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Abstract

In 2018, Agrium and PotashCorp merged to become the world's largest manufacturer of potash, from which potassium is extracted for use as one of the three main nutrients in agricultural fertilizer. The merged firm held a 60 percent share of North American capacity, suggesting the merger may have been close to the enforcement margin. This paper studies the effects of the merger on North American potash prices relative to offshore prices and other crop nutrients. The evidence does not indicate that the firms were able to impose an anticompetitive price increase in the wake of the merger.

1. Introduction

Renewed calls to strengthen antitrust enforcement, and merger review in particular, often aim to use these policy tools as potential vehicles for increasing economic growth and reducing inequality.[1] While these arguments generally present aggregate statistics, merger review is conducted on a case-by-case basis. Retrospective analysis of mergers near the enforcement margin helps inform the question of whether current antitrust policy is too strong or too weak. This paper studies the merger of two North American crop nutrient fertilizer manufacturers, which is a particularly fitting subject because the agricultural sector is one of the areas where observers have noted concerns about rising concentration leading to higher input prices paid by farmers and higher food prices paid by consumers.[2] Focusing on agriculture also broadens the scope of the merger retrospective literature, which tends to study retail and formerly regulated industries, where data is more readily available.

Three primary nutrients – nitrogen, phosphate, and potassium (potash) – are used to make agricultural fertilizer. While each nutrient requires a different production process, several manufacturers produce all three. When Agrium and PotashCorp announced a $36 billion merger to form the world's largest crop nutrient company in September 2016, some industry observers expected antitrust authorities to focus their regulatory review on potash, as the companies controlled 60 percent of North American potash capacity, compared to roughly 30 percent for nitrogen and phosphate.[3]

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[*] The views expressed in this article are those of the author and do not necessarily represent those of the Federal Trade Commission, or any individual Commissioner. I am grateful to Lou Silvia, Dave Schmidt, Dan Hosken, Dan Greenfield, and Andrew Sweeting for comments on earlier drafts.

[1] Jason Furman, "Beyond Antitrust: The Role of Competition Policy in Promoting Inclusive Growth," remarks at the Searle Center Conference on Antitrust Economics and Competition Policy, September 16, 2016, referencing the Council of Economic Advisors' April 2016 issue brief "Benefits of Competition and Indicators of Market Power."

[2] The CEA report cites to reports by Fuglie et al. (2012) from the Economic Research Service of the US Department of Agriculture and Shields (2010) from the Congressional Research Service. However, note also that a Government Accountability Office (2009) analysis found that "Based on our review, empirical economic literature has not established that concentration has adversely affected commodity or food prices in these agricultural sectors."

[3] Reuters, "Potash Corp, Agrium talk merger; competition scrutiny expected." August 30, 2016.

After negotiating settlements with antitrust authorities in multiple countries, the companies completed the merger on January 2, 2018, renaming the firm Nutrien.[4] The U.S. Federal Trade Commission required divestitures of a nitrogen plant and a phosphate facility.[5] Competition authorities in China and India required PotashCorp to divest minority holdings in other potash businesses based in Jordan, Israel, and Chile.[6] However, the merged firm retained all of its North American potash assets.

In light of the merged firm's combined share of North American potash capacity, this study analyzes the effect of the Agrium/PotashCorp merger on potash prices in the "Corn Belt" region of the United States. Using a difference-in-differences approach with a variety of control markets and under several alternative specifications, the results suggest that North American potash prices did not increase after the merger. While this finding is consistent with the merger having no anticompetitive impact, it is difficult to isolate the merger's effect from that of contemporaneous capacity additions as well as developments in international trade policy.

Difference-in-differences requires identification of one or more control markets that experience similar demand and cost shocks. First, I compare potash prices in the Corn Belt and Brazil, the world's largest potash import market. Because the geographic market for potash may be broader than North America, as an alternative control I consider a the price of a different grade of potash sold in Southeast Asia, where it is consumed relatively more heavily than in North America. Finally, I turn to the other two primary crop nutrients, nitrogen and phosphorus, as potential controls. A drawback is that the production process, particularly for nitrogen, differs for these nutrients to a larger degree than other grades of potash. However, as these nutrients are complements, demand for any one of them derives from overall demand for agricultural commodities. Therefore, demand is highly correlated across nutrients.

The next section describes the institutional details of the potash market and events leading up to the merger, including a history of potash export cartels. Section 3 describes the available data and research design. Section 4 presents results, and Section 5 concludes.

2. Background

All plants require relatively large amounts of nitrogen, phosphorus, and potassium. These three "macronutrients" are just as necessary as water, sunlight, and carbon dioxide. Different soils naturally contain different levels of each nutrient, and different crops absorb them in varying proportions. The manner in which a crop is harvested also affects the need to replenish nutrients in the soil.

The three macronutrients play complementary roles in plant development. Nitrogen is responsible for the growth of leaves and other plant tissues. Phosphorus stimulates root development and fosters drought resistance. Potassium is central to photosynthesis, but also helps plants resist disease and extreme temperatures, improving overall crop quality and yield.

[4] Nutrien, Ltd. Press Release, "Agrium and PotashCorp Merger Completed Forming Nutrien, a Leader in Global Agriculture."
[5] Federal Trade Commission, "FTC Requires Canadian Fertilizer and Chemical Companies PotashCorp and Agrium to Divest 2 Production Facilities as Condition of Merger."
[6] Agrium press releases on October 18, 2017 and November 7, 2017. PotashCorp also had a minority investment in a Chinese potash subsidiary, which it was required to convert to a passive stake.

The term potash refers to a variety of minerals containing potassium. The most common use for potash is as an agricultural fertilizer, usually as potassium chloride (KCl). Potash fertilizer is commonly sold as muriate of potash, or MOP, which contains at least 95 percent KCl.

