A Surrebuttal: There Are No Anti-Competitive Effects of Common Ownership in the Airline Industry*

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ABSTRACT

The influential paper by Azar et al. (2018) presents empirical evidence from the airline industry that institutional investors who own shares in firms that are product-market rivals leads to anti-competitive behavior and higher prices. Dennis et al. (2022) refute this contention and show using a placebo analysis that the results in Azar et al. (2018) are driven by the market share component of the measure of common ownership rather than the investor component. Azar et al. (2022) present a critique of the Dennis et al. (2022) placebo analysis and argue that the conclusions of Azar et al. (2018) are valid. This paper shows that the conclusions in Dennis et al. (2022) still hold in light of the Azar et al. (2022) critique.

JEL classification: G33, G34, G38, L41, L11.

*A surrebuttal is a response to a rebuttal.

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1 Introduction

In this paper we respond to Azar et al. (2022) (henceforth referred to as AST (2022)), which levels a criticism of our paper Dennis et al. (2022), "Common Ownership Does Not Have Anti-Competitive Effects in the Airline Industry," (henceforth referred to as DGS), which, in turn, casts doubt on the original findings in Azar et al. (2018) (henceforth referred to as AST (2018)). Specifically, AST (2022) claim that the placebo analysis conducted in DGS (section II in the paper) is invalid.

AST (2018)'s finding that increased common ownership leads to higher airline ticket prices is identified by a non-linear interaction of airline market shares and institutional ownership. Using a placebo analysis, DGS conclude that it is variation in market shares, not ownership, that is identifying the AST (2018) common ownership effect, casting doubt on the interpretation that common ownership has a causal effect on prices through reduced competition. While AST (2022) claim that the placebo analysis in DGS is not valid, we find two shortcomings in their analysis. First, AST (2022) ignore half of the DGS placebo analysis, namely that DGS find that using true market shares and placebo ownership yields a statistically significant, positive relationship between common ownership and prices of a similar magnitude as that documented in AST (2018). This finding is consistent with market shares, rather than institutional common ownership driving the AST (2018) results.

The second shortcoming of AST (2022) is their critique of the other half of the DGS placebo analysis, which uses placebo market shares and true ownership. AST's critique is based on the fact that the DGS placebo market share variable does not eliminate all time-series variation in airline market shares due to the unbalanced nature of the panel data. As an alternative, AST (2022) propose a placebo which they claim does purge all variation in airline market shares, and then show that the alternative placebo yields results that are opposite to the DGS findings and consistent with the AST (2018) findings. While we acknowledge that the DGS placebo market share does not eliminate all time-series variation in airline market shares, we show that the alternative placebo

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proposed by AST (2022) purges significantly *less* of the variation in market shares than the original DGS placebo. Since the AST (2022) placebo retains much of the variation in true market shares, we argue that it is not surprising that AST (2022) find results similar to those in AST (2018).

The remainder of the paper is structured as follows: In section 2, we will provide a summary of the main empirical finding of Azar et al. (2018), the primary criticism levied by DGS, and finally, the AST (2022) critique of the DGS placebo analysis. In section 3, we will assess the AST (2022) criticism and evaluate its merits. Finally, we will offer concluding remarks in section 4.

2 Background

Since the DGS paper is a critique AST (2018), we first provide a brief summary of the main AST (2018) results as well as the motivation and details behind the DGS placebo exercise. We will then summarize AST's (2022) critique of the DGS placebo analysis.

2.1 Recap of AST (2018) and DGS

The main econometric specification in the original AST analysis is a regression of the logarithm of the average airfare charged by carrier j in market r during year-quarter t on a measure of common ownership, $MHHI\ delta_{rt}$, the traditional Herfindahl Index, HHI_{rt}, a set of control variables and fixed effects:[1]

$$\log(p_{rjt}) = \alpha \cdot \underbrace{MHHI\ delta_{rt}}_{\substack{\text{Ownership \& Control} \\ \text{And Market Shares}}} + \eta \cdot \underbrace{HHI_{rt}}_{\text{Market Shares}} + \theta \cdot X_{rjt} + \delta_t + \nu_{rj} + \varepsilon_{rjt}, \tag{1}$$

where p_{rjt} is the average ticket price for airline j in market r and year-quarter t. The specification includes year-quarter fixed effects, δ_t, and market carrier fixed effects ν_{rj} (and in some specifications

[1]Note that the DGS paper uses slightly different nomenclature and refers to the measure of common ownership, $MHHI\ delta$, as $HHI\Delta$. In this paper, we will use the AST (2018) nomenclature.

