

Carbon Taxation and Greenflation: Evidence from Europe and Canada*

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Abstract

This paper studies the effects of carbon pricing on inflation dynamics. We construct a sample of carbon taxes implemented in Europe and Canada over three decades and estimate the response of inflation and price components to carbon pricing. Our empirical results suggest that carbon taxes did not significantly increase inflation, with dynamic effects estimated around zero in most specifications. Instead we find support for relative price changes, increasing the cost of energy but leaving the price of other goods and services unaffected. This is consistent with previous findings on the limited aggregate economic costs of carbon taxes. Based on the cross-section of taxes in Europe, we provide suggestive evidence that the response of inflation was especially muted in countries with revenue-neutral carbon taxes and autonomous central banks that can accommodate potential inflationary pressure associated with carbon pricing.

Keywords: Climate policy, carbon taxes, carbon pricing, inflation, monetary policy, climate change.

JEL classification codes: E31, E50, Q54, Q43.

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1 Introduction

Rising inflation has once again become a primary concern for policy makers, markets and the general public in advanced economies. The aftermath of the Covid-19 pandemic was marked by increasing energy prices, and was further exacerbated by the Russian invasion of Ukraine in 2022. At the same time, many countries have committed to de-carbonize their economies, giving rise to concerns around the economic consequences of the climate transition, in particular regarding inflation. In 2021, Larry Fink, CEO of Black Rock made headlines by predicting that policies against climate change would fuel global inflation.¹ The European Central Bank emphasized the consequences of climate change in its strategy review (see ECB 2021) and acknowledged that it could be forced to take “Greenflation”, i.e. inflationary pressure arising from climate policies, into account in monetary policy operations (Schnabel 2022).

The uncertainty surrounding the economic effects of climate mitigation policies such as carbon taxes illustrates that they remain poorly understood. This paper attempts to shed light on the inflationary consequences of climate policy. We study whether past carbon taxes contributed to inflation, by drawing on a comprehensive set of carbon taxes and estimating dynamic impulse responses.

At first glance, oil price shocks might appear a close cousin of carbon taxes. A long literature has documented the contractionary and inflationary properties of oil price shocks (see e.g. Hooker 2002, Barsky and Kilian 2004, Kilian 2008, Hamilton 2009), although the economic effects appear more muted today as a result of monetary policy credibility and fewer wage rigidities (see Blanchard and Gali 2007, Blanchard and Riggi 2013). We argue that there are several features of carbon taxes, that distinguish them from conventional oil price shocks and merit a separate analysis.

First, the magnitudes are vastly different: For illustration, consider the recent movements in European energy prices between January and August of 2022. The futures prices of key commodities including natural gas, oil, coal, electricity and diesel fuel increased substantially, between 34% for oil and 280% for electricity. Using commodity-specific carbon intensities (e.g. 2.08 tons of CO₂ per ton of coal), we compute an implied carbon tax that would mechanically illicit the same price response. Specifically, we estimate carbon taxes of 95 USD per ton for coal, 268 USD per ton for crude oil, 597 USD per ton for diesel fuel, 862 USD per ton for natural gas and 1,838 USD per ton for electricity.² In most cases, the taxes are orders of magnitude larger than the observed taxes in our data, as well as the estimates of the social cost of carbon which tend to lie between 100 and 200 USD per ton (NGFS 2021). Moreover, these implied taxes send the wrong signals from a climate mitigation perspective, with higher implied prices for relatively cleaner energy sources. Similar calculations for the 1973 oil crisis leads to equally sizeable implied carbon

¹Bloomberg, June 18, 2021, see <https://www.bloomberg.com/news/articles/2021-06-18/the-climate-change-fight-is-adding-to-the-global-inflation-scare>.

²We use energy futures data retrieved from Thomson Reuters and carbon intensities from the US EIA and EU EEA.

tax of 347 USD for crude oil.³ These examples illustrates that typical energy shocks lead to much larger price adjustments than even an ambitious carbon tax.

Second, energy price shocks are typically caused by sudden events that are not anticipated by economic agents. Instead, most of the carbon taxes are pre-announced well in advance with scheduled paths for future tax increases, such that firms and households are given time to substitute at the margins. Indeed, [Andersson \(2019\)](#) shows that the carbon tax elasticity of gasoline consumption is three times the price elasticity. Third, the effects of climate policy critically depend on design, inducing the tax rate and coverage, as well as revenue-recycling. Indeed a large number of carbon taxes are revenue-neutral, offsetting other existing taxes or re-distributing tax revenues. Unlike an oil price shock, it is therefore possible that the median firms' and households' tax burden is not affected by a revenue-neutral carbon tax. The lack of coordinated global climate policy has forced countries to implement national taxes, implying that in contrast to oil shocks the effects are confined to the domestic economy.

Further, it is important to study the effects of carbon taxes empirically, in addition to simulation-based studies that often point to economic costs of climate policy.⁴ To the best of our knowledge, this is the first study to emphasize the effects of carbon pricing on inflation. We explore 18 individual carbon taxes enacted in European countries and Canadian provinces over three decades. Conceptually our study is in the spirit of [Metcalf and Stock \(2020a\)](#) and [Metcalf and Stock \(2020b\)](#), who assess the economic effects of carbon pricing on output and employment in Europe. We complement their work by concentrating on the equally important monetary consequences of carbon taxation. Specially, we estimate dynamic impulse responses of inflation to changes in the carbon tax rate based on the local projections methodology of [Jordà \(2005\)](#), adapted to panel data.

Our main finding is that carbon taxes do not lead to aggregate inflation. Both in the European and Canadian data, we do not find robust evidence that pricing carbon leads to an increase in inflation in a counterfactual scenario of a 40 USD per ton tax applied on 30% of an economy's emissions. In our baseline specification for Europe, including country and year fixed effects and controlling for economic conditions, we find a cumulative response of headline inflation by 0.5 percentage points after 5 years post-tax enactment. The one standard deviation error bands always include zero. For the Canadian sample the results point to slightly deflationary responses associated with putting a price on carbon. Our findings survive to a battery of robustness checks, such as adding a broader set of controls and excluding smaller carbon taxes. Further, our results are comparable when we employ panel-VARs, or use alternative price and carbon tax data.

Although we do not find evidence of carbon taxes affecting inflation, our results suggest

³The price of crude oil increased from 2.75 to 11.10 USD per barrel between January 1973 and March 1974. Expressed in 2018 prices this amounts to a 41 USD increase, from 15.56 to 56.56 USD per barrel. We use a carbon intensity of 0.118 tons of CO₂ per barrel.

⁴For instance, [Goulder and Hafstead \(2018\)](#) estimate that a 40 USD tax rising at 5% annually leads to a fall in GDP by 1.5% relative to baseline by 2035 in the US economy. [McKibbin, Morris, and Wilcoxon \(2014\)](#) find that a more modest tax of 15 USD generates a 0.8% increase in inflation during the first year of the policy.

that they change relative prices. When comparing the responses of headline, core and energy and food inflation, we observe that inflationary pressure associated with carbon taxation is confined to the food and energy component of the consumer price index (CPI). As a result, our dynamic responses for core inflation persistently lie below those for headline inflation. This is consistent with carbon taxes increasing the price of energy, but not spilling over to a broad basket of consumption goods and services.

Finally, we exploit differences in countries' revenue recycling and monetary policy autonomy by drawing on the rich cross-section of carbon taxes in Europe. Our results suggest that countries without revenue recycling experience more inflationary effects after implementing a carbon tax. Moreover, we find that the responses of inflation are relatively smaller in countries that are not part of the Euro area and have central banks that can in principle react to carbon price shocks. Although we do not formally test the effects of monetary policy and revenue recycling as amplifying forces, our results serve as suggestive evidence that is consistent with prior research.

Related Literature. Our paper contributes to a growing empirical literature studying the effects of carbon taxes, which economists frequently advocate as the most efficient tools to combat climate change. Prior studies document that carbon taxes indeed achieve their goal of reducing emissions (e.g. [Murray and Rivers 2015](#), for Canada; [Andersson 2019](#), [Martin, De Preux, and Wagner 2014](#), [Lin and Li 2011](#), [Best, Burke, and Jotzo 2020](#), for Europe; [Rafaty, Dolphin, and Pretis 2020](#) for a survey of this literature).

Studies focusing on the economic effects of climate policies are scarce by comparison. One branch of literature is based on simulations from computable general equilibrium models (see e.g. [McKibbin et al. 2017](#), [IMF 2020](#)). As discussed above, model-based studies predict adverse effects for output and employment, in addition to an increase in inflation.

In recent work, [Metcalf and Stock \(2020a, 2020b\)](#) provide empirical evidence on the economic consequences of carbon pricing based on a sample of 15 European countries since 1990. The authors find no support for a negative effect on GDP or employment associated with carbon taxation. Our contribution is to assess the equally important response of inflation to carbon taxation, based on the same approach and sample. Indeed, our findings underpin the limited economic effects of carbon taxes present in the data.

In addition to national carbon taxes we consider, European countries also tax emissions under the umbrella of the EU Emissions Trading System (ETS). The cap-and-trade system was first introduced in 2005, but due to design problems related to oversupply and free allocation, the price of certificates remained at low levels for some time. Prices have only started to increase steadily in 2018, after the European Commission addressed some of the related issues, has the price of the ETS started to rise steadily.⁵

Exploring exogenous variation in the price of ETS certificates, [Känzig \(2021\)](#) documents a negative effect on output and an increase in headline consumer prices associated with ETS carbon price changes, which is in contrast to results from national carbon taxes.

⁵Switzerland had a parallel cap-and-trade system in place since 2008, that was linked to the EU ETS in 2020. For more details, see https://ec.europa.eu/clima/policies/ets_en.

However, the estimates for inflation are modest in size (between 0.15% on impact and 0.10% increase over four years in response to a shock calibrated to increase the energy component of HICP by 1%) and limited to headline inflation. For comparison, under our counterfactual scenario HICP energy would mechanically increase by 12%, which would translate to an increase of HICP by 1.2%.

While an assessment of the different economic effects related to carbon taxation and cap-and-trade is beyond the scope of this paper, there are several potential explanations: First, [Känzig \(2021\)](#) is based on high-frequency shocks and thus plausibly captures more unpredictable changes in carbon prices, compared to our carbon taxes at annual frequency. This is especially true if prices vary a lot within a year, as is the case in the ETS.⁶ Second, given that the ETS system includes the most energy-intensive firms, one potential explanation is related to differences in pass-through of carbon taxes by firms depending on their energy intensity.⁷ Third, many of the national carbon taxes are part of broader tax reforms that recycle tax revenues. Conversely, the majority of ETS proceeds are used to finance green technology projects, such that the overall tax burden is increased for most firms and households.⁸

However, given the difference in institutional design and firm coverage, as well as the limited overlap between national carbon taxes and the EU ETS, we view the results from the two carbon policies as complementary to each other. Indeed, [Moessner \(2022\)](#) provides suggestive evidence that when studied jointly, only changes in the ETS price are associated with a small inflationary response.

Most of the early literature on the economic effects of carbon pricing is based on the Canadian province British Columbia, which adopted a comprehensive carbon tax in 2008. For instance, [Metcalf \(2019\)](#) and [Bernard, Kichian, and Islam \(2018\)](#) find no evidence of negative aggregate effects on GDP or employment. [Yamazaki \(2017\)](#) confirms the findings for aggregate employment, but finds a small, negative response of wages in British Columbia related to the carbon tax. Our study corroborates the finding of limited economic effects in British Columbia (and Canada more broadly) by emphasizing the lack of an inflationary price response.

Conceptually, our central finding that carbon taxes change relative prices but do not lead to aggregate inflation is consistent with the idea of inflation having both a flexible (energy) and a persistent component (core CPI), in the spirit of [Aoki \(2001\)](#). Recent microeconomic evidence showing that the effects of oil price shocks are confined to a subset of consumer prices (see [Gao, Kim, and Saba 2014](#)) is supportive of this view.

The remainder of the paper is structured as follows: The next section introduces our two samples of carbon taxes, in Europe and Canada. Section 3 presents the additional

⁶The price of ETS certificates has exhibited especially high volatility in 2022 as the result of the Russian invasion of Ukraine, see <https://www.ft.com/content/202fb19b-d0f4-4a8a-8464-cf8c78048be4>.