Two-thirds of global potash reserves lay in evaporated sea beds in Canada, Russia, and Belarus.[7] Mines extract potash ore from underground. The ore is then refined into standard-grade product or a higher-quality granular product. While plant growth depends only on overall potassium content, which is generally identical in the two grades of potash, granular MOP is more evenly sized, allowing for more accurate placement for farmers able to invest in such equipment. As a result, granular MOP is relatively more popular in wealthier regions (North America, Europe, and Brazil) while standard MOP is the product of choice in China, India, and Southeast Asia.

Table 1 displays approximate global potash mine capacities at the time of the Agrium/PotashCorp merger. The major North American producers were Agrium, PotashCorp, and Mosaic, with most of their mines in Saskatchewan. In June 2017, K+S, a German potash producer, commenced production at a new 2.0 Mt/y (million metric tons per year) mine in Saskatchewan. K+S had spent five years and over $3 billion to construct the mine.[8] The "Other" category in Table 1 includes a small amount of U.S. production in New Mexico and Utah, but this makes up less than 1 Mt/y.

Table 1: Approximate Global Potash Mine Capacities (Mt/y, KCl equivalent)[9]

Company	Location(s)	Capacity	Share
PotashCorp	Canada	19.1	20%
Agrium	Canada	3.0	3%
Mosaic	Canada	11.9	12%
Uralkali	Russia	12.4	13%
Belaruskali	Belarus	12.8	13%
K+S	Germany, Canada	7.0	7%
ICL	Israel, Spain, UK	5.5	6%
Chinese Companies[10]	China	10.4	11%
Other[11]		13.7	14%
Total		95.8	

In 2016, the world consumed approximately 60 Mt of potash. North American potash consumption amounted to roughly 8.5 Mt in 2016, of which the U.S. portion was 7.1 Mt. Most U.S. consumption is in the Corn Belt region. According to USGS, around 80-85 percent of U.S. imports are from the Canadian producers. These imports likely arrive via rail from Saskatchewan. Uralkali and Belaruskali provide the

[7] Potash can also be harvested from the brines in certain saltwater bodies, using solar evaporation. This method accounts for less than 15 percent of global potash capacity.
[8] See https://www.mining.com/ks-bethune-mine-canada-churns-first-tonnes-potash/23/.
[9] Sources: Nutrien's 2018 Factbook, the US Geological Survey's Potash Statistics and Information publications, Agrium and PotashCorp's September 2016 investor presentation announcing the merger (available at http://www.ureaknowhow.com/ukh2/images/stories/worldnews/AGU-POT-Presentation.pdf), and the International Fertilizer Association. Swiss producer Eurochem was finalizing construction of two new potash mines in Russia, but only one of these began production by 2018 so these mines are excluded from the table. See https://www.eurochemgroup.com/project/eurochem-usolskiy-potash/.
[10] There are nominally over 30 Chinese potash producers, but USGS notes that most capacity is concentrated in three firms. Industry observers often treat them as a single entity.
[11] Roughly half of the capacity in "Other" consists of Arab Potash Company in Jordan, SQM in Chile, and Intrepid Potash and Compass Minerals in the U.S.

vast majority of remaining U.S. imports, with delivery to the Corn Belt taking place through the port of New Orleans and Mississippi River barges.

The world's largest potash import market is Brazil (9.0 Mt in 2016 imports), where the potassium-deficient soils need regular replenishment.[12] The spot market for granular potash in Brazil is a common price benchmark. While other import markets typically operate on a spot basis, China (7.0 Mt) and India (3.9 Mt) typically negotiate annual contracts for standard grade potash imports.[13] Since 1972, Agrium, PotashCorp, and Mosaic have coordinated all of their offshore potash sales through Canpotex, which operates as an export cartel for all customers outside Canada and the U.S.[14] Uralkali and Belaruskali operated a similar export cartel until it collapsed in July 2013.[15]

If the geographic market for potash is global, Table 1 indicates that the Agrium/PotashCorp merger would not have had a large impact on market structure. By the standards set forth in the FTC/Department of Justice *Horizontal Merger Guidelines*, the post-merger market would be unconcentrated based on global potash capacities. By contrast, Table 2 shows that capacity shares in North America are significantly higher. The elasticity of offshore import supply likely plays a key role in whether the merger could lead to an increase in North American prices.

Table 2: Approximate North American Potash Mine Capacities (Mt/y, KCl equivalent)[16]

Company	Location(s)	Capacity	Share
PotashCorp	Canada	19.1	51%
Agrium	Canada	3.0	8%
Mosaic	Canada, USA	12.8	34%
K+S	Canada	2.0	5%
Intrepid Potash	USA	0.4	1%
Compass Minerals	USA	0.3	1%

Some observers viewed the merged firm as the marginal supplier of potash to North America, if not the world.[17] A global potash market would invalidate the difference-in-differences econometric approach of comparing domestic and offshore prices, because any changes in market power would affect both.

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[12] See https://www.canpotex.com/our-business/marketing/our-potash-markets/brazil; import figures from Nutrien's 2018 Factbook,

[13] Industry reports, as well as market participants, often refer to a single contract between an exporter and several buyers in China (and likewise for India). See, e.g. Canpotex News Release, "Indian Companies to Buy More Saskatchewan Potash," Nov. 20, 2014; describing an "Enhanced Market Development Agreement" between Canpotex and three Indian companies, the signing of which was witnessed by the Canadian premier and representatives of the Indian Ministry of Agriculture. See also Kulkarni, K. and R. Nickel, "India has enough potash to keep Canpotex waiting," *The Globe and Mail*, Jan. 17, 2013; noting that "India and China have long bought potash through contracts, rather than on the spot market from the big producers, and usually at market-low prices. China signed its most recent deal in December, ending a long holdout, and India last inked a contract in August 2011."