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market fixed effects).

The coefficient of interest is α. AST (2018) find positive and statistically significant estimates of α and interpret the results as evidence of anti-competitive effects of common ownership. That is, increased common ownership, as measured by a higher $MHHI\ delta_{rt}$, lowers competitive pressures, thus increasing airline ticket prices.

One of the primary critiques levied in the DGS paper is that identification of α in equation (1) stems from variation in the endogenous market share component of $MHHI\ delta_{rt}$, rather than the common ownership components. To see this, consider the formal definition of $MHHI\ delta_{rt}$:

$$MHHI\ delta_{rt} = \sum_{j} \sum_{k \neq j} \underbrace{\left(\frac{\sum_i \gamma_{ijt} \cdot \beta_{ikt}}{\sum_i \gamma_{ijt} \cdot \beta_{ijt}} \right)}_{\text{Ownership \& Control}} \underbrace{s_{rjt} \cdot s_{rkt}}_{\text{Market Shares}} \tag{2}$$

where γ_{ij} and β_{ij} represent investor i's control and cash flow rights over carrier j, respectively; and s_{rjt} (s_{rkt}) is the market share of carrier j (k) in market r at time t.

$MHHI\ delta_{rt}$ is a non linear function of both airline market shares, as well as measures of investors' ownership and control over these airlines. DGS argue that to support the AST interpretation, it is necessary to determine whether the source of identification of the $MHHI\ delta_{rt}$ coefficient is its market share components ($s_{rkt},\ s_{rjt}$), or its ownership and control components ($\gamma_{ijt},\ \beta_{ijt}$). To address this, DGS design a placebo test that involves constructing two new versions of $MHHI\ delta_{rt}$[2]

1. One that mutes time-series variation in ownership and control, while retaining true time-series variation in market shares: $MHHI\ delta^{Placebo\ Own}_{True\ MS}$.

2. One that mutes time-series variation in market shares, and retains true time-series variation in ownership and control $MHHI\ delta^{Placebo\ MS}_{True\ Own}$.

[2]The argument for focusing on the within market *time series* variation in ownership and control in $MHHI\ delta^{Placebo\ Own}_{True\ MS}$, and the within market *time series* variation in market shares in $MHHI\ delta^{Placebo\ MS}_{True\ Own}$ is that the AST (2018) regression equation includes market fixed effects which absorb all cross-market variation in prices.

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The placebo test involves re-estimating the AST (2018) pricing regressions using these alternative measures of $MHHI\ delta$. The logic behind the placebo tests is as follows: If the ownership and control components of $MHHI\ delta$ are driving the positive correlation with average prices, then the coefficient estimate of the measure using placebo ownership and true market shares should be zero, $MHHI\ delta_{True\ MS}^{Placebo\ Own} \approx 0$, *and* the coefficient of the meaure using true ownership and placebo market shares should be positive and significant, $MHHI\ delta_{True\ Own}^{Placebo\ MS} > 0$.

In contrast, if the market share components are driving the correlation between $MHHI\ delta$ and prices, the coefficient estimate associated with true market shares and placebo ownership, $MHHI\ delta_{True\ MS}^{Placebo\ Own} > 0$, *and* the coefficient estimate associated with the placebo using true market shares and placebo ownership $MHHI\ delta_{True\ Own}^{Placebo\ MS} \approx 0$.

DGS find that the coefficient on $MHHI\ delta_{True\ MS}^{Placebo\ Own} > 0$ and that the coefficient associated with $MHHI\ delta_{True\ Own}^{Placebo\ MS} \approx 0$, and thus conclude that it is the market shares components that are driving the positive correlation with average ticket prices. This in turn, suggests that there is not a causal relationship of common ownership on airline prices, but rather that the endogeneity of market shares results in positive bias in the α coefficient.