⁷For instance, [Fabra and Reguant \(2014\)](#) show that power companies pass on the cost of higher carbon prices to consumers, whereas less energy-intensive manufacturing firms exhibit lower pass-through of energy costs to consumer prices ([Ganapati, Shapiro, and Walker 2020](#)).

⁸See e.g. <https://www.dehst.de/EN/european-emissions-trading/>.

data and outlines the empirical strategy. In Section 4, we turn to the empirical analysis on the effects of carbon pricing on inflation in Europe and Canada. The last part of the section is devoted to robustness checks. We complement the main analysis by exploring the cross-section of European carbon taxes in Section 5. Finally, Section 6 concludes and discusses the results.

2 Carbon taxes in Europe and Canada

Despite their recent resurgence in the public debate, carbon taxes have been employed as tools to reduce emissions since the early 1990s. In Europe, the Scandinavian countries were the first countries to put a price on carbon and today continue to have some of the highest carbon tax rates globally. At about the same time a set of Eastern European countries including Poland also introduced carbon taxes, albeit at much lower levels.

Since 2000 a second wave of countries in Europe began to price carbon, among them Switzerland, Ireland and Iceland. Of the countries considered in this study, the United Kingdom and a set of Southern European countries form a third wave of carbon tax economies. Although we do not include them here due the short time span, Germany and the Netherlands also introduced national policies to price carbon in 2021.

In total, our European sample encompasses 15 carbon taxes and provides the basis for the empirical analysis. All countries we consider are taxing emissions in the energy and power sector under the jurisdiction of the EU ETS. Fortunately there is little overlap between our carbon taxes and the ETS, i.e. no double taxation, based on data by the World Bank's Carbon Pricing Dashboard. Moreover, any changes in prices associated with the EU ETS are common to all countries in our sample and should be accounted for when including year fixed effects.

In addition to the European taxes implemented nationally, we also explore a separate set of carbon taxes at the provincial level in Canada. Besides the aforementioned carbon tax in British Columbia (BC), we also consider carbon pricing in Quebec and Alberta.⁹ In 2019 Canada enacted a national carbon tax that is complementary to the existing provincial taxes.

Much like Euro area countries, Canadian provinces provide a neat setting to evaluate the effects of climate policy on inflation since they do not have autonomous monetary policy, which potentially reacts to higher energy prices. The mandate of the Bank of Canada (BOC) is to stabilize inflation at the national level rather than for individual provinces.¹⁰

⁹Alberta introduced a carbon tax in 2017, which was abolished in 2019. Quebec introduced a cap-and-trade system including a price floor in 2013. We use the minimum price of the cap-and-trade system analogous to a carbon tax, as it puts an effective lower bound on the price of emissions.

¹⁰We checked minutes of monetary policy announcements around the year of the carbon tax implementation in BC. We could not find any evidence of the carbon tax implementation, or potentially increasing energy prices in BC factoring into monetary policy decisions in Canada. However, we cannot rule out that the BOC implicitly offset national inflationary pressure related to carbon pricing.

Table 1 summarizes our sample of carbon taxes, based on data retrieved from the World Bank. We observe considerable heterogeneity, both in terms of initial and current tax rates (expressed in 2018 US dollars per ton of CO₂ emissions), as well as in the tax base (expressed as the share of total greenhouse gas (GHG) emissions in an economy covered by the tax).¹¹ Carbon taxes range from a negligible 70 cents in Poland to more than 100 USD per ton of CO₂e emissions in Sweden. In European countries, taxes tends to cover around one third of total GHG emissions, on average. Data on Canadian tax rates (bottom rows) are collected from provincial websites at monthly frequency, and expressed as annual averages in Table 1. They are characterized by a relatively larger coverage compared to their European counterparts, with tax rates of 23 USD per ton of CO₂e emissions, on average.

Economists often advocate for carbon taxes to be redistributed to the population (e.g., [Metcalf and Weisbach 2009](#)), since the purpose of the tax is to change consumption behavior and internalize externalities by correcting relative prices, not to increase government revenues. A number of economies have followed this path by introducing carbon taxes in conjunction with redistribution schemes for the tax revenues.

For instance, carbon tax proceeds in Switzerland are used to finance an energy efficiency program and a technology fund. Moreover, two-thirds of the revenues are redistributed to households on a per capita basis (as a rebate on the compulsory health insurance) and to firms, in proportion to their payroll ([Hintermann and Zarkovic 2020](#)). The provincial carbon tax in British Columbia features a progressive redistribution scheme, where low-income households receive lump-sum payments, in addition to reductions in the personal and corporate income taxes.

For the purposes of this study we broadly distinguish between European economies that recycle revenues and those that do not. We acknowledge that the taxes in our sample potentially differ along several other dimensions, which are however hard to capture with our aggregate data. For further background on the carbon taxes we refer the reader to [Metcalf and Stock \(2020a\)](#) (for Europe) and [Yamazaki \(2017\)](#) (for British Columbia). Table C3 of Appendix C gives an overview of different designs and redistribution schemes for our carbon tax sample.

3 Data and empirical strategy

This section first describes the data we use in the empirical analysis, based on the carbon taxes listed in Table 1. Then, we introduce the main empirical strategy to identify the effect of carbon pricing on inflation based on local projections.

¹¹The tax base is a function of the number of sectors that are included in the tax, as well as the range of fossil fuels that are covered. For instance, most taxes with a large base (e.g. Ireland) span all fossil fuels, whereas those with a small base (e.g. Spain) tend to only apply to a minority of fossil fuels. For more details, see the Carbon Pricing Dashboard of the World Bank.

Table 1: Carbon taxes in Europe and Canada

Economy	Enacted	Initial rate (USD)	2018 rate (USD)	Coverage
Finland	January 1990	2.14	70.65	0.36
Poland	January 1990	0.68	0.16	0.04
Norway	January 1991	54.81	49.30	0.62
Sweden	January 1991	44.72	128.90	0.40
Denmark	May 1992	22.47	24.92	0.40
Slovenia	January 1996	15.24	29.74	0.24
Estonia	January 2000	1.30	3.65	0.03
Latvia	January 2004	1.59	9.01	0.15
Switzerland	January 2008	10.01	80.70	0.33
Ireland	January 2010	19.75	24.92	0.49
Iceland	January 2010	9.88	25.88	0.29
United Kingdom	April 2013	7.66	25.71	0.23
Spain	January 2014	31.82	30.87	0.03
France	April 2014	9.30	57.57	0.35
Portugal	January 2015	8.99	11.54	0.29
British Columbia	July 2008	9.64	29.01	0.70
Quebec	January 2013	9.58	16.67	0.85
Alberta	January 2017	17.08	24.87	0.48

Notes: Summary statistics of the carbon taxes used for the empirical analysis, for European countries and Canadian provinces. Tax rates from the World Bank's Carbon Pricing Dashboard are expressed in 2018 USD per ton of carbon dioxide (CO₂) equivalent (e) emissions, using the national GDP deflator and 2018 exchange rate. Coverage denotes the share of total GHG emissions covered by the tax in 2019. For the United Kingdom, and Quebec, we use the price floor of the respective cap-and-trade systems as the carbon tax rate. Source: <https://carbonpricingdashboard.worldbank.org/>, accessed 15.02.2021.

3.1 Data

We use a number of additional data sources to complement the carbon taxes described above. For the sample of European countries, we use CPI data at annual frequency, retrieved from the OECD. We construct three separate series for headline, core and energy and food inflation based on consumer price data. In total, our sample comprises of 26 European countries with available data, all part of the EU ETS. Our main economic controls consist of real GDP growth from the World Bank and monetary policy rates, from the Bank for International Settlements. In some specifications we also include employment, the trade deficit and the terms of trade from Eurostat and the OECD, respectively. More details on the European sample, including descriptive statistics on headline and core inflation are presented in Appendix C, Table C1.

We construct an analogous panel of consumer price data at quarterly frequency for Canadian provinces, obtained from Statistics Canada. Unfortunately, economic controls are only available at annual frequency at the provincial level. We therefore also assemble an annual dataset, including the growth rate of gross provincial product from Statistics Canada. The data include the ten Canadian provinces since the year 2000. We summarize the headline and core inflation figures in Table C2 of Appendix C.

3.2 Empirical strategy

Our main empirical analysis builds on the local projections approach of Jordà (2005) adapted to panel data, which allows us to identify the dynamic response of inflation to carbon taxation.

Importantly, local projections permit to control for the economic environment that potentially impacts an economy’s decision to implement or change an existing carbon tax.¹² Although we argue that concerns of endogeneity are less pressing when assessing the response of inflation compared to aggregate economic activity, our approach nonetheless accounts for potential confounding factors.

Specifically, we estimate a sequence of panel (OLS) regressions,

$$\Delta CPI_{i,t+h} = \alpha_i + \Theta_h \tau_{i,t} + \beta(L) \tau_{i,t-1} + \delta(L) \Delta CPI_{i,t-1} + \mu(L) \Delta \mathbf{X}_{i,t-1} + \gamma_t + \epsilon_{i,t}, \quad (1)$$

where τ_{it} is the real carbon tax rate in economy i in year t . Θ_h is the effect of an unexpected change in the carbon tax at year t on annual inflation in h years. $\Delta \mathbf{X}_{i,t-1}$ is a varying set of covariates, in the baseline model it includes GDP growth and changes in the domestic monetary policy rates. To control for persistence of the tax rate, inflation and the additional controls, we use the four latest lags of each variable in the regression. Unobserved heterogeneity specific to an economy or year is absorbed by a set of fixed effects, α_i and γ_t .

Importantly, this methodology allows for feedback from historical inflation and economic conditions to the carbon tax rate. For our dynamic effect, Θ_h , to be properly identified we rely on the assumption that only those components of the tax that are not predicted by historical carbon taxes and economic conditions, are exogenous. One example of such an exogenous change could be a green party assuming government and abruptly increasing the carbon tax rate.

We restrict our European sample to 26 countries with available data and part of the EU ETS (listed in Table C1 of Appendix C), spanning the period 1985–2018. For Canada, the impulse responses are estimated separately for quarterly and annual data. To distinguish between broad price changes and changes confined to energy prices we separately compute impulse responses for headline, core and energy and food inflation.

For the baseline model, we use a standard two-way fixed effects (TWFE) estimator. However, a recent literature (see Callaway and Sant’Anna 2021, Goodman-Bacon 2021) has documented that the TWFE estimator might suffer from bias in case of heterogeneous treatment effects. This is especially prevalent in the presence of multiple treatment waves, which applies also to our carbon taxes. To alleviate this concern, we present separate results adopting the approach of Dube et al. (2022) (henceforth DGJT), with continuous treatment and including a “clean control condition” in the spirit of de Chaisemartin et al. (2022).

¹²For instance, British Columbia deferred the scheduled 2020 increase of its carbon tax until 2021 as a response to the COVID-19 pandemic. See <https://www2.gov.bc.ca/gov/covid-19-tax-changes>.

Formally, we impose the following sample restriction, where an observation has to satisfy one of two conditions to be included in the estimation,

$$\begin{aligned} \tau_{i,t} &> 0, \\ \tau_{i,t+k} &= 0 \text{ for } k = 0, \dots, h, \end{aligned} \tag{2}$$

where h is the time horizon to estimate dynamic effects. Intuitively, we exclude economies from the estimation if they introduced a carbon tax during the time horizon we consider.

Following [Metcalf and Stock \(2020b\)](#), we interact all carbon tax rates with their 2019 emissions coverage, to obtain an effective carbon tax. Standard errors are heteroscedasticity robust (see [Montiel Olea and Plagborg-Møller 2021](#)) and clustered on country or province, respectively.

Our counterfactual exercise consists of a one-time permanent increase in the carbon tax by 40 USD that applies to 30% of an economy’s GHG emissions, broadly corresponding to our sample averages. Mechanically, the tax would raise the price gasoline or diesel by ten cent per liter.¹³ We compute dynamic impulse responses for the five years after the tax increase.