[14] K+S does not participate in Canpotex; see "K+S says EU law keeps it from joining Canpotex", *Reuters*, Nov. 29, 2011.

[15] A. McDonald, "How a Potash Cartel Collapsed," *The Wall Street Journal*, Dec. 14, 2015.

[16] Compass Minerals produces sulfate of potash (SOP). Sulfur is also a crop nutrient but less critical than nitrogen, phosphorus, and potash. Similalry, until 2014 Mosaic produced MOP at a mine in New Mexico, but has converted production there to a product known as SOP-M, which contains both sulfur and magnesium. Inclusion or exclusion of these capacities does not meaningfully affect the shares in Tables 1 and 2.

[17] Silver Coast Research, "Nutrien: The Potash Market's Swing Producer?", Aug. 30, 2018. See also R. Nickel & B. Lewis, "Nutrien steers potash recovery as BHP waits in the wings," *Reuters*, Aug. 20, 2018.

However, in this case, a comparison with the prices of other crop nutrients could still be informative as to the merger's impact.

Phosphorus fertilizer supply shares many similarities with potash. Production begins with the mining of phosphate rock. Phosphate rock is dissolved into phosphoric acid, which can be used to make dry and liquid phosphorus fertilizers. According to USGS, three-quarters of US phosphorus production occurs in Florida and North Carolina, with the balance in Idaho and Utah.[18] Imports, almost entirely from Peru and Morocco, accounted for 2-5 percent of US phosphate rock supply between 2015 and 2018. Prior to the merger, Agrium and PotashCorp had a combined share of 25 percent of North American phosphoric acid capacity. Three other firms, led by Mosaic, accounted for the balance.

Relative to potash and phosphorus, nitrogen offers a contrast in production and market structure. Nitrogen-based fertilizers are derived from ammonia (NH_3), which is typically manufactured by reacting the methane (CH_4) in natural gas with atmospheric nitrogen (N_2). As nitrogen is the most abundant element in the atmosphere, access to natural gas drives plant location with Oklahoma, Louisiana, and Texas accounting for half of US capacity. USGS reports that 15 companies produced ammonia at 32 plants in 16 states in 2017. Agrium and PotashCorp combined for 30 percent of North American ammonia capacity prior to the merger. For use as a fertilizer, ammonia is reacted with carbon dioxide to create synthetic urea. While the urea (nitrogen) market may not share the same cost structure as potash, production is much less concentrated and it potentially presents a useful competitive benchmark.

In addition to difficulties in choosing an appropriate control market, developments in international trade policy may complicate identification of any post-merger change in potash pricing. A substantial reduction in Chinese purchases of U.S. soybeans in 2019 may have caused Corn Belt farmers to shift to corn production, which is a more nitrogen-intensive crop.[19] In addition, China banned seaborne imports of potash for large parts of 2019.[20] Producers, including Nutrien, Mosaic, and Belaruskali, announced cuts in potash production in mid- to late 2019.[21] Proposed changes to the royalty rate charged on potash mining by the provincial government in Canada created additional uncertainty around the same time.[22]

In summary, if the analysis were to show that potash prices increased after the merger of Agrium and PCS, that would be consistent with the theory that competition from importers and K+S's entry were insufficient to offset an anticompetitive merger effect. A price decrease would be more difficult to interpret, but potentially consistent with the merger having no anticompetitive effects. Analyzing merger effects relative to multiple control markets is useful given that each option has potential drawbacks.

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[18] US Geological Survey, Phosphate Rock Statistics and Information.
[19] World Bank, "Fertilizer Market Outlook", June 3, 2019.
[20] See https://www.kpluss.com/en-us/press/press-releases/KS-reduces-potash-production/.
[21] K. Keen (S&P Global Market Intelligence), "Potash cuts aimed at bolstering spot prices amid weak market, analysts say", Sep. 13, 2019. Note, however, that Mosaic's decision to idle its Colonsay mine is somewhat offset by its planned opening of a new, lower cost mine (known as "K3") nearby.
[22] P. Sinkewicz, "Potash production faces challenge of cost vs. market price", *The Saskatoon Star-Phoenix*, May 24, 2019.

3. Data and Research Design

Data for this study come from Mosaic, a producer of all three macronutrients, which publishes average weekly spot prices for several crop nutrients in multiple international markets.[23] I aggregate the data to the monthly level to reduce the impact of serial correlation. The primary data series of interest is the price for granular potash in the Corn Belt.

The most intuitive control market is the price for granular potash in Brazil, the world's largest international potash market. Because Agrium and PotashCorp only sold potash into Brazil (and all other offshore markets) through Canpotex, the merger should have no direct effect on offshore potash prices. For Brazil to be a valid control, the Corn Belt and Brazil need to reside in separate geographic markets. A global potash market would undermine this econometric approach, and would also weaken the structural basis on which to presume the merger could have anticompetitive effects.

An alternative control market available in the data is the price for standard potash in Southeast Asia.[24] To the extent that geography is a good but imperfect delineation between treatment and control markets, considering a different grade of potash may add a degree of differentiation in the product market dimension as well.

Domestic prices for the two other key nutrients offer potential control markets as well, so long as the merger did not affect these markets.[25] A key marker for nitrogen-based fertilizer is the New Orleans spot price for urea. The primary phosphate-based fertilizer is di-ammonium phosphate, or DAP. The Tampa spot price is an oft-cited benchmark for DAP due to the presence of large phosphate mines in central Florida. Table 3 provides summary statistics for each of these spot prices.

