Shrouded sin taxes

Johannes Kasinger

Goethe University Frankfurt &
Leibniz Institute for Financial Research SAFE

March 2023

Motivation

- Firms strategically shroud price attributes to exploit consumers' underreactions to shrouded attributes, e.g., hidden fees, add-on pricing
- When firms can choose how to present and collect taxes, they may optimally shroud those taxes
- Tax shrouding decreases the salience of taxes, affecting the behavioral response to those taxes (Chetty et al., 2009)
- Essential for carbon taxes or sin taxes as corrective effects depend on (perceived) tax-induced price changes

Motivation

- Firms strategically shroud price attributes to exploit consumers' underreactions to shrouded attributes, e.g., hidden fees, add-on pricing
- When firms can choose how to present and collect taxes, they may optimally shroud those taxes
- Tax shrouding decreases the salience of taxes, affecting the behavioral response to those taxes (Chetty et al., 2009)
- Essential for carbon taxes or sin taxes as corrective effects depend on (perceived) tax-induced price changes

Motivation

- Firms strategically shroud price attributes to exploit consumers' underreactions to shrouded attributes, e.g., hidden fees, add-on pricing
- When firms can choose how to present and collect taxes, they may optimally shroud those taxes
- Tax shrouding decreases the salience of taxes, affecting the behavioral response to those taxes (Chetty et al., 2009)
- Essential for carbon taxes or sin taxes as corrective effects depend on (perceived) tax-induced price changes

Motivation

- Firms strategically shroud price attributes to exploit consumers' underreactions to shrouded attributes, e.g., hidden fees, add-on pricing
- When firms can choose how to present and collect taxes, they may optimally shroud those taxes
- Tax shrouding decreases the salience of taxes, affecting the behavioral response to those taxes (Chetty et al., 2009)
- Essential for carbon taxes or sin taxes as corrective effects depend on (perceived) tax-induced price changes

Motivation

- Equilibrium responses and market outcomes may differ if salience is an active decision by firms (Gabaix and Laibson, 2006; Carlin, 2009)
- Strategic tax shrouding and underlying market structure have important welfare implications
- Standard theory: Consumers optimize fully with respect to tax-inclusive prices $\rightarrow$ tax shrouding is irrelevant (Kotlikoff and Summers, 1987; Weyl and Fabinger, 2013)
- Behavioral public finance literature: Tax salience is exogenous and independent of firms' strategic decisions $\rightarrow$ no equilibrium effects (Chetty et al., 2009; Finkelstein, 2009; Goldin and Homonoff, 2013; Allcott and Taubinsky, 2015)

Motivation

- Equilibrium responses and market outcomes may differ if salience is an active decision by firms (Gabaix and Laibson, 2006; Carlin, 2009)
- Strategic tax shrouding and underlying market structure have important welfare implications
- Standard theory: Consumers optimize fully with respect to tax-inclusive prices $\rightarrow$ tax shrouding is irrelevant (Kotlikoff and Summers, 1987; Weyl and Fabinger, 2013)
- Behavioral public finance literature: Tax salience is exogenous and independent of firms' strategic decisions $\rightarrow$ no equilibrium effects (Chetty et al., 2009; Finkelstein, 2009; Goldin and Homonoff, 2013; Allcott and Taubinsky, 2015)

Motivation

- Equilibrium responses and market outcomes may differ if salience is an active decision by firms (Gabaix and Laibson, 2006; Carlin, 2009)
- Strategic tax shrouding and underlying market structure have important welfare implications
- Standard theory: Consumers optimize fully with respect to tax-inclusive prices $\rightarrow$ tax shrouding is irrelevant (Kotlikoff and Summers, 1987; Weyl and Fabinger, 2013)
- Behavioral public finance literature: Tax salience is exogenous and independent of firms' strategic decisions $\rightarrow$ no equilibrium effects (Chetty et al., 2009; Finkelstein, 2009; Goldin and Homonoff, 2013; Allcott and Taubinsky, 2015)

Motivation

- Equilibrium responses and market outcomes may differ if salience is an active decision by firms (Gabaix and Laibson, 2006; Carlin, 2009)
- Strategic tax shrouding and underlying market structure have important welfare implications
- Standard theory: Consumers optimize fully with respect to tax-inclusive prices $\rightarrow$ tax shrouding is irrelevant (Kotlikoff and Summers, 1987; Weyl and Fabinger, 2013)
- Behavioral public finance literature: Tax salience is exogenous and independent of firms' strategic decisions $\rightarrow$ no equilibrium effects (Chetty et al., 2009; Finkelstein, 2009; Goldin and Homonoff, 2013; Allcott and Taubinsky, 2015)

This Project

Goal: Explore the prevalence, effects, and welfare implications of strategic tax shrouding in the context of a corrective tax

- **Reform**: In 2012, Germany introduced a 5% tax, levied on betting turnover generated by German customers, to discourage overconsumption of online sports betting
- **Data**: Extensive novel panel data set on online betting prices from 68 betting agencies for more than 80,000 events, plus additional information on firms' strategies
- **Approach**: Exploit quasi-experimental variation to estimate (heterogeneous) effects of the tax on consumer prices, employing a difference-in-differences (DID) framework

This Project

Goal: Explore the prevalence, effects, and welfare implications of strategic tax shrouding in the context of a corrective tax

- **Reform**: In 2012, Germany introduced a 5% tax, levied on betting turnover generated by German customers, to discourage overconsumption of online sports betting
- **Data**: Extensive novel panel data set on online betting prices from 68 betting agencies for more than 80,000 events, plus additional information on firms' strategies
- **Approach**: Exploit quasi-experimental variation to estimate (heterogeneous) effects of the tax on consumer prices, employing a difference-in-differences (DID) framework

This Project

Goal: Explore the prevalence, effects, and welfare implications of strategic tax shrouding in the context of a corrective tax

- **Reform**: In 2012, Germany introduced a 5% tax, levied on betting turnover generated by German customers, to discourage overconsumption of online sports betting
- **Data**: Extensive novel panel data set on online betting prices from 68 betting agencies for more than 80,000 events, plus additional information on firms' strategies
- **Approach**: Exploit quasi-experimental variation to estimate (heterogeneous) effects of the tax on consumer prices, employing a difference-in-differences (DID) framework

Preview of results

Empirical Results:

- Most, but not all, firms strategically shroud the tax, i.e., exclude tax surcharges from posted prices
- Tax-induced market segmentation/product differentiation in shrouding and non-shrouding firms
- Bettors bear the largest part of the effective tax burden (75-80% on average)
- Large and long-lasting heterogeneity in pass-through rates, 16% vs. 90%, depending on firms' "shrouding" policies

Preview of results

Empirical Results:

- Most, but not all, firms strategically shroud the tax, i.e., exclude tax surcharges from posted prices
- Tax-induced market segmentation/product differentiation in shrouding and non-shrouding firms
- Bettors bear the largest part of the effective tax burden (75-80% on average)
- Large and long-lasting heterogeneity in pass-through rates, 16% vs. 90%, depending on firms' "shrouding" policies

Preview of results

Empirical Results:

- Most, but not all, firms strategically shroud the tax, i.e., exclude tax surcharges from posted prices
- Tax-induced market segmentation/product differentiation in shrouding and non-shrouding firms
- Bettors bear the largest part of the effective tax burden (75-80% on average)
- Large and long-lasting heterogeneity in pass-through rates, 16% vs. 90%, depending on firms' "shrouding" policies

Preview of results

Empirical Results:

- Most, but not all, firms strategically shroud the tax, i.e., exclude tax surcharges from posted prices
- Tax-induced market segmentation/product differentiation in shrouding and non-shrouding firms
- Bettors bear the largest part of the effective tax burden (75-80% on average)
- Large and long-lasting heterogeneity in pass-through rates, 16% vs. 90%, depending on firms' "shrouding" policies

Theoretical model: Intuition & implications

Optimal sin tax model (connecting O'Donoghue and Rabin, 2006 and Varian, 1980) that allows for strategic tax shrouding and heterogeneously attentive consumers:

- Shrouding behavior is only attainable in equilibrium if (some) consumers underreact to shrouded taxes
- Positive corrective effects of sin tax undermined by profit-maximizing firms
- Market segmentation in shrouded and non-shrouded goods in equilibrium if attention to shrouded taxes is heterogeneous
- Employed linear tax rate cannot implement the first-best outcome
- Requiring firms to post tax-inclusive prices restores the effectiveness of corrective taxes

Theoretical model: Intuition & implications

Optimal sin tax model (connecting O'Donoghue and Rabin, 2006 and Varian, 1980) that allows for strategic tax shrouding and heterogeneously attentive consumers:

- Shrouding behavior is only attainable in equilibrium if (some) consumers underreact to shrouded taxes
- Positive corrective effects of sin tax undermined by profit-maximizing firms
- Market segmentation in shrouded and non-shrouded goods in equilibrium if attention to shrouded taxes is heterogeneous
- Employed linear tax rate cannot implement the first-best outcome
- Requiring firms to post tax-inclusive prices restores the effectiveness of corrective taxes

Theoretical model: Intuition & implications

Optimal sin tax model (connecting O'Donoghue and Rabin, 2006 and Varian, 1980) that allows for strategic tax shrouding and heterogeneously attentive consumers:

- Shrouding behavior is only attainable in equilibrium if (some) consumers underreact to shrouded taxes
- Positive corrective effects of sin tax undermined by profit-maximizing firms
- Market segmentation in shrouded and non-shrouded goods in equilibrium if attention to shrouded taxes is heterogeneous
- Employed linear tax rate cannot implement the first-best outcome
- Requiring firms to post tax-inclusive prices restores the effectiveness of corrective taxes

Theoretical model: Intuition & implications

Optimal sin tax model (connecting O'Donoghue and Rabin, 2006 and Varian, 1980) that allows for strategic tax shrouding and heterogeneously attentive consumers:

- Shrouding behavior is only attainable in equilibrium if (some) consumers underreact to shrouded taxes
- Positive corrective effects of sin tax undermined by profit-maximizing firms
- Market segmentation in shrouded and non-shrouded goods in equilibrium if attention to shrouded taxes is heterogeneous
- Employed linear tax rate cannot implement the first-best outcome
- Requiring firms to post tax-inclusive prices restores the effectiveness of corrective taxes

Theoretical model: Intuition & implications

Optimal sin tax model (connecting O'Donoghue and Rabin, 2006 and Varian, 1980) that allows for strategic tax shrouding and heterogeneously attentive consumers:

