The Effects of Vertical Arrangements in a Vertical Supply Chain*

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Abstract

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*The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the Board research staff, by the Federal Reserve Board of Governors, by the Federal Trade Commission, or by its Commissioners.

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1 Introduction

Data Generating Process

This section provides an overview of our methodology, with additional details appearing in the Appendix. We simulate markets by randomly sampling shares from a Dirichlet distribution for 2, 3, 4, or 5 retailers or wholesalers, respectively.[1] We also assume that in the pre-merger state, anywhere from 0 to 4 retailers are vertically integrated with a single wholesaler. We assume that vertically integrated wholesalers supply inputs to non-integrated retailers and that vertically integrated retailers purchase inputs from non-integrated wholesalers. The price coefficient α is calibrated by assuming that in the pre-merger world, there is a vertically integrated outside option available to all customers. The other goods are differenced relative to this option, which maintains the outside good normalization. The market size is set to 1.

We specify values for the bargaining parameter ranging from from 0.1 (wholesalers have the advantage) to 0.9 (retailers have the advantage). To better understand the relative bargaining strength of these parameter values, we report our results in terms of $(1-\lambda)/\lambda$, which range from 9 (wholesaler power is nine times greater than retailer power) to 1/9 (retailer power is nine times greater than wholesaler power). The bargaining parameter is identical for all of the retailers in each simulation, unless noted otherwise.

For each combination of number of retailers, number of wholesalers, and bargaining parameter, we draw 1,000 different sets of market primitives. This results in 2.2 million merger simulations. We then eliminate mergers where the merger is unprofitable to the merging firms, as well as markets that do not pass the Hypothetical Monopolist Test, yielding XX million markets.[2] All 2.2 million markets treat as primitives the number of retailers, the

[1] We parametrize the Dirichlet distribution so it is equivalent to a uniform distribution.

[2] The Hypothetical Monopolist Test requires that were a monopolist to jointly own all products in a candidate market, that firm would raise the price of at least one of the merging producers' products by at least a "small but significant non-transitory increase in price" (SSNIP), which we take to be 5%.

number of wholesalers, the bargaining parameter, and the wholesaler and retailer marginal costs, which we allow to be either constant or linear.

When simulating a horizontal merger, we assign the products produced by the two largest firms in the market to a single entity post-merger. Similarly, when simulating a vertical merger, we assign the products produced by the largest wholesaler and the largest retailer to a single entity post-merger. This assignment is purposefully skewed towards mergers that are more likely to have competitive effects and to come under agency review.

Table **??** provides summary statistics across our various simulations.[3] The median average wholesale pre-merger price is almost \$5, and the median average retail pre-merger price is \$13. Because the market size is set to 1, these average prices are equal to total pre-merger expenditures. Pre-merger HHIs range between 2,629 at the 25^{th} percentile to 4,287 at the 75^{th}, with a median of 3,688. HHIs for horizontal downstream mergers increase by 2,027 points at the median, resulting in a median post-merger HHI equal to 4,963. HHIs for upstream mergers increase by 2,040 points at the median, resulting in a median post-merger HHI equal to 5,207. HHIs for vertical mergers increase by 1,292 points at the median, resulting in a median post-merger HHI equal to 6,016.[4] HHIs for integrated mergers increase by 2,800 points at the median, resulting in a median post-merger HHI equal to 7,272. Many of these markets fall into the span designated by the DOJ/FTC Horizontal Merger Guidelines as "Highly Concentrated Markets," with HHIs over 2,500.[5]

Results Overview

Our overall results are depicted in Figure 1, which is divided into four panels, each showing how the distribution of surplus changes for a particular set of agents (consumers, retailers,

[3]The `antitrust` R package contains the computer code needed to calibrate and simulate the effects of mergers in a range of competitive scenarios, including the ones described here.

[4]We compute the post-merger HHI for vertical mergers by calculating the merged firms' market share as the sum of all the shares of downstream products that either incorporate the upstream partner's input or are sold by the downstream partner.

[5]HHI thresholds are discussed in the 2010 Horizontal Merger Guidelines, Section 5.3.

or wholesalers), as well as the net effect on the market as a whole. Surplus is presented as a percentage change relative to total pre-merger expenditure in the downstream market.

Each panel contains four pairs of box and whisker plots, with each pair corresponding to a different type of merger. The blue box and whisker plots (on the left in each pair) depict outcomes assuming that marginal costs are constant, and the orange box and whisker plots (on the right in each pair) show outcomes assuming that marginal costs are linear. The whiskers display the 5^{th} and 95^{th} percentiles of the outcome distribution, the boxes denote the 25^{th} and 75^{th} percentiles, and the solid horizontal line marks the median. Note that negative outcome values imply agent harm, and positive values imply agent benefits.