Table 3: 2015-2019 Crop Nutrient Prices, Mean and Standard Deviation ($ per Metric Ton)

	MOP Corn Belt		MOP Brazil		Std. MOP SE Asia		DAP Tampa		Urea NOLA	
Year	Mean	StdDv	Mean	StdDv	Mean	StdDv	Mean	StdDv	Mean	StdDv
2015	395.6	39.8	324.1	29.5	322.2	12.7	459.2	25.8	313.1	40.3
2016	266.6	15.6	231.6	9.7	253.5	14.6	346.5	19.2	227.1	28.0
2017	279.7	4.3	262.3	11.7	248.9	5.0	353.8	17.3	229.1	32.9
2018	316.2	20.9	322.3	26.8	284.2	16.1	418.2	14.0	285.0	32.8
2019	329.7	20.5	329.6	23.8	297.0	10.1	344.4	47.0	268.7	19.6

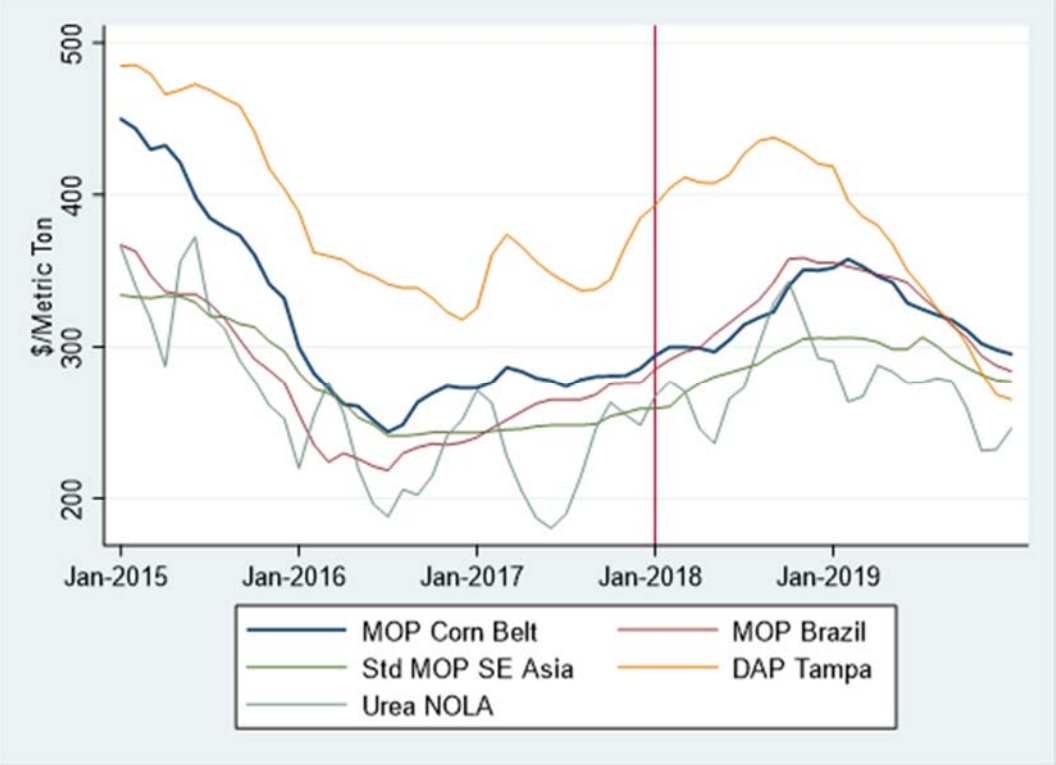
[23] Mosaic Plant Nutrient Price Dashboard, available at http://www.mosaicco.com/resources/3185.htm.

[24] Mosaic cites to a variety of price reporting services in its weekly price dashboards, so the extent of "Southeast Asia" is unclear. For one reporting service, Argus Media, the Southeast Asia spot market for standard grade potash appears to consist largely of Indonesia and Malaysia. These transactions are potentially influenced by demand and supply conditions in China and India, which also mostly consume standard grade potash. Other Southeast Asian countries, such as Vietnam and Thailand, appear to consume mostly granular potash. See Argus Media Group, "Argus *Potash* Issue 18-39," Sep. 27, 2018 (sample report available free online as of Feb. 14, 2020).

[25] Notably, the FTC's required divestitures aimed to do just that. It is also worth noting that the divested facilities are somewhat removed from the spot prices available in the Mosaic data. The nitrogen facility only produced nitric acid, which is a feedstock in the production of nitrogen fertilizer (urea) but also has industrial uses. The FTC complaint (see footnote 5) noted that the affected customers in the nitrogen divestiture ranged from Kentucky to New Jersey. The divested phosphate facility produced a liquid phosphate fertilizer, which is distinct from the dry fertilizer (DAP) used in this study. As noted in the FTC's complaint, the price difference between liquid and dry phosphate "has at times expanded significantly without prompting customers to shift their purchases from liquid to dry phosphate fertilizers." See footnote 5.

Figure 1 plots each of the price series, with the thicker line representing the potash (MOP) price in the Corn Belt. The other potash prices, in Brazil and (for standard grade) in Southeast Asia, follow similar trends before and after the merger. All crop nutrient prices were trending upward just prior to merger, and followed that trend in the year after the merger. Prices generally began to decline in 2019, although the benchmark phosphate price (DAP Tampa) falls more rapidly than the other nutrients.[26] Throughout the entire sample, the benchmark nitrogen price (urea NOLA) is more volatile than the other price series.

