Do Farm Payments Raise Cash Rents? Evidence from Commodity Programs and Ad Hoc Assistance*

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Abstract

Federal support to U.S. crop producers has shifted toward ad hoc programs, which account for the majority of the $95 billion attributed to the 2018–2024 crop years. Because about 40 percent of U.S. farmland is rented, part of these payments may pass through to landowners through higher rents. We estimate this pass-through separately for commodity program payments and ad hoc payments using county cash rents for non-irrigated cropland in 2,601 counties over 2019–2024 and a dynamic panel design. A marginal dollar of commodity program payments raises rents by about 45 cents in the short run. In contrast, the estimated pass-through of ad hoc payments for the corresponding crop year is statistically insignificant, and the confidence interval rules out a positive response comparable to the commodity program estimate. The difference between the two payment types is statistically significant and remains similar across alternative specifications. One possible explanation is the information available when leases are negotiated. Commodity program formulas are established in advance, while the specific ad hoc programs in our sample had not yet been announced when leases for the corresponding crop years were signed.

Keywords: rent pass-through, cash rents, ad hoc payments, commodity programs, farmland rental markets

JEL codes: H22, Q15, Q18

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1. Introduction

Federal farm support has changed substantially since 2018. In addition to standing commodity programs authorized under the farm bill, the federal government has provided a series of large ad hoc payments in response to trade disruptions, the COVID-19 pandemic, and natural disasters. Payments attributed to the 2018-2024 crop years total roughly $95 billion, with more than $80 billion coming from ad hoc programs. As a result, ad hoc assistance has become a major source of direct support to U.S. crop producers during this period. Figure 1 shows the change in the composition of these payments. Before 2018, direct payments in our data were concentrated in the Agriculture Risk Coverage (ARC) and Price Loss Coverage (PLC) programs. Beginning in 2018, ad hoc payments increased sharply and exceeded ARC and PLC payments by a wide margin during the largest payment years. Although ad hoc payments declined after 2020, they increased again for the 2024 crop year.

Although these payments are made to farm operators, rental markets can affect how the benefits are divided between operators and landowners. Roughly 40 percent of U.S. farmland is rented (Bigelow et al. 2016), creating a channel through which government payments may be partially capitalized into cash rents (Floyd 1965, Alston and James 2002). We refer to this relationship as rental capitalization, or the pass-through of payments into annual cash rents. When rents rise, part of the payment accrues to landowners and the cost of farming rented land increases. We examine how much of the marginal payment dollar is reflected in cash rents and whether this pass-through differs between statutory commodity programs and ad hoc assistance.

A substantial literature examines whether farm support is capitalized into farmland values. Early studies generally find evidence that government payments are reflected in land values, although estimated capitalization depends on how payments and expectations are measured. Barnard et al. (1997) find evidence of capitalization across U.S. regions, while Weersink et al. (1999) find that government payments are discounted less heavily than market-based returns in Ontario farmland values. Goodwin et al. (2003) show that capitalization estimates are sensitive to how expected payments are constructed, and Shaik et al. (2005) estimate that farm program payments accounted for 30 to 40 percent of agricultural land values in the mid-twentieth century, with the share declining

to 15 to 20 percent after 1980. More recent evidence also points to differences across payment types. Goodwin et al. (2011) find that disaster assistance is priced very differently across land market margins, raising land values while entering cash rents with a negative sign. Ifft et al. (2015) estimate that an additional dollar of decoupled payments increased cropland values by about $18 per acre.

Cash rents provide a more direct measure of short-run incidence because rents are the annual price of land services and respond within one contracting cycle. In the U.S., studies generally find partial capitalization of government payments into rents. Lence and Mishra (2003) estimate the effects of several farm programs on Iowa county cash rents, and Roberts et al. (2003) find partial pass-through of government payments into cash rents using Census farm data. Using field-level data, Kirwan (2009) estimates that landlords capture about 25 cents of the marginal subsidy dollar in the first year, while Hendricks et al. (2012) estimate capitalization rates of about 12 cents in the short run and 37 cents in the long run for Kansas. Kirwan and Roberts (2016) similarly find incomplete capitalization using field-level data. Evidence from Europe is broadly consistent with these findings. Patton et al. (2008) find positive capitalization of several livestock-related payments into rents in Northern Ireland, with the magnitude varying across programs. Ciaian and Kancs (2012) estimate that 18 to 20 cents per euro of area payments are reflected in rents in new EU member states, while O'Neill and Hanrahan (2016) estimate short-run capitalization rates of approximately 7 to 32 cents per euro for Pillar 1 payments in Ireland and find no significant capitalization of Pillar 2 payments. Synthesizing 719 estimates, Ciaian et al. (2021) report an average pass-through into U.S. rents of roughly 42 percent and identify empirical identification as one of the central challenges in this literature.

Farm programs beyond the commodity title can also affect farmland rental markets. The Conservation Reserve Program (CRP) pays landowners to retire environmentally sensitive cropland under ten- to fifteen-year contracts. By removing land from production, CRP can affect local land markets through changes in the supply of available farmland (Wu 2000, Roberts and Lubowski 2007). CRP rental rates are also based on county average cash rents, creating a mechanical relationship with our dependent variable that our empirical specification addresses. Federal crop insurance, another major source of farm support, subsidizes premiums, affects acreage and input decisions (Goodwin et al. 2004, Yu et al. 2018), and generates indemnity payments that track local production adversity.

A related issue in this literature is the role of expectations in determining capitalization. Economic theory suggests that land values and rents should respond to government support that is expected when land is priced, not just the realized payments alone (Alston and James 2002). This distinction is relevant for payments that are uncertain or difficult to anticipate. Consistent with this prediction, Goodwin et al. (2011) find that disaster assistance, which is hard to anticipate when leases are set, is associated with lower cash rents, while O'Neill and Hanrahan (2016) find no significant capitalization of payments that cannot be attached to the rented acre within the lease term.

