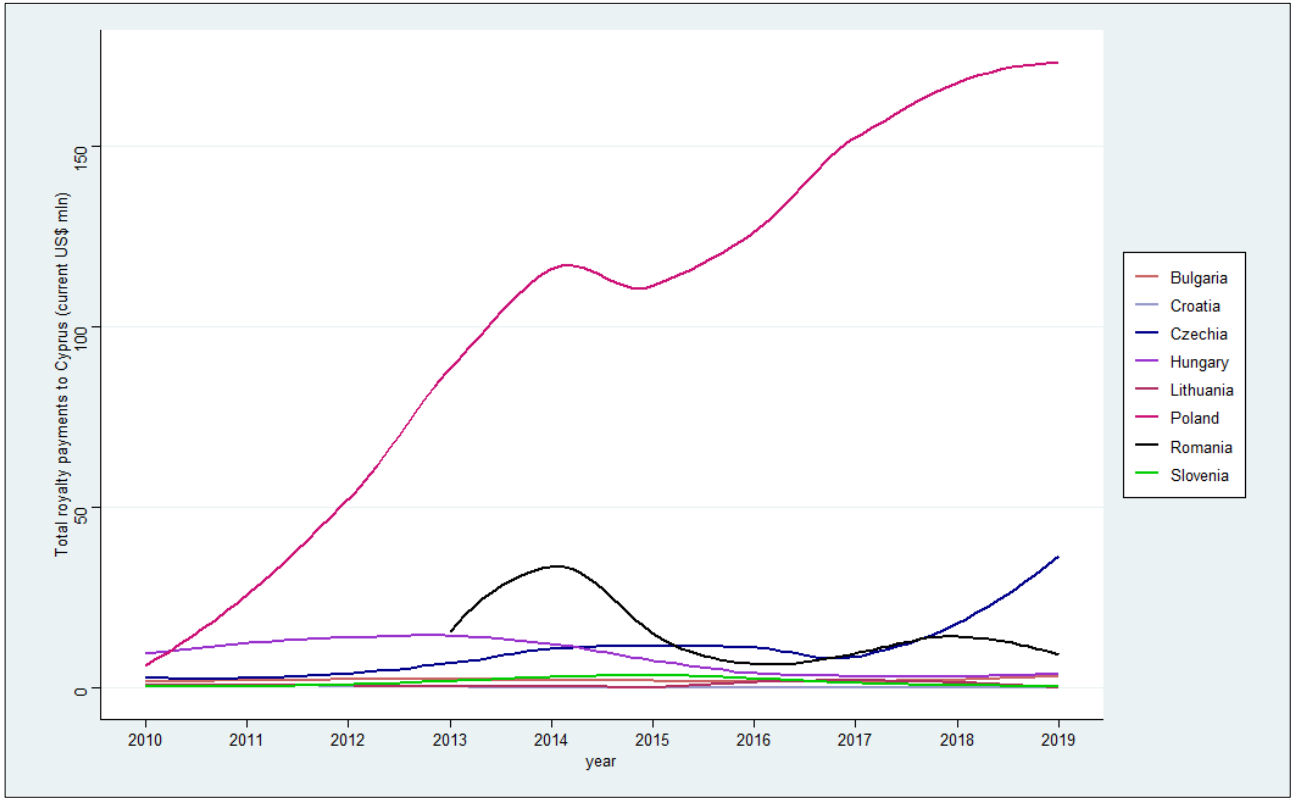
Appendix
Part A: Data



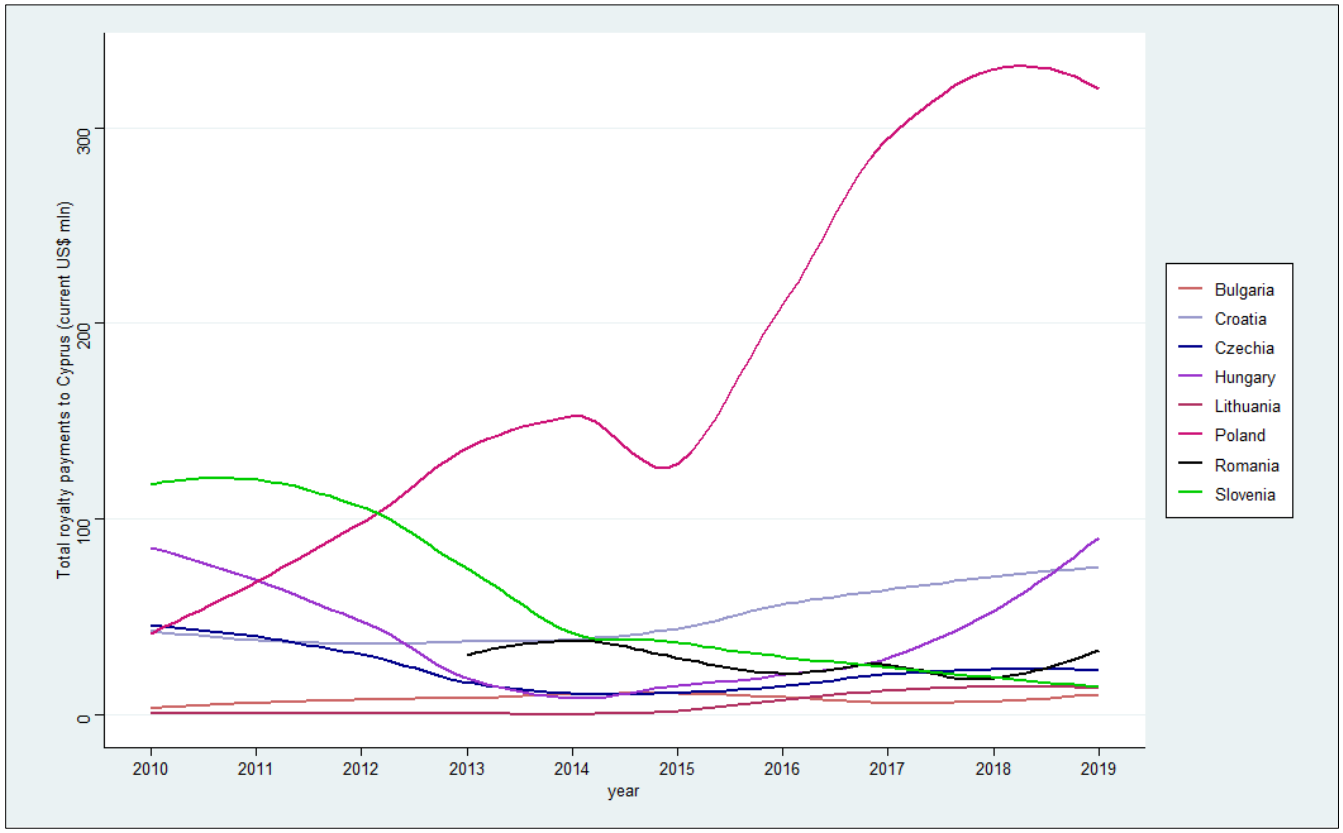
Source: Eurostat (2024).

Figure A1. Annualized IP royalty payments, all studied economies, USD mln, 2010-2019.



Source: Eurostat (2024).

Figure A2. Annualized IP royalty payments with Cyprus, all studied economies, USD mln, 2010-2019.



Source: Eurostat (2024).

Figure A3. Annualized IP royalty payments with Ireland, all studied economies, USD mln, 2010-2019.

Table A1. Sample of countries used in the empirical analysis, 2010-2019.

Reporting countries	Bulgaria, Croatia, Czechia, Hungary, Lithuania, Poland, Romania, Slovenia
Partner countries	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden, Switzerland, the United Kingdom
Profit shifting partners	Cyprus, Luxembourg, Ireland, Netherlands, Malta

Source: own summary.

Table A2. Description of variables, 2010-2019.

Variable	Description	Source
P	log of charges for the use of intellectual property n.i.e. (debit). Originally reported in current EUR million, then, converted to current USD using annual average exchange rate	Eurostat
F	log of inward foreign direct investment (equity, current USD mln)	IMF
R	ratio between charges for the use of intellectual property n.i.e. (debit) and inward foreign direct investment	Author
PS_j	dummy variable, unity if country is associated with transnational profit shifting	Author
$DAC1_{i,t}$	dummy variable, unity if country has completed transposition of DAC1 and transacts with another EU member	European Commission

Source: own summary.

Table A3. Summary statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
P	1842	1.473	2.062	-2.201	6.435
F	2166	5.48	2.823	-5.854	10.979
R	2166	.692	12.505	0	376.131
DAC1	2400	.487	0.5	0	1
CYP	2400	.033	0.18	0	1
NED	2400	.033	0.18	0	1
LUX	2400	.033	0.18	0	1
IRE	2400	.033	0.18	0	1
PS	2400	.167	.373	0	1

Source: own summary.