Figure 1: Monthly Crop Nutrient Prices



I use variations of a difference-in-differences approach to attempt to identify any impact of the Agrium/PotashCorp merger on potash prices. This is a standard approach in the merger retrospective literature; see Weinberg (2008). The baseline approach uses the Corn Belt potash price as the treatment relative to a potential control market, by estimating the following equation:

(1) $$\ln p_t^T - \ln p_t^C = \alpha + \gamma X_t + \beta * PostMerger_t + \varepsilon_t$$

X_t can include monthly average U.S. corn prices to control for demand shifts and monthly average hourly earnings for Saskatchewan employees in the mining sector to control for costs.[27] Unfortunately, similar

[26] Capacity additions in Morocco, home to 70 percent of global phosphate reserves, combined with weak demand appeared to drive the DAP price decline in 2019. See World Bank, "Fertilizer Market Outlook," footnote 19. By contrast, potash capacity additions – including, notably, K+S's mine in Canada, fell short of projected 2019 production.

[27] Average U.S. Corn Prices Received from USDA, available at http://www.nass.usda.gov/Charts_and_Maps/Agricultural_Prices/pricecn.php. Saskatchewan mining wages from Statistics Canada, Table 14-10-0205-01, Average hourly earnings for employees paid by the hour, by industry,

controls are not available in every control market, so these shifters are sometimes excluded as a robustness check. In every specification, X_t incorporates monthly dummies to allow for seasonality. Crop nutrient fertilizers can be applied in spring alongside seed planting, or after the fall harvest. Fertilizer is bought and sold year-round, and easily inventoried at various stages of the supply chain.

I estimate equation (1) via OLS separately for each of the available control markets. The identifying assumption is that supply and demand shocks not included in X_t affect treatment and control markets equally. In that case, differencing allows us to interpret β as the (log-point) change in prices associated with the merger. Given trade-related developments in 2019, alternate versions of (1) estimate the post-merger variable separately for 2018 and 2019.

As an alternative specification, I also estimate the full panel of data using the following equation:

$$\ln p_{it} = \alpha_i + \gamma X_t + \sum_{\tau} \delta_\tau * 1(\tau = t) + \beta * 1(i = MOPCornBelt) * PostMerger_t + \varepsilon_{it} \quad (2)$$

Here, each α_i is a fixed effect for each crop nutrient price. The δ's are time fixed effects that absorb seasonality, but also allow for common shocks across all crop nutrient prices in a given month/year.[28] Thus, the results from equation (2) are not necessarily the simple averaging of results from equation (1). The coefficient of interest remains β, which measures the log-point change in the price of Corn Belt potash after the merger, relative to changes in the other spot prices. Another strategy is to interact the time fixed effects with a North American indicator and then a MOP indicator. This controls for common time effects among North American fertilizer prices and common time effects among global potash prices.

As a final specification check, I adapt an approach from Ashenfelter et al. (2013) and use the following equation to examine more closely any differences in pre-merger trends between Corn Belt potash prices and other nutrients:

$$\ln p_{it} = \alpha_i + \gamma X_t + \sum_{\tau} \delta_\tau^C * 1(\tau = t) + \sum_{\tau} \delta_\tau^T * 1(\tau = t) * 1(i = MOPCornBelt) + \varepsilon_{it} \quad (3)$$

Equation (3) estimates time fixed effects separately for control (C) and treatment (T) markets, where the only treated group is the Corn Belt potash price. This equation allows me to examine whether the assumption of similar pre-merger trends in the treatment and control prices after controlling for other observables, which is implicit in equations (1) and (2), is consistent with the data.

In estimating equations (1)-(3), I calculate Newey-West standard errors to account for heteroscedasticity and first-order serial correlation.

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monthly, unadjusted for seasonality. Results are generally robust to exclusion of these controls, neither of which is perfect. As noted above, higher potash prices could be a cause of higher corn prices. Likewise, as discussed below, the merger could potentially enhance monopsony power and affect mining wages.

[28] Estimating separate time fixed effects for each crop nutrient would arguably be more consistent with equation (1), but would create collinearity with the *PostMerger* variable. A linear or polynomial time trend would avoid this problem. When a time trend is included, the estimated coefficient on *PostMerger* is generally statistically indistinguishable from zero. But the sign of the coefficient can vary with the exact form of the time trend. This sensitivity leads me to prefer the less parametric approach of using time fixed effects.

4. Results and Discussion

As context for estimating equation (1), Figure 2a plots the log-point difference between the price of Corn Belt MOP and the price of Brazil MOP, as well as the difference between the Corn Belt (granular MOP) and Southeast Asia (standard MOP) prices. Figure 2b plots the difference between Corn Belt MOP and nitrogen (urea) and phosphate (DAP) prices. For each of the available control markets, the figures generally do not show an increase in the price difference – the dependent variable in equation (1) – after the merger closed in January 2018. The only exception is that the difference relative to DAP increases in 2019, but as seen in Figure 1 this is more an artifact of declining DAP prices than increasing MOP prices.

Figure 2a: Log Price Differences between Corn Belt Potash Prices and Other Potash Benchmarks