2.2 Summary of AST (2022)

AST (2022) levy a critique of the second piece of the DGS placebo exercise. Specifically, the paper claims that the DGS placebo $MHHI\ delta_{True\ Own}^{Placebo\ MS}$ is invalid because it does not purge all time-series variation in $MHHI\ delta$ originating from variation in market shares. The authors highlight that DGS perform the placebo exercise on an unbalanced panel of airlines. Specifically, DGS hold an airline's market share constant when it is operating in a market, but set it to zero when it is not operating in the market. This leaves some time-series variation in the placebo market shares measure.

AST (2022) then construct an alternative placebo that claims to eliminate *all* time-series varia-

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tion in market shares. This alternative placebo is shown to yield a statistically significant, positive α coefficient in the airline ticket price regressions described in equation (1) above, which suggests that the AST interpretation is in fact correct.

3 Evaluating the merit of the AST (2022) critique

In this section we will assess whether the AST (2022) critique of the DGS placebo exercise has merit and whether the alternative placebo developed by the authors is superior to the DGS placebo. However, before we get into the details of the AST (2022) critique and alternative placebo, it is important to point out that the AST (2022) critique focuses exclusively on one half of the DGS placebo exercise and ignores the other half of the exercise.

Specifically, AST (2022) focus entirely on the $MHHI\ delta_{True\ Own}^{Placebo\ MS}$ placebo, which mutes time-series variation in market shares and retains true time-series variation in ownership and control. However, the paper does not address the $MHHI\ delta_{True\ MS}^{Placebo\ Own}$ placebo, which mutes time-series variation in ownership and control, while retaining true time-series variation in market shares. As detailed above, DGS show that using $MHHI\ delta_{True\ MS}^{Placebo\ Own}$, yields positive, and statistically significant estimates of α (see Table II in DGS), that are similar in magnitude to those in the original AST (2018) paper. This is inconsistent with a causal interpretation because if ownership and control were truly identifying α, then using $MHHI\ delta_{True\ MS}^{Placebo\ Own}$ should yield insignificant coefficient estimates.

Thus, even if we assume that AST (2022) are correct in their critique of the DGS placebo exercise and their alternative placebo is valid, it would still be a mistake to conclude that the ownership and control components of $MHHI\ delta$ drive the positive correlation with airline ticket prices. More precisely, AST (2022)'s claim that the endogeneity of market shares biases their results *towards* zero rather than *away* from zero is inconsistent with the DGS result that the coefficient associated with $MHHI\ delta_{True\ MS}^{Placebo\ Own}$ is positive and statistically significant.

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3.1 The DGS placebo is valid

AST (2022) begin by conducting an empirical exercise that they claim shows that the DGS placebo, $MHHI\ delta^{Placebo\ MS}_{True\ Own}$, is invalid. Specifically, Figures 1 and 2 in the paper show that there is a negative correlation between the residualized $MHHI\ delta^{Placebo\ MS}_{True\ Own}$ and the residualized true airline market shares. The authors claim that this negative correlation invalidates the DGS placebo exercise, because a valid $MHHI\ delta$ placebo should exhibit zero correlation with true average market shares. Specifically, they state on page 3:

> "If the DGS "fixed-market shares placebo" truly muted time-series variation stemming from market shares, we would expect no correlation between the "placebo" and average market shares in this chart. Figure 1, however, shows a clear negative correlation between these variables, suggesting that the "placebo" is not valid."

This logic is faulty however. As we see above in equation (2), $MHHI\ delta$ is a non-linear function of market shares and ownership and control shares (γs and βs). Even if market shares are completely fixed over time within a market, there will still be within-market, time-series variation in $MHHI\ delta$ due to the fact that the ownership and control terms vary over time. It isn't clear why one should expect zero correlation between the within-market time-series variation of true market shares and the within-market time-series variation of such a placebo $MHHI\ delta$. It could be zero, but it could also be positive or negative, depending on whether there is a trend over time in ownership and control concentration and a trend over time in average market shares.

With that said, AST (2022) are correct in their claim that the DGS market shares placebo, $MHHI\ delta^{Placebo\ MS}_{True\ Own}$, does not eliminate all time-series variation in airline market shares. While this is a valid point, it is not an entirely novel insight as footnote 13 in DGS explains that market shares are set to zero in the quarters after airlines exit a market and in the quarters before airlines enter a market:

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> "For all year-quarter observations in which airline j serves market m^*, we replace j's market share by the market share observed in the selected time period t^*: $ms_{ctm} = ms_{jt^*m^*} \; \forall \; t$. If carrier j does not serve market m^* during a specific year-quarter t, then for that period t we set carrier j's market share equal to zero."