Despite the rapid expansion of ad hoc assistance, its incidence in farmland rental markets has received little attention. Existing studies examine how these payments were allocated (U.S. Government Accountability Office 2020), how commodity futures responded to their announcements (Sun et al. 2025), and how they supported farm income and solvency during the pandemic (Schnitkey et al. 2021). Ad hoc payments also differ from statutory commodity payments in a way that is directly relevant to capitalization. Cash leases for a crop year are generally negotiated in the late summer and fall of the preceding year. For ARC and PLC, program rules and payment formulas are established in advance, allowing producers and landowners to form expectations about potential payments when leases are negotiated. In contrast, each ad hoc program in our study period was announced only after leases for the corresponding crop year had been signed. In the context of MFP, extension economists therefore advised landlords and tenants to set rents without incorporating anticipated trade assistance and to negotiate any sharing after payments were announced (Schnitkey and Swanson 2019). This setting allows us to compare the rental incidence of commodity program and ad hoc payments within the same counties and years, while the two payment channels differ in the information available when leases are negotiated.

In this paper, we estimate how these two channels of federal support are reflected in farmland rents. We assemble a county panel of cash rents for non-irrigated cropland covering 2,601 counties from 2019 to 2024, match it to administrative Farm Service Agency payment records dated by the crop year to which each payment accrues, and estimate a dynamic spatial rental equation using two-step difference generalized method of moments (GMM) in the tradition of Hendricks et al. (2012) and O'Neill and Hanrahan (2016). We find substantial differences across the two payment channels. A dollar per acre of ARC and PLC payments increases county cash rents by about 45 cents in the short

run, with an implied long-run rate of roughly 81 cents. In contrast, the estimated pass-through of realized ad hoc payments into rents for the corresponding crop year is statistically insignificant. The baseline short-run estimate is −6 cents per dollar, with a 95 percent upper bound of 9 cents, and the estimate is stable when lagged crop revenue is added as a control. The difference between the two pass-through rates is 51 to 52 cents and statistically significant. Pooling the two payment types into a single measure instead produces a small and insignificant coefficient, masking the different incidence of the two channels.

Identifying these effects is challenging because payments are not randomly assigned. ARC and PLC payments rise when prices fall, while ad hoc payments respond to trade disruptions, weather losses, and other shocks that may also affect rents directly. Our estimation strategy addresses these sources of endogeneity in several ways. Within the panel, each payment variable is instrumented with its own deeper lags, and we evaluate the resulting moment conditions using Hansen tests, Arellano–Bond serial correlation tests, and difference-in-Hansen tests. These diagnostics reject specifications using second-lag instruments and the level-equation moments of system GMM, leading us to use difference GMM as the baseline estimator (Arellano and Bond 1991, Roodman 2009). We also construct a simulated-payment instrument that interacts predetermined county program exposure with national payment rates, following the logic of shift-share designs (Goldsmith-Pinkham et al. 2020), and obtain a similar estimate for statutory commodity payments. For ad hoc payments, we examine whether the results depend on how payments are timed and whether similar patterns appear in program-specific settings. We also use pre-period soybean exposure during the 2018–2019 trade-policy shock as a separate source of variation that does not rely on the internal panel instruments.

This paper makes three contributions. First, to our knowledge, it provides the first estimates of the incidence of post-2018 ad hoc farm payments in farmland rental markets and estimates statutory and ad hoc pass-through rates within a single empirical design, allowing their difference to be tested directly. Second, it provides a detailed assessment of the dynamic panel estimator commonly used in the rental capitalization literature, including tests of instrument depth and the additional moment conditions required by system GMM, with an external simulated-payment instrument providing additional validation. This is relevant given the identification challenges emphasized in reviews of the capitalization literature (Ciaian et al. 2021). Third, we document differences in the rental

incidence of commodity program and ad hoc payments within a common empirical setting. The contrast is consistent with a possible role for the information available when leases are negotiated.

The remainder of the paper proceeds as follows. Section 2 describes the payment programs and the leasing institutions. Section 3 describes the data. Section 4 develops the empirical framework and the identification strategy. Section 5 reports the main estimates, the interpretation of each payment channel, the implications for production costs, and robustness checks. Section 6 discusses the findings and concludes.

2. Policy Background

2.1 Statutory commodity programs

Under the 2014 and 2018 farm bills, Title I authorizes standing counter-cyclical commodity programs, including ARC and PLC. Both programs make payments on 85 percent of base acres, which reflect a farm's historical planting record and are decoupled from current planting decisions. PLC provides payments when the marketing-year average price of a covered commodity falls below its effective reference price. The payment rate is determined by the price shortfall multiplied by the farm's historical program yield. ARC at the county level (ARC-CO) provides payments when realized county revenue falls below 86 percent of benchmark revenue, which is based on five-year Olympic averages of county yields and national prices. ARC-CO payments are capped at 10 percent of benchmark revenue. Producers elect ARC or PLC by commodity and farm, with annual elections beginning in the 2021 crop year. Payments for crop year t are generally disbursed in October of $t + 1$, after the marketing year closes.

ARC and PLC payments can be anticipated to some extent when leases are negotiated. Reference prices are established in statute, base acres and program yields are fixed farm records, and futures markets provide information about expected prices for the coming crop year during fall lease negotiations. Producers and landowners can therefore form expectations about potential ARC and PLC payments before the crop year begins, even though realized payments remain uncertain. The same program formulas make realized payments countercyclical, with payments increasing when prices or revenues fall and declining when market conditions improve. Over the 2014–2024 crop

years, annual ARC and PLC payments ranged from approximately $0.3 billion in 2021 to $7.9 billion in 2015. Within our estimation period, the two programs paid roughly $6.0 billion for the 2019 crop, $2.1 billion for 2020, less than $0.5 billion in each year from 2021 through 2023 as prices increased, and $2.1 billion for 2024. This countercyclicality is important for the empirical analysis because the same price declines that trigger commodity payments can also reduce rents through lower farm revenues.