We focus first on the results for consumers in the left-most panel of Figure 1. The median change is negative, indicating harm, across all four types of mergers for both cost specifications. However, the distributions and magnitudes differ. In Bertrand markets, there is only a partial rank-ordering of consumer harm across different types of mergers: consumer harm from integrated mergers first-order stochastically dominates consumer harm from all other merger types, while downstream and upstream mergers each first-order stochastically dominate consumer harm from vertical mergers, but do not stochastically dominate one other. Median harm from integrated mergers is 20% of pre-merger total expenditures, more than 2 times the magnitude of that from downstream mergers, 3.1 times the magnitude of that from upstream mergers, and 5.4 times the magnitude of vertical mergers. Consumer harm under linear marginal costs first-order stochastically dominates consumer harm under constant marginal costs. The median harm from markets with linear marginal costs is about 6.8% of pre-merger total expenditures, 1.2 times the magnitude of markets with constant marginal costs.

Four types of mergers are unlikely to benefit consumers: upstream under both constant and linear marginal costs, vertical mergers with linear marginal costs, and integrated mergers with linear marginal costs. That upstream horizontal mergers are largely net harmful is

somewhat surprising, as it indicates that any EDM from the unintegrated upstream firm merging with its integrated rival is outweighed by the recapture effect. Similar logic applies to integrated mergers. Likewise, the fact that vertical mergers with linear marginal costs are almost never beneficial when marginal costs are linear is surprising, as it suggests that the incentive to raise rivals' cost dominates the benefit from EDM. **Is it worth exploring which effect dominates: the lessening of EDM or the strengthening of RRC? Maybe do this by allowing assymetric cost structures between merging and non-merging parties?**

Harm is less prevalent for vertical mergers, downstream mergers and integrated mergers when firms have constant marginal costs. Vertical mergers when firms have constant marginal costs benefit consumers in about 33% of all simulations , downstream horizontal mergers benefit consumers in about 13% of all simulations, and integrated mergers benefit consumers in about 4.9% of all simulations. The median consumer benefit among positive outcomes equals 5.9% of pre-merger total expenditures from vertical mergers, 9.5% of pre-merger total expenditures from downstream mergers, and 4.9% of integrated mergers.

Turning to retailers in the second panel of Figure 1, we find that while downstream mergers, vertical mergers and integrated mergers always benefit retailers, upstream mergers harm retailers in about 79% of all simulation. Moreover, there is a partial rank-ordering across mergers: the retailer surplus distribution from integrated mergers first-order stochastically dominates the retailer surplus distribution from downstream mergers, which dominates the retailer surplus distribution from upstream mergers, but not the retailer surplus distribution from vertical mergers. We also find that for vertical and integrated mergers, retailer surplus under constant marginal cost first-order stochastically dominates the retail surplus distribution under linear costs, again suggesting that the incentive to raise rivals' costs dominates the benefits from EDM. By contrast, for downstream and upstream mergers, there is no clear rank-ordering between markets with constant marginal costs and markets with linear costs.

As for wholesaler surplus, which appears in the third panel, the effects seen there are largely the mirror image of those for retailers: upstream mergers increase wholesaler surplus in about 97% of all simulated mergers, while the other merger types decrease wholesaler surplus from anywhere between 81% (downstream mergers) and 68% (integrated mergers) of all simulated mergers. **comparing these results to Sheu/Taragin, the effects are less stark (ie less of a transfer.** Again, we see a a partial rank-ordering across mergers: the retailer surplus distribution from upstream mergers first-order stochastically dominates the retailer surplus distribution from downstream mergers, which dominates the retailer surplus distribution from upstream mergers, but not the retailer surplus distribution from vertical mergers.

In terms of total welfare, with the exception of the approximately 16% of vertical mergers with constant costs that are beneficial, our simulated mergers are almost always net harmful. Moreover there is a complete rank ordering of mergers, with total harm from integrated mergers first-order stochastically dominating total harm from downstream mergers, which dominates total harm from upstream mergers, which dominates totals harm from vertical mergers. Finally, there is little difference in total harm under constant and linear costs, though total harm under linear costs continues to first-order stochastically dominate total harm under constant marginal costs for vertical and integrated mergers.