This footnote implies that the DGS placebo exercise eliminates all time-series variation on the *intensive* margin (i.e. it sets market shares to a constant level for airlines that do not exit the sample) but does not eliminate variation on the *extensive* margin (i.e. for airlines that exit the sample, market shares are set to zero). The reason for doing this is that due to the non-linear relationship between airline market shares and ownership and control shares in the $MHHI$ *delta* formula, it is impossible to eliminate the time-series variation in market shares on the extensive margin and still retain true time-series variation in ownership and control. It is clear from the formula for $MHHI$ *delta* above that when an airline exits a market and its market share goes to zero, the ownership and control parameters are "turned off" since they are multiplied by 0. Similarly, when an airline enters a market and its market share becomes positive, the ownership and control parameters are "turned on" and contribute to $MHHI$ *delta*. Thus, if DGS had created a balanced panel and set airline market shares to a constant value within a market over time (i.e. eliminating time-series variation on both the intensive and extensive margins), it would have introduced fake variation in ownership and control.

Perhaps this issue would have been clearer if the discussion in footnote 13 in DGS was in the main text of the paper with a more detailed discussion of the tension between muting variation in market shares and the unbalanced nature of the panel. However, we show below, while the DGS market shares placebo does not eliminate *all* time-series variation in market shares, it does significantly mute the variation, and in fact, has roughly one-third the variation in market shares compared to the the alternative placebo constructed by AST (2022).

Furthermore, it isn't completely clear whether setting market shares to zero when airlines do

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not operate in a given market will bias the placebo analysis and which direction the bias will go if it is in fact nonzero. This is because airline entry and exit will have opposing effects on time-series variation in the placebo measure, $MHHI\ delta^{Placebo\ MS}_{True\ Own}$. AST (2022) focus entirely on exits, and show that setting market shares to zero for firms that exit a market will have a negative effect on changes over time in the placebo measure (see equation (3.5) in their paper). However, AST (2022) ignore the fact that setting market shares to zero for firms that have not yet entered the market, but that eventually will enter, will have an offsetting, positive effect on changes over time in the placebo measure. Thus, the effect of the unbalanced nature of the panel on time-series variation in the placebo measure will depend on the relative importance of entry vs. exit in the airline industry during the sample period.

3.2 Assessing the AST alternative placebo

The alternative placebo developed by AST (2022) in section 4 of the paper is problematic for at least two reasons. First, it does not eliminate (within-market) time-series variation in airline market shares. Second, it does not retain all of the true time-series variation in ownership and control.

Rather than fix market shares over time at a specific value for a given carrier in a given market to mute within-market time-series variation as in DGS, AST (2022) restrict the sample to those carriers that are present in a market in adjacent quarters and re-normalizes so that the sum across carriers in a given market is one. From equation (4.1) in AST (2022):

$$\Delta P_{jk,t} = \sum_{j \epsilon J^{t-1} \bigcap J^t} \sum_{k \epsilon J^{t-1} \bigcap J^t \backslash j} w_{j,t-1} w_{k,t-1} \Delta \lambda_{jk,t},$$

where $\Delta P_{jk,t}$ is the change in the level of their placebo from $t-1$ to t. The double summation is calculated only over the pairs of airlines that are present in the market at both time $t-1$ and t, and the w terms, which are functions of (true) lagged airline market shares, are indexed by $t-1$ and therefore vary over time. AST (2022) then express the level of their placebo for $MHHI\ delta$

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at time T, in terms of changes, ΔP, by summing all changes in the placebo up to time T.

As an example, the diagram below shows a market with three quarters and five airlines:

A Market With Five Airlines and Three Periods

Quarter:	1	2	3
Carriers serving market	DL	–	DL
	AA	AA	–
	US	US	US
	UA	UA	UA
	–	SW	SW

In the first quarter, Delta (DL), American (AA), US Air (US), and United (UA) are all operating in the market. In the second quarter, DL drops out and Southwest (SW) enters. The change in the placebo, ΔP, between quarters 1 and 2 is calculated using only ownership/control and market shares for AA, US, and UA, while DL's and SW's contributions to common ownership are ignored. The change in the placebo between quarters 1 and 2 is:

$$\Delta P_2 = \sum_{j \in \{AA,US,UA\}} \sum_{k \in \{AA,US,UA\} \setminus j} w_{j1} w_{k1} \Delta \lambda_{jk2}.$$