2.2 The ad hoc channel

Ad hoc agricultural assistance expanded sharply beginning in 2018 and has accounted for a large share of direct federal support to crop producers since then (Figure 1). Table 1 summarizes the six programs included in our data, the crop years they compensate, their announcement dates, and county-aggregated payments attributed to each crop year. The Market Facilitation Program (MFP) compensated producers for losses associated with retaliatory tariffs during the 2018–2019 trade conflict, providing $8.6 billion for the 2018 crop and $14.5 billion for 2019. The 2018 program paid commodity-specific per-unit rates on realized production, while the 2019 program used county-level per-acre rates ranging from $15 to $150 on planted acres of eligible crops. The Coronavirus Food Assistance Program (CFAP), announced in two rounds in April and September 2020, provided $31.6 billion attributed to the 2020 crop through payment formulas based on production and inventories. The Emergency Relief Program (ERP) compensated weather-related losses for the 2020–2022 crop years, accounting for roughly $11 billion in our data. The first ERP tranche was announced in May 2022, with payments pre-filled using crop insurance indemnity records. The Pandemic Assistance Revenue Program (PARP), announced in January 2023, compensated revenue losses associated with the 2020 crop year. These amounts are payments recorded in the Farm Service Agency (FSA) administrative files as of our data download and can differ from announced program sizes, in particular for ECAP and SDRP, whose disbursements were still in progress in 2025. Finally, the American Relief Act of December 2024 authorized two additional programs. The Emergency Commodity Assistance Program (ECAP) provided $9.4 billion based on 2024 planted acres beginning in March 2025, while the Supplemental Disaster Relief Program (SDRP) provided $5.9 billion attributed to 2023 and 2024 losses beginning in July 2025.

None of these six programs is a standing program authorized under Title I of the farm bill. They were created through executive action under the Commodity Credit Corporation Charter Act or through supplemental legislation, used payment formulas established when the programs were announced, and were introduced as temporary assistance. The announcement dates in Table 1 are important for the timing of our empirical analysis. Each program was announced after leases had been negotiated for its earliest compensated crop year. MFP assistance for the 2019 crop was announced in May 2019, after 2019 leases had been set, while CFAP was first announced in April 2020. ERP was announced one or more years after the crop years associated with the losses it compensated. ECAP and SDRP payments attributed to the 2024 crop were authorized in December 2024 and implemented in 2025, after the 2024 harvest.

Cash rental contracts for a crop year are generally negotiated in the late summer and fall of the preceding calendar year and typically last for one year (Bigelow et al. 2016). This timing creates an important difference in the information available for statutory and ad hoc payments when rents are negotiated. For ARC and PLC, program formulas, base acres, and information about expected prices are available before the crop year begins, allowing producers and landowners to form expectations about potential payments. For the ad hoc programs in our study period, the specific programs, eligibility rules, and payment rates had not yet been announced when leases for the corresponding crop years were signed. Consistent with this timing, Schnitkey and Swanson (2019) advised Illinois landlords and tenants to set 2020 rents without incorporating additional trade assistance and to negotiate any sharing after payments were announced. Repeated ad hoc programs could nevertheless affect rents in later years if producers and landowners begin to anticipate future assistance. We examine this possibility using alternative payment timing and program-specific designs.

2.3 The Conservation Reserve Program

The CRP, established under the Food Security Act of 1985, pays landowners to retire environmentally sensitive cropland under contracts lasting ten to fifteen years. During our study period, enrollment ranged from roughly 21 to 26 million acres under acreage caps established by the 2018 farm bill, while annual rental payments remained between $1.7 and $1.9 billion. CRP differs from the commodity programs in two ways that are relevant to our analysis. First, CRP payments accrue to owners of

land withdrawn from production and therefore do not directly enter the rent of operating cropland. Any effect on cash rents instead operates through land supply, as retirement removes acres from the rental market (Wu 2000, Roberts and Lubowski 2007). Second, CRP is mechanically related to our dependent variable because the Farm Service Agency uses county average cash rents reported by USDA National Agricultural Statistics Service (NASS) when setting CRP soil rental rates. A contemporaneous CRP payment measure may therefore partly reflect changes in the outcome itself. We address this relationship by entering CRP payments with a one-year lag, which corresponds to information available during lease negotiations and reduces the direct rate-setting feedback. CRP also provides a useful comparison with ARC and PLC. Its payments are established under multi-year contracts but affect operating cropland rents primarily through changes in land supply, while ARC and PLC payments can affect rents through the expected return to the rented acre.

3. Data

Our dependent variable is the average cash rental rate for non-irrigated cropland, measured in dollars per acre, from the USDA NASS Cash Rents Survey. NASS collects rental information from producers during the reference year and publishes county-level estimates in late summer. The reported rent for year t therefore largely reflects leases negotiated in the fall of $t-1$. We focus on cash rents because cash leases are the most common rental arrangement for cropland (Bigelow et al. 2016). We use non-irrigated cropland because it is the most widely reported rental category and because non-irrigated rents reflect the value of the land without the additional value of irrigation infrastructure. County estimates are published only when survey responses are sufficient, with between roughly 2,150 and 2,500 counties reported in each year of our study period.

Cash rents vary considerably across counties but change relatively slowly within counties. During our study period, rents range from $22 per acre at the tenth percentile to $209 at the ninetieth percentile, reflecting the geographic pattern from lower-rent areas in the Plains to higher-rent areas in the Corn Belt shown in Figure 2. Within counties, rents are highly persistent. The year-to-year correlation in county rents is 0.99. Roughly one-third of county rents change by less than 5 percent from one year to the next, and the sample mean increased from $87 to $98 per acre over the six-year period. County fixed effects account for persistent cross-sectional differences, while the lagged

dependent variable captures the within-county persistence in rents.

County cash-rent estimates are available for 2009–2014 and for 2016 and 2017, but no county estimates were published for 2015 or 2018. Because the dynamic model requires a continuous sequence of annual observations for the lagged dependent variable and lagged instruments, the earlier gaps prevent us from using a longer continuous panel. The first uninterrupted annual series begins in 2019 and covers a period in which ARC/PLC and repeated ad hoc programs operate concurrently. Our estimation window therefore spans 2019–2024.