- Shrouding behavior is only attainable in equilibrium if (some) consumers underreact to shrouded taxes
- Positive corrective effects of sin tax undermined by profit-maximizing firms
- Market segmentation in shrouded and non-shrouded goods in equilibrium if attention to shrouded taxes is heterogeneous
- Employed linear tax rate cannot implement the first-best outcome
- Requiring firms to post tax-inclusive prices restores the effectiveness of corrective taxes

Theoretical model: Intuition & implications

Optimal sin tax model (connecting O'Donoghue and Rabin, 2006 and Varian, 1980) that allows for strategic tax shrouding and heterogeneously attentive consumers:

- Shrouding behavior is only attainable in equilibrium if (some) consumers underreact to shrouded taxes
- Positive corrective effects of sin tax undermined by profit-maximizing firms
- Market segmentation in shrouded and non-shrouded goods in equilibrium if attention to shrouded taxes is heterogeneous
- Employed linear tax rate cannot implement the first-best outcome
- Requiring firms to post tax-inclusive prices restores the effectiveness of corrective taxes

Background - Tax reform

- Betting agencies (mostly with concessions in Malta) operate in a tolerated grey market
- Until 2021, the regulatory landscape in Germany for online sports betting remained essentially unchanged besides the tax reform
- 2012 Sports Bet Tax imposes a 5% duty on betting turnovers by German bettors, remitted by firms irrespective of their jurisdiction and legal status of their services

Background - Tax reform

- Betting agencies (mostly with concessions in Malta) operate in a tolerated grey market
- Until 2021, the regulatory landscape in Germany for online sports betting remained essentially unchanged besides the tax reform
- 2012 Sports Bet Tax imposes a 5% duty on betting turnovers by German bettors, remitted by firms irrespective of their jurisdiction and legal status of their services

Background - Tax reform

- Betting agencies (mostly with concessions in Malta) operate in a tolerated grey market
- Until 2021, the regulatory landscape in Germany for online sports betting remained essentially unchanged besides the tax reform
- 2012 Sports Bet Tax imposes a 5% duty on betting turnovers by German bettors, remitted by firms irrespective of their jurisdiction and legal status of their services

Background - Tax reform

- Main motive of tax reform: prevent betting addiction and problem gambling (and raise tax revenues from online betting)
- No restrictions on how to present or collect the tax
- Taxation on betting turnover—analogous to a per-unit sin tax
- No effective taxation of sports betting services before and after the reform, except the Sports Bet Tax

Background - Tax reform

- Main motive of tax reform: prevent betting addiction and problem gambling (and raise tax revenues from online betting)
- No restrictions on how to present or collect the tax
- Taxation on betting turnover—analogous to a per-unit sin tax
- No effective taxation of sports betting services before and after the reform, except the Sports Bet Tax

Background - Tax reform

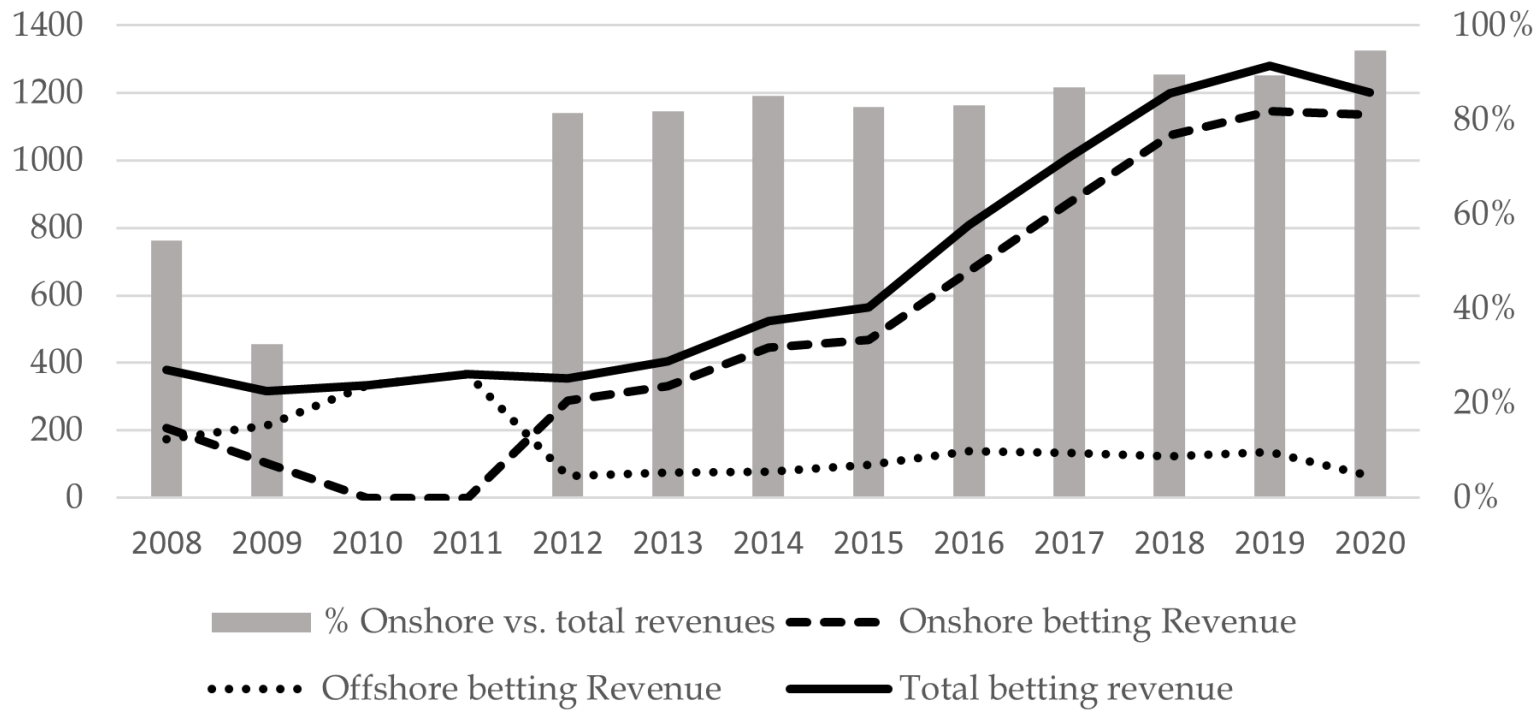
- Main motive of tax reform: prevent betting addiction and problem gambling (and raise tax revenues from online betting)
- No restrictions on how to present or collect the tax
- Taxation on betting turnover—analogous to a per-unit sin tax
- No effective taxation of sports betting services before and after the reform, except the Sports Bet Tax

Background - Tax reform

- Main motive of tax reform: prevent betting addiction and problem gambling (and raise tax revenues from online betting)
- No restrictions on how to present or collect the tax
- Taxation on betting turnover—analogous to a per-unit sin tax
- No effective taxation of sports betting services before and after the reform, except the Sports Bet Tax

German betting revenues

Figure 1: Vast majority of betting agencies paid the tax despite missing jurisdiction in Germany



Notes: This figure illustrates the annual total gross betting revenues between 2008 and 2020 in Germany (in €M), disaggregated in onshore and offshore betting revenues. Gross betting revenues are equal to the total wagered amount (including bonuses) minus all winnings by bettors. Source: H2 Gambling Capital (July 2021)

Tax revenues

Fixed odds betting markets and prices

- In this paper, bets can be best understood as a consumption good that comes with a price equal to the expected net return of a (random) bet from the perspective of a bookmaker
- Fixed odds betting markets: prices are fixed at the time of "purchase"
- Bets are contingent claims on the outcome of an event (Home/Draw/Away)
- The decimal odds represents the amount one wins per € wagered (inverses of odds equal state prices)

Details

Fixed odds betting markets and prices

- In this paper, bets can be best understood as a consumption good that comes with a price equal to the expected net return of a (random) bet from the perspective of a bookmaker
- Fixed odds betting markets: prices are fixed at the time of "purchase"
- Bets are contingent claims on the outcome of an event (Home/Draw/Away)
- The decimal odds represents the amount one wins per € wagered (inverses of odds equal state prices)

Details

Fixed odds betting markets and prices

- In this paper, bets can be best understood as a consumption good that comes with a price equal to the expected net return of a (random) bet from the perspective of a bookmaker
- Fixed odds betting markets: prices are fixed at the time of "purchase"
- Bets are contingent claims on the outcome of an event (Home/Draw/Away)
- The decimal odds represents the amount one wins per € wagered (inverses of odds equal state prices)