In quarter 3, DL re-enters and AA drops out, so ΔP between quarters 2 and 3 is calculated using data on US, UA, and SW, while DL's and AA's presence in the market and their contribution to ownership/control in the market are ignored. Hence, the change in the placebo between quarters 2 and 3 is:

$$\Delta P_3 = \sum_{j \in \{US,UA,SW\}} \sum_{k \in \{US,UA,SW\} \setminus j} w_{j2} w_{k2} \Delta \lambda_{jk3}.$$

To determine the placebo for $MHHI\ delta$ at each date, P_t, AST (2022) sum the time series of

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changes in the placebo as follows:

$$P_1 = 0$$

$$P_2 = P_1 + \Delta P_2$$

$$P_3 = P_1 + \Delta P_2 + \Delta P_3.$$

Changing the sample in this way does not eliminate within-market, time series variation in market shares. As the example above shows, $\Delta P_{jk,t}$ in equation (4.1) is not the variable that is actually used in the regression analysis. AST (2022) state (page 9): "We then construct the valid placebo time series by adding the changes $\Delta Placebo_{jk,t}$ over time." The alternative placebo used in the regression is, in fact, the *running sum* of $\Delta Placebo_{jk,t}$. This introduces variation in the alternative placebo from variation in lagged market shares. Market shares vary quarter-to-quarter and lagging them does not eliminate this time series variation. The alternative placebo varies over time due to both changes in control and ownership for airlines that operate in consecutive quarters and due to the market shares of those airlines changing over time. AST (2022)'s claim that the alternative placebo "is based only on changes in ownership from period to period and not on changes in market shares, even when the panel is unbalanced" (page 8) is inconsistent with its actual construction.

To gain more insight into how well AST (2022)'s alternative placebo mutes time-series variation in market shares, we reproduced AST (2022)'s alternative placebo using their code. We then took the market share weights, $w_{j,t-1}$ used by AST (2022)'s alternative placebo, calculated the average market share for each market, and then averaged across all markets in each year-quarter. The time-series of this average market share is displayed below in Figure 1. As shown in the plot, there is a significant amount of variation in this variable over time.

In Figure 2, we compare the standard deviation of the time-series of this placebo market share (red line) with the standard deviation of the true market shares (green line) and the standard

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deviation of the DGS placebo market shares (blue line). Note that since DGS construct 56 sets of placebo market shares (one for each year-quarter in the sample), there are 56 different standard deviations in the plot. The standard deviation of the alternative placebo market shares that AST (2022) propose is approximately 0.027, which is very similar to the standard deviation of the time-series average of true market shares, which is 0.032. In contrast, the standard deviation of the DGS placebo market shares is significantly lower and hovers between 0.005 and 0.015. This makes sense since DGS mute time series variation in airline market shares by fixing them at a positive value when an airline is operating in the market. Hence, the DGS placebo market shares have significantly lower variability and thus, mute more of the time-series variation in market shares than the alternative placebo constructed by AST (2022) (although they do not eliminate all variation due to the unbalanced nature of the panel).

Given the evidence in Figure 2 it isn't surprising that the alternative $MHHI$ *delta* placebo developed in AST (2022) delivers results in the airline ticket pricing regressions that are similar to those found in the original AST (2018) paper. The alternative placebo includes time series variation in market shares that is close to the true variability in the data, and thus, the upward bias caused by the endogeneity of market shares is still present, consistent with the DGS claim.

The second problem with the alternative placebo is that it doesn't use all of the true time-series variation in ownership and control (the λs). This is easy to see in the diagram on page 9 as the change in ownership and control due to Delta exiting and Southwest entering the market in Q2 is being ignored and the change in ownership and control due to Delta re-entering and American exiting in Q3 is also being ignored. AST (2022) do acknowledge this issue in the paper stating "it is not possible to calculate the change in the common ownership profit weights $\lambda_{jk,t}$ for pairs of firms that are not present in both periods."