Payment data are county totals constructed from Farm Service Agency administrative records covering payments disbursed by the agency.[1] We construct three payment variables. Statutory commodity payments are the sum of ARC and PLC payments, ad hoc payments are the sum of the six programs listed in Table 1, and CRP payments control for the land-supply channel described in Section 2. During the study period, counties in our sample received approximately $11 billion through the statutory channel and $70 billion through the ad hoc channel. Of the roughly $95 billion attributed to the 2018–2024 crop years nationally, $11 billion accrues to the 2018 crop year, which falls outside our estimation window, and about 3 percent accrues to counties without published rent estimates. The $11 billion statutory and $70 billion ad hoc figures above therefore cover the counties and years we actually study.

We date each payment by crop year. FSA records payments using three accounting conventions: calendar year of disbursement, federal fiscal year, and program year. The program year identifies the year of the event associated with the payment, and we use this measure as the crop year. This convention assigns each payment to the lease year associated with the underlying crop or loss, but its interpretation differs across the two payment channels. For statutory programs, the crop year is the marketing year of the covered commodity and corresponds to the year for which payment expectations are formed. An ARC or PLC payment for crop year t can be anticipated using information available during lease negotiations in the fall of $t-1$, although the realized payment is not disbursed until October of $t+1$. For ad hoc programs, the crop year identifies the year

[1] We access the FSA files through the `rfsa` package, which compiles the agency's individual-payment records.

of the compensated loss, as reported in Table 1. A payment attributed to crop year t therefore compensates losses associated with that year's crop, even though each ad hoc program in our sample was announced after leases for the corresponding crop year had been negotiated.

Farm programs outside the commodity title can also affect farmland rental markets and enter our analysis as controls. FSA sets CRP soil rental rates using the same NASS non-irrigated cash rent series as our dependent variable, creating a direct link between contemporaneous CRP payments and the outcome. We therefore enter CRP payments with a one-year lag. Federal crop insurance is another major source of agricultural support. Premium subsidies can affect acreage and input decisions (Goodwin et al. 2004, Yu et al. 2018), while indemnity payments reflect recent production losses that may also affect local rents.

All payments are converted to dollars per acre using each county's cropland and pastureland acres from the 2007 Census of Agriculture. Because the 2007 acreage base predates both the ad hoc programs and our estimation period, the denominator does not respond to the payments studied. CRP payments, crop insurance indemnities, and county crop revenue enter with a one-year lag to reflect information available when leases are negotiated. Lagged CRP payments capture the land-supply channel described above. Crop insurance indemnities come from county-level RMA records and are divided by insured acres to measure recent production adversity (Goodwin et al. 2004, Yu et al. 2018). Lagged county crop revenue, which enters the results as a robustness control, is NASS county production of corn, soybeans, wheat, sorghum, rice, and cotton, with cotton converted at 480 pounds per bale and sorghum at 0.56 hundredweight per bushel, valued at NASS state annual average prices received by farmers, divided by the same acreage denominator and set to zero where production is not reported. Weather controls are annual county averages of monthly temperature and precipitation from NOAA's nClimGrid data. The spatial lag of rents is constructed as the inverse-distance-weighted average rent of the ten nearest counties, with weights renormalized each year over neighboring counties with published rent estimates.

The estimation sample contains 13,406 county-year observations across 2,601 counties from 2019–2024. There are 13,916 county-years with published cash rents during this period, of which 510 are excluded because of missing lagged indemnities, spatial lags, or weather covariates. Most of these

exclusions are due to missing lagged indemnities. The counties in the estimation sample account for 86 percent of U.S. cropland and pastureland measured in the 2007 Census of Agriculture. Table 2 reports summary statistics. The mean cash rent is $91 per acre. Ad hoc payments average $18.5 per acre per year, approximately one-fifth of the mean rent, and are positive in 97 percent of county-years. Statutory payments average $3.0 per acre and are positive in 64 percent of county-years. Panel B reports sample means by year. Statutory payments are highest in 2019 and 2024, at $9.8 and $3.7 per acre, respectively, and fall below $1 per acre from 2021 through 2023. Ad hoc payments peak at $56 per acre in the 2020 crop year, approximately two-thirds of that year's average rent, and increase again to $19 per acre in 2024. The two payment channels follow different time patterns, providing variation that helps distinguish their relationships with cash rents.

Figure 2 shows the geographic distribution of rents and payments across counties. Cash rents are highest in the Corn Belt and lowest across the wheat and grazing regions of the Plains and Mountain West. Statutory payments reflect historical program enrollment and are concentrated in the wheat-producing regions of the Northern and Southern Plains, the Mississippi Delta, and the peanut and cotton regions of the Southeast. Ad hoc payments reach nearly every agricultural county, with higher payment intensity in soybean-producing counties affected by trade assistance and in regions receiving disaster-related payments. The geographic patterns of rents, statutory payments, and ad hoc payments differ across counties. Combined with changes in national payment levels over time, these differences in county exposure provide the variation used in the empirical analysis.

4. Empirical Framework

4.1 Rent determination and partial adjustment

Our framework follows the standard approach in the rental capitalization literature, in which cash rents reflect expected returns to farmland (O'Neill and Hanrahan 2016). Tenants bid for land based on the returns they expect an acre to generate, and competition moves rents toward the expected residual return to land. Government payments that are expected to accrue to the rented acre can therefore be reflected in rents, with the share captured by landowners depending on relative factor supply elasticities (Floyd 1965, Alston and James 2002). Full capitalization is the limiting case

when land supply is fixed, while empirical estimates are generally below this benchmark. We write the equilibrium rent in county i for crop year t as

$$\ln R^*_{it} \;=\; \phi_i + \phi_t + \theta_m \,\mathrm{E}_{s(t)}[M_{it}] + \theta_c \,\mathrm{E}_{s(t)}[C_{it}] + \theta_a \,\mathrm{E}_{s(t)}[A_{it}]\,, \tag{1}$$

where expectations are formed at $s(t)$, the fall of $t-1$ when leases for crop year t are negotiated. M_{it} denotes market returns, while C_{it} and A_{it} denote statutory and ad hoc payments per acre. The parameters θ_c and θ_a measure the response of equilibrium rents to expected statutory and ad hoc payments. Because the dependent variable is in logs and payments are measured in dollars per acre, multiplying θ_c or θ_a by the rent level converts the coefficient into the share of a marginal payment dollar reflected in rent. We evaluate this share at the sample mean rent of \$91 per acre throughout.