Details

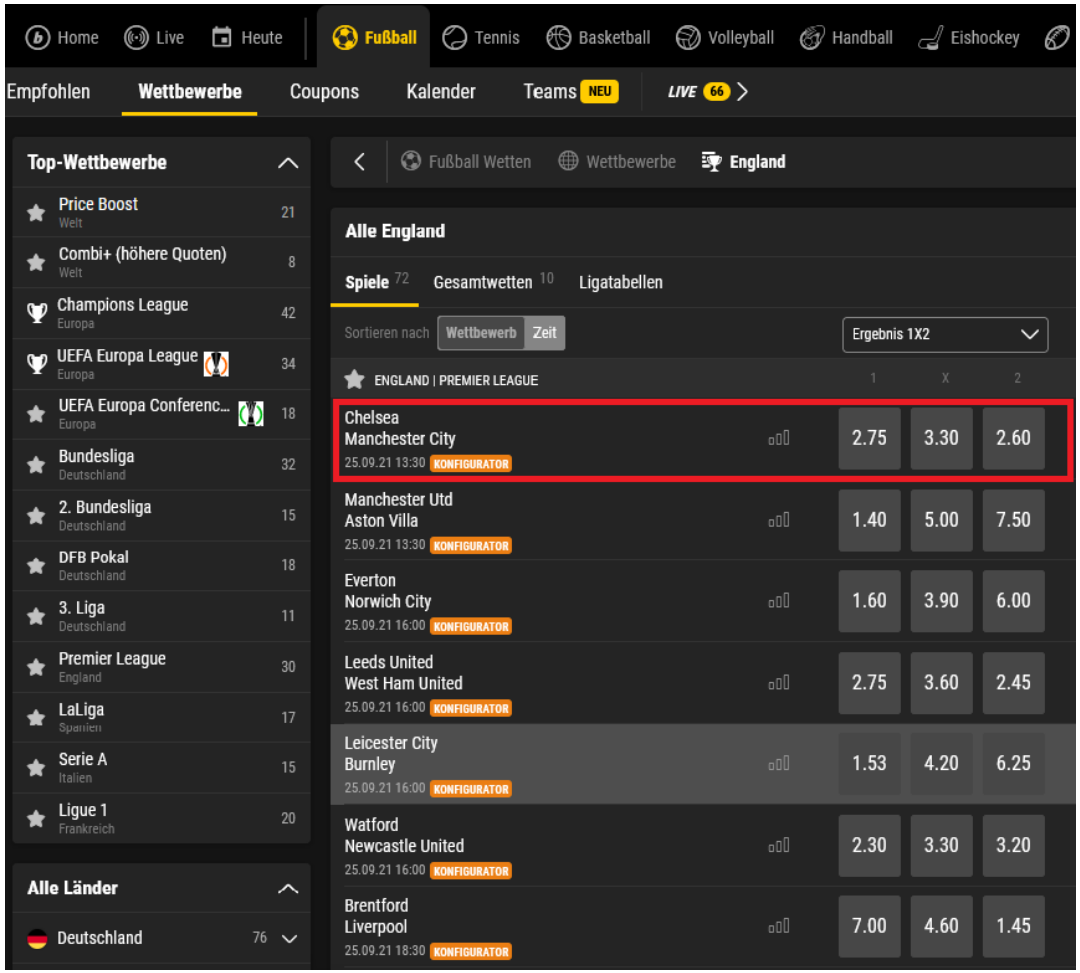
Fixed odds betting markets and prices

- In this paper, bets can be best understood as a consumption good that comes with a price equal to the expected net return of a (random) bet from the perspective of a bookmaker
- Fixed odds betting markets: prices are fixed at the time of "purchase"
- Bets are contingent claims on the outcome of an event (Home/Draw/Away)
- The decimal odds represents the amount one wins per € wagered (inverses of odds equal state prices)

Details

Fixed odds betting markets and prices

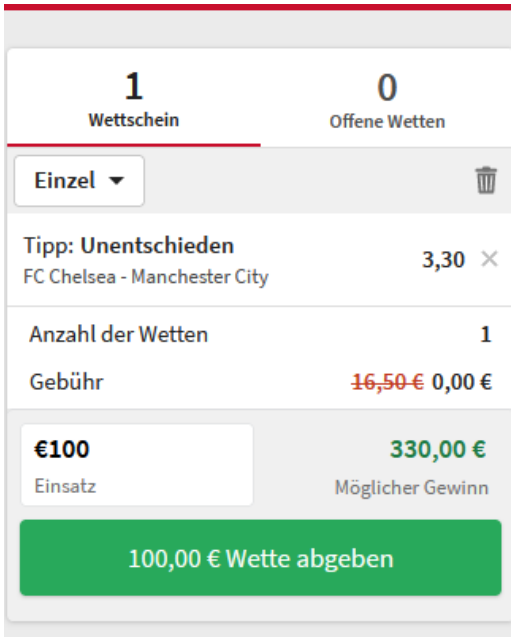
Figure 2: Presentation of surcharge-exclusive betting odds



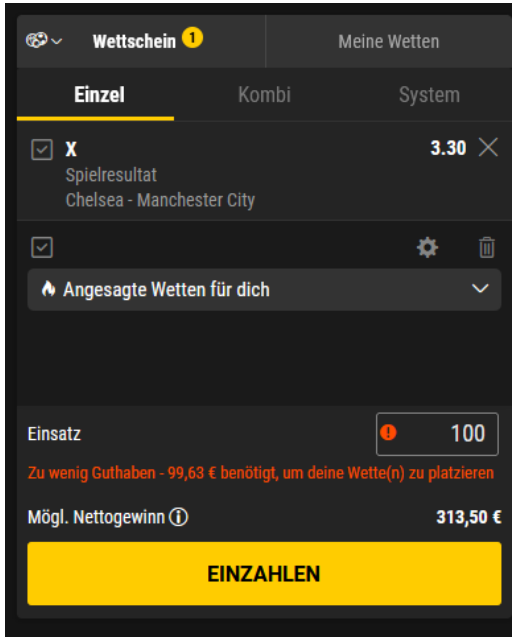
Source: bwin.com

Shrouding of taxes

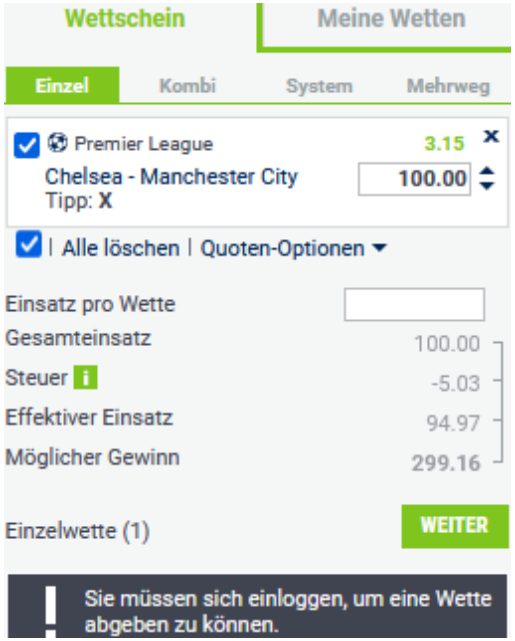
Figure 3: Exemplary betting slips for different shrouding policies



i) No further deductions



ii) Deducting from winnings



iii) Deducting from wager

Difference in prices

Data

- Historical pre-match closing odds from 68 online betting agencies between 2008 and 2018
- More than 80,000 events in 16 different leagues
- Web-scraped data from *oddsportal.com* that provides odd comparison tools to their users
- More detailed information on agencies (e.g., Timing and type of tax pass-through policies) from Montone (2021), *Top100bookmakers.com*, agencies' websites, forums, annual report, etc.

List of competitions

Summary statistics

Table 1: Summary statistics - Betting prices

League - Sport	Mean	Std.Dev.	Observations
All agencies:			
All events	0.0706	0.0317	3,289,135
Soccer events	0.0734	0.0315	2,067,137
German agencies by shrouding policy (pre-reform):			
No "shrouding" (i)	0.0737	0.0199	24,351
Deduction from winnings (ii)	0.0726	0.0225	143,842
Deduction from wager (iii)	0.0745	0.0207	47,068

Identification Strategy

- Goal: estimate the tax-induced change in (equilibrium) consumer prices
- Estimate Δp by comparing changes in betting prices of agencies in the German market (Treatment) with changes in betting prices outside the German market (Control)
- The tax pass-through rate ($\Delta p / \Delta t$) is essential for the corrective welfare effect of the tax
- If the common trend assumption hold, Diff-in-Diff setting causally identifies the average tax effect on prices

Defining control and treatment groups

Identification Strategy

- Goal: estimate the tax-induced change in (equilibrium) consumer prices
- Estimate Δp by comparing changes in betting prices of agencies in the German market (Treatment) with changes in betting prices outside the German market (Control)
- The tax pass-through rate ($\Delta p / \Delta t$) is essential for the corrective welfare effect of the tax
- If the common trend assumption hold, Diff-in-Diff setting causally identifies the average tax effect on prices

Defining control and treatment groups

Identification Strategy

- Goal: estimate the tax-induced change in (equilibrium) consumer prices
- Estimate Δp by comparing changes in betting prices of agencies in the German market (Treatment) with changes in betting prices outside the German market (Control)
- The tax pass-through rate ($\Delta p / \Delta t$) is essential for the corrective welfare effect of the tax
- If the common trend assumption hold, Diff-in-Diff setting causally identifies the average tax effect on prices

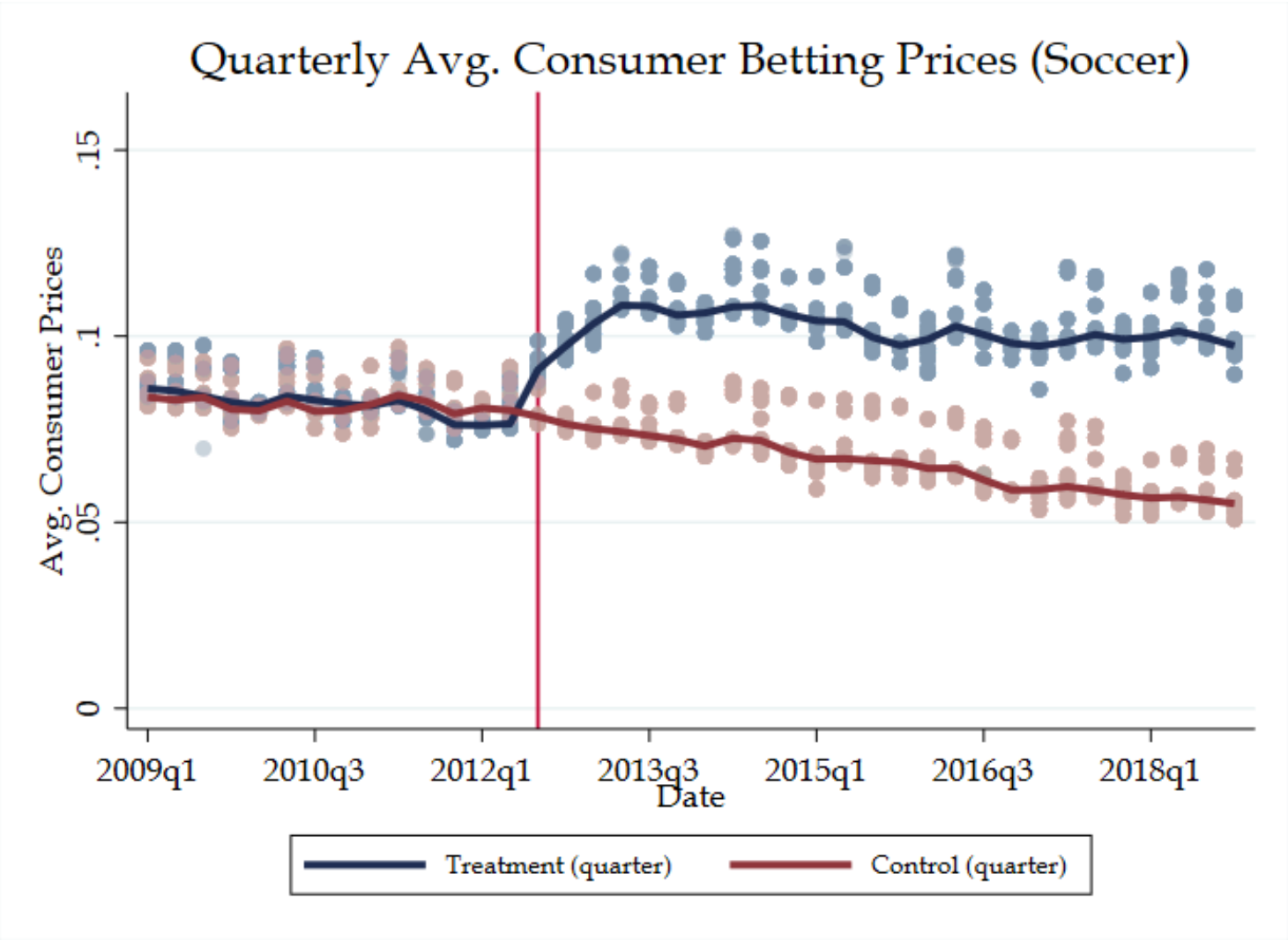
Defining control and treatment groups

Identification Strategy

- Goal: estimate the tax-induced change in (equilibrium) consumer prices
- Estimate Δp by comparing changes in betting prices of agencies in the German market (Treatment) with changes in betting prices outside the German market (Control)
- The tax pass-through rate ($\Delta p / \Delta t$) is essential for the corrective welfare effect of the tax
- If the common trend assumption hold, Diff-in-Diff setting causally identifies the average tax effect on prices

Defining control and treatment groups

Average consumer prices over time



Notes: This figure illustrates the average quarterly and weekly betting margins in the Control and Treatment groups, based on the effective odds faced by consumers. Only soccer events are considered.