We subject our main results to a battery of robustness checks. In section 4.3, we focus on subsamples excluding smaller carbon taxes, and show that the estimates remain unchanged when using emissions-weighted carbon taxes from [Dolphin, Pollitt, and Newbery \(2020\)](#). Moreover, [Appendix A](#) presents complementary results adding time trends, employing panel-vector autoregressive (VAR) models and an alternative dataset on inflation in Europe. Finally, we carry out event studies based on the synthetic control method ([Abadie and Gardeazabal 2003](#)) in [Appendix B](#),

4 Main results

This section presents the main empirical results. First, we provide evidence for European countries, showing that past carbon taxes have not been inflationary, but changed relative prices. Second, we confirm our results based on Canadian provinces, using data at quarterly and annual frequency. Third, we test that our main findings remain robust in different subsamples and when using an alternative dataset on carbon taxes.

4.1 European countries

We begin with the analysis on the set European carbon tax countries. [Table 2](#) contains the results, starting with headline inflation in [Panel A](#). The first row is based on a specification including country and year fixed effects. We distinguish between the contemporaneous (in year 0), short-term (in years 1–2) and medium-term (year 3–5) average effects of the carbon tax. The estimated responses are small in magnitude: Quantitatively a 40 USD carbon

¹³The IPCC ([Eggleston et al. 2006](#)) calculates with 8.89×10^{-3} to 10.18×10^{-3} tCO₂e emissions per gallon of gasoline and diesel, respectively. One gallon corresponds to 3.785 liters.

tax applied on 30 % of emissions leads to an immediate increase of headline inflation by 0.42 percentage points and between 0.14 and 0.25 percentage points in the following five years, on average. None of the responses are statistically significant.

Next, we add GDP growth and the change in the domestic monetary policy rate (entering with four lags each) in the model, to control for changes in the macro-financial environment around the tax increase. In this baseline specification, we find more muted impulse responses close to zero, but with smaller standard errors. In the final specification we add the change in employment, trade deficit and the terms of trade as additional controls. The estimated effects are slightly larger but remain quantitatively small. In part, this difference may be attributed to the shortened sample span, since the additional control variables are only available since 1990.

The bottom row of panel A shows the estimates from the baseline model estimated using the DGJT instead of the TWFE estimator. Reassuringly, the dynamic responses are of similar size and statistical precision for both approaches. At the medium term the estimated response changes sign, but remains close to zero.

For illustration we plot the cumulative impulse responses (under a parallel path assumption), based on the baseline specification, in Figure 1 (Panel A). Shaded gray bounds denote confidence bands of one and two standard deviations, respectively. In each of the five years after the tax implementation, the estimates are within one standard deviation of zero.

Next, we turn to the response of core inflation, in panel B of Table 2. Consistent with the results for headline inflation, the estimates are close to zero and rarely exceed their standard errors. For the baseline specification, the estimates over all horizons are below a tenth of a percentage point, on average. When adding additional controls the coefficients increase slightly. Using the DGJT estimator also leaves the estimates unchanged.

We graphically illustrate the cumulative dynamic effect of core inflation for the baseline model, including country and year fixed effects and economic controls in Panel B of Figure 1. In the five years after the tax, the response of inflation is very close to zero. Compared with headline inflation (Panel A), we note that core inflation shows a more muted response to an increase in carbon pricing.

To shed more light on these differential effects for headline and core inflation, we estimate a specification with energy and food inflation as the dependent variable. The estimates point towards an increase in energy and food inflation related to carbon pricing. In the baseline model, we find an immediate increase by one percentage point that fades out over the next five years. The estimates increase in size when including additional controls, and are of similar magnitude when applying the DGJT estimator.

Panel C of Figure 1 highlights the dynamic response over time. We see an initial increase in energy and food inflation that persists over the 5-year horizon. Due to the higher volatility of this series, the estimates are less precise compared to the other price components. Nonetheless, the one standard deviation confidence bands are always in positive territory.

Table 2: Dynamic effects of a carbon tax, European sample

Estimator	Specification	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	0.38 (0.35)	0.17 (0.28)	0.16 (0.28)
TWFE	FE + controls	0.07 (0.32)	0.17 (0.25)	−0.01 (0.21)
TWFE	FE + add. controls	0.56 (0.24)	0.50 (0.23)	0.02 (0.24)
DGJT	FE + controls	0.07 (0.32)	0.16 (0.26)	0.06 (0.22)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	0.20 (0.41)	−0.03 (0.32)	0.02 (0.27)
TWFE	FE + controls	0.08 (0.32)	0.07 (0.26)	−0.03 (0.22)
TWFE	FE + add. controls	0.27 (0.23)	0.25 (0.20)	−0.12 (0.23)
DGJT	FE + controls	0.08 (0.32)	0.09 (0.29)	0.01 (0.23)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	0.68 (0.67)	0.26 (0.35)	−0.01 (0.31)
TWFE	FE + controls	1.13 (0.64)	0.51 (0.39)	−0.06 (0.35)
TWFE	FE + add. controls	1.47 (0.58)	0.67 (0.44)	−0.21 (0.36)
DGJT	FE + controls	1.13 (0.64)	0.46 (0.39)	0.03 (0.38)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the European sample. All specifications include country and year fixed effects, “controls” includes GDP growth and the domestic monetary policy rate, “add. controls” further includes unemployment, the trade deficit scaled by GDP and the terms of trade, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on country.

4.2 Canadian provinces

After documenting that carbon taxes did not lead to inflation in European countries, we now replicate our analysis based on the sample of provincial carbon taxes in Canada. The main distinguishing feature is an analysis at quarterly frequency, in addition to the annual

data. Panel A of Table 3 uses annual headline inflation as the dependent variable. We start with a specification including only province and year fixed effects, before sequentially adding GDP growth (baseline specification), the change in employment and trade balance respectively. In the baseline model we estimate a small positive initial effect that persists over the first two years. In the following three years, the responses are negative, at three quarters of a percentage point, on average. The estimates remain of similar magnitude and statistical precision when adding controls or using the DGJT estimator.

Figure 2 (Panel A) shows the cumulative impulse response of headline inflation for the baseline specification. In contrast with the European estimates, the responses for Canadian sample are more precisely estimated, although the error bands (shaded gray) exclude zero only in year five.¹⁴ After a zero impact in the first two years post-tax, headline inflation continues to fall in the following years, until -1.5% (after 5 years).

Although we emphasize the non-existence of an inflationary response, there are plausible explanations for negative (deflationary) effects of carbon pricing. First, household income could be depressed as a result of the tax, causing households to cut back consumption, which creates downward pressure on prices. For instance, British Columbia adopted a very progressive redistribution scheme, which potentially reduced high-income household's consumption of goods and especially services. Second, a carbon tax that raises the cost of energy potentially lowers the net present value of energy-intensive durable goods, contributing to a fall in prices. Third, pricing carbon could foster higher investment in less energy-intensive goods and services, leading to lower prices in certain segments due to greater supply.

Along the same lines, the estimated responses of core inflation are broadly consistent with the European results (Panel B). We find negative initial and medium-term effects across the different specifications. The latter responses are precisely estimated, at roughly three times the standard error.

Panel B of Figure 2 highlights this graphically: We find evidence of a deflationary response of core inflation in years 1, 4 and 5 after the tax implementation. Compared to headline inflation, the dynamic response path is slightly shifted downwards, but still very close to zero for most years. Albeit at a lower level, the responses corroborate the evidence from Europe on the lack of an inflationary effect of historical carbon taxes.

Lastly, we turn to energy and food inflation. We find positive initial responses of about one percentage point, that persist for the first two years after the tax change. In the final three years the effect turns negative. Once again we illustrate the response of energy and food inflation graphically in Panel C of Figure 2. In line with the European results, we see a positive initial response that persists for three years and then fades out. Moreover, the error bands are wider relative to headline and core inflation.

One potential reason for the non-responsiveness of inflation to carbon pricing could be that effects are short-lived and not detectable with annual data. To test this hypothesis,

¹⁴One reason for the improved precision could be that inflation dynamics are more synchronized in Canadian provinces compared to European countries.

Table 3: Dynamic effects of a carbon tax, Canadian sample

Estimator	Specification	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	−0.21 (0.60)	0.31 (0.29)	−0.78 (0.30)
TWFE	FE + controls	0.11 (0.59)	0.29 (0.34)	−0.76 (0.32)
TWFE	FE + add. controls	0.11 (0.53)	0.32 (0.33)	−0.72 (0.28)
DGJT	FE + controls	0.11 (0.59)	0.26 (0.36)	−0.78 (0.34)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	−0.60 (0.63)	0.05 (0.26)	−0.60 (0.21)
TWFE	FE + controls	−0.23 (0.54)	0.07 (0.26)	−0.62 (0.21)
TWFE	FE + add. controls	−0.15 (0.48)	0.20 (0.27)	−0.59 (0.18)
DGJT	FE + controls	−0.23 (0.54)	0.04 (0.27)	−0.68 (0.22)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	1.16 (1.07)	1.10 (1.00)	−0.92 (0.71)
TWFE	FE + controls	1.06 (1.05)	0.99 (1.15)	−0.83 (0.77)
TWFE	FE + add. controls	0.81 (1.17)	0.88 (1.11)	−0.88 (0.81)
DGJT	FE + controls	1.06 (1.05)	1.02 (1.23)	−0.73 (0.74)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the Canadian sample. All specifications include province and year fixed effects, “controls” includes GDP growth, “add. controls” further includes unemployment and the trade deficit scaled by GDP, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on province.

we estimate dynamic impulse responses at quarterly frequency for the Canadian sample. We follow a similar empirical approach, with the quarterly change in consumer prices as the dependent variable and time and provincial fixed effects, including eight quarterly lags of all variables.

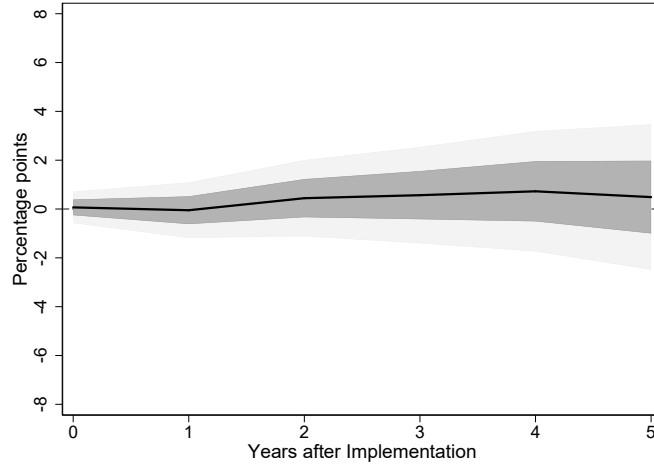
Figure 3 illustrates the corresponding impulse responses over 20 quarters after the

tax introduction of a similarly sized carbon tax. Quantitatively they are consistent with the annual estimates, albeit with smaller standard errors. Headline inflation (panel A) depicts a small initial effect, but remains flat for two years, before turning slightly negative. The response of core inflation (panel B) is estimated around zero on impact, but quickly tails into negative territory. Energy and food inflation (panel C) increases immediately, and remains elevated until two years post-tax. After, the effect remains positive but less precisely estimated.

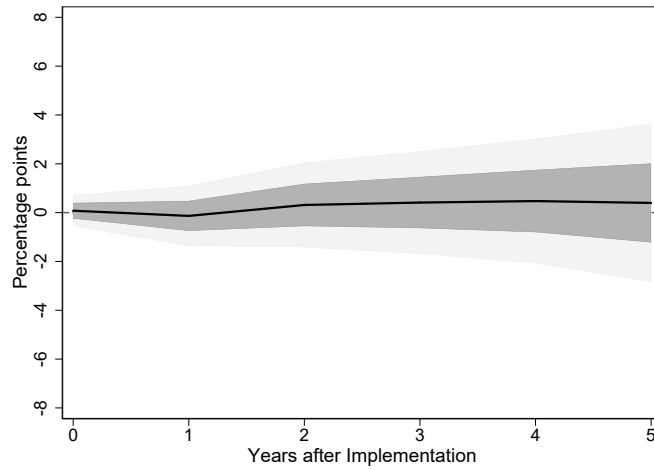
In summary, empirical estimates from European countries and the Canadian provinces provide little support for inflationary effects associated with carbon pricing. Whereas the results point to modest and imprecisely estimated effects in Europe, we find slightly deflationary responses in Canadian provinces. Moreover, we show that any inflationary responses are confined to headline inflation, driven by an increase in the energy and food component. Conversely, there is no apparent spillover to core inflation, consistent with relative price changes.