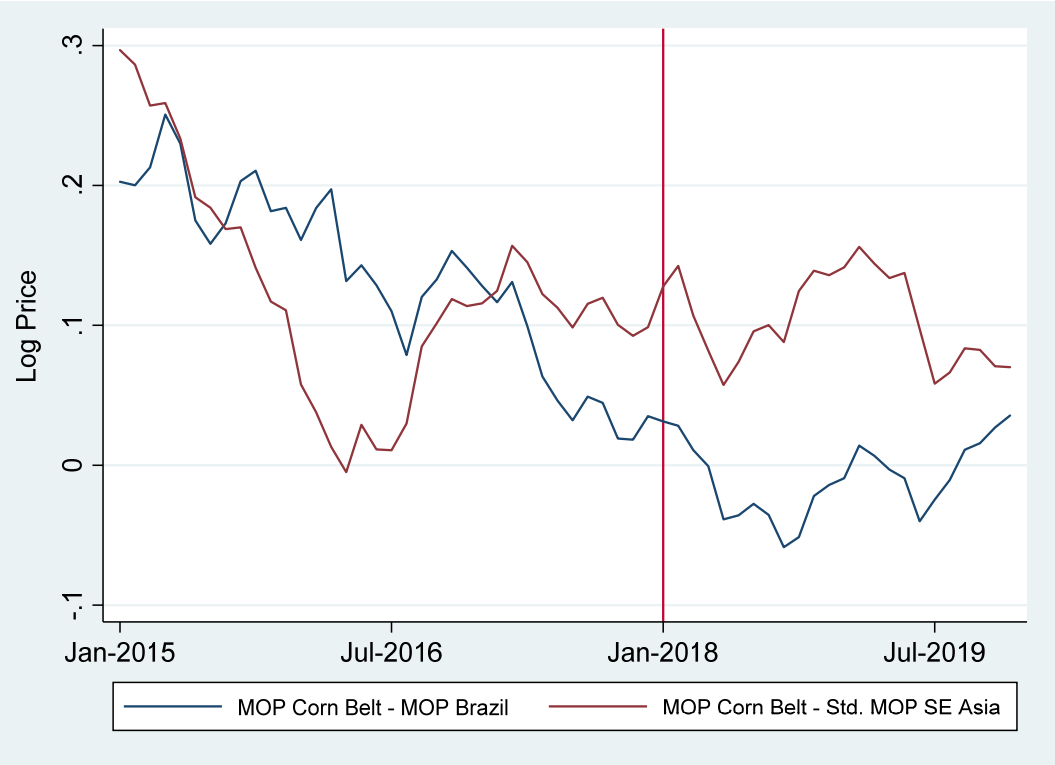


Figure 2b: Log Price Differences between Corn Belt Potash Prices and Other Nutrients

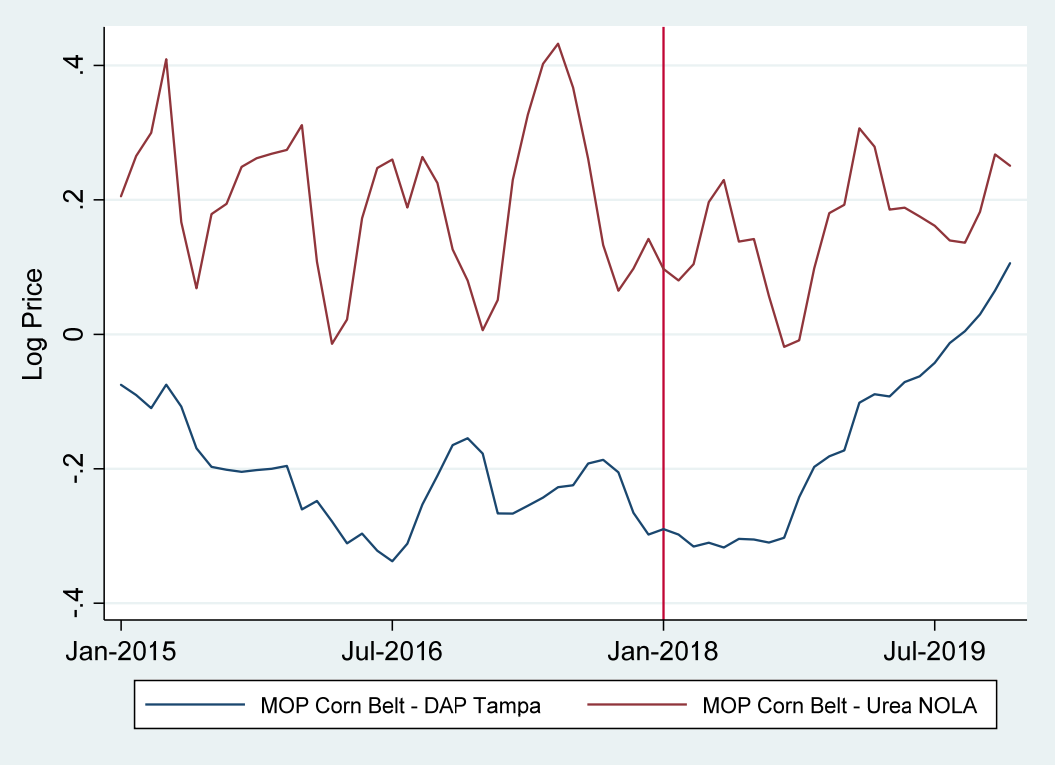


Table 4 presents the results of estimating equation (1) separately for each available control market: the prices of granular potash (MOP) in Brazil, standard MOP in Southeast Asia, phosphate (DAP) in Tampa, and nitrogen (urea) in New Orleans. The baseline result in column (1) of Table 4 shows a 0.143 log-point decline (or 15.4 percent) in Corn Belt potash prices relative to Brazil potash prices after the merger. Had the merger caused Corn Belt prices to increase relative to the control, we would have expected the opposite sign. Columns (2)-(4) show similar effects when estimating the merger effect separately by year, and when controlling for corn prices and mining wages. The controls enter with the expected signs.

Columns (5)-(8) repeat the exercise for Corn Belt potash prices relative to standard-grade potash prices in Southeast Asia. The estimated merger effects are all negative, but smaller and not statistically different from zero. Columns (13)-(16) tell a similar story for urea (nitrogen fertilizer) prices, although the effects are larger in magnitude and more often statistically significant. The only control market against which Corn Belt potash prices do not decline is for DAP (phosphate fertilizer). It appears that prices decreased in the first year after the merger, but then increased in 2019, as seen in columns (10) and (12). This result corresponds with industry reports of significant international phosphate capacity additions in 2019 (see footnote 26) which appear to have led to decreasing DAP prices (see Figure 1). Thus, it is difficult to conclude that this one category with a positive and statistically significant result should be interpreted as evidence of an anticompetitive effect of the merger.