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4 Conclusion

Azar et al. (2022) (AST (2022)) claim that the placebo exercise in Dennis et al. (2022) (DGS) is not valid, but we find two major flaws in their analysis. First, they ignore the half of the DGS analysis that shows that using true market shares and placebo ownership replicates the results in Azar et al. (2018) (AST (2018)). This finding in DGS is key since it shows that it is variation in market shares, not ownership that identifies the main result in AST (2018). Second, DGS find that the AST (2018) result disappears when using placebo market shares and true ownership. AST (2022) criticize this part of the DGS analysis since the DGS placebo market shares is constructed using an unbalanced panel of airlines and as a result, does not completely eliminate time-series variation in market shares. While it is true that the DGS placebo market shares are constructed using an unbalanced panel, it is not a revelatory critique as DGS explain this in the paper. More importantly, the alternative placebo market shares that AST (2022) propose suffers even more from the unbalanced panel critique and we show that the DGS placebo is much more effective in muting time-series variation in market shares than the AST (2022) alternative placebo. Hence it is not surprising that the original AST result holds when using the AST (2022) alternative market share placebo. In sum, we find little merit to the AST (2022) critique and conclude that the DGS claim that there is no compelling evidence of anti-competitive effects of increased common ownership in the airline industry remains valid.

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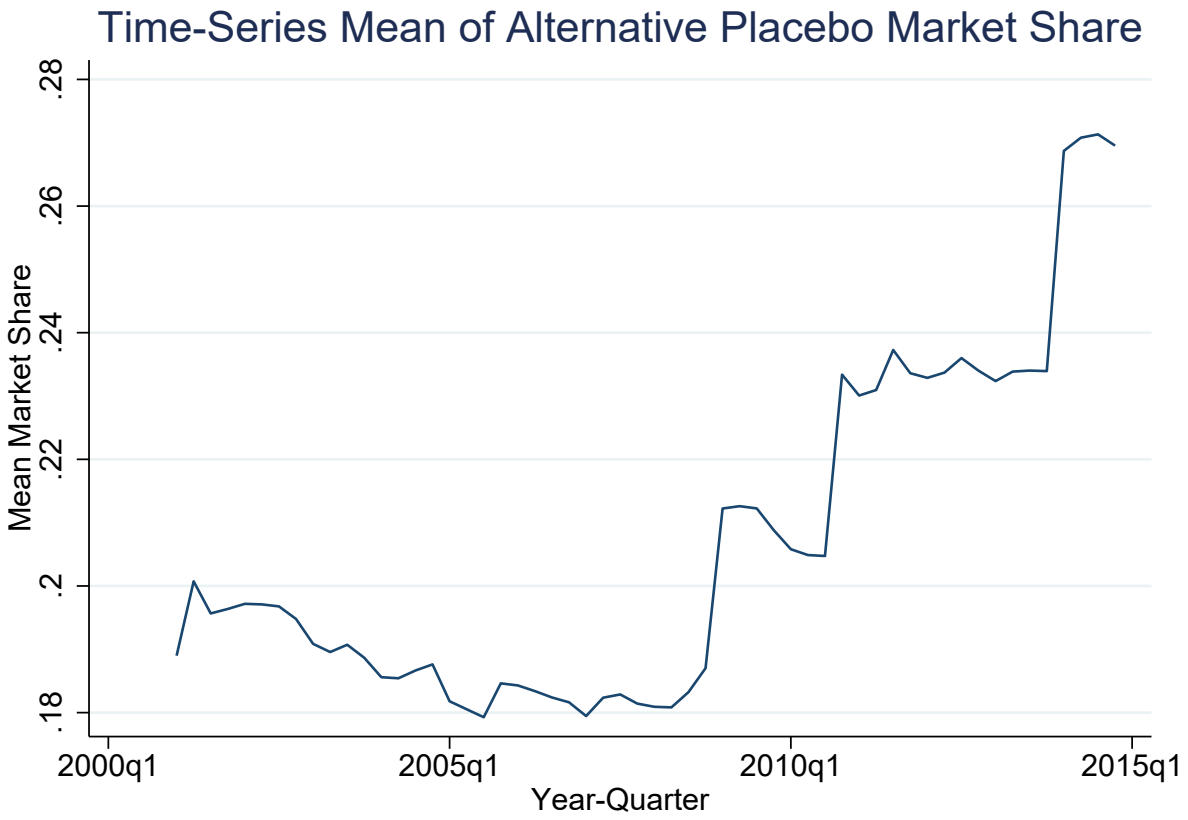
Figure 1: Time Series of Market Shares used in the Alternative Placebo



This graph plots the time-series of the average value, across all markets in a given year-quarter t, of the market share weights, w_t that the authors' code produces and uses as an input into the placebo MHHI *delta*. That is, for each year-quarter, the graph displays $s_t = \sum_r \sum_j w_{jrt}$, and shows there is a significant amount of variation over time in the variable.