Figure 1: Impulse responses to a carbon tax, European sample

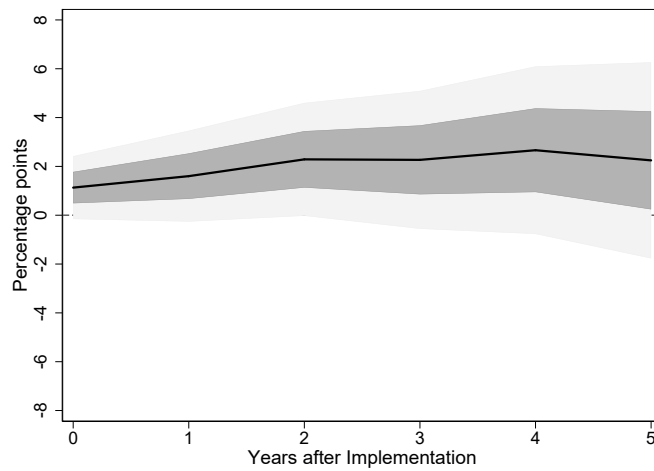
A. Headline inflation



B. Core inflation



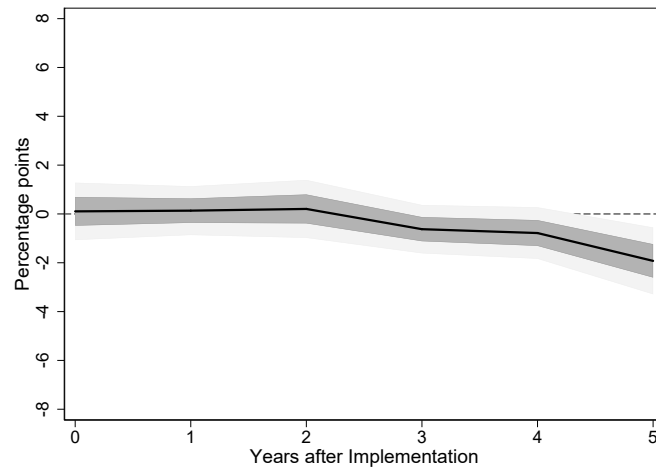
C. Energy and food inflation



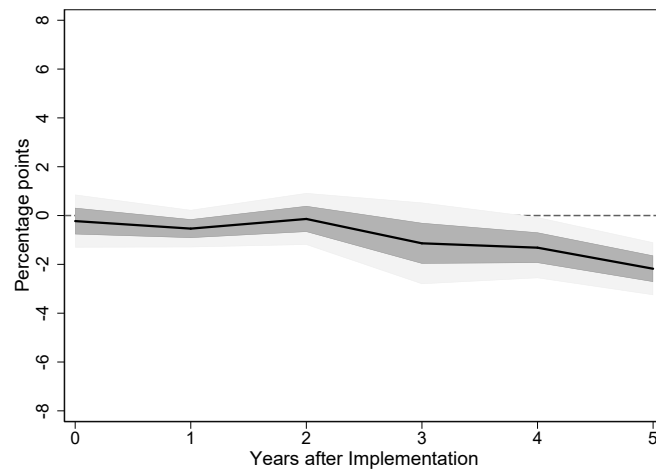
Notes: Impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. All impulse responses are based on the baseline specification, including country and year fixed effects, as well as GDP growth and the domestic monetary policy rate. Shaded gray bounds denote one (light gray) and two (dark gray) standard deviations around the estimated response.

Figure 2: Impulse responses to a carbon tax, Canadian sample

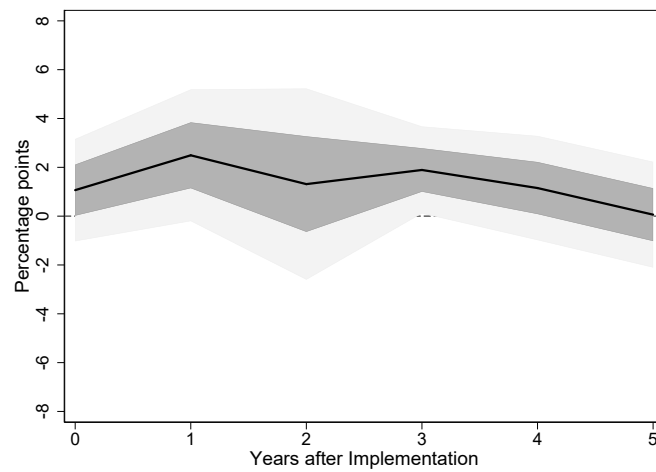
A. Headline inflation



B. Core inflation

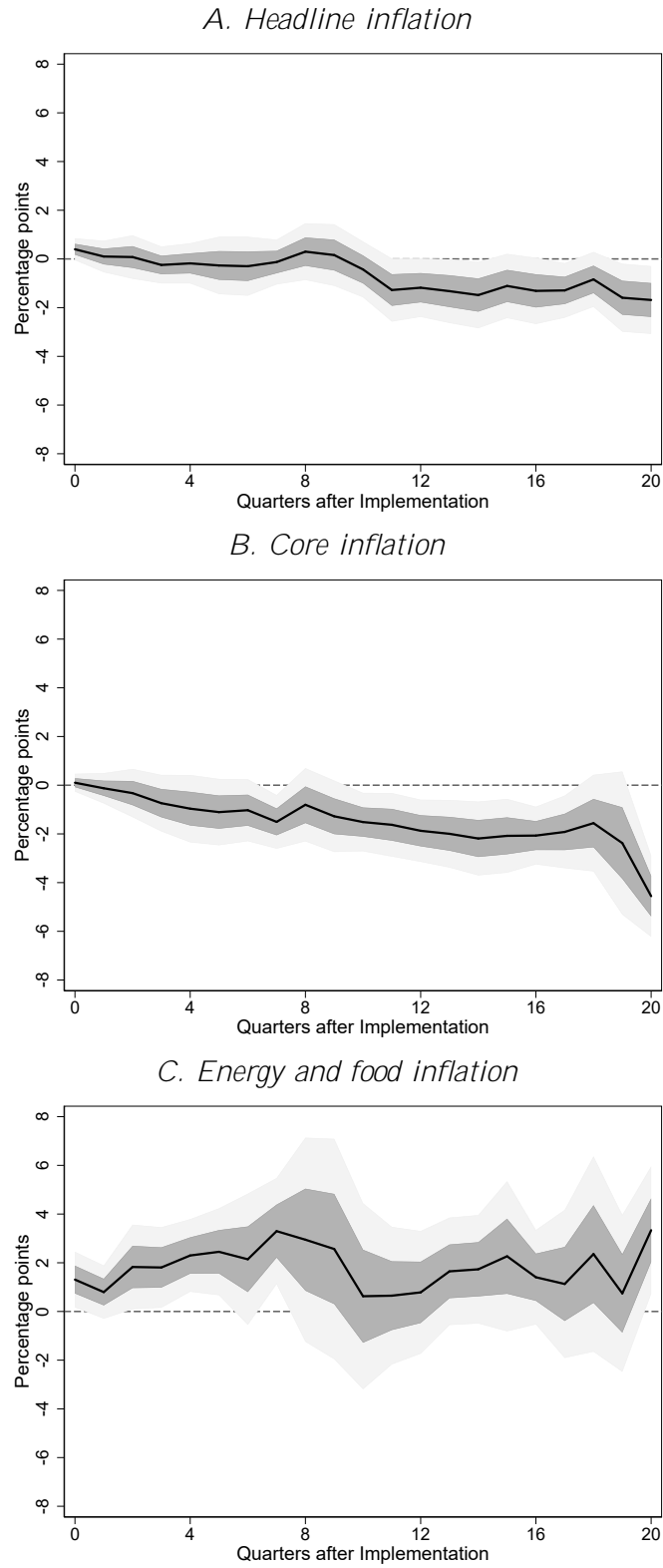


C. Energy and food inflation



Notes: Impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. All impulse responses are based on the baseline specification, including province and year fixed effects and GDP growth. Shaded gray bounds denote one (light gray) and two (dark gray) standard deviations around the estimated response.

Figure 3: Impulse responses to a carbon tax, Canadian sample, quarterly data



Notes: Impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. All impulse responses are based on quarterly data, including province and time fixed effects. Shaded gray bounds denote one (light gray) and two (dark gray) standard deviations around the estimated response.

4.3 Robustness

In this section we provide additional estimates to ensure that our results are robust. First, we turn to subsamples in Europe and Canada, excluding smaller carbon taxes to rule out that they are driver of our findings. Second, we draw on an alternative dataset of emissions-weighted carbon tax rates by [Dolphin, Pollitt, and Newbery \(2020\)](#). Although the correlation with our effective carbon tax rates is high (0.93) the idea is that emissions-weighted tax rates based on sectoral data provide a more accurate picture of the effective carbon tax compared to our approach of interacting tax rates with coverages.

We begin by replicating our main analysis for different subsamples in Europe and Canada. First, we include only large carbon taxes in Europe, exceeding 20 USD in the sample. Reassuringly, the results in [Table 4](#) are in line with the estimates from the full sample. If anything the responses are smaller in magnitude, suggesting that carbon taxes had smaller effects on prices in countries with larger taxes. The more muted reaction of inflation is apparent for all components of the CPI basket, in panels A-C.

For Canada, we estimate impulse responses separately for the province British Columbia, both due to its early adoption and relevance in the academic literature. The results, excluding the other two carbon tax provinces are contained in [Table 5](#). We observe larger initial effects on headline, core and energy and food inflation in British Columbia compared to the full sample. However, in the five years after the tax the estimates switch sign (for headline and core inflation), resulting in a deflationary overall response over the 5-year period. For energy and food inflation the estimates remain positive in the short-term but also become negative over the medium term, on average.

Next, we use emission-weighted carbon tax data to ensure that our approach accurately measures effective carbon taxes in an economy. This is motivated by the fact that carbon pricing schedules are non-linear in most cases, and vary across and within sectors due to exemptions.¹⁵ Although the data retrieved from the World Bank should in principle capture the overall effective tax rate, we use figures by [Dolphin, Pollitt, and Newbery \(2020\)](#) based on sectoral data as a robustness check.

[Table 6](#) presents the estimates based on the European sample. Reassuringly, they are comparable to the responses using the World Bank data. We find dynamic effects around zero for headline and core inflation across all our specifications, and when using the TWFE or DGJT estimator. The results for energy and food inflation are smaller compared to the baseline estimates. Indeed, except for the contemporaneous positive response the estimates at longer horizons point to smaller effects around zero.

We also estimate impulse responses based on emission-weighted carbon taxes for the sample of Canadian provinces, in [Table 7](#). Consistent with the baseline results, we find muted responses of headline and core inflation to carbon taxation across the different models. Compared to the estimates based on the World Bank data, the deflationary responses are more front-loaded at short horizons, whereas the medium-term effects are

¹⁵E.g. for the case of France, see <https://www.oecd.org/tax/tax-policy/effective-carbon-rates-france.pdf>.

Table 4: Dynamic effects of a carbon tax, large European taxes

Estimator	Specification	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	0.35 (0.36)	0.18 (0.29)	0.03 (0.29)
TWFE	FE + controls	−0.09 (0.32)	−0.06 (0.25)	−0.29 (0.22)
TWFE	FE + add. controls	0.25 (0.23)	0.11 (0.22)	−0.52 (0.20)
DGJT	FE + controls	−0.09 (0.32)	−0.14 (0.27)	−0.24 (0.24)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	0.25 (0.39)	0.03 (0.27)	−0.05 (0.21)
TWFE	FE + controls	−0.07 (0.32)	−0.17 (0.29)	−0.33 (0.24)
TWFE	FE + add. controls	0.10 (0.18)	0.07 (0.21)	−0.33 (0.18)
DGJT	FE + controls	−0.07 (0.32)	−0.20 (0.31)	−0.31 (0.26)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	0.70 (0.66)	0.22 (0.35)	−0.15 (0.32)
TWFE	FE + controls	0.88 (0.70)	0.31 (0.37)	−0.26 (0.36)
TWFE	FE + add. controls	0.89 (0.69)	0.02 (0.49)	−0.77 (0.46)
DGJT	FE + controls	0.88 (0.70)	0.20 (0.38)	−0.11 (0.43)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the European sample, excluding taxes below 20 USD. All specifications include country and year fixed effects, “controls” includes GDP growth and the domestic monetary policy rate, “add. controls” further includes unemployment, the trade deficit scaled by GDP and the terms of trade, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on country.

positive. Energy and food inflation also shows smaller dynamic effects before the second year when using emissions-weighted carbon taxes. From the third year post-tax, the responses become positive.