Empirical strategy – Average tax effects

I. Average price change:

$$p_{i,m(t,c)} = \beta_1 T_{i,t} + \alpha_i + \lambda_t + \psi_c + \epsilon_{i,m},$$

II. Dynamic event study specification:

$$p_{i,m(t,c)} = \sum_{k=-13}^{25} \beta_k D_{i,t}^k T_{i,t} + \alpha_i + \lambda_t + \psi_c + \epsilon_{i,m},$$

- $p_{i,m(t,c)}$: betting price of agency i for event m
- $T_{i,t}$ equals 1 if agencies i is in the treatment group and the event takes place after the tax reform
- α_i, λ_t, ψ_c : agency, week and league fixed effects
- $D_{i,t}^k$: indicator for being k quarters relative to tax reform

Empirical strategy – Average tax effects

I. Average price change:

$$p_{i,m(t,c)} = \beta_1 T_{i,t} + \alpha_i + \lambda_t + \psi_c + \epsilon_{i,m},$$

II. Dynamic event study specification:

$$p_{i,m(t,c)} = \sum_{k=-13}^{25} \beta_k D_{i,t}^k T_{i,t} + \alpha_i + \lambda_t + \psi_c + \epsilon_{i,m},$$

- $p_{i,m(t,c)}$: betting price of agency i for event m
- $T_{i,t}$ equals 1 if agencies i is in the treatment group and the event takes place after the tax reform
- α_i, λ_t, ψ_c : agency, week and league fixed effects
- $D_{i,t}^k$: indicator for being k quarters relative to tax reform

Empirical strategy – Heterogeneity

I. Running **subsample analyses** of the specifications above for different agencies depending on policies set (at some point)

II. **Interact treatment with a $noShroud_{i,m}$ indicator** that equals 1 if the event took place after the tax reform and if agency i had a NO shrouding policy in place for event m: In detail, I estimate the following equations for the average tax effects on betting prices:

$$p_{i,m(t,c)} = \beta_1 T_{i,t} + \beta_2 T_{i,t} \times noShroud_{i,t} + \alpha_i + \lambda_t + \psi_c + \epsilon_{i,m}$$

Dynamic interactions

Empirical strategy – Heterogeneity

I. Running **subsample analyses** of the specifications above for different agencies depending on policies set (at some point)

II. **Interact treatment with a $noShroud_{i,m}$ indicator** that equals 1 if the event took place after the tax reform and if agency i had a NO shrouding policy in place for event m: In detail, I estimate the following equations for the average tax effects on betting prices:

$$p_{i,m(t,c)} = \beta_1 T_{i,t} + \beta_2 T_{i,t} \times noShroud_{i,t} + \alpha_i + \lambda_t + \psi_c + \epsilon_{i,m}$$

Dynamic interactions

Results – Average tax effects

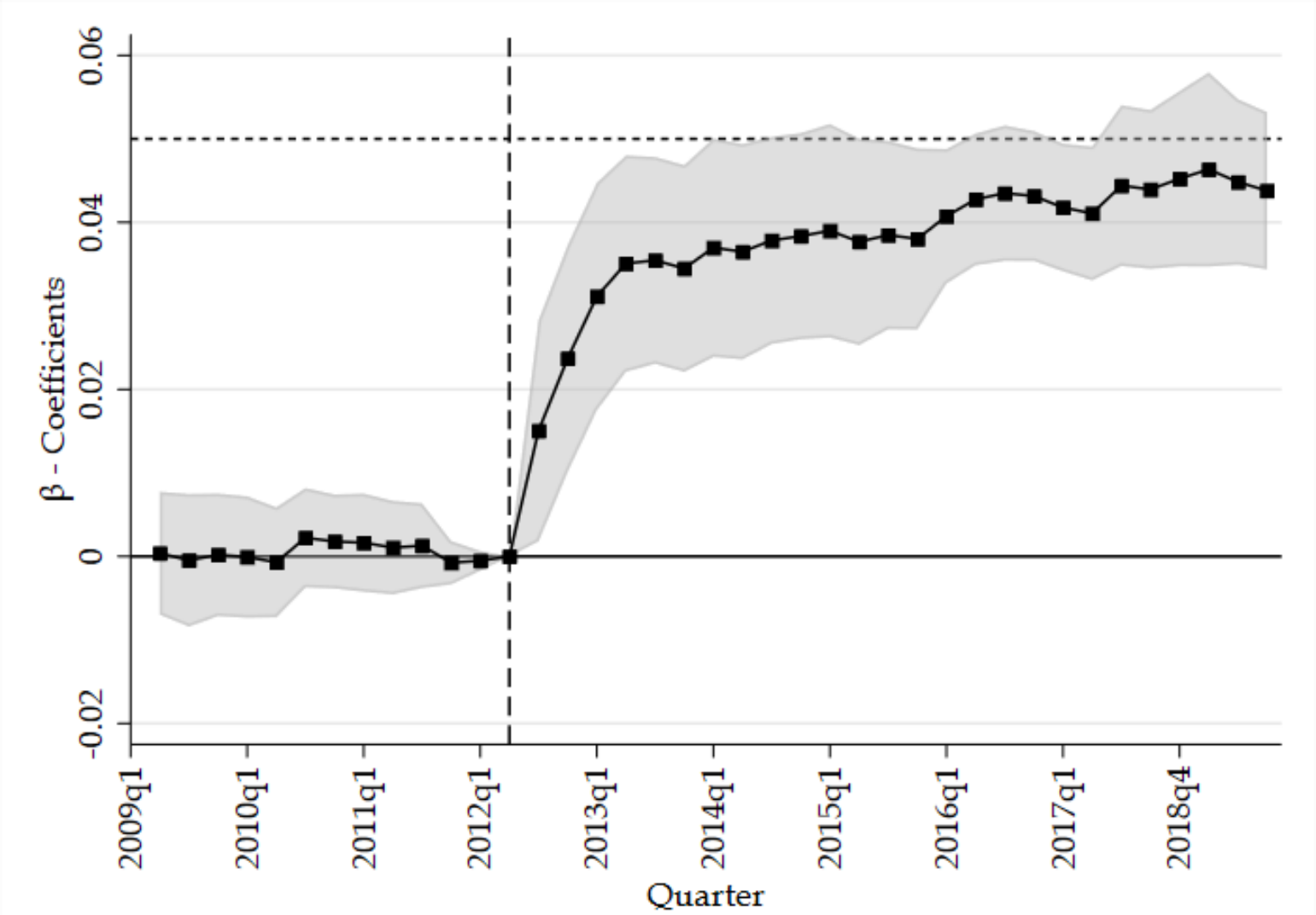
Table 2: Bettors bear most of the effective tax burden

	All Leagues		Excl. "cross" leagues		Compl. agencies	
	(1)	(2)	(3)	(4)	(5)	(6)
Tax effect on prices	0.038***	0.038***	0.041***	0.041***	0.038***	0.038***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	1,936,322	1,936,322	1,290,843	1,290,843	1,276,400	1,276,400
R^2	0.759	0.811	0.754	0.809	0.699	0.747
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Agency FE	Yes	No	Yes	No	Yes	No
League FE	Yes	No	Yes	No	Yes	No
League-agency FE	No	Yes	No	Yes	No	Yes

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results – Dynamic average tax effects