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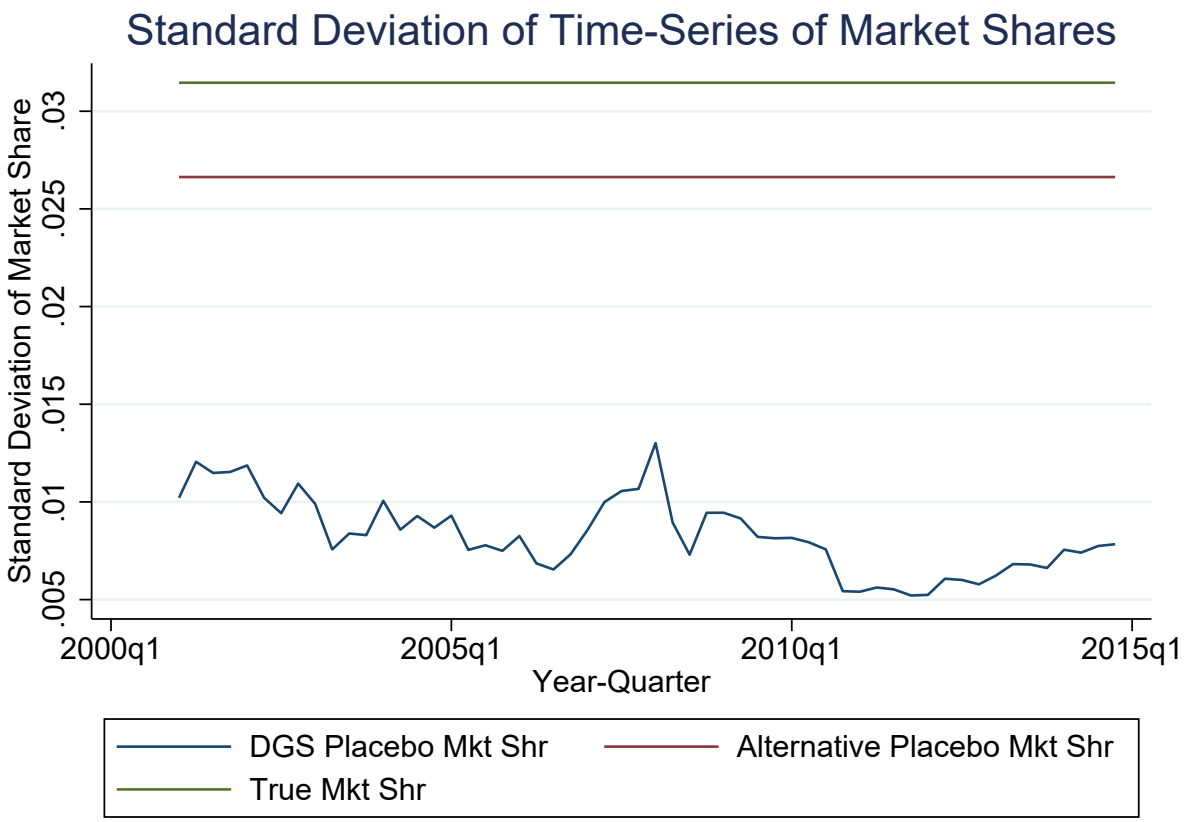
Figure 2: Standard deviation of Market Shares



This graph compares the standard deviation of:

1. The time-series of the true average market shares (green line), which equals 0.032.
2. The time-series of the alternative placebo average market share (red line), which equals 0.027.
3. The time-series of the DGS placebo average market shares (blue line). Note that since DGS construct 56 market share placebos (one for each year-quarter in the sample), there are 56 different standard deviations in the plot.

The variation in the time-series of average market shares used in the alternative placebo is very similar to the variation of the time-series of average true market shares. In contrast, the standard deviation of the time-series of average DGS placebo market shares is significantly lower and hovers between 0.005 and 0.015.

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