Variable	Merger	Markets	Min	25th	50th	75th	Max
\# Retailers	All	2,202,997	2	3	4	5	5
\# Wholesalers		2,202,997	2	3	4	5	5
\# Integrated		2,202,997	0	0	1	2	4
Bargaining Power		2,202,997	0.1	0.4	0.6	0.8	0.9
Nesting Parameter		2,202,997	0	0	0	0	0
Avg. Upstream Price ()		2,202,997	0.6	2.2	4.7	9.8	270
Avg. Downstream Price ()		2,202,997	5.8	10	13	19	297
Market Elasticity		2,202,997	-60	-0.85	-0.51	-0.37	-0.23
Pre-Merger HHI	Integrated	384,325	2,205	3,591	4,275	5,358	9,998
	Upstream	701,936	2,011	2,572	3,166	4,257	10,000
	Downstream	654,731	2,008	2,393	2,876	3,794	10,000
	Vertical	462,005	2,100	3,623	4,391	5,679	9,962
Post-Merger HHI	Integrated	384,325	3,633	6,242	7,272	8,648	10,000
	Upstream	701,936	2,931	4,135	5,207	7,391	10,000
	Downstream	654,731	2,915	4,011	4,963	6,780	10,000
	Vertical	462,005	3,120	5,069	6,016	7,293	10,000
Delta HHI	Integrated	384,325	2	2,463	2,800	3,187	5,000
	Upstream	701,936	0	1,431	2,040	2,934	5,000
	Downstream	654,731	0	1,546	2,027	2,891	5,000
	Vertical	462,005	32	1,051	1,292	1,755	4,314