Table 4: Estimated Merger Effects Relative to Individual Control Markets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CONTROL MARKET:	MOP Brazil	MOP Brazil	MOP Brazil	MOP Brazil	Std. MOP	Std. MOP	Std. MOP	Std. MOP
Year=2018		0.152***		0.147***		0.017		0.017
		(0.016)		(0.017)		(0.022)		(0.021)
Year=2019		0.134***		0.194***		0.019		0.059
		(0.019)		(0.017)		(0.021)		(0.036)
PostMerger (2018-19)	0.143***		0.164***		0.018		0.032	
	(0.017)		(0.015)		(0.020)		(0.024)	
lnCornPriceUS			0.614***	0.757***			0.255	0.385
			(0.143)	(0.138)			(0.202)	(0.255)
lnMiningWageSK			0.073	0.125			0.139	0.187
			(0.074)	(0.075)			(0.097)	(0.114)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CONTROL MARKET:	DAP	DAP	DAP	DAP	Urea	Urea	Urea	Urea
Year=2018		0.065***		0.058***		0.096***		0.097***
		(0.020)		(0.019)		(0.033)		(0.035)
Year=2019		0.180***		0.135***		0.001		0.037
		(0.030)		(0.039)		(0.038)		(0.041)
PostMerger (2018-19)	0.057		0.011		0.047		0.076***	
	(0.045)		(0.033)		(0.035)		(0.026)	
lnCornPriceUS			1.234***	0.640**			0.529*	0.345
			(0.251)	(0.265)			(0.281)	(0.379)
lnMiningWageSK			0.238	0.019			0.271	0.204
			(0.152)	(0.101)			(0.193)	(0.218)

Newey-West standard errors in parentheses
N=60 in each specification
*** p<0.01, ** p<0.05, * p<0.1

Across all of these control markets, the results in Table 4 indicate that the Agrium/PotashCorp merger broadly was not associated with an increase in Corn Belt potash prices. Appendix Table 1 shows that results are generally similar when restricting the pre-merger data sample to two years. In most cases the estimated coefficients in the smaller sample are closer to zero, although in one specification using standard MOP as the control the estimated price effect is positive and statistically significant. Again, the bulk of the evidence indicates that the merger did not lead to an anticompetitive increase in the price of potash in the Corn Belt.

Table 5 presents results from estimating equation (2) across the entire panel of data. In percentage terms, the results in column (1) indicate that the merger is associated with an average price decrease of 3.9 percent. Column (2) shows that this effect combines a larger decline in 2018 with essentially no relative change in 2019, when trade policy developments are more likely to have confounded identification of any merger effect. Column (3) incorporates a cubic time trend as well as US corn prices and Saskatchewan mining wages, finding a small but statistically insignificant price increase after the merger. Results are qualitatively similar for different forms of the time trend and/or exclusion of corn prices and wages. Columns (4) and (5) show that the merger coefficient is either statistically insignificant or negative when controlling for common time effects among North American fertilizer prices or among global potash prices.

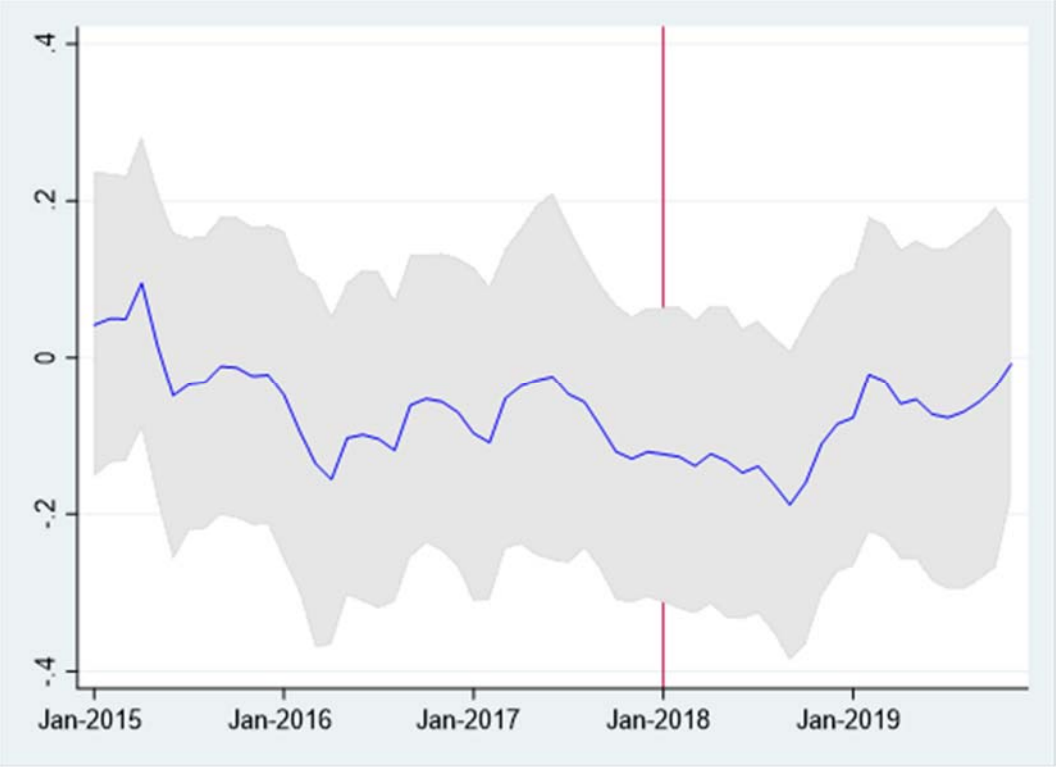
Table 5: Panel Data Estimation of Merger Effects