Table A4. Average annual CIT rates (%) across three groups of countries in the EU and EFTA, 2004-2023.

year	new EU[a)]	old EU[b)]	old EU + EFTA[c)]
2004	20.38	30.67	29.12
2005	19.88	29.17	27.78
2006	19.67	28.93	27.58
2007	18.30	27.95	26.79
2008	17.80	26.83	25.73
2009	18.10	26.67	25.60
2010	17.30	26.61	25.46
2011	17.30	26.46	25.31
2012	17.10	26.42	25.28
2013	17.64	26.75	25.54
2014	17.55	26.33	25.16
2015	17.45	25.98	24.87
2016	17.45	25.68	24.54
2017	16.45	25.29	24.17
2018	16.91	25.07	23.94
2019	16.91	24.68	23.58
2020	16.91	24.60	23.25
2021	16.91	24.32	22.97
2022	16.91	24.08	22.79
2023	16.91	24.03	23.03

a) new EU (post-2004 members: Bulgaria, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia). Bulgaria and Romania excluded pre-2007, Croatia excluded pre-2013.
b) old EU (pre-2024 members: Austria, Belgium, Cyprus, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Sweden, the United Kingdom). The United Kingdom is excluded for old-EU sample post-2020.
c) old EU + EFTA (Austria, Belgium, Cyprus, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Iceland, Italy, Liechtenstein, Luxembourg, Malta, the Netherlands, Norway, Portugal, Sweden, Switzerland, the United Kingdom).
Source: Tax Foundation (2023).

Part B: Diagnostics and additional empirical results

Table B1. Pairwise correlation coefficients (cross section and panel): interaction DAC1 * PS and log of IP royalty payments.

year	P
2015	0.016
	(0.804)
2016	0.141*
	(0.029)
2017	0.1540*
	(0.018)
2018	0.086
	(0.175)
2019	0.102
	(0.1099)
entire panel	0.083*
	(0.0001)

Note: p-values in parenthesis, * if at least $p < 0.05$.
Source: own summary.

Table B2. Impact of DAC1 on outgoing intra-EU IP payments from new member states, all post-2004 profit shifting destinations only.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t$	-1.157***	-0.669***	-1.302***	0.0359	-1.810***
	(0.295)	(0.252)	(0.322)	(0.0340)	(0.378)
NEW_j	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
$DAC1_t \times NEW_j$	-2.380***	-2.229***	-2.234***	-0.0534	0.128
	(0.542)	(0.527)	(0.558)	(0.0342)	(0.603)
F		0.434***			
		(0.0534)			
R			0.0122***		
			(0.00403)		
N	1612	1486	1486	1928	1928
R^2	0.575	0.684	0.549	0.167	0.495

Note: All results with partner-year fixed effects, country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B3. Impact of DAC1 on outgoing intra-EU IP payments from new member states, all pre-2004 profit shifting destinations only.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t$	-1.157***	-0.714***	-1.302***	0.0359	-1.810***
	(0.294)	(0.256)	(0.321)	(0.0340)	(0.378)
OLD_j	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
$DAC1_t \times OLD_j$	-1.451**	-1.282**	-1.307**	0.164	0.294
	(0.648)	(0.576)	(0.663)	(0.369)	(0.739)
F		0.404***			
		(0.0546)			
R			0.00650***		
			(0.00214)		
N	1727	1600	1600	2009	2009
R^2	0.592	0.690	0.565	0.130	0.514

Note: All results with partner-year fixed effects, country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B4. Impact of DAC1 on outgoing intra-EU intellectual property payments from new member states, all profit shifting destinations, inclusion of Switzerland, robustness.

	(1) P	(2) P	(3) P	(4) R	(5) F
$DAC1_t \times PS_j$	-1.673***	-1.539***	-1.542***	0.0486	0.259
	(0.455)	(0.422)	(0.466)	(0.189)	(0.495)
F		0.294***			
		(0.0506)			
R			0.00828***		
			(0.00170)		
N	1836	1709	1709	2166	2166
R^2	0.752	0.799	0.762	0.168	0.701

Note: To obtain these estimates, we assume DAC1 reporting between EU-Switzerland pairs. All results include $DAC1_t$ dummy, reporter-year, partner-year fixed effects, and country-pair clustered standard errors in parentheses, significance levels: $^{+}$ $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.