Table 1: Summary Statistics

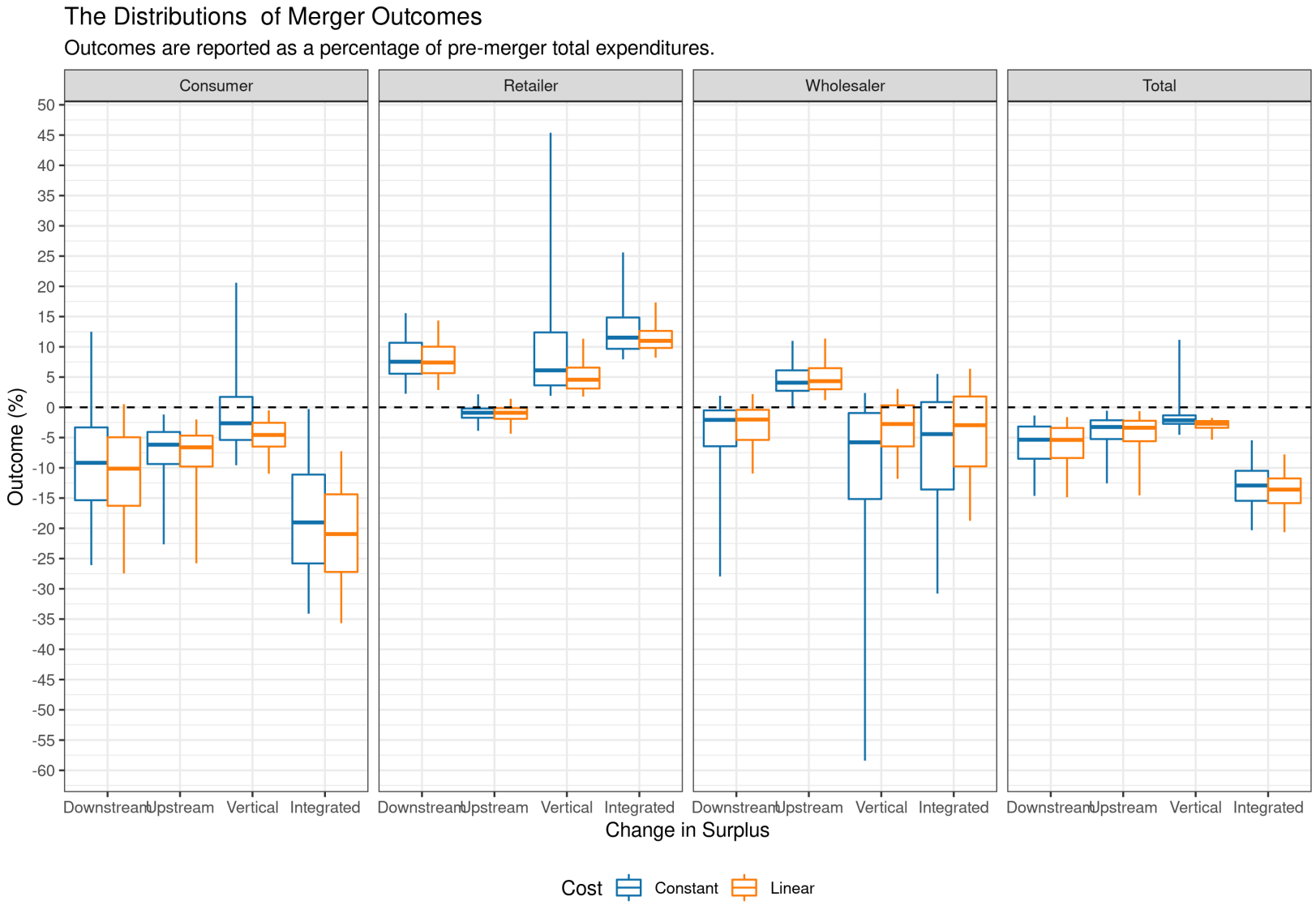

Figure 1 The figure displays box and whisker plots summarizing the extent to which mergers affect consumer, retailer, wholesaler, and total surplus. Each blue box depicts the effects assuming that retailers are playing a Bertrand pricing game. Whiskers depict the 5^{th} and 95^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