In sum, our main results that carbon pricing does not lead to an increase in inflation also survives a battery of robustness checks, using subsamples and alternative carbon tax

Table 5: Dynamic effects of a carbon tax, British Columbia

Estimator	Specification	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	2.16 (1.46)	−0.82 (0.87)	−1.03 (0.42)
TWFE	FE + controls	2.11 (1.49)	−0.83 (0.86)	−1.00 (0.41)
TWFE	FE + add. controls	1.14 (1.32)	−0.64 (0.77)	−1.10 (0.41)
DGJT	FE + controls	2.11 (1.49)	−0.85 (0.93)	−1.06 (0.42)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	1.92 (1.21)	−1.10 (0.50)	−0.49 (0.32)
TWFE	FE + controls	1.80 (1.21)	−1.04 (0.51)	−0.49 (0.35)
TWFE	FE + add. controls	1.07 (1.01)	−0.67 (0.49)	−0.60 (0.35)
DGJT	FE + controls	1.80 (1.21)	−1.11 (0.57)	−0.61 (0.36)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	2.35 (2.54)	0.74 (2.22)	−2.10 (1.05)
TWFE	FE + controls	2.26 (2.66)	0.64 (2.19)	−1.95 (1.03)
TWFE	FE + add. controls	0.61 (2.48)	0.59 (2.20)	−2.18 (1.05)
DGJT	FE + controls	2.26 (2.66)	0.82 (2.28)	−1.83 (1.07)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the Canadian sample, excluding Alberta and Quebec. All specifications include province and year fixed effects, “controls” includes GDP growth, “add. controls” further includes unemployment and the trade deficit scaled by GDP, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on province.

data. Further, Appendix A includes estimations using time trends as controls, dynamic effects estimated from panel-VAR models, and using alternative inflation data. Our findings remain unchanged.

Table 6: Dynamic effects of a carbon tax using emission-weighted carbon taxes, European sample

Estimator	Specification	Average impact in year		
		0	1-2	3-5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	0.30 (0.17)	0.16 (0.11)	0.32 (0.10)
TWFE	FE + controls	0.17 (0.12)	0.01 (0.11)	0.22 (0.09)
TWFE	FE + add. controls	0.18 (0.14)	-0.02 (0.12)	0.21 (0.10)
DGJT	FE + controls	0.17 (0.12)	-0.01 (0.11)	0.19 (0.10)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	0.02 (0.09)	0.04 (0.08)	0.05 (0.08)
TWFE	FE + controls	0.01 (0.09)	0.03 (0.10)	0.09 (0.09)
TWFE	FE + add. controls	0.03 (0.09)	-0.04 (0.09)	0.07 (0.07)
DGJT	FE + controls	0.01 (0.09)	0.02 (0.10)	0.11 (0.09)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	0.47 (0.32)	-0.08 (0.17)	0.41 (0.20)
TWFE	FE + controls	0.57 (0.28)	-0.12 (0.18)	0.34 (0.20)
TWFE	FE + add. controls	0.53 (0.28)	-0.08 (0.18)	0.26 (0.18)
DGJT	FE + controls	0.57 (0.28)	-0.15 (0.17)	0.08 (0.12)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the European sample, using tax data from [Dolphin, Pollitt, and Newbery \(2020\)](#). All specifications include country and year fixed effects, “controls” includes GDP growth and the domestic monetary policy rate, “add. controls” further includes unemployment, the trade deficit scaled by GDP and the terms of trade, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on country.

Table 7: Dynamic effects of a carbon tax using emission-weighted carbon taxes, Canadian sample

Estimator	Specification	Average impact in year		
		0	1-2	3-5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	-0.49 (0.18)	-0.42 (0.17)	0.69 (0.15)
TWFE	FE + controls	-0.31 (0.23)	-0.31 (0.21)	0.73 (0.17)
TWFE	FE + add. controls	0.04 (0.28)	-0.23 (0.24)	0.69 (0.19)
DGJT	FE + controls	-0.31 (0.23)	-0.33 (0.21)	0.67 (0.17)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	-0.56 (0.30)	-0.48 (0.17)	0.39 (0.12)
TWFE	FE + controls	-0.32 (0.26)	-0.41 (0.19)	0.42 (0.13)
TWFE	FE + add. controls	-0.03 (0.24)	-0.35 (0.21)	0.40 (0.16)
DGJT	FE + controls	-0.32 (0.26)	-0.41 (0.19)	0.39 (0.13)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	0.53 (0.56)	-0.55 (0.36)	1.39 (0.35)
TWFE	FE + controls	0.29 (0.51)	-0.25 (0.46)	1.42 (0.40)
TWFE	FE + add. controls	0.50 (0.68)	-0.10 (0.52)	1.48 (0.46)
DGJT	FE + controls	0.29 (0.51)	-0.33 (0.46)	1.26 (0.39)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the Canadian sample, using tax data from [Dolphin, Pollitt, and Newbery \(2020\)](#). All specifications include province and year fixed effects, “controls” includes GDP growth, “add. controls” further includes unemployment and the trade deficit scaled by GDP, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on province.

5 The cross-section of European carbon taxes

So far, we have documented the response of inflation to carbon taxation in the average European and Canadian economy. The relatively large number of adopters in Europe also permits to analyse to what extent the effects differ, by splitting the sample depending on country characteristics. In particular, we consider the role of revenue recycling and monetary policy independence. Countries that recycle tax revenues potentially limit economic effects of carbon taxes by compensating firms and households. Independent monetary policy in principle allows the central bank to offset inflationary pressure stemming from carbon pricing, whereas the same is not true of Euro area countries. Indeed, we find support for both monetary policy and revenue recycling affecting the response of inflation to putting a price on carbon.

5.1 Revenue recycling

Some countries introduced carbon taxes in conjunction with revenue recycling mechanisms, where tax proceeds are used to offset existing distortionary taxes, or for lump-sum payments to firms and households. To assess whether revenue recycling affects the response of inflation to carbon pricing, we classify countries following the definition of [Metcalf and Stock \(2020a\)](#) and re-estimate the local projections for each group separately.¹⁶

We present the results in [Table 8](#), focusing only on our baseline specification including GDP growth, changes in policy rates and country and year fixed effects. Starting with the set of revenue recycling countries (“RR1”), we find responses of headline inflation (Panel A) that are small and do not exceed their standard errors. The estimated effects are larger in magnitude for the sample of non-revenue recycling countries (“RR0”). On impact, the coefficient is small and imprecisely estimated, but increases over time until 1.17 percentage points in the final three years, on average.

Panel B shows similar responses for core inflation, in line with the previous findings. Estimates based on the sample of revenue recycling countries are all around zero, on average. For the countries that do not recycle tax proceeds the responses are positive initially but decay over the five years after the tax enactment. None of the estimates exceed their standard errors. We find positive responses for energy and food inflation (Panel C) on impact for the sample of revenue recycling countries, that tail off over time. For the counterpart the initial effects are more modest, but appear to increase in the medium term.

In sum, it does appear as though the response of inflation is more muted for economies that introduced carbon taxes in conjunction with revenue recycling mechanisms. Although we do not test this relationship further, it is broadly in line with suggestive evidence by [Metcalf and Stock \(2020a\)](#), emphasizing the potential growth enhancing effects of revenue recycling.

¹⁶We note that this simple classification might not fully account for more complex differences in tax design. For instance, France announced it would use revenues to lower the tax burden on low-income households and pensioners (see [Marten and Van Dender 2019](#)), but is classified as a non-revenue recycling country in [Metcalf and Stock 2020a](#).

Table 8: Dynamic effects of a carbon tax for revenue recycling countries

Sample	Controls	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
RR1	FE + controls	0.19 (0.31)	0.07 (0.22)	0.02 (0.15)
RR0	FE + controls	0.25 (1.06)	0.34 (1.19)	1.17 (1.15)
<i>Panel B. Core inflation</i>				
RR1	FE + controls	−0.10 (0.30)	−0.03 (0.24)	0.04 (0.15)
RR0	FE + controls	0.87 (1.51)	−0.40 (1.07)	0.87 (1.31)
<i>Panel C. Energy and food inflation</i>				
RR1	FE + controls	1.59 (0.77)	0.47 (0.43)	−0.03 (0.41)
RR0	FE + controls	0.16 (1.26)	0.01 (1.65)	1.07 (1.06)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the European sample. “RR1” includes only those carbon tax countries that recycle revenues, based on the classification by [Metcalf and Stock \(2020a\)](#). This includes Denmark, Finland, Norway, Portugal, Sweden and Switzerland. “RR0” excludes all carbon taxes of countries that recycle tax proceeds. All specifications include country and year fixed effects, GDP growth and the domestic monetary policy rate, each entering with four lags. Standard errors are heteroscedasticity robust and clustered on country.

5.2 The role of monetary policy

Finally, we test whether the effect of carbon taxation on inflation depends on a country’s autonomy over monetary policy. This channel is emphasized by [McKibbin, Konradt, and Weder di Mauro \(2021\)](#), who show that the economic consequences of climate policies are not independent of monetary policy. The Euro area provides a neat setting to distinguish between countries with and without independent monetary policy, since the ECB considers a weighted index of consumer prices in its member countries. Grouping countries along this line allows to test whether inflation responded differently to carbon policy in countries with and without monetary policy that could react. Although, to the best of our knowledge, climate policy only recently started receiving attention by central banks it is nonetheless possible that they offset inflationary pressure driven by carbon pricing implicitly in the past.

When focusing only on countries with independent monetary policy (“MP1”), we estimate dynamic responses that point to slight negative effects on headline inflation, in the baseline specification (Table 9, Panel A). Conversely, the estimates are quantitatively larger for the sample including the Euro area countries (“MP0”). Indeed, the average

dynamic response is about one percentage point in size, albeit with larger standard errors.

We find broadly similar results for core inflation (Panel B). While the dynamic responses are negative for countries with independent monetary policy, they are larger and less precisely estimated for the countries without monetary policy. Compared with headline inflation the effects are more muted. For energy and food inflation (Panel C) the difference between the two group is even more pronounced. For independent monetary policy countries there is a modest initial increase that fades out after the first year. Instead, energy and food inflation increases by a sizeable 1.49 percentage points and remains elevated throughout the 5-year period, for the non-monetary policy countries.

It is important to note that this is not a formal test of the role of monetary policy in cushioning the effects of climate policy. However, our results do suggest that countries without a central bank that can accommodate inflationary pressure associated with climate policy could experienced more inflation, driven in part by substantially larger responses of energy and food prices. Indeed, estimates using the policy rate as independent variable point to a small tightening response only for the sample of countries with independent monetary policy. In contrast, we find no evidence of inflationary effects in the sample of Canadian provinces, which also do not have monetary policy autonomy. Further, some most countries in the group with independent monetary policy also recycle tax revenues, making it hard to disentangle the two.

6 Conclusion

Against the backdrop of the current debate on the economic effects of climate mitigation policies by market participants and central banks, this paper empirically assesses the response of inflation to carbon pricing. Does putting a price on carbon in fact lead to “greenflation”?

Our findings, drawing on 18 carbon taxes from Europe and Canada, cast doubt on the view that carbon pricing leads to inflation. Controlling for country and year fixed effects, as well as economic controls, we find no robust evidence of an inflationary response, on average. This result holds both for European countries and Canadian provinces, and survives a battery of robustness checks.

Moreover, we document that any inflationary effects associated with carbon taxation are confined to headline inflation, but do not spill over to core inflation. This is consistent with the idea that carbon taxes change relative prices, increasing the cost of energy, but do not lead to a broad increase in prices. Indeed, our estimates of the responses of energy and food inflation confirm this view.