Figure 4: Dynamic average tax effects on consumer prices



Results – Heterogeneous tax effects

Table 3: Effects of tax on consumer betting prices are heterogeneous

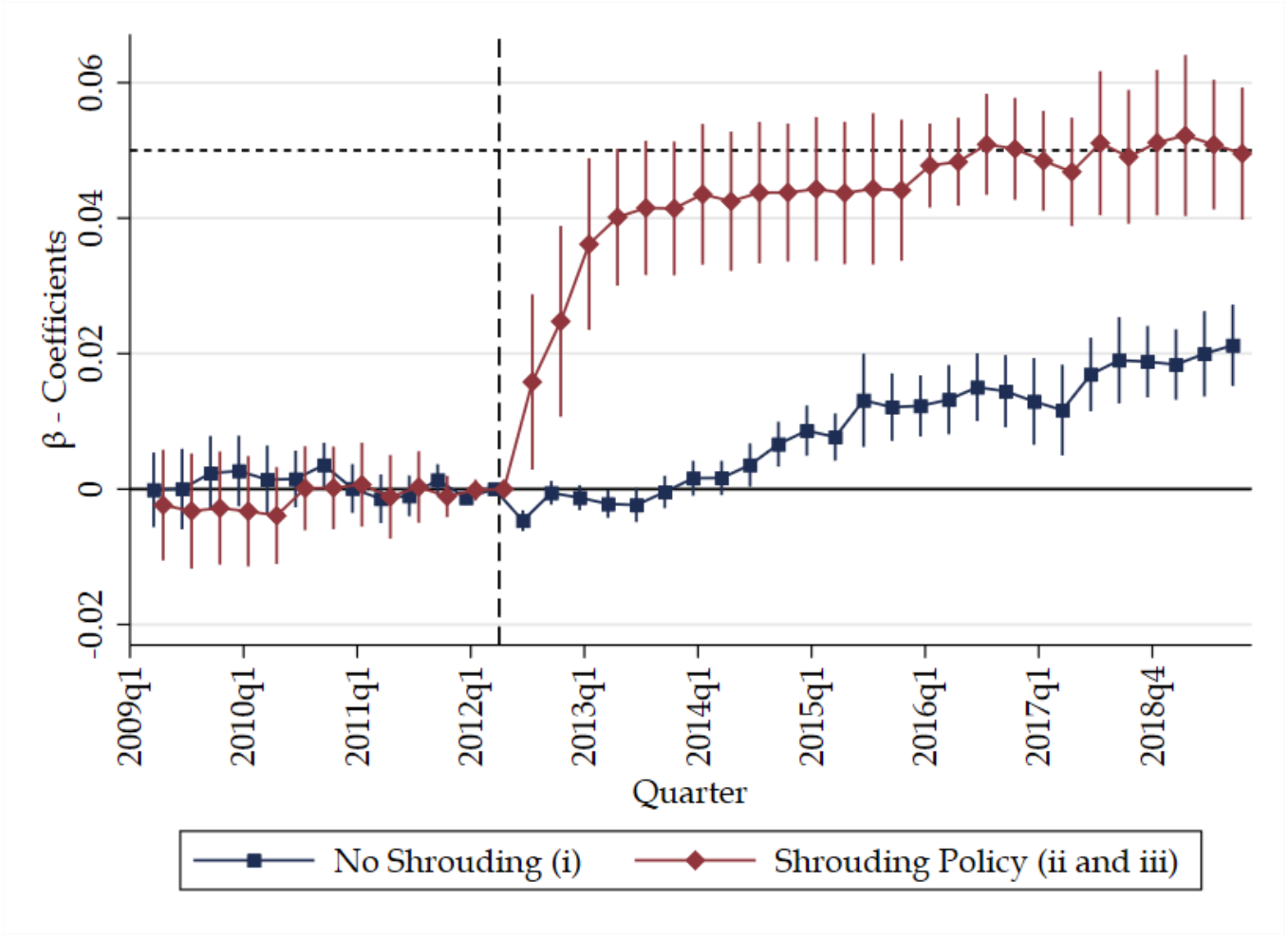
	Subsamples		Interact.
	No shrouding	Shrouding	
	(1)	(2)	(3)
Tax effect on prices	0.008***	0.041***	
	(0.002)	(0.003)	
$T_{i,m}$			0.046***
			(0.003)
$T_{i,m} \times noShroud_{i,m}$			-0.041***
			(0.002)
Constant	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Agency FE	Yes	Yes	Yes
League FE	Yes	Yes	Yes
Observations	1,587,090	1,881,406	1,936,322
R^2	0.728	0.767	0.779

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

All policies

Results – Heterogeneous tax effects dynamics

Figure 5: Pass-through rates differences last but decrease over time



Notes: This figure illustrates the estimated β_k of the event study estimation equation for the shrouding and non-shrouding subsample. All leagues and agencies are included.

Conclusion

- Tax shrouding is a widespread response to the German sports betting tax reform and matters for the tax pass-through
- Policymakers should account for strategic firms' response beyond price adaptions in the context of corrective taxation or other corrective policies
- Requiring firms to post tax-inclusive prices may be one efficient solution (Bradley and Feldman, 2020)
- Firms that manipulate salience provides an argument for environmental subsidies
- Correlation between attention and self-control problems or income may be interesting dimensions for future research

Conclusion

- Tax shrouding is a widespread response to the German sports betting tax reform and matters for the tax pass-through
- Policymakers should account for strategic firms' response beyond price adaptions in the context of corrective taxation or other corrective policies
- Requiring firms to post tax-inclusive prices may be one efficient solution (Bradley and Feldman, 2020)
- Firms that manipulate salience provides an argument for environmental subsidies
- Correlation between attention and self-control problems or income may be interesting dimensions for future research

Conclusion

- Tax shrouding is a widespread response to the German sports betting tax reform and matters for the tax pass-through
- Policymakers should account for strategic firms' response beyond price adaptions in the context of corrective taxation or other corrective policies
- Requiring firms to post tax-inclusive prices may be one efficient solution (Bradley and Feldman, 2020)
- Firms that manipulate salience provides an argument for environmental subsidies
- Correlation between attention and self-control problems or income may be interesting dimensions for future research

Conclusion

- Tax shrouding is a widespread response to the German sports betting tax reform and matters for the tax pass-through
- Policymakers should account for strategic firms' response beyond price adaptions in the context of corrective taxation or other corrective policies
- Requiring firms to post tax-inclusive prices may be one efficient solution (Bradley and Feldman, 2020)
- Firms that manipulate salience provides an argument for environmental subsidies
- Correlation between attention and self-control problems or income may be interesting dimensions for future research

Conclusion

- Tax shrouding is a widespread response to the German sports betting tax reform and matters for the tax pass-through
- Policymakers should account for strategic firms' response beyond price adaptions in the context of corrective taxation or other corrective policies
- Requiring firms to post tax-inclusive prices may be one efficient solution (Bradley and Feldman, 2020)
- Firms that manipulate salience provides an argument for environmental subsidies
- Correlation between attention and self-control problems or income may be interesting dimensions for future research

Shrouded sin taxes

Appendix

References I

Allcott, H. and D. Taubinsky (2015). "Evaluating Behaviorally Motivated Policy: Experimental Evidence from the Lightbulb Market". In: *American Economic Review* 105.8, pp. 2501–38.

Bradley, S. and N. E. Feldman (2020). "Hidden baggage: Behavioral responses to changes in airline ticket tax disclosure". In: *American Economic Journal: Economic Policy* 12.4, pp. 58–87.

Carlin, B. I. (2009). "Strategic price complexity in retail financial markets". In: *Journal of Financial Economics* 91.3, pp. 278–287.

Chetty, R., A. Looney, and K. Kroft (2009). "Salience and taxation: Theory and evidence". In: *American Economic Review* 99.4, pp. 1145–77.

Finkelstein, A. (2009). "E-ztax: Tax Salience and Tax Rates". In: *The Quarterly Journal of Economics* 124.3, pp. 969–1010.

Gabaix, X. and D. Laibson (May 2006). "Shrouded attributes, consumer myopia, and information suppression in competitive markets". In: *Quarterly Journal of Economics* 121.2, pp. 505–540.

References II

Goldin, J. and T. Homonoff (2013). "Smoke gets in your eyes: Cigarette tax salience and regressivity". In: *American Economic Journal: Economic Policy* 5.1, pp. 302–336.

Kotlikoff, L. J. and L. H. Summers (1987). "Tax incidence". In: *Handbook of Public Economics*. Vol. 2. Elsevier, pp. 1043–1092.

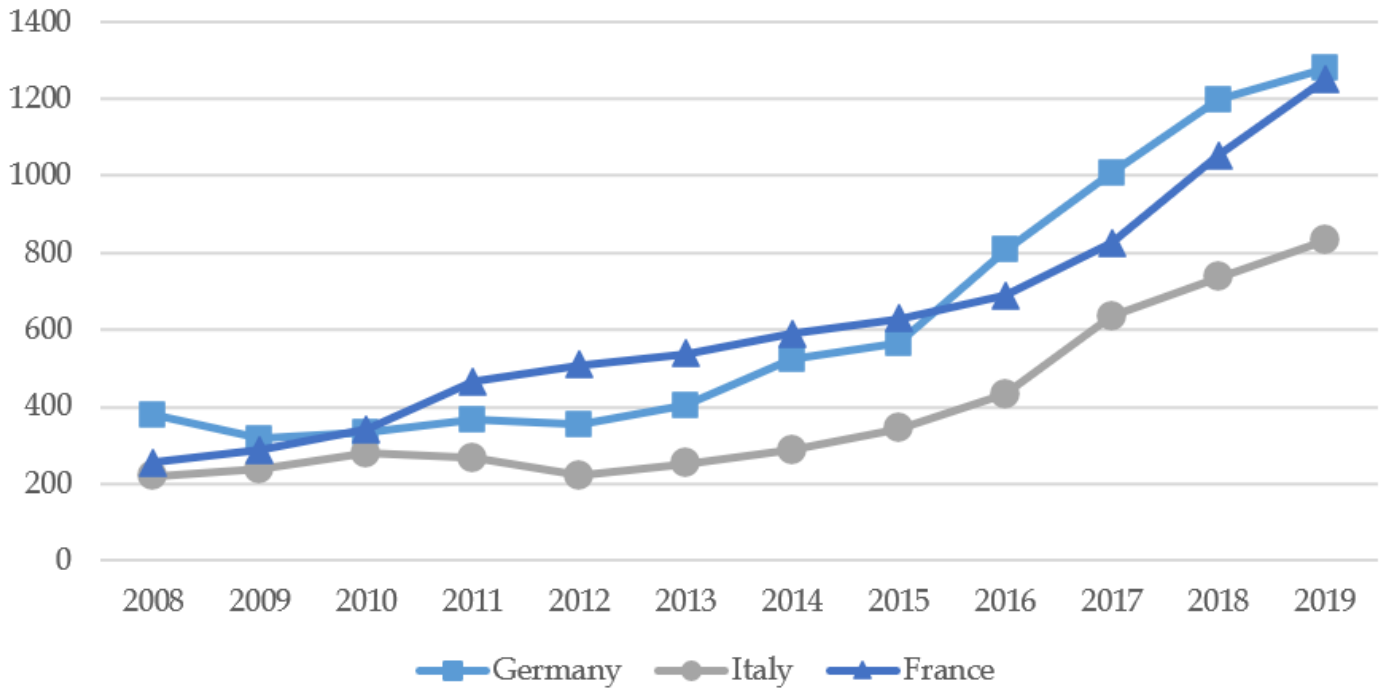
O'Donoghue, T. and M. Rabin (2006). "Optimal sin taxes". In: *Journal of Public Economics* 90.10-11, pp. 1825–1849.

Varian, H. R. (1980). "A model of sales". In: *American Economic Review* 70.4, pp. 651–659.

Weyl, E. G. and M. Fabinger (2013). "Pass-through as an economic tool: Principles of incidence under imperfect competition". In: *Journal of Political Economy* 121.3, pp. 528–583.