The two payment channels enter equation (1) differently. At the time of lease negotiation, ARC and PLC payments for the coming crop year can be projected from published formulas, base acres, and futures prices, allowing producers and landowners to form expectations about these payments. In contrast, the specific ad hoc programs and payment formulas in our study period were announced only after leases for the corresponding crop years had been signed. For the early years of our sample, this timing limited the information available about program-specific ad hoc payments at signing. As ad hoc assistance recurred, however, producers and landowners may have begun to anticipate some form of future support even before a specific program was announced. Repeated ad hoc programs could therefore generate expectations that affect later rental negotiations, and we examine this possibility separately.

Observed rents may adjust gradually toward equilibrium because previous rental rates can influence current negotiations (Kirwan 2009, Hendricks et al. 2012, O'Neill and Hanrahan 2016). Rental markets are also spatially connected, as neighboring counties compete for the same tenants and information about prevailing rates spreads locally (Lence and Mishra 2003, Breustedt and Habermann 2011). We therefore model observed rents as a partial-adjustment process, $\ln R_{it} - \ln R_{i,t-1} = \lambda\,(\ln R^*_{it} - \ln R_{i,t-1})$ with $0 < \lambda \leq 1$, and add a spatial lag of rents, which yields the estimating equation

$$\ln R_{it} = \gamma \ln R_{i,t-1} + \rho \ln \bar{R}_{it} + \beta_c C_{it} + \beta_a A_{it} + X'_{it}\delta + \alpha_i + \tau_t + \varepsilon_{it}\,. \tag{2}$$

In this specification, $\gamma = 1 - \lambda$ measures rental persistence, and $\bar{R}_{it}$ is the inverse-distance-weighted average rent of the ten nearest counties. The control vector X_{it} includes lagged CRP payments, lagged crop insurance indemnities, and annual mean temperature and precipitation. Lagged CRP payments capture local retirement intensity, as greater CRP enrollment reduces the supply of cropland available for rent and is therefore expected to increase rents on the remaining land (Wu 2000, Roberts and Lubowski 2007). County fixed effects capture time-invariant differences in land quality and location, while year fixed effects absorb national changes in prices, production costs, and policy. We specify rents in logarithms to account for the large differences in rent levels across counties and to model adjustment in proportional terms.

Partial adjustment maps the structural parameters of equation (1) into the estimated coefficients as $\beta_c = \lambda\theta_c$, $\beta_a = \lambda\theta_a$, and $\alpha_i = \lambda\phi_i$. The coefficients β_c and β_a are therefore short-run semi-elasticities with respect to payments measured in dollars per acre, and multiplying them by the sample mean rent converts them to short-run pass-through rates in cents per payment dollar. Dividing further by $(1-\gamma-\rho)$ recovers the equilibrium response $\theta_c\bar{R}$ of equation (1), which we report as the steady-state rent pass-through (Hendricks et al. 2012). Two qualifications apply to that conversion. The spatial lag is added to the partial-adjustment model rather than derived from it, so ρ has no counterpart in equation (1). And because the spatial multiplier operates through the rents of neighboring counties, the long-run rate is the steady-state response to a payment change that is common across counties rather than to a change in one county alone. We estimate the payment types separately in the same equation, consistent with Lence and Mishra (2003), who find that different farm programs can have different effects on cash rents.

Because the specific ad hoc programs in our sample were announced after leases for the corresponding crop years had been negotiated, β_a measures the same-crop-year response of rents to realized ad hoc payments. That response can arise through mid-year renegotiation, flexible lease provisions, informal sharing between tenants and landowners, or expectations created by repeated assistance. Payments received during the crop year may also relax liquidity and credit constraints or strengthen operator balance sheets, which could affect bidding for rented land in subsequent lease cycles. We therefore interpret β_a as the same-crop-year pass-through of realized ad hoc payments and examine possible delayed responses using alternative timing and program-specific analyses.

Expected market returns are not observed directly. Year fixed effects absorb national market conditions, while county fixed effects account for persistent differences in local productivity. County-specific shocks that vary over time remain in the error term and may also affect program payments, creating an endogeneity concern that motivates the use of instruments. A robustness check reported with the main results controls for part of this remaining variation directly using lagged county crop revenue.

4.2 Endogeneity and dynamic panel estimation

The payment variables in equation (2) are realized payments, while rents are determined based on the payments expected when leases are negotiated in equation (1). Realized payments therefore provide an imperfect measure of the expectations relevant to rent determination. Writing $C_{it} = \mathrm{E}_{s(t)}[C_{it}] + e_{it}$, where e_{it} is the forecast error realized after signing, least squares yields

$$\operatorname{plim} \hat{\beta}_c = \beta_c \cdot \frac{\operatorname{Var}\big(\mathrm{E}_{s(t)}[C_{it}]\big)}{\operatorname{Var}\big(\mathrm{E}_{s(t)}[C_{it}]\big) + \operatorname{Var}(e_{it})}, \tag{3}$$

under classical measurement-error assumptions. The resulting estimate is attenuated toward zero, with greater attenuation when a larger share of realized payment variation was not anticipated at signing (Goodwin et al. 2003, O'Neill and Hanrahan 2016).

The forecast error is also systematically related to factors that determine rents. ARC and PLC payments increase when prices or county revenues fall. An unexpectedly low price therefore raises the realized payment relative to the amount expected at signing while also reducing rents through lower farm revenues. This creates a negative correlation between e_{it} and the disturbance in equation (2), which can push least-squares estimates of β_c below the attenuation benchmark in equation (3). Negative coefficients on countercyclical support in simple specifications have also been documented in the capitalization literature (Ifft et al. 2015).

Ad hoc payments present a separate endogeneity problem because they are tied to the losses they are intended to compensate. The same underlying shocks may also affect rents directly, so regressions using realized ad hoc payments can confound the effect of the payment with the effect of the underlying loss.

Taken together, these issues mean that realized payments cannot be treated as exogenous regressors in the rent equation. Previous studies address this problem using direct measures of expected payments, information on how payments are forecast, or instrumental variables that isolate variation in payments from the underlying shocks (Roberts et al. 2003, Lence and Mishra 2003, Hendricks et al. 2012, O'Neill and Hanrahan 2016). We use the instrumental variables approach to address the endogeneity of realized payments.