Drawing our attention to a subset of European carbon taxes allows us to exploit differences in tax design and implementation. We find that the response of inflation to a similarly sized carbon tax shock is more muted in countries that, recycle tax revenues and have monetary autonomy to react to changing prices.

When seen in conjunction with the prior literature on the limited economic effects of

Table 9: Dynamic effects of a carbon tax for countries with autonomous monetary policy

Sample	Controls	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
MP1	FE + controls	−0.36 (0.37)	−0.07 (0.30)	−0.26 (0.20)
MP0	FE + controls	0.84 (0.49)	1.11 (0.71)	1.37 (0.71)
<i>Panel B. Core inflation</i>				
MP1	FE + controls	−0.36 (0.40)	−0.07 (0.37)	−0.23 (0.20)
MP0	FE + controls	0.93 (0.78)	0.59 (0.65)	0.88 (0.67)
<i>Panel C. Energy and food inflation</i>				
MP1	FE + controls	0.82 (0.83)	0.10 (0.51)	−0.22 (0.47)
MP0	FE + controls	1.49 (0.78)	2.15 (0.58)	0.84 (0.76)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the European sample. “MP0” includes only the sample of carbon taxes in countries without autonomous monetary policy, i.e. Euro area members and Denmark (the krone is pegged to the Euro). “MP1” instead uses the set of countries with autonomous monetary policy. All specifications include country and year fixed effects, GDP growth and the domestic monetary policy rate, each entering with four lags. Standard errors are heteroscedasticity robust and clustered on country.

carbon taxes, our results imply that worries of drastic adverse economic consequences and “greenflation” might be overblown. Nonetheless, we acknowledge that future climate policy needs to be increasingly aggressive in order to reach the ambitious emission goals. Carbon taxes on the order of magnitude of tax rates in Scandinavia or Switzerland (exceeding 100 USD per ton of CO₂ or more), with universal coverage potentially have broader economic effects than those documented in this paper.¹⁷

Since our analysis is at the aggregate level we are not well equipped to investigate potential channels of how carbon pricing affects inflation dynamics. At the firm level, understanding tax incidence seems paramount: (how) do firms pass on carbon taxes to consumers?¹⁸ Moreover, households could form expectations of more ambitious climate policy and accommodate higher energy prices already prior to the tax enactment (see e.g. [Coibion and Gorodnichenko 2015](#)). Household expenditure behavior might also shed light on whether the tax induces them to switch from more expensive energy-intensive goods

¹⁷Although we do our best to capture the role of tax coverage in our analysis by interacting tax rates with tax bases, one might expect potentially different effects if a carbon tax was to apply universally and in many countries.

¹⁸We provide suggestive evidence in [McKibbin, Konradt, and Weder di Mauro \(2021\)](#) that producer prices increase more than consumer prices after carbon tax enactment, for Euro area countries.

and services to cheaper, less energy-intensive alternatives (e.g. [Bems and Di Giovanni 2016](#)).

The distributional consequences of carbon taxes also have to be seen in synthesis with their effects on prices. As prior studies suggest (see e.g. [Känzig 2021](#)) carbon taxes tend to burden low income households most in the absence of a progressive redistribution mechanism. To the extent that low income households consumption baskets include relatively more energy-intensive goods and services, our findings offer an additional explanation for this distributional pattern.

Of course, in most countries carbon taxes are only one part of a comprehensive toolkit to combat climate change. Focusing solely on carbon taxes might blur the picture when trying to understand the economic effects of climate policy more broadly. A study encompassing shadow prices from other instruments complementary to the carbon taxes could be a promising avenue for future research.

Finally, although our results might initially appear counterintuitive in comparison with findings on oil price shocks, we argue drawing this parallel is overly simplistic. Conventional energy price shocks, seen in the 1970s or in 2022, increased the price of crude oil six to eight times more than the average carbon tax in our sample. Further, differences in the type of shock and use of tax revenue complicate this comparison.

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Appendix A Robustness checks

In this appendix we provide additional results building on the main empirical analysis. Section A.1 expands on the the local projections, by adding time trends to capture increases in carbon taxes over time. In section A.2 we test whether our main results are sensitive to the empirical methodology by using panel-VARs. We re-estimate the local projections for Europe based on inflation data covering a longer time span in section A.3 ([Ha, Kose, and Ohnsorge 2021](#)).

A.1 Additional control variables

In this section, we present additional results of a model including linear and quadratic time trends instead of time fixed effects. This potentially helps to capture the increasing level of carbon taxes over time. Tables [A1](#) and [A2](#) contain the results, separately estimated for the European and Canadian samples. Reassuringly, the dynamic responses remain of similar size when using time trends instead of time fixed effects.

Table A1: Dynamic effects of a carbon tax including linear and quadratic time trends, European sample

Specification	Average impact in year		
	0	1–2	3–5
<i>Panel A. Headline inflation</i>			
Baseline	0.07 (0.32)	0.17 (0.25)	−0.01 (0.21)
Linear trend	0.16 (0.37)	−0.05 (0.24)	0.04 (0.23)
Quadratic trend	0.17 (0.37)	−0.02 (0.24)	0.08 (0.23)
<i>Panel B. Core inflation</i>			
Baseline	0.08 (0.32)	0.07 (0.26)	−0.03 (0.22)
Linear trend	0.17 (0.33)	−0.06 (0.24)	0.02 (0.26)
Quadratic trend	0.17 (0.33)	−0.04 (0.25)	0.05 (0.27)
<i>Panel C. Energy and food inflation</i>			
Baseline	1.13 (0.64)	0.51 (0.39)	−0.06 (0.35)
Linear trend	0.59 (0.76)	0.04 (0.44)	−0.02 (0.35)
Quadratic trend	0.67 (0.76)	0.14 (0.44)	0.04 (0.35)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the European sample. “Baseline” includes country and year fixed effects, as well as GDP growth and the domestic monetary policy rate, entering with four lags. The next two specifications add linear and quadratic time trends, respectively. Standard errors are heteroscedasticity robust and clustered on country.

Table A2: Dynamic effects of a carbon tax including linear and quadratic time trends, Canadian sample

Specification	Average impact in year		
	0	1–2	3–5
<i>Panel A. Headline inflation</i>			
Baseline	0.11 (0.59)	0.29 (0.34)	−0.76 (0.32)
Linear trend	0.27 (0.54)	0.08 (0.41)	−0.51 (0.51)
Quadratic trend	0.32 (0.53)	0.09 (0.41)	−0.50 (0.53)
<i>Panel B. Core inflation</i>			
Baseline	−0.23 (0.54)	0.07 (0.26)	−0.62 (0.21)
Linear trend	−0.04 (0.46)	−0.43 (0.44)	−0.17 (0.30)
Quadratic trend	−0.09 (0.47)	−0.44 (0.44)	−0.21 (0.30)
<i>Panel C. Energy and food inflation</i>			
Baseline	1.06 (1.05)	0.99 (1.15)	−0.83 (0.77)
Linear trend	1.52 (1.63)	1.26 (1.92)	−0.82 (0.90)
Quadratic trend	1.78 (1.59)	1.27 (1.88)	−0.67 (0.98)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections for the Canadian sample. “Baseline” includes province and year fixed effects, as well as GDP growth, entering with four lags. The next two specifications add linear and quadratic time trends, respectively. Standard errors are heteroscedasticity robust and clustered on province.

A.2 Panel-VAR models

In this section, we estimate the effects of carbon taxation on inflation based on a structural vector autoregressive (VAR) model, adapted to panel data. Although we do not expect this to substantially affect the results (see e.g. [Montiel Olea and Plagborg-Møller 2021](#)) it serves as an additional check on our findings. Formally, we estimate a similar model as before separately for headline, core and energy and food inflation as a dependent variable,

$$\Delta CPI_{i,t+h} = \alpha_i + \Theta_h \tau_{i,t} + \beta(L) \tau_{i,t-1} + \delta(L) \Delta CPI_{i,t-1} + \mu(L) \Delta \mathbf{X}_{i,t-1} + \gamma_t + \epsilon_{i,t} ,$$

where τ_{it} is the real carbon tax rate in economy i in year t . Θ_h is the effect of an unexpected change in the carbon tax at year t on annual CPI in h years. $\Delta \mathbf{X}_{i,t-1}$ is a varying set of covariates. To control for persistence of the tax rate and CPI, we include the 4 latest lags of each variable in the regression. Unobserved heterogeneity specific to each economy or year is absorbed by a set of fixed effects, α_i and γ_t . The identifying assumption is identical to the local projections. For comparability we consider a similar carbon tax scenario as before, i.e. a 40 USD carbon tax applied on 30% of GHG emissions.

The estimated responses for the whole European sample of carbon tax countries are summarized in [Table A3](#). Panel A reports the responses of headline inflation and points to very similar estimates compared to the local projections-based results. The dynamic responses are small and imprecisely estimated, in neither case do they exceed their standard errors. For core inflation (Panel B), we find similar estimates that are both small in magnitude and imprecisely estimated. If anything, the VAR-based results for the European sample imply more muted responses of inflation to carbon pricing, compared to the local projections.

Results based on Canadian provinces are presented in [Table A4](#). Again, we estimate responses that enter with a negative sign, but are estimated with low precision for headline CPI inflation (Panel A). For core inflation the results are slightly larger in magnitude, but remain negative and imprecisely estimated. Overall, these dynamic responses are remarkably consistent with the local projections-based results in [Table 3](#).

Table A3: Dynamic effects of a carbon tax based on panel-VAR, European sample

Specification	Impact in year		
	0	1–2	3–5
<i>Panel A. Headline inflation</i>			
Fixed effects	0.60 (0.51)	0.05 (0.45)	0.28 (0.50)
FE+controls	0.91 (0.52)	0.68 (0.46)	0.58 (0.53)
<i>Panel B. Core inflation</i>			
Fixed effects	0.25 (0.47)	0.03 (0.42)	0.13 (0.46)
FE+controls	0.46 (0.47)	0.32 (0.41)	−0.02 (0.48)
<i>Panel C. Energy and food inflation</i>			
Fixed effects	0.92 (0.90)	−0.19 (0.80)	0.75 (0.88)
FE+controls	0.84 (0.96)	0.98 (0.83)	−0.28 (0.89)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on the panel-VAR model for the European sample and include country and year fixed effects. Standard errors are bootstrapped.

Table A4: Dynamic effects of a carbon tax based on panel-VAR, Canadian sample

Specification	Impact in year		
	0	1-2	3-5
<i>Panel A. Headline inflation</i>			
Fixed effects	-0.61 (0.66)	-0.50 (0.72)	-0.22 (0.75)
FE+controls	-0.24 (0.68)	-0.15 (0.57)	-0.11 (0.62)
<i>Panel B. Core inflation</i>			
Fixed effects	-1.34 (0.56)	-0.84 (0.62)	-0.62 (0.64)
FE+controls	-0.73 (0.57)	-0.50 (0.48)	-0.26 (0.52)
<i>Panel C. Energy and food inflation</i>			
Fixed effects	0.19 (1.36)	0.08 (1.49)	0.41 (1.55)
FE+controls	0.15 (1.42)	0.72 (1.19)	-0.15 (1.29)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on the panel-VAR model for the Canadian sample and include province and year fixed effects. Standard errors are bootstrapped.

A.3 Alternative inflation data

In a recent paper, [Ha, Kose, and Ohnsorge \(2021\)](#) introduce a novel database on inflation, spanning a long period and encompassing a rich set of countries. The authors compile data from several sources in an effort to attain maximum coverage. The main advantage of the data compared to the OECD figures we use in the main analysis is greater coverage, especially in the early part of the sample. We therefore re-estimate the baseline local projections model with the alternative data, focusing on the European sample since the data are only available at the national level.

Overall the results (in [Table A5](#)) are in line with our baseline estimates. In the specification using country and time fixed effects we find a positive response for headline CPI (Panel A), that is precisely estimated in year zero and in the medium-term. Compared with the baseline results this implies a more inflationary effect when using the alternative inflation data.

Panel B displays the dynamic responses of core inflation to a change in the tax rate. The estimates are both small and do not exceed their standard errors, consistent with our earlier results, when including country and time fixed effects.