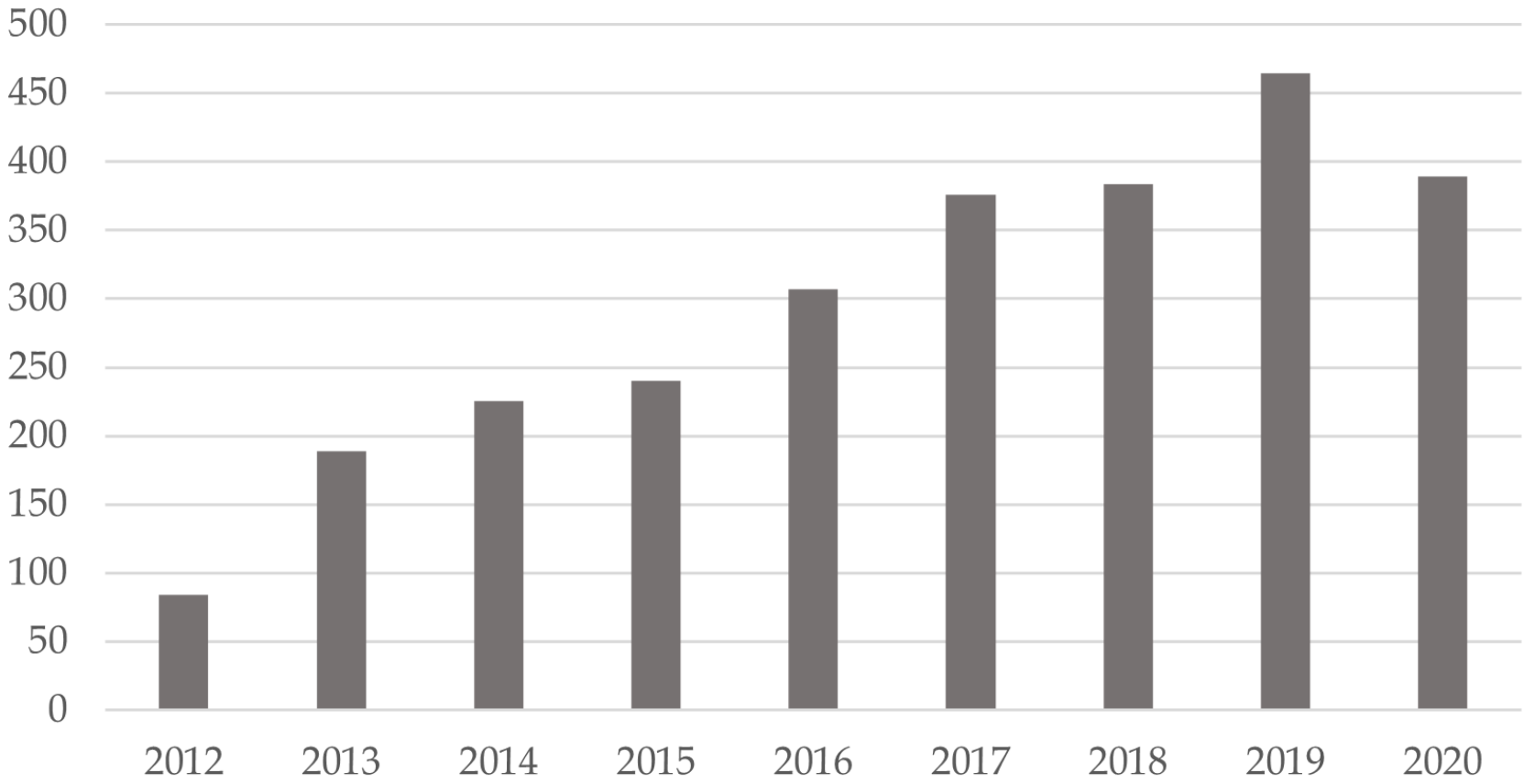
Background – Betting markets in Europe

Figure 6: European online betting revenues on the rise



Notes: This figure illustrates the annual total gross betting revenues between 2008 and 2020 in Germany, Italy and France (in €M). Gross betting revenues are equal to the total wagered amount (including bonuses) minus all winnings by bettors. Source: H2 Gambling Capital – July 2021.

German tax betting revenues



Notes: This figure illustrates the aggregated annual tax revenue generated by the German sports betting tax between 2012 and 2020. The tax revenue in 2012 only covers a period of 6 months, as the tax was introduced on 1 July 2012. Source: German Federal Ministry of Finance.

Back

The price of a sports bet

Bookmaker b promises bettors to pay r_{isb} for every \$1 wagered if outcome s in event i is realized and zero otherwise:

$$r_{isb} = \frac{1}{\theta_{i,b}\pi_{i,s}},$$

Summing over all states and rearranging gives us the "betting markup":

$$\theta_{i,b} \underbrace{\sum_{s=1}^{n} \pi_{i,s}}_{=1} = \sum_{s=1}^{n} \frac{1}{r_{i,s,b}}$$

I define the consumer price of a bet as the expected net return of a 1\$ bet from the perspective of the bookmaker:

$$p_{ib} = 1 - \frac{1}{\theta_{ib}},$$

▸ Back

Shrouding of taxes

Shrouding policies by agencies affect the difference between displayed and effective betting prices: $\tau = p_{ib} - \tilde{p_{ib}}$

i) **No further deductions**

ii) **Deducting from winnings**, i.e. odds are multiplied by $\tilde{r}_{i,s}(1 - 0.05)$

iii) **Deducting from wager**, i.e. the effective wager is equal to: $\tilde{r}_{i,s}/(1 + 0.05)$

Back

Data

Table 4: List of included competitions and number of unique matches

League	Sport	Country	# Outcomes	# Matches	Percent
Bundesliga	Soccer	Germany	3-way	3,060	3.78
2. Bundesliga	Soccer	Germany	3-way	3,109	3.84
3. Liga	Soccer	Germany	3-way	3,802	4.70
Premier League	Soccer	England	3-way	3,801	4.70
Championship	Soccer	England	3-way	5,558	6.87
Primera Division	Soccer	Spain	3-way	3,807	4.71
Segunda Division	Soccer	Spain	3-way	4,691	5.80
Serie A	Soccer	Italy	3-way	3,819	4.72
Serie B	Soccer	Italy	3-way	4,668	5.77
Ligue 1	Soccer	France	3-way	3,789	4.68
Ligue 2	Soccer	France	3-way	3,818	4.72
Handball - Bundesliga	Handball	Germany	3-way	3,097	3.83
Basketball - Bundesliga	Basketball	Germany	2-way	3,305	4.08
NBA	Basketball	USA	2-way	13,702	16.94
NFL	Am. Football	USA	2-way	3,323	4.11
NHL	Hockey	USA	2-way	13,560	16.76
Total				80,909	100.00

Back

Identification Strategy

Main challenges is to identify a proper treatment/control group:

- Treatment: **Part of DSWV** (account for around 90% of all betting revenues in Germany in 2017) and active over entire period
- Main control group: all other agencies, excluding those that were only active in Germany for a part of the period
- Alternative control group: Foreign domain or no German language version
- Exclude "cross-leagues", i.e., considering only German Leagues in the treat and non-German games in the Control group

Back

Empirical Strategy - heterogeneity

Similarly, I capture the dynamics in the differential tax effects over time by interacting $noShroud_{i,m}$ with lags and leads of treatment:

$$p_{i,m(t,c)} = \alpha_i + \lambda_t + \psi_c + \sum_{k=-13}^{25} \beta_k D_{i,m}^k + \sum_{k=-13}^{25} \beta_k D_{i,m}^k \times noShroud_{i,m} + \epsilon_{i,m},$$

▸ Back

A model of optimal sin taxes

Basic setup follows O'Donoghue and Rabin (2006):

- Sin good x, say sports betting, and composite good z
- Consumption of x associated with (future) costs due to potential problem gambling: $c_i(x_i)$
- Consumers may not fully internalize costs ($0 \leq \gamma_i \leq 1$)
- Difference between consumer i's *true* (long-run) utility and *decision* utility ($\tilde{u}_i$)
- Government can levy per unit tax t on sin good, financing transfer per period lump sum transfer L

A model of optimal sin taxes

Basic setup follows O'Donoghue and Rabin (2006):

- Sin good x, say sports betting, and composite good z
- Consumption of x associated with (future) costs due to potential problem gambling: $c_i(x_i)$
- Consumers may not fully internalize costs ($0 \leq \gamma_i \leq 1$)
- Difference between consumer i's *true* (long-run) utility and *decision* utility ($\tilde{u}_i$)
- Government can levy per unit tax t on sin good, financing transfer per period lump sum transfer L

A model of optimal sin taxes

Basic setup follows O'Donoghue and Rabin (2006):

- Sin good x, say sports betting, and composite good z
- Consumption of x associated with (future) costs due to potential problem gambling: $c_i(x_i)$
- Consumers may not fully internalize costs ($0 \leq \gamma_i \leq 1$)
- Difference between consumer i's *true* (long-run) utility and *decision* utility ($\tilde{u}_i$)
- Government can levy per unit tax t on sin good, financing transfer per period lump sum transfer L

A model of optimal sin taxes

Basic setup follows O'Donoghue and Rabin (2006):

- Sin good x, say sports betting, and composite good z
- Consumption of x associated with (future) costs due to potential problem gambling: $c_i(x_i)$
- Consumers may not fully internalize costs ($0 \leq \gamma_i \leq 1$)
- Difference between consumer i's *true* (long-run) utility and *decision* utility ($\tilde{u}_i$)
- Government can levy per unit tax t on sin good, financing transfer per period lump sum transfer L

A model of optimal sin taxes

Basic setup follows O'Donoghue and Rabin (2006):

- Sin good x, say sports betting, and composite good z
- Consumption of x associated with (future) costs due to potential problem gambling: $c_i(x_i)$
- Consumers may not fully internalize costs ($0 \leq \gamma_i \leq 1$)
- Difference between consumer i's *true* (long-run) utility and *decision* utility ($\tilde{u}_i$)
- Government can levy per unit tax t on sin good, financing transfer per period lump sum transfer L

A model of optimal sin taxes

Homogeneous consumers solve:

$$\max_{x,z} \tilde{u} = v(x) - \gamma c(x) + z$$

$$\text{s.t. } (p+t)x + z \leq W + L$$

If consumers are homogeneous and x is supplied under perfect competition ($p = MC$):

I. Overconsumption of x: $\tilde{x}^* > x^*$ if $\gamma < 1$

II. A sin tax $t^* = (1-\gamma)c_x(x^*)$ would implement first best solution x^*

III. If tax is not fully salient (homogeneously perceived as θt) optimal sin tax increases to: $t_\theta^* = \dfrac{(1-\gamma)c_x(x^*)}{\theta}$

A model of optimal sin taxes

Homogeneous consumers solve:

$$\max_{x,z} \tilde{u} = v(x) - \gamma c(x) + z$$

$$\text{s.t. } (p+t)x + z \leq W + L$$

If consumers are homogeneous and x is supplied under perfect competition ($p = MC$):