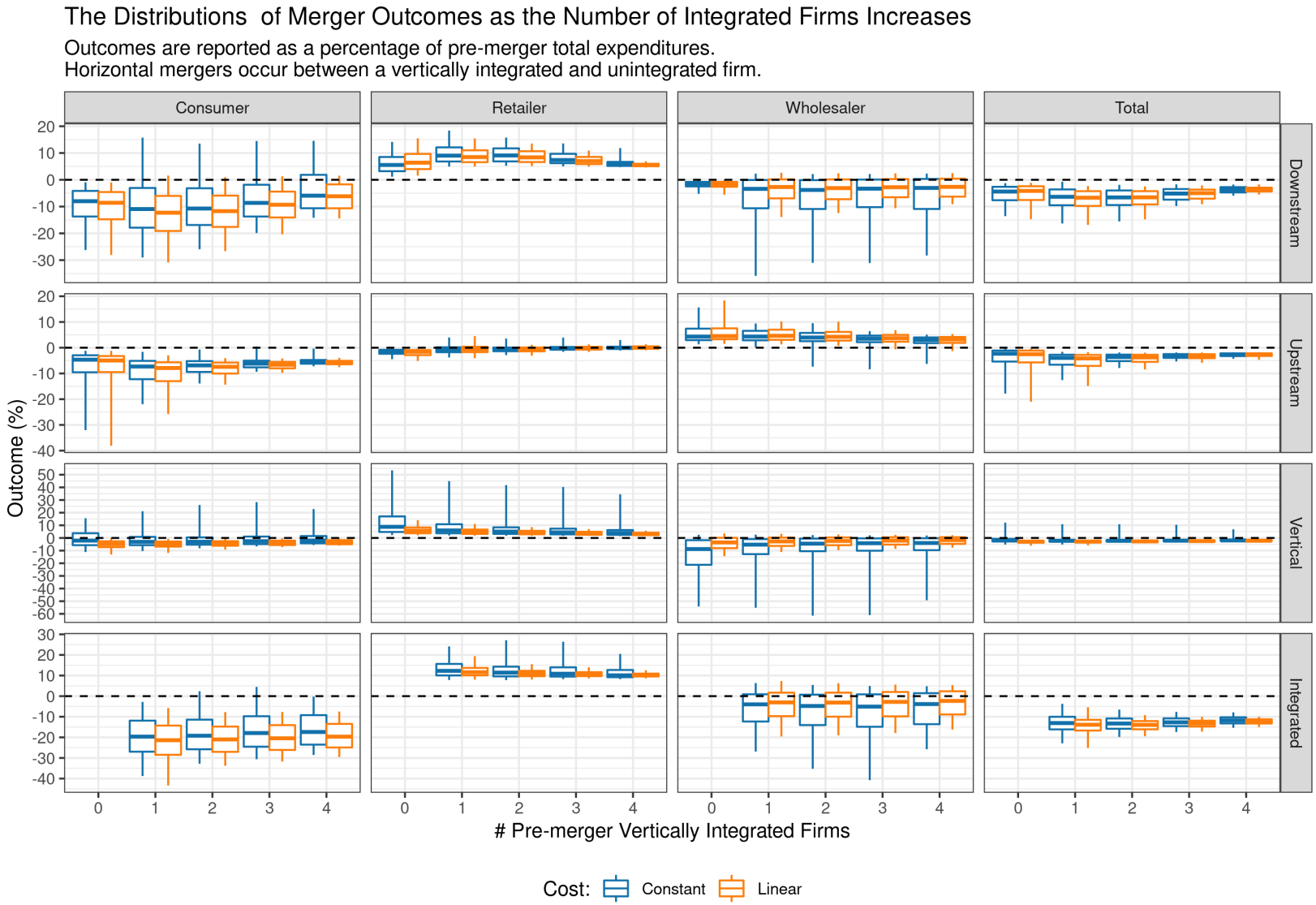

Figure 2 The figure displays box and whisker plots summarizing the extent to which mergers affect consumer, retailer, wholesaler, and total surplus as the number of vertically integrrated firms present in a market change. Each blue box depicts the effects assuming that retailers are playing a Bertrand pricing game. Whiskers depict the 5^{th} and 95^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

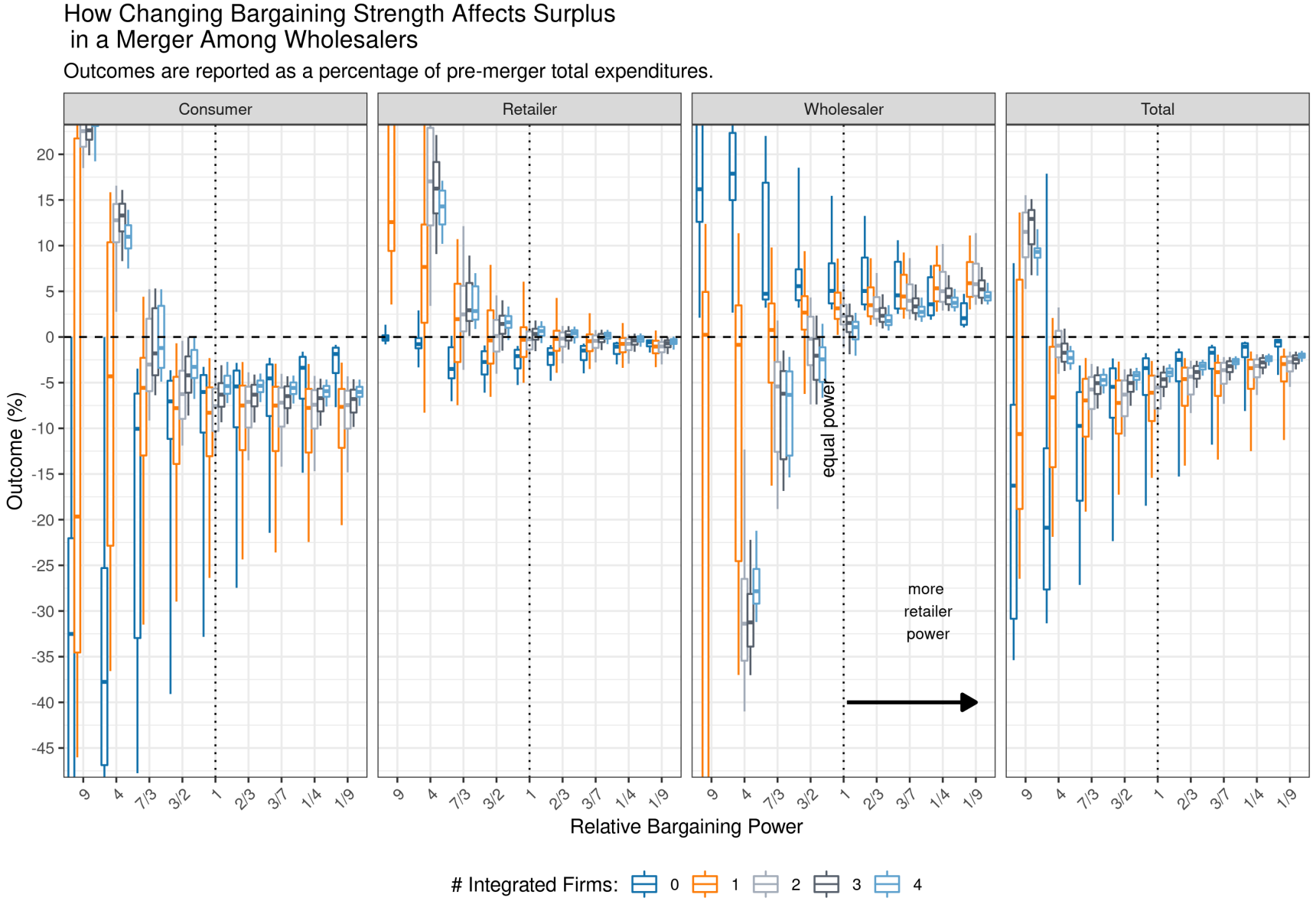

Figure 3 The figure displays box and whisker plots summarizing the extent to which mergers among an integrated and unintegrated wholesaler affect consumer, retailer, wholesaler, and total surplus as the bargaining power of wholesalers relative to retailers changes. The different colored boxes display how outcomes change as the number of vertically integrated firms increases. Whiskers depict the 5^{th} and 95^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