The dynamic structure of equation (2) introduces an additional estimation challenge. The lagged dependent variable is correlated with the county fixed effect, causing pooled OLS to overstate γ and the within estimator to understate it (Nickell 1981, Bond 2002). We therefore estimate the model in first differences, which removes the county fixed effect. Differencing, however, leaves $\Delta \ln R_{i,t-1}$ correlated with the differenced error. We treat the lagged dependent variable, the payment variables, and the contemporaneous spatial lag as endogenous. Lagged CRP payments are treated as endogenous as well, because the Farm Service Agency sets CRP soil rental rates from the same published rent series that forms our dependent variable, as described in Section 2. We instrument all of these using their own lagged levels within a GMM framework, following the approach in Anderson and Hsiao (1981), Holtz-Eakin et al. (1988), and Arellano and Bond (1991).

Let K_{it} denote CRP payments lagged by one year. For the endogenous variables, the baseline moment conditions are

$$\mathrm{E}\big[z_{i,t-s}\Delta\varepsilon_{it}\big] = 0, \qquad s \in \{3,4\}, \qquad z \in \{\ln R, \ln \bar{R}, C, A, K\}. \tag{4}$$

The third and fourth lags of each variable in levels are used as instruments for the differenced equation. Because K_{it} is already defined as the one-year lag of CRP payments, its instruments are CRP payments dated $t-4$ and $t-5$ in the original series. We begin the instrument set at the third lag to reduce the possibility that more recent lags remain correlated with persistent shocks affecting rents and payments. The validity of this choice is evaluated empirically in Section 4.3, where we compare alternative lag structures using difference-in-Hansen tests. Lagged crop insurance indemnities and weather variables are treated as exogenous and serve as their own instruments.

These moment conditions require earlier payments to be uncorrelated with current rent changes

after conditioning on the included variables. This assumption could be violated if earlier payments have persistent effects on producers' financial conditions or expectations that carry into later rents. Difference GMM addresses dynamic-panel bias and removes time-invariant county heterogeneity under these conditions, but it does not separate ad hoc payments from time-varying shocks that may also affect rents. The Hansen and serial-correlation tests provide specification checks but do not directly test these economic mechanisms.

The validity of the lagged instruments also depends on the serial correlation of the differenced errors. First-order serial correlation is expected after first differencing and does not by itself indicate misspecification. Second-order serial correlation, however, would call the validity of the lagged instruments into question. We therefore use the Arellano–Bond AR(2) test to assess serial correlation and the Hansen J test to evaluate the overidentifying restrictions jointly.

Instrument proliferation is an important practical concern in dynamic panel GMM. Without collapsing the instrument matrix, the number of instruments increases rapidly with the number of lags and time periods, which can overfit the endogenous variables and weaken the Hansen test (Roodman 2009). We therefore collapse the instrument matrix so that each lag distance contributes a single instrument, leaving 16 instruments for 2,601 counties in the baseline specification. Year dummies are included throughout. We estimate the model using two-step GMM and apply the Windmeijer (2005) finite-sample correction to the standard errors.[2] The baseline specification uses difference GMM and begins the instrument set at the third lag. Both choices are evaluated using specification tests.

The available rent series and the chosen instrument depth limit the differences used in estimation. Because county rents are continuously available only from 2019 and the baseline instruments begin at the third lag, the differenced equations are estimated for 2022, 2023, and 2024. This yields 5,955 differenced county-year observations from 2,182 counties. Among these counties, 1,748 contribute all three annual differences, 277 contribute two, and 157 contribute one. Earlier observations in

[2] Estimation uses the `plm` package (Croissant and Millo 2008). We report the Hansen J statistic from the two-step weighting matrix and the Arellano–Bond tests for first- and second-order serial correlation in the differenced residuals.

the 13,406-observation panel still contribute to estimation as lagged values used to construct the instruments and the lagged dependent variable. The resulting estimation period is therefore shorter than the full panel window. We complement the dynamic panel estimates with levels specifications that use the full 2019–2024 period.

4.3 Identification and specification tests

The commodity coefficient is identified from instrumented within-county changes in ARC and PLC payments after accounting for common year effects. Cross-county variation arises because national price movements interact with differences in program exposure determined by historical program records and prior county yields and prices. The mechanism is easiest to see in the 2019 crop year, when the season-average wheat price fell about one dollar below the $5.50 reference price. Counties with wheat base acres received PLC payments scaled by their program yields, while ARC payments depended on whether realized county revenue fell below the county-specific benchmark. Counties could therefore experience different payment changes in the same year under the same national price movement. In the differenced specification, the estimating equations use payment changes from 2022 through 2024, while earlier payment shocks contribute through the lagged instruments. The levels specifications use these earlier years directly. The ad hoc coefficient is identified from instrumented within-county changes in realized ad hoc payments. Because these payments respond to local trade, pandemic, and weather shocks, the estimated coefficient may reflect both the payments and the underlying shocks.

We evaluate the baseline lag structure using several specification tests. The Arellano–Bond AR(2) test finds no evidence of second-order serial correlation in the differenced residuals ($p = 0.45$), supporting the serial-correlation condition required for the lagged instruments (Arellano and Bond 1991). A difference-in-Hansen test rejects the addition of second-lag instruments ($C = 16.4$, df $= 5$, $p = 0.006$), while the addition of fifth-lag instruments is not rejected ($p = 0.40$). These results support the baseline choice to use the third and fourth lags as instruments.

The choice of difference GMM is supported by tests of the additional moment conditions required for system GMM. System GMM adds level-equation moments that require lagged differences to be uncorrelated with the county-specific effects (Blundell and Bond 1998, Bun and Windmeijer

2010). All system GMM variants are rejected by the Hansen test at $p < 0.001$, and a difference-in-Hansen test specifically rejects the additional level-equation moments ($C = 46.6$, df $= 8$, $p < 0.001$) (Kripfganz 2019). In contrast, the baseline difference GMM specification is not rejected by the Hansen test ($p = 0.63$). Hendricks et al. (2012) also use difference GMM in a related cash-rent setting.