I. Overconsumption of x: $\tilde{x}^* > x^*$ if $\gamma < 1$

II. A sin tax $t^* = (1-\gamma)c_x(x^*)$ would implement first best solution x^*

III. If tax is not fully salient (homogeneously perceived as θt) optimal sin tax increases to: $t^*_\theta = \frac{(1-\gamma)c_x(x^*)}{\theta}$

A model of optimal sin taxes

Homogeneous consumers solve:

$$\max_{x,z} \tilde{u} = v(x) - \gamma c(x) + z$$

$$\text{s.t. } (p+t)x + z \leq W + L$$

If consumers are homogeneous and x is supplied under perfect competition ($p = MC$):

I. Overconsumption of x: $\tilde{x}^* > x^*$ if $\gamma < 1$

II. A sin tax $t^* = (1-\gamma)c_x(x^*)$ would implement first best solution x^*

III. If tax is not fully salient (homogeneously perceived as θt) optimal sin tax increases to: $t^*_\theta = \dfrac{(1-\gamma)c_x(x^*)}{\theta}$

A model of optimal sin taxes

Homogeneous consumers solve:

$$\max_{x,z} \tilde{u} = v(x) - \gamma c(x) + z$$

$$\text{s.t. } (p+t)x + z \leq W + L$$

If consumers are homogeneous and x is supplied under perfect competition ($p = MC$):

I. Overconsumption of x: $\tilde{x}^* > x^*$ if $\gamma < 1$

II. A sin tax $t^* = (1-\gamma)c_x(x^*)$ would implement first best solution x^*

III. If tax is not fully salient (homogeneously perceived as θt) optimal sin tax increases to: $t_\theta^* = \dfrac{(1-\gamma)c_x(x^*)}{\theta}$

A model of optimal sin taxes

Extend the textbook model along the following dimensions:

- Sin good market is imperfect with Bertrand-Nash price competition between N firms, following Varian (1980)
- Firms set salient base price p_s and shrouded tax surcharge $\tau \in \{0, t\}$, implying effective consumer prices: $p = p_s + \tau$
- Two types of consumers:
  - λ *attentive* consumers know and understand all effective prices
  - $1 - \lambda$ *inattentive* consumers only observe salient base prices but misperceive shrouded taxes to be equal to θt

A model of optimal sin taxes

Extend the textbook model along the following dimensions:

- Sin good market is imperfect with Bertrand-Nash price competition between N firms, following Varian (1980)
- Firms set salient base price p_s and shrouded tax surcharge $\tau \in \{0, t\}$, implying effective consumer prices: $p = p_s + \tau$
- Two types of consumers:
  - λ *attentive* consumers know and understand all effective prices
  - $1 - \lambda$ *inattentive* consumers only observe salient base prices but misperceive shrouded taxes to be equal to θt

A model of optimal sin taxes

Extend the textbook model along the following dimensions:

- Sin good market is imperfect with Bertrand-Nash price competition between N firms, following Varian (1980)
- Firms set salient base price p_s and shrouded tax surcharge $\tau \in \{0, t\}$, implying effective consumer prices: $p = p_s + \tau$
- Two types of consumers:
  - λ *attentive* consumers know and understand all effective prices
  - $1 - \lambda$ *inattentive* consumers only observe salient base prices but misperceive shrouded taxes to be equal to θt

A model of optimal sin taxes

Benchmark case with no taxes and homogeneous consumers:

I. $t = 0$: Symmetric Bertrand competition: $p = MC$

II. $\lambda = 1$: Firms unshroud taxes, implying a perfect pass-through of taxes $p = MC + t \rightarrow$ sin tax t^* works as intended

III. $\lambda = 0$: Perfect pass-through, but taxes are shrouded $\rightarrow$ optimal sin tax increases to t^*_θ

A model of optimal sin taxes

Benchmark case with no taxes and homogeneous consumers:

I. $t = 0$: Symmetric Bertrand competition: $p = MC$

II. $\lambda = 1$: Firms unshroud taxes, implying a perfect pass-through of taxes $p = MC + t \rightarrow$ sin tax t^* works as intended

III. $\lambda = 0$: Perfect pass-through, but taxes are shrouded $\rightarrow$ optimal sin tax increases to t^*_θ

A model of optimal sin taxes

Benchmark case with no taxes and homogeneous consumers:

I. $t = 0$: Symmetric Bertrand competition: $p = MC$

II. $\lambda = 1$: Firms unshroud taxes, implying a perfect pass-through of taxes $p = MC + t \rightarrow$ sin tax t^* works as intended

III. $\lambda = 0$: Perfect pass-through, but taxes are shrouded $\rightarrow$ optimal sin tax increases to t^*_θ

A model of optimal sin taxes

With $0 < \lambda < 1$:

- No equilibrium in pure strategies where all firms unshroud taxes
- There is a market segmentation equilibrium in pure strategies (if $N \geq 4$):
  - Some firms shroud taxes and sell to inattentive consumers and other firms unshroud and sell to attentive consumers
  - No homogeneous linear sin tax-transfer scheme implements (first-best) social optimum
  - Social planner faces tradeoff between "overcorrecting" attentive consumers and "undercorrecting" inattentive consumers
  - Easy solution: Require firms to unshroud taxes

Mixed strategy equilibrium

A model of optimal sin taxes

With $0 < \lambda < 1$:

- No equilibrium in pure strategies where all firms unshroud taxes
- There is a market segmentation equilibrium in pure strategies (if $N \geq 4$):
  - Some firms shroud taxes and sell to inattentive consumers and other firms unshroud and sell to attentive consumers
  - No homogeneous linear sin tax-transfer scheme implements (first-best) social optimum
  - Social planner faces tradeoff between "overcorrecting" attentive consumers and "undercorrecting" inattentive consumers
  - Easy solution: Require firms to unshroud taxes

Mixed strategy equilibrium

A model of optimal sin taxes

With $0 < \lambda < 1$:

- No equilibrium in pure strategies where all firms unshroud taxes
- There is a market segmentation equilibrium in pure strategies (if $N \geq 4$):
  - Some firms shroud taxes and sell to inattentive consumers and other firms unshroud and sell to attentive consumers
  - No homogeneous linear sin tax-transfer scheme implements (first-best) social optimum
  - Social planner faces tradeoff between "overcorrecting" attentive consumers and "undercorrecting" inattentive consumers
  - Easy solution: Require firms to unshroud taxes

Mixed strategy equilibrium

A model of optimal sin taxes

With $0 < \lambda < 1$:

- No equilibrium in pure strategies where all firms unshroud taxes
- There is a market segmentation equilibrium in pure strategies (if $N \geq 4$):
  - Some firms shroud taxes and sell to inattentive consumers and other firms unshroud and sell to attentive consumers
  - No homogeneous linear sin tax-transfer scheme implements (first-best) social optimum
  - Social planner faces tradeoff between "overcorrecting" attentive consumers and "undercorrecting" inattentive consumers
  - Easy solution: Require firms to unshroud taxes

Mixed strategy equilibrium

A model of optimal sin taxes

With $0 < \lambda < 1$:

- No equilibrium in pure strategies where all firms unshroud taxes
- There is a market segmentation equilibrium in pure strategies (if $N \geq 4$):
  - Some firms shroud taxes and sell to inattentive consumers and other firms unshroud and sell to attentive consumers
  - No homogeneous linear sin tax-transfer scheme implements (first-best) social optimum
  - Social planner faces tradeoff between "overcorrecting" attentive consumers and "undercorrecting" inattentive consumers
  - Easy solution: Require firms to unshroud taxes

Mixed strategy equilibrium

Symmetric mixed strategy equilibrium

Symmetric mixed strategy equilibrium:

- With probability P a firm shroud set $p \in [p_0, p_1)$
- With probability $1 - P$ a firm unshrouds and set $p \in (p_1, v^S)$
- Boundary prices p_0 and p_1 are given by:

$$p_1 = (k + t) + \frac{\lambda P^{N-1}}{\lambda + (1 - \lambda)(1 - P)^{N-1}}(v^S - c - t) \leq v^S$$

$$p_0 = p_1(1 - P)^{N-1} \leq p_1$$

$\rightarrow$ presence of myopes harms sophisticates $\rightarrow$ effectiveness of sin taxes depend λ and the number of firms N

Back

Tax incidence in the standard model

- Suppliers price net of taxes: $q = p - t$
- Effective consumer prices can be decomposed in displayed prices and tax surcharge: $p = \tilde{p} + \tau$
- Standard theory: perfect competition, only tax-inclusive prices matter, tax (surcharge) elasticity equal to (displayed) price elasticity:

$$\frac{dp}{dt} = \frac{\eta_S}{(\eta_S - \eta_D)},$$

- where $\eta_D = \frac{\delta D}{\delta p} \frac{p}{D(p)}$ and $\eta_S = \frac{\delta S}{\delta p} \frac{q}{S(p)}$

Tax incidence in the tax salience model

- Consumer only perceive a fraction of the tax $0 \leq \psi$ of the actual tax surcharge ($\tau = t$): $p_\psi = q + \psi t$
- ψ can be interpreted as degree of inattention and is determined by the ratio of the tax ($\eta_{D,p_\psi|t}$) and price elasticity ($\eta_{D,p_\psi|q}$)
- Fully differentiating equilibrium condition $D(q + \psi t) = S(q)$ yields following tax incidence on consumers:

$$\frac{dq}{dt} = \frac{\frac{\delta D}{\delta p_\psi|t}}{\left(\frac{\delta S}{\delta q} - \frac{\delta D}{\delta p_\psi|q}\right)} = \frac{\psi\frac{\delta D}{\delta p_\psi|q}}{\left(\frac{\delta S}{\delta q} - \frac{\delta D}{\delta p_\psi|q}\right)} = \frac{\psi\eta_{D,p_\psi|q}}{\left(\frac{p}{q}\eta_{S,q} + \eta_{D,p_\psi|q}\right)}$$