Table A5: Dynamic effects of a carbon tax based on alternative inflation data, European sample

Estimator	Specification	Average impact in year		
		0	1–2	3–5
<i>Panel A. Headline inflation</i>				
TWFE	Fixed effects	−0.54 (3.27)	1.68 (2.02)	1.91 (1.78)
TWFE	FE + controls	0.05 (0.33)	0.07 (0.25)	0.00 (0.21)
TWFE	FE + add. controls	0.56 (0.24)	0.50 (0.23)	0.02 (0.24)
DGJT	FE + controls	0.05 (0.33)	0.06 (0.25)	0.06 (0.21)
<i>Panel B. Core inflation</i>				
TWFE	Fixed effects	−0.09 (0.90)	−0.17 (0.91)	−0.05 (0.40)
TWFE	FE + controls	−0.32 (0.81)	1.13 (0.76)	−0.45 (0.33)
TWFE	FE + add. controls	0.26 (1.09)	1.90 (0.88)	−0.88 (0.54)
DGJT	FE + controls	−0.32 (0.81)	1.23 (0.75)	−0.16 (0.28)
<i>Panel C. Energy and food inflation</i>				
TWFE	Fixed effects	1.08 (0.65)	0.40 (0.38)	0.34 (0.29)
TWFE	FE + controls	0.64 (0.64)	0.35 (0.32)	0.13 (0.29)
TWFE	FE + add. controls	1.08 (0.49)	0.81 (0.37)	0.13 (0.33)
DGJT	FE + controls	0.64 (0.64)	0.30 (0.33)	0.22 (0.31)

Notes: Dynamic impulse responses of headline (Panel A), core (Panel B) and energy and food inflation (Panel C) to a 40 USD carbon tax with 30% emission coverage. Estimates are based on local projections using inflation data by [Ha, Kose, and Ohnsorge \(2021\)](#) for the European sample. All specifications include country and year fixed effects, “controls” includes GDP growth and the domestic monetary policy rate, “add. controls” further includes unemployment, the trade deficit scaled by GDP and the terms of trade, each entering with four lags. “TWFE” and “DGJT” correspond to the two-way fixed effects estimator, and the [Dube et al. \(2022\)](#) estimator, respectively. Standard errors are heteroscedasticity robust and clustered on country.

Appendix B Synthetic Control Method

This appendix contains event-study results based on the synthetic control method. We ask whether a carbon tax contributes to inflation when implemented, using monthly data in

Europe and Canada. Section B.1 starts by explaining the empirical approach, sections B.2 and B.3 present results.

B.1 Empirical approach

The synthetic control method (SCM) proposed by [Abadie and Gardeazabal \(2003\)](#) and [Abadie, Diamond, and Hainmueller \(2010\)](#) enables us to construct a data-driven counterfactual economy that is identical to the economy implementing a carbon tax, except for the tax itself. For instance, to assess the response of CPI to the carbon tax in BC, the algorithm would construct a counterfactual (as a weighted average) consisting of the remaining 9 provinces. By minimizing the difference in CPI leading up to the tax enactment, the algorithm chooses a more accurate counterfactual compared to classic event studies. Identification relies on the assumption that both economies (actual and counterfactual) would evolve in the same way in the absence of the carbon tax.¹

For estimation we select a 10-year event window around the enactment date and use the period leading up to the tax for the selection of the counterfactual economy. Since our data are at monthly frequency, this exercise amounts to minimizing the difference in CPI based on 60 individual observations. We exclude economies from the donor pool (set of potential economies to construct the counterfactual) that themselves introduced a carbon tax during the event window.

More formally, for each carbon tax enacted in economies E we denote Y_e the vector of CPI in the carbon tax economy and X_e the CPI matrix for the potential counterfactual economies C , in the donor pool. The individual weights w_c^e are contained in the weighting vector W_e . The optimal vector W_e^* minimizes the following mean squared error:

$$(Y_e - X_e W_e)' V_e (Y_e - X_e W_e), \quad e = 1, \dots, E$$

subject to $\sum_{c=1}^C w_c = 1$, and $w_c \geq 0 \forall e, c$. The matrix V_e is positive-semidefinite and symmetric (see [Abadie, Diamond, and Hainmueller \(2010\)](#) for more details).

Since our sample encompasses multiple carbon taxes, we seek to assess the average response of CPI to carbon tax enactments. We therefore adapt the approach of [Acemoglu et al. \(2016\)](#), to take averages of CPI across all carbon tax economies, and their synthetic counterfactuals, respectively. Finally, we compute the gap between the average carbon tax economy and the average counterfactual, to illustrate the effect of the carbon tax. We repeat this procedure separately for headline CPI, core CPI, energy and food, as well as for European and Canadian carbon taxes.

B.2 Aggregate results

We start with the European estimates. Panel A of Figure [B1](#) illustrates the path of headline CPI of the average European economy with a carbon tax (solid line) against the average of the constructed counterfactual economies (dashed line) in the five years around the tax implementation.² Similar graphs for a subset of the underlying individual countries are contained in the next section. Table [B1](#) lists the weights the algorithm selects for the construction of each counterfactual economy. Reassuringly, CPI moves in lockstep until the

¹The SCM has been used extensively to evaluate the economic effects at the country level due to changes in government (e.g. [Born et al. 2019](#), [Funke, Schularick, and Trebesch 2021](#)); national tax policies (e.g. [Andersson 2019](#), [Leroutier 2022](#), [Grogger 2017](#)); and financial policies (e.g. [Billmeier and Nannicini 2013](#), [Chamon, Garcia, and Souza 2017](#)).

²We normalize the CPI to 100 in the month of the tax implementation to highlight the patterns after the tax.

tax implementation, which illustrates that the selected counterfactuals that are accurate representations of the actual economies. In the period after the tax is implemented, we see divergence: whereas CPI in the average counterfactual economy continues to grow at a linear path, inflation is much more muted in the average carbon tax economy: Five years after the tax enactment, headline CPI in the average carbon tax economy lies 10 percentage points below the counterfactual economy.

The results for Canadian provinces (Panel B of Figure B1) confirm this finding: Again, the paths of the carbon tax economy and the counterfactual are almost identical prior to the tax enactment, on average. The initial period after the tax is marked by stronger increase in CPI in the counterfactual, compared to the carbon tax economy. Put differently, headline inflation is higher in the provinces without a carbon tax, compared to the average province that implemented a carbon tax. Five years removed the gap is about 4 percentage points, broadly in line with the European results.

The average counterfactual is more accurately estimated for the sample of Canadian provinces (Panel B). We see little deviation prior to the tax implementation, afterwards we find similar results as in Europe: Energy prices tend to increase slightly in the carbon tax economies, before they oscillate around zero. Conversely, food prices experience a modest fall, and core CPI declines persistently, by roughly 4.5 percentage points after five years.

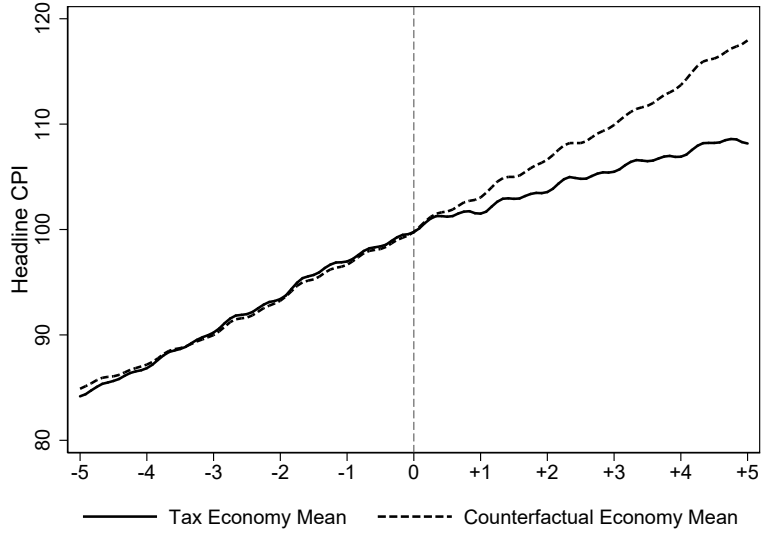
Table B1: SCM donor economies

Tax economy	Donor economies
Finland	United Kingdom, Germany, Canada
Norway	France, Iceland
Sweden	France, United Kingdom, South Korea
Denmark	France, Iceland
Switzerland	Japan, Norway, Belgium
Ireland	Japan, Latvia, Portugal
Iceland	Turkey, Latvia
United Kingdom	Estonia, South Korea, Netherlands
Spain	Slovenia, Austria, Greece
France	Italy, Sweden, Czech Republic
Portugal	Sweden, Lithuania, Hungary
British Columbia	Manitoba, Ontario, Prince Edward Island
Quebec	Nova Scotia, Manitoba, New Brunswick

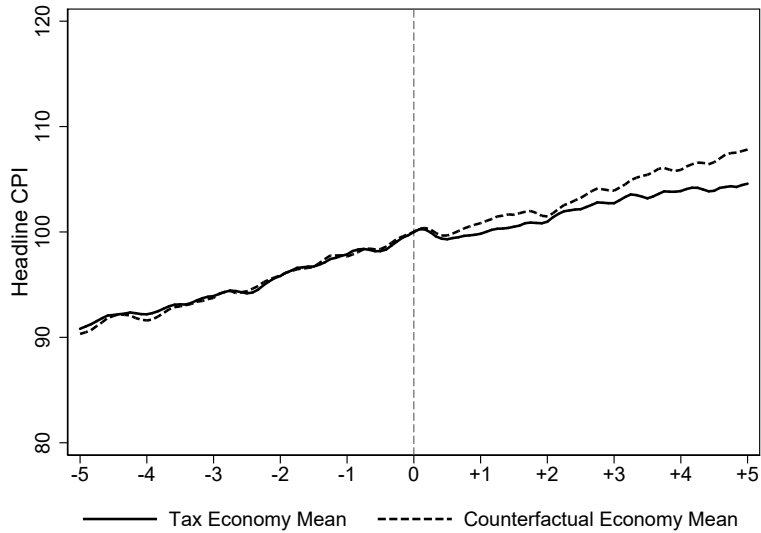
Notes: Main donor economies (by weight) for the construction of the synthetic counterfactuals in Figure B1. The donor pool consists of 32 OECD countries (for Europe) and the 10 provinces (for Canada), respectively and is restricted to economies that did not introduce a carbon tax in 10 year period around a carbon tax implementation.

Figure B1: Aggregate event studies using SCM

A. Europe



B. Canada



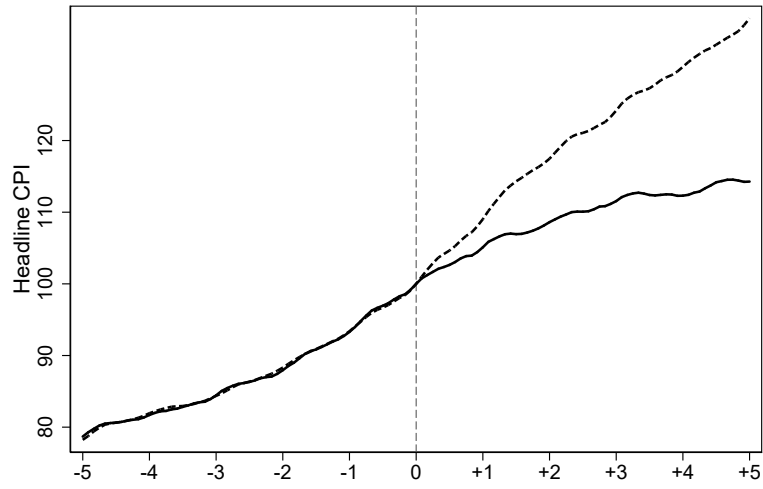
Notes: Headline CPI for the average European (Panel A) and Canadian (Panel B) carbon tax economies, in the 10 years around the tax implementation date (normalized to 100 in the month of the tax enactment) relative to the average counterfactual economies (dashed lines). More details on the construction of the counterfactual economies in Table B1.