In the baseline specification, ad hoc payments are treated as endogenous and instrumented with their third and fourth lags. Given this timing, the same-crop-year coefficient captures rent responses to payments that had not yet been announced when the lease was signed. Such responses may still occur after the lease is signed, either through rent adjustments or through changes in producers' financial conditions and expectations. The precipitation coefficient reported in Section 5.1 also suggests that reported rents can reflect conditions realized during the crop year. We further examine the timing of these responses using the disbursement-year specification in Section 5.2, the CFAP analysis, and the trade-policy analysis in Section 5.1. These analyses provide additional evidence on rent responses after payments are received and on expectations associated with the underlying losses. Because the shocks that trigger ad hoc assistance may also affect rents directly, we control for weather conditions and lagged indemnities. Standard errors are clustered at the county level throughout.

5. Results

5.1 Main estimates

Table 3 presents the main results. Column (1) pools all payments into a single variable, column (2) separates statutory and ad hoc payments and is our main specification, and column (3) adds lagged county crop revenue to the baseline as a robustness check. Each payment variable, and lagged revenue in column (3), is instrumented by its own third and fourth lags. All three columns pass the Arellano–Bond AR(2) test. The disaggregated columns pass the Hansen test with p-values of 0.63 and 0.75, while the pooled column has a lower p-value of 0.068.

A dollar of commodity program payments increases rents by 44.9 cents in the short run, and the estimate is statistically significant at the 5 percent level. The ad hoc coefficient is -6 cents per

dollar and statistically insignificant, providing little evidence that realized payments passed through to rents in the corresponding crop year. Column (1), which pools the two payment types, yields a pooled estimate of 5.8 cents that is also insignificant. The study period contains $11 billion of statutory payments and $70 billion of ad hoc payments, while the pooled specification produces a much smaller estimate than the statutory payment estimate. The difference between the two channels is 51.1 cents ($p = 0.037$) in the baseline and 51.6 cents ($p = 0.050$) with the revenue control, so the hypothesis of equal pass-through of the two payment types is rejected in the baseline and sits at the margin of conventional significance with the revenue control.

Estimated rental persistence is close to 0.8 in the disaggregated columns, indicating substantial persistence in county cash rents. The spatial lag is negative and statistically insignificant, and excluding it lowers the commodity estimate to 32 cents but does not change its significance. The remaining controls have little effect on the main payment estimates. Adding lagged crop revenue in column (3) leaves both payment coefficients essentially unchanged, while its own coefficient is close to zero. Lagged indemnities are also negative and statistically insignificant. The weather coefficients are small, although precipitation is negative and statistically significant. Because precipitation is realized during the crop year, its association with reported rents indicates that the rent series reflects within-year conditions.

Lagged CRP payments are positive in all three columns and statistically significant in the two disaggregated specifications. A one dollar per acre increase in county CRP payments, roughly the sample mean, is associated with cropland rents that are about 0.6 percent higher in the following year. This positive relationship is consistent with a land-supply effect. CRP payments accrue to owners of land withdrawn from production, while enrollment reduces the acreage available for rent, consistent with the land-market responses documented by Wu (2000) and Roberts and Lubowski (2007). The existing literature points in the same direction. Lence and Mishra (2003) report a positive but insignificant CRP coefficient in Iowa county rents, and Wu and Lin (2010) find that CRP enrollment increased farmland values by 2 to 14 percent in high-enrollment regions. Because CRP rental rates are based partly on past county rents, some of the association may also reflect this mechanical relationship, and we treat the CRP coefficient primarily as a control. Unlike ARC/PLC payments, CRP payments are contractual and predictable but affect operating cropland rents

through land retirement rather than through the expected return to the rented acre.

The statutory estimate is close to the 42 percent average that Ciaian et al. (2021) report for the U.S. rent literature, and it is above the short-run estimate of roughly 12 cents and the long-run estimate of 37 cents that Hendricks et al. (2012) report for Kansas during the direct payment era. Part of the difference is expected, because direct payments were stable annual transfers with relatively little year-to-year variation, while ARC/PLC payments vary with prices and revenues and provide more variation for identifying a short-run response. Estimated rental persistence is also comparable to the 0.675 reported by Hendricks et al. (2012), consistent with gradual adjustment in cash rents.

The estimate is stable when lagged county crop revenue is added as a direct control for market returns. Column (3) instruments this variable in the same way as the other endogenous variables, and the commodity estimate is essentially unchanged at 45.2 cents with a standard error of 20.9 cents. The difference between the two channels also remains similar at 51.6 cents ($p = 0.050$). The stability of these estimates indicates that controlling directly for lagged crop revenue does not materially change the estimated relationship between payments and rents, while the revenue coefficient itself is close to zero.

The size of the correction from instrumenting is also visible in the within-county least squares estimate of the commodity coefficient, which is 4 cents compared with 44.9 cents in the baseline GMM specification. The gap is consistent with the attenuation in equation (3) and the countercyclical confounding discussed above. A simulated-payment instrument constructed from predetermined program exposure provides an external check on this result, yielding 28.6 cents in a static levels specification and 47.1 cents when added to the dynamic GMM instrument set.

The implied long-run pass-through is $\beta_c \bar{R}/(1 - \hat{\gamma} - \hat{\rho}) \approx 81$ cents per dollar. Because the conversion depends on $1 - \hat{\gamma} - \hat{\rho}$, the long-run estimate inherits the uncertainty in both coefficients, and the delta-method 95 percent confidence interval ranges from 4 to 158 cents. We therefore treat the short-run estimate as our primary quantitative result, while the long-run point estimate suggests greater pass-through over time. The interval excludes zero and includes the long-run estimates reported in the prior literature, including the 54 to 90 cents that O'Neill and Hanrahan (2016) report for Pillar 1 payments.

In contrast, we find no statistically significant same-crop-year pass-through of realized ad hoc payments into rents. The baseline coefficient is -0.0007 with a standard error of 0.0008, corresponding to -6.1 cents per dollar with a 95 percent upper confidence bound of 8.7 cents. The revenue specification in column (3) gives a similar estimate of -6.4 cents with an upper bound of 6.5 cents.