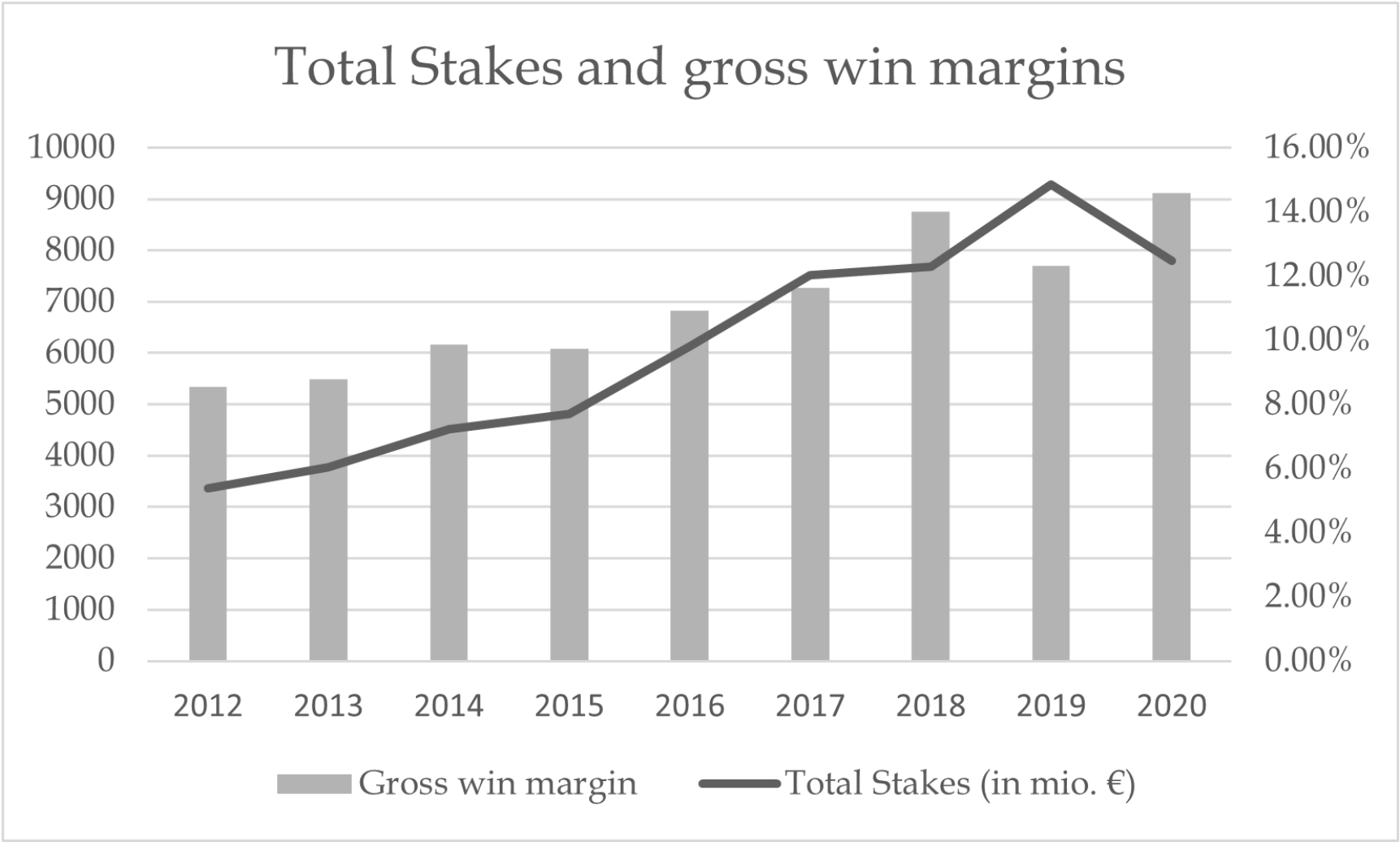
Tax incidence in the presence of shrouded taxes and inattentive consumers

- Previous literature: perfect competition, salience parameter is exogenously given and independent of firms' shrouding choices, tax is remitted by consumers
- Rules out equilibrium feedback effects
- Idea: model motivated Gabaix and Laibson, 2006 with myopic and sophisticated consumers where firms remit the tax and actively decide to shroud taxes or not

Main tradeoff by firms

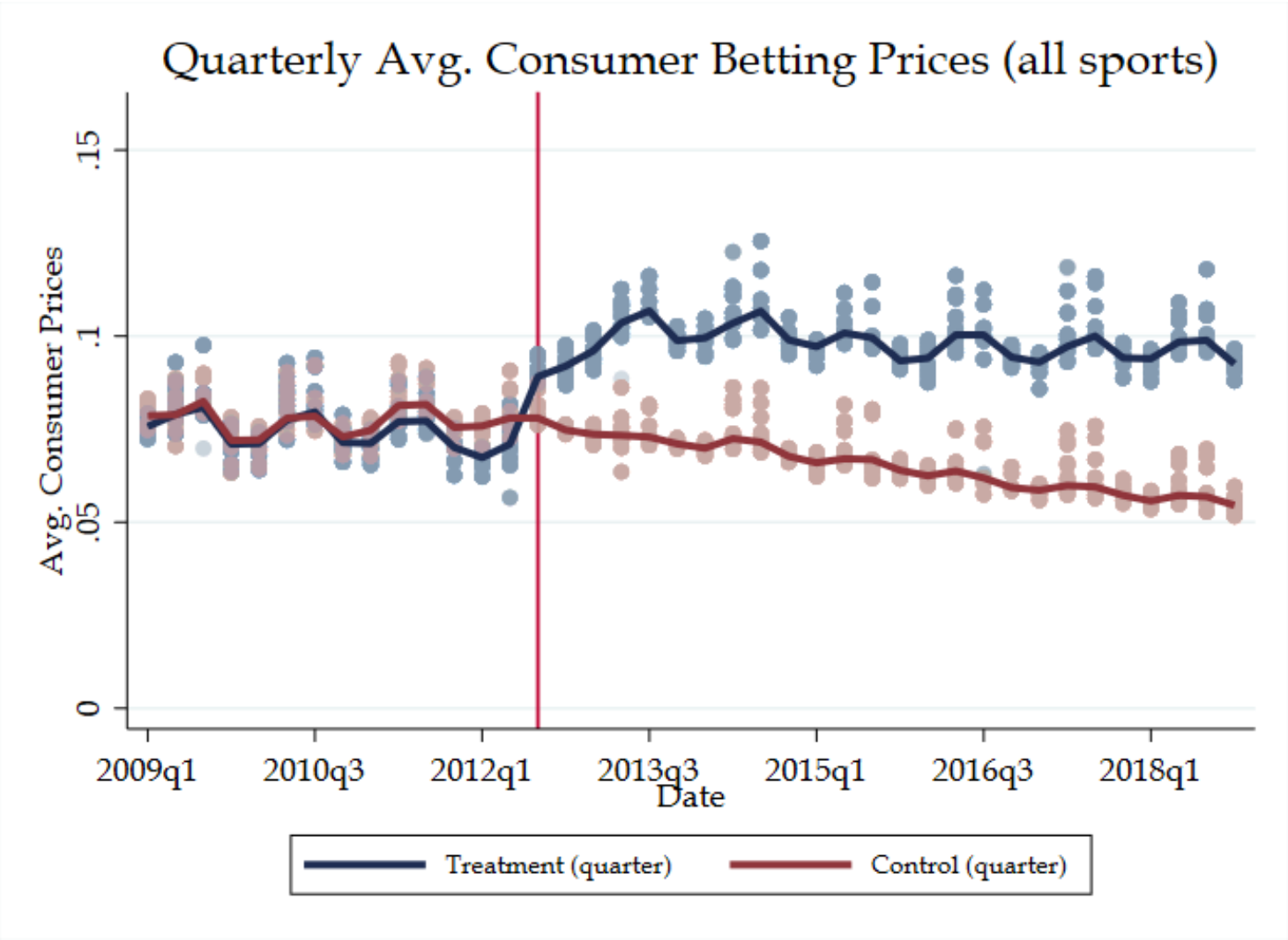
- No tax surcharge:
  - – Lower margins
  - \+ More demand from sophisticated consumers, both through the intensive and extensive margin
- Tax surcharge
  - \+ Higher margins as tax is completely passed onto myopic consumers,
  - – Less demand from sophisticated consumers, both through the intensive and extensive margin
- Several open issues: perfect competition? Sperating equilibrium in shrouding policies? Solving the model for welfare effects...

Sports betting tax revenue



Notes: The solid line illustrates the total wagered amount in Germany between 2012 and 2020, based on the official tax data. Th grey bars presents the implied gross win margins of the betting agencies, which are equal to the gross betting revenues (provide by H2) divided by the total wagered amount.

Descriptive - Avg. consumer prices - All sports



Notes: This figure illustrates the average quarterly and weekly betting margins in the Control and Treatment group, based on t
effective odds faced by consumers. All leagues and agencies are included.

Betting market efficiency - Simple Betting Tips

- If bettors are risk neutral bettor and hold unbiased beliefs, efficiency implies that the final distribution of bets should be directly proportional to the market's implied probability of winning.
- The favorite-longshot bias is not consistent with this, as it implies that winners are underpredicted by market probabilities for favorites and over predicted for longshots
- Similarly, it should not play a role whether you bet on Home Team, Draw, Away Team

Table 5: Rate of return - Summary

	Return of Random bet	Return of Home bet	Return of Draw	Return of Away	Return Favorite	Return Outsider
Mean	-0.0885	-0.0633	-0.0725	-0.130	-0.0523	-0.124
SD	(0.408)	(1.166)	(1.546)	(1.653)	(0.987)	(1.793)
Observations	1939628	1939628	1939628	1939628	1939628	1939628

Notes: The Table illustrates the mean and standard deviation of expected rate of return on a bet on different outcomes. Only soccer game are included

Heterogeneity in tax incidence

Table 6: Avg. effect of tax on consumer betting prices - Subsamples different policies

	All Leagues			Excl. "cross" leagues		
"Shrouding" policy	(ii)	(iii)	(i)	(ii)	(iii)	(i)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Soccer						
Tax effect on prices	0.043***	0.036***	0.008***	0.046***	0.043***	0.008**
	(0.003)	(0.007)	(0.002)	(0.003)	(0.005)	(0.002)
Constant	0.085***	0.085***	0.085***	0.091***	0.091***	0.091***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	1,793,974	1,619,606	1,587,090	1,257,582	1,217,911	1,211,548
R^2	0.764	0.743	0.728	0.754	0.743	0.737
Panel B: All sports						
Tax effect on prices	0.044***	0.034***	0.002	0.041***	0.037***	0.001
	(0.002)	(0.007)	(0.002)	(0.002)	(0.007)	(0.002)
Constant	0.079***	0.084***	0.084***	0.088***	0.088***	0.088***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	2,815,902	2,512,623	2,466,796	1,974,102	1,912,848	1,901,791
R^2	0.745	0.716	0.703	0.736	0.721	0.713
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Agency FE	Yes	Yes	Yes	Yes	Yes	Yes
League FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Back