B.3 Individual results

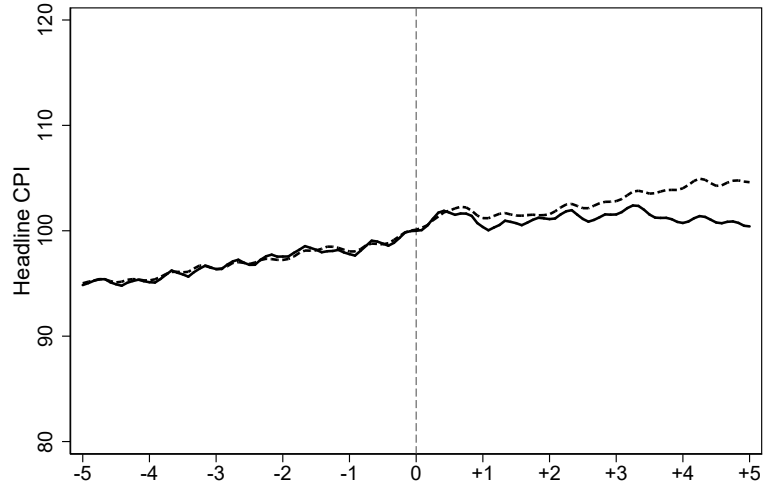
In section 4.1 we base all our results on the average effect of introducing a carbon tax, by computing the mean over all carbon tax economies and their counterfactuals. Underlying the overall average are individual responses of each economy, some of which are highlighted here. Figure B2 presents individual results based on the headline CPI index for Finland (Panel A), Switzerland (Panel B) and France (Panel C), respectively. Similarly, we separately show the responses of British Columbia (Panel A) and Quebec (Panel B) in Figure B3.

Figure B2: Individual event studies using SCM, European sample

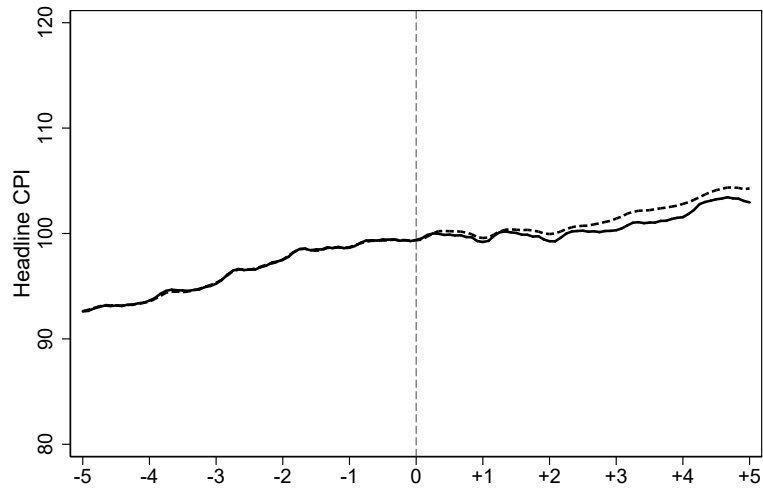
A. Finland



B. Switzerland



C. France



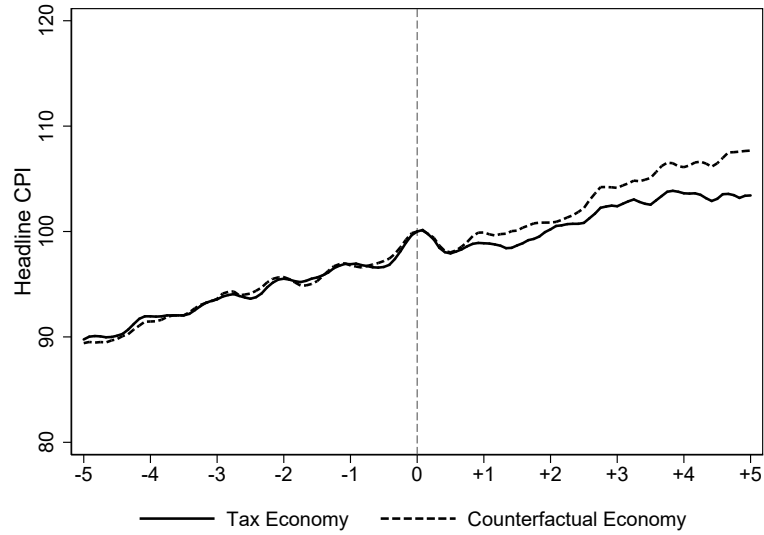
— Tax Economy - - - - Counterfactual Economy

Notes: Headline CPI for carbon tax countries Finland (Panel A), Switzerland (Panel B) and France (Panel C) compared to the respective counterfactual economies. The donor pool was restricted to OECD countries which did not themselves enact a carbon tax during the 5 years before and after the tax implementation.

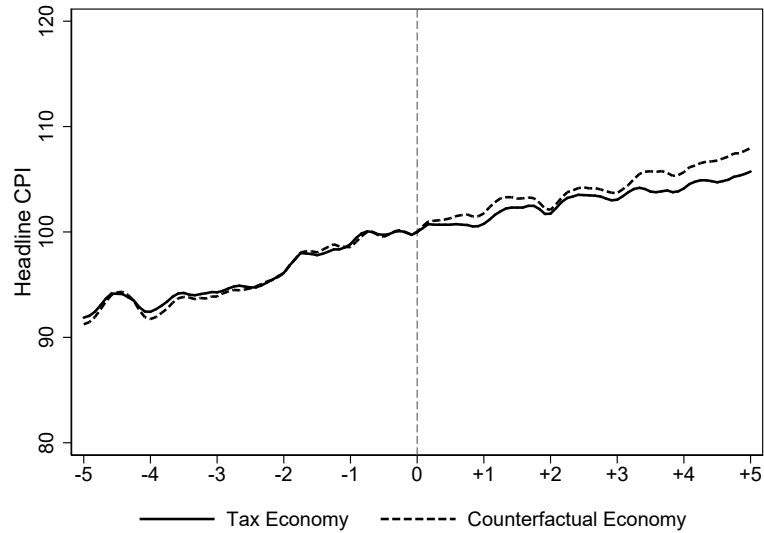
More details on the construction of the counterfactual economies in Table B1.

Figure B3: Individual event studies using SCM, Canadian sample

A. British Columbia



B. Quebec



Notes: Headline CPI for carbon tax provinces British Columbia (Panel A) and Quebec (Panel B), compared to the respective counterfactual economies. The donor pool was restricted to provinces which did not themselves enact a carbon tax during the 5 years before and after the tax implementation. More details on the construction of the counterfactual economies in Table B1.

Appendix C Data

In this appendix we provide supplementary summary statistics on the economies that are part of the empirical analysis. Section C.1 further separately summarizes the samples we employ in the empirical analysis, for Europe and Canada. Section C.2 provides additional information on the specific designs for each carbon tax.

C.1 Inflation data

This section presents summary statistics on our dependent variables. Table C1 summarizes the headline and core inflation data for the sample European countries. Table C2 does the same for the 10 Canadian provinces.

Table C1: Descriptive inflation statistics, European sample

Country	Headline inflation					Core inflation				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
Austria	34	1	4	2	1	34	1	4	2	1
Belgium	34	0	5	2	1	34	1	6	2	1
Czech Republic	27	0	21	5	5	23	-2	8	2	3
Denmark	34	0	5	2	1	34	1	5	2	1
Estonia	21	0	10	4	3	21	1	10	3	2
Finland	34	0	7	2	2	34	0	8	2	2
France	34	0	6	2	1	34	0	6	2	1
Germany	34	0	5	2	1	34	1	6	2	1
Greece	34	-2	23	7	7	34	-2	24	7	7
Hungary	34	0	35	11	9	28	1	36	10	9
Iceland	34	2	32	7	8	26	1	11	4	3
Ireland	34	-4	6	2	2	34	-4	6	2	2
Italy	34	0	9	3	2	34	0	10	3	2
Latvia	27	-1	952	45	182	23	-3	21	4	5
Lithuania	27	-1	1021	60	208	23	-1	20	3	5
Luxembourg	34	0	4	2	1	34	1	4	2	1
Netherlands	34	-1	4	2	1	34	0	4	2	1
Norway	34	0	9	3	2	34	1	9	3	2
Poland	29	-1	812	39	150	23	0	21	4	6
Portugal	34	-1	19	5	5	34	0	21	6	6
Slovakia	27	-1	23	6	5	23	0	10	4	3
Slovenia	34	-1	1281	83	236	19	0	8	3	3
Spain	34	-1	9	3	2	34	0	10	3	3
Sweden	34	0	10	3	3	34	-1	11	2	3
Switzerland	34	-1	6	1	2	34	-1	6	1	2
United Kingdom	34	0	8	3	2	34	0	10	3	2
		0	166	12	32		0	11	3	3

Notes: Descriptive inflation statistics for the European sample, which we use in the baseline analysis. The sample starts in 1985, or the earliest available year for a given country. Columns 3–6 and 8–11 provide summary statistics (minimum, maximum, mean and standard deviation) for headline and core inflation, respectively.

Table C2: Descriptive inflation statistics, Canadian sample

Province	Headline inflation					Core inflation				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
Alberta	28	-1	8	2	2	28	0	6	2	1
British Columbia	28	0	4	2	1	28	0	4	2	1
Manitoba	28	0	4	2	1	28	0	4	2	1
New Brunswick	28	-1	6	2	1	28	0	6	2	1
Newfoundland and Labrador	28	-1	5	2	1	28	1	6	2	1
Nova Scotia	28	0	5	2	1	28	-1	4	2	1
Ontario	28	0	3	2	1	28	0	4	2	1
Prince Edward Island	28	-1	6	2	2	28	-1	6	2	1
Quebec	28	-2	5	2	1	28	-2	7	2	1
Saskatchewan	28	0	4	2	1	28	0	4	2	1
		0	5	2	1		0	5	2	1

Notes: Descriptive inflation statistics for the Canadian sample, which we use in the baseline analysis. The sample starts in 1990. Columns 3–6 and 8–11 provide summary statistics (minimum, maximum, mean and standard deviation) for headline and core inflation, respectively.

C.2 Tax design in Europe and Canada

In this section we attempt to distinguish between the specific design of the carbon taxes in our analysis. Table C3 details the main sectors that are subject to a particular carbon tax. Moreover, in case a revenue recycling scheme is in place we supplement information on how revenues used.

Table C3: Tax design, European countries and Canadian provinces

Tax economy	Main sectors taxed	Revenue recycled
Finland (1990)	Transportation (mainly road), Industry, Residential & Commercial, Agriculture	Corporate and income tax cuts
Poland (1990)	/	/
Norway (1991)	Transportation (Road and Off-road), Industry, Residential & Commercial, Agriculture	Corporate tax cut
Sweden (1991)	Transportation (Road), Residential & Commercial, Industry	Corporate and income tax cuts
Denmark (1992)	Transportation (mainly road), Industry, Residential & Commercial, Agriculture	Corporate and income tax cuts
Slovenia (1996)	Transportation (mainly road), Residential & Commercial, Industry	/
Estonia (2000)	Industry	/
Latvia (2004)	Industry	/
Switzerland (2008)	Residential & Commercial, Industry	Climate Investment Fund, Redistribution to households, firms
Ireland (2010)	Transportation (Road), Residential & Commercial, Agriculture, Industry	/
Iceland (2010)	Transportation (Road), Agriculture, Industry	/
United Kingdom (2013)	Electricity	/
Spain (2014)	/	/
France (2014)	Transportation (Road), Residential & Commercial, Industry	Lower tax burden on low-income households and pensioners
Portugal (2015)	Transportation (Road), Residential & Commercial, Agriculture, Industry	Income tax cut
British Columbia (2008)	All sectors, tax mostly accrues to businesses and households	Corporate and income tax cuts, Rebates to low-income households
Quebec (2013)	Industry, Power, Transport and Buildings	/
Alberta (2017)	Households and small industrial emitters	Rebates to low-income households, green infrastructure investments, corporate tax cut

Notes: Tax design for the European and Canadian carbon taxes, including the main sectors the tax applies to (based on 2019 data) and details on revenue recycling. Sources: Country notes of [OECD \(2019\)](#), [Marten and Van Dender \(2019\)](#) for Europe. Carbon Pricing Dashboard, [Winter \(2020\)](#) for Canada.