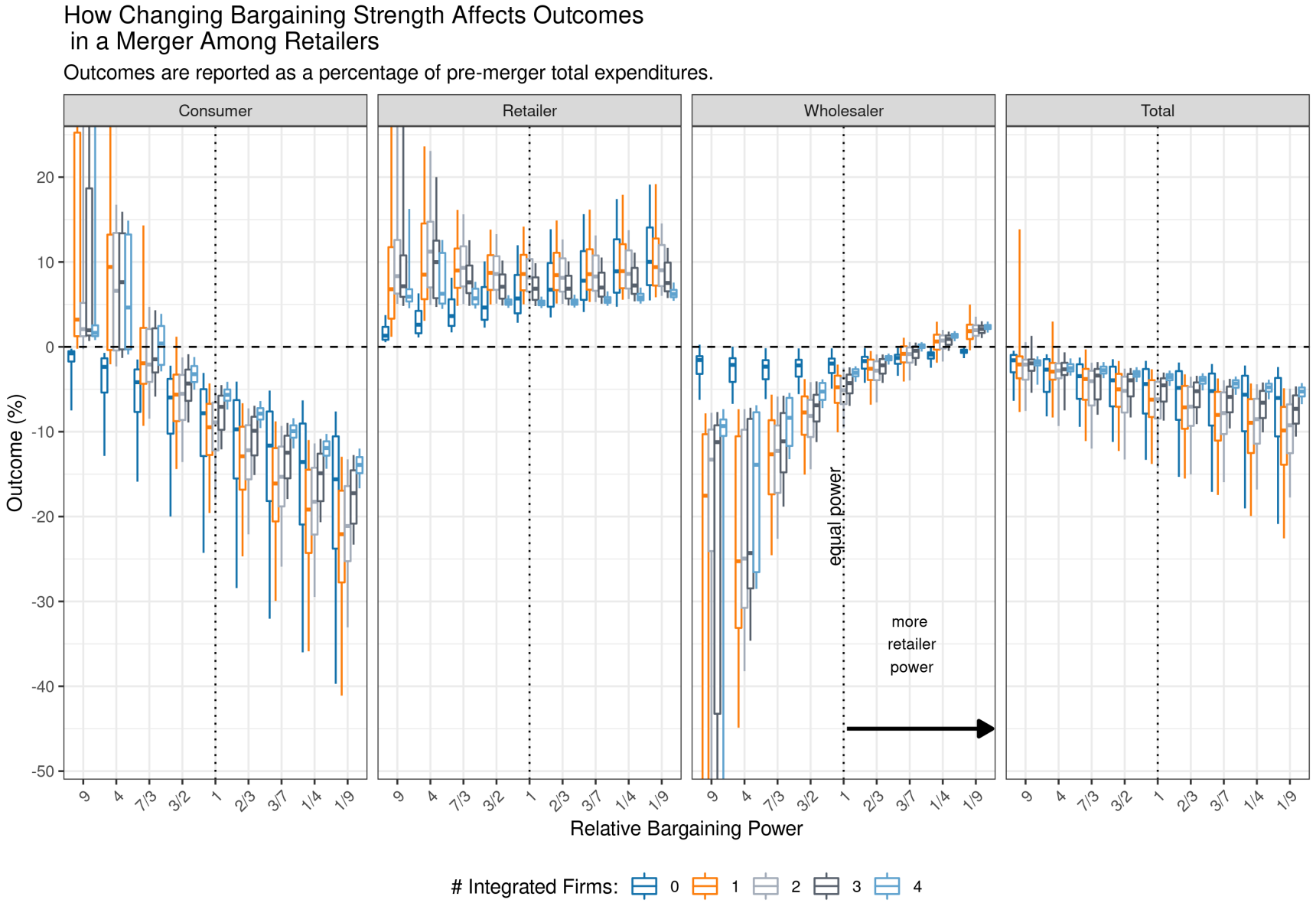

Figure 4 The figure displays box and whisker plots summarizing the extent to which mergers among an integrated and unintegrated retailer affect consumer, retailer, wholesaler, and total surplus as the bargaining power of wholesalers relative to retailers changes. The different colored boxes display how outcomes change as the number of vertically integrated firms increases. Whiskers depict the 5^{th} and 95^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