	(1)	(2)	(3)	(4)	(5)
Time Controls	Yr-Mo FE	Yr-Mo FE	Time Trend	Yr-Mo FE interacted w/ N. Am. Dummy	Yr-Mo FE interacted w/ MOP Dummy
Year=2018		-0.083***			
		(0.020)			
Year=2019		0.007			
		(0.027)			
PostMerger (2018-19)	-0.038*		0.027	0.005	-0.081***
	(0.023)		(0.041)	(0.035)	(0.020)
lnCornPriceUS			1.122***		
			(0.171)		
lnMiningWageSK			0.324***		
			(0.103)		

Newey-West standard errors in parentheses
N=300 in each specification
*** p<0.01, ** p<0.05, * p<0.1

Finally, Figure 3 summarizes the main results of estimating equation (3). It plots the estimated δ_τ^T's, i.e. the time fixed effects for the treatment group (Corn Belt potash prices) relative to all other control groups (i.e. all other prices). The shaded area of the graph plots the 95 percent confidence interval for each estimate, showing that – both before and after the merger – they are generally indistinguishable from zero. Thus, we cannot reject the null hypothesis of identical pre-merger trends. While the size of the pre-merger fixed effects may not be economically insignificant, averaging 5.3 percent lower, they are smaller in magnitude than the average post-merger time fixed effects, which average 9.1 percent lower.

Figure 3: Estimated Difference between Time Fixed Effects for Corn Belt MOP and Control Prices[29]



5. Conclusion

In its review of the Agrium/PotashCorp merger the FTC had to evaluate whether a substantial increase in the concentration of North American potash capacity would hurt US farmers and consumers. Aggressive intervention could have wide-ranging impacts. USDA estimates that agriculture and related industries accounted for 5.4 percent of U.S. gross domestic product in 2017, and 11 percent of employment.[30] Ultimately, while the Federal Trade Commission required divestitures related to nitrogen and phosphate, it placed no restrictions on the firm's consolidation of 60 percent of North American potash production capacity. Especially in light of a history of export cartel behavior, this combination of potash producers may have been close to the enforcement margin. Retrospective analysis of potential price effects of the merger may be informative as to the overall effectiveness of current antitrust policy.

The evidence reviewed here generally does not find that the Agrium/PotashCorp merger raised North American potash prices. Of course, it is possible that North American potash prices would have declined anyway, due to other developments such as the ramp up of production at K+S's mine in Saskatchewan and other global capacity additions. Changes in global trade policy are yet another confounding factor for each of the treatment and control markets used in this study.

As is common in the merger retrospective literature, this paper studies price effects to the exclusion of other effects. One area for potential study consistent with calls to strengthen antitrust enforcement

[29] The blue line indicates the estimates of the monthly effects, and the shaded area is the 95 percent confidence interval.

[30] See https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/.

would be on the merger's labor market effects. The control variable used in this study is the average Saskatchewan wage for all mining industries. Statistics Canada publishes an average monthly wage for mining exclusive of oil and gas as well, which may be more closely correlated with potash mining wages. At the time of this study, this data series currently has numerous missing observations, but the available data indicate that this wage increased after the merger ($42.02 per hour to $45.10) more than overall mining wages ($41.49 to $43.57) in Saskatchewan. This is only preliminary evidence that the Agrium/PotashCorp merger did not lead to increased monopsony power in the Saskatchewan potash mining labor market. A more rigorous analysis of better data, other control variables, and alternative comparison groups may be a fruitful avenue for future research of any potential monopsony effect.

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Appendix

Table A1: Results using only two years of pre-merger data (compare to Table 4)

VARIABLES	(1) MOP Brazil	(2) MOP Brazil	(3) MOP Brazil	(4) MOP Brazil	(5) StdMOP	(6) StdMOP	(7) StdMOP	(8) StdMOP
Year==2018		0.121***		0.132***		0.023		0.033**
		(0.015)		(0.015)		(0.017)		(0.015)
Year==2019		0.102***		0.161***		0.020		0.079***
		(0.018)		(0.022)		(0.021)		(0.021)
PostMerger (2018-19)	0.111***		0.136***		0.021		0.040**	
	(0.015)		(0.015)		(0.017)		(0.016)	
lnCornPriceUS			0.397***	0.549***			0.394***	0.630***
			(0.128)	(0.167)			(0.126)	(0.154)
lnMiningWageSK			0.065	0.106			0.077	0.013
			(0.073)	(0.084)			(0.062)	(0.059)

VARIABLES	(9) DAP	(10) DAP	(11) DAP	(12) DAP	(13) Urea	(14) Urea	(15) Urea	(16) Urea
Year==2018		0.033*		-0.033**		-0.080**		-0.074*
		(0.017)		(0.016)		(0.039)		(0.041)
Year==2019		0.211***		0.204***		0.018		0.055
		(0.024)		(0.035)		(0.048)		(0.082)
PostMerger (2018-19)	0.089*		0.001		-0.031		-0.055	
	(0.044)		(0.038)		(0.041)		(0.041)	
lnCornPriceUS			1.387***	0.164			0.231	0.430
			(0.316)	(0.254)			(0.394)	(0.613)
lnMiningWageSK			0.224	0.108			0.231	0.052
			(0.173)	(0.075)			(0.209)	(0.239)

Newey-West standard errors in parentheses
N=48 in each specification
*** p<0.01, ** p<0.05, * p<0.1