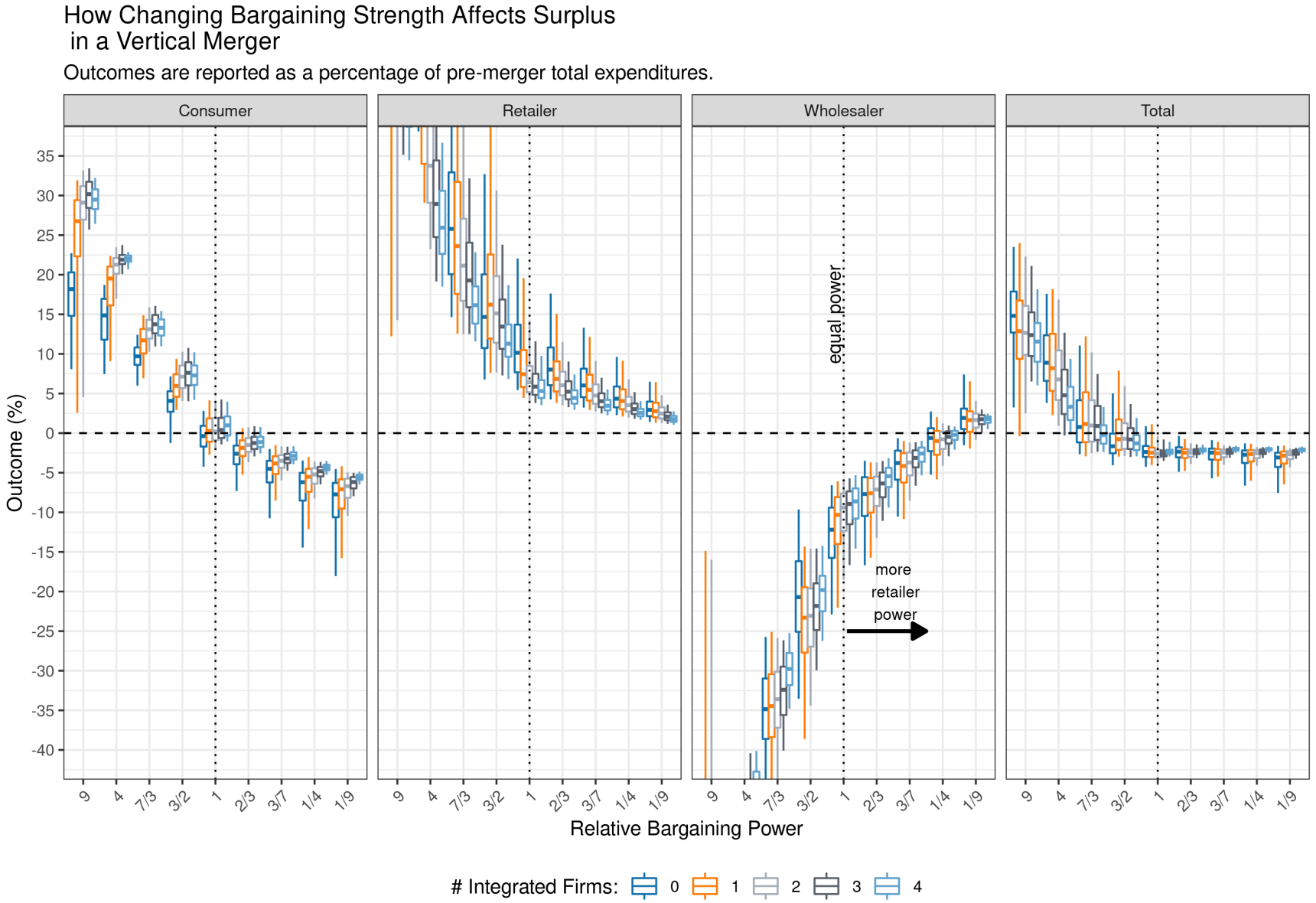

Figure 5 The figure displays box and whisker plots summarizing the extent to which mergers among an unintegrated wholesaler and unintegrated retailer affect consumer, retailer, wholesaler, and total surplus as the bargaining power of wholesalers relative to retailers changes. The different colored boxes display how outcomes change as the number of vertically integrated firms increases. Whiskers depict the 5^{th} and 95^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.

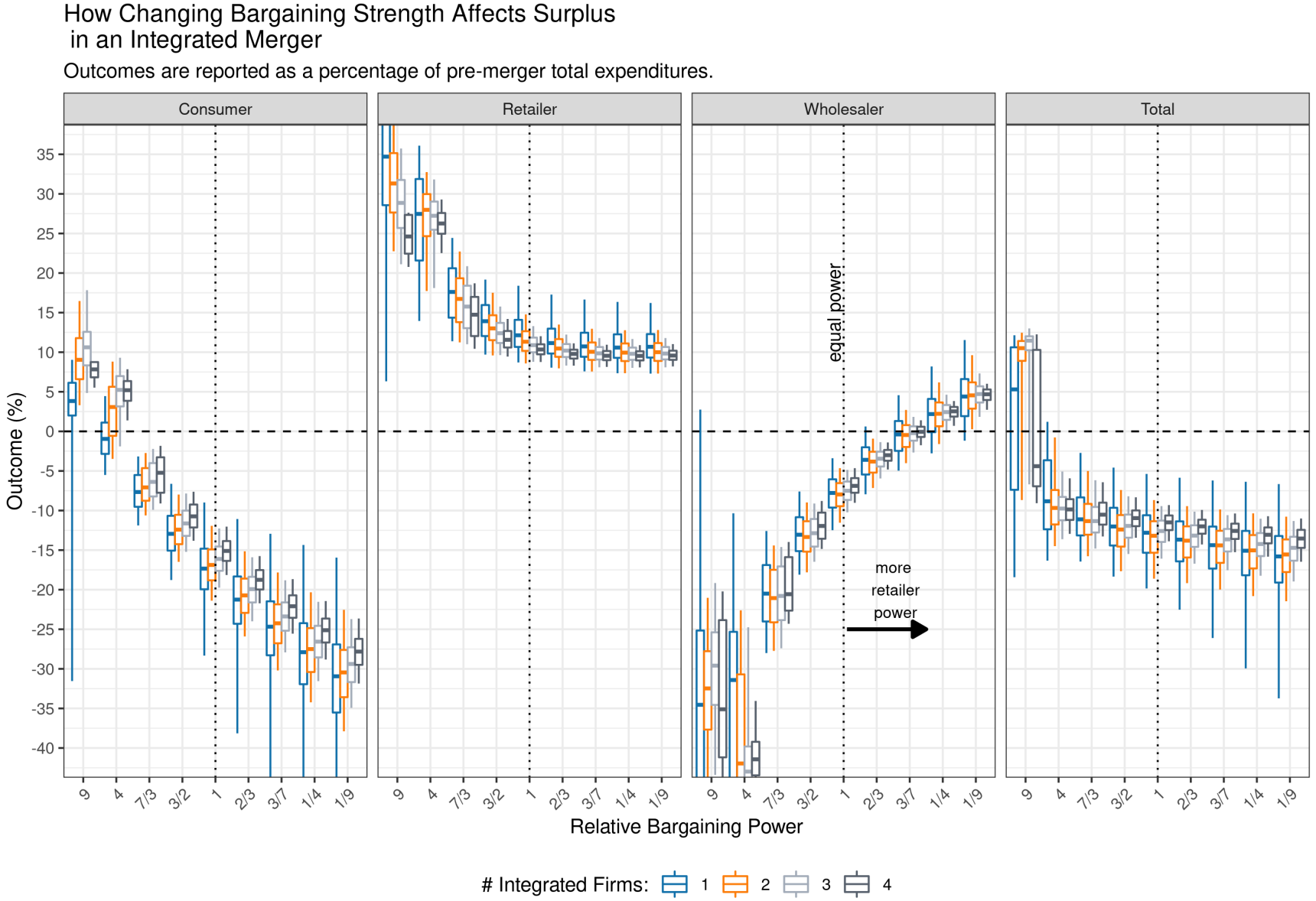

Figure 6 The figure displays box and whisker plots summarizing the extent to which mergers among two integrated wholesalers and retailers affect consumer, retailer, wholesaler, and total surplus as the bargaining power of wholesalers relative to retailers changes. The different colored boxes display how outcomes change as the number of vertically integrated firms increases. Whiskers depict the 5^{th} and 95^{th} percentiles of a particular outcome, boxes depict the 25^{th} and 75^{th} percentiles, and the solid horizontal line depicts the median.