Although the ad hoc estimate is statistically insignificant, its confidence interval does not support a positive pass-through comparable to the commodity program estimate. Ad hoc payments were large and widespread during the study period. They totaled $70 billion in our sample, more than six times the amount of statutory commodity payments, and were positive in 97 percent of county-years. The standard errors on the ad hoc pass-through, between 6.6 and 7.6 cents in the main specifications, are smaller than those on the statutory estimate, resulting in relatively narrow confidence intervals around the estimated effect.

The baseline estimate measures the response of rent for the crop year to which the payment is attributed. A separate question is whether landowners adjust rents in the following lease cycle after observing the payments received by tenants. CFAP provides a program-specific check on rent adjustment in the following lease cycle. Producers received the 2020 CFAP payments during 2020, so the payments were already known when leases for the 2021 crop year were negotiated in the fall of 2020. Instrumenting county CFAP receipts with predetermined program exposure and examining 2021 rents yields an estimate of 2.4 cents per dollar with a standard error of 7.4 cents. The estimate is statistically insignificant, with a 95 percent upper bound of approximately 17 cents per dollar.

The trade war provides a separate check on the ad hoc result using variation that does not rely on the panel's internal instruments. The 2018 retaliatory tariffs led to MFP payments allocated according to estimated trade damage, with soybean exposure as the largest component (U.S. Government Accountability Office 2020). We instrument county ad hoc receipts with the pre-period soybean share of farmland interacted with the trade-war window in a levels specification with county and year fixed effects over 2013–2020. The first-stage F statistic is approximately 3,400. The two-stage estimate is -3.7 cents per dollar with a standard error of 6.1 cents and -5.4 cents with a standard error of 7.2 cents when a signing-year revenue control is included. Figure 3 shows the year-by-year pattern. Rents in soybean-exposed counties remain relatively flat through the 2020 crop year and

increase beginning in 2021, when the commodity price boom that began in late 2020 entered newly signed leases. The tariff-incidence estimates of Yu et al. (2022) imply that the tariffs alone would have reduced rents in more exposed counties. Despite roughly $23 billion in nationwide MFP payments concentrated in these counties, we do not observe a corresponding increase in rents during the aid years, consistent with little net pass-through of MFP payments to rents, although this comparison cannot exclude a payment response that offset a tariff-induced decline.

A simulated instrument for ad hoc payments provides an additional check using county exposure to the program allocation formulas. Counties with greater simulated exposure have lower relative rents, with a coefficient of -3.0 cents per simulated dollar (standard error 0.5). The corresponding two-stage estimate, reported in Table 5, is -32.8 cents per dollar of actual ad hoc payments with a standard error of 4.9. Because the same exposure measure reflects both program allocation and the underlying losses, we interpret the estimate as the combined effect of the shock and the assistance on rents. The negative estimate is consistent with the panel results and provides no evidence that greater ad hoc exposure increased rents on net. Related evidence in the prior literature also points to limited rental capitalization for these types of payments. O'Neill and Hanrahan (2016) find no significant capitalization of Pillar 2 payments into Ireland's eleven-month conacre rental system, even though Pillar 1 payments are capitalized. Goodwin et al. (2011) similarly find that disaster payments are associated with lower cash rents even though they are positively associated with land values.

The ARC/PLC estimates also have implications for production costs. According to USDA cost-of-production estimates, land costs make up about 20 to 30 percent of total per-acre production costs for major field crops. In 2019, the largest statutory-payment year in our study period, ARC/PLC payments averaged $9.8 per acre in sample counties. Applying the short-run pass-through rate of 44.9 cents per dollar implies rents about $4.40 per acre higher, equivalent to about 5 percent of the mean rent and 1 percent of total production costs on rented land. The effect is about twice as large in counties in the top decile of statutory payment intensity, and the implied long-run effect is nearly twice the short-run amount. Although the effect in a single year is modest, it recurs when statutory payments are triggered, with part of the program benefit accruing to landowners through higher rents. Roughly two-fifths of U.S. farmland is rented, much of it from non-operator owners (Bigelow

et al. 2016).

5.2 Robustness checks

Table 4 reports estimator comparisons for the dynamic specification, including the rejected second-lag and system GMM variants discussed in Section 4.3. Pooled OLS overstates the persistence parameter and the within estimator understates it, so a consistent estimate should lie between the two (Bond 2002). The pooled and within estimates are 0.83 and 0.07, and the baseline estimate of 0.79 falls within this range. The system GMM specifications imply $\hat{\gamma} + \hat{\rho} \approx 1.08$, while the baseline difference GMM specification implies a sum of 0.44. The estimates are also stable when the instrument set is extended to the fifth lag. The commodity estimate changes from 44.9 to 42.4 cents, and the difference between the two pass-through rates remains statistically significant at 52.4 cents ($p = 0.042$).

The commodity estimate is stable across the control and sample variations reported in Table 5. Because CRP rental rates are based partly on the same NASS rent data used for our dependent variable, we first examine the results without the CRP control. The commodity estimate remains similar at 43.7 cents with a standard error of 18.3 cents. The spatial lag is negative and statistically insignificant in the baseline specification. Excluding it lowers the commodity estimate to 32.0 cents with a standard error of 13.5 cents but does not change its statistical significance. We also examine the 444 county-year observations excluded because of missing lagged indemnities. Setting missing indemnities to zero restores these observations and yields an estimate of 39.3 cents with a standard error of 17.6 cents. Across these specifications, the commodity estimate ranges from 32 to 44 cents, and the Hansen and AR(2) tests pass in every case.

External instruments provide a check on whether the lagged levels used as internal instruments remain correlated with persistent local shocks that also affect rents. Following the logic of shift-share designs (Goldsmith-Pinkham et al. 2020), we construct simulated ARC/PLC payments by combining predetermined 2019 program enrollment, base acres, and program yields by commodity with national payment rates by commodity and year, scaled by the same 2007 acreage denominator. For PLC, the simulated payment closely reproduces the actual payment formula by construction, and the county-year correlation between simulated and actual PLC payments is 0.99. Most of the additional

variation therefore comes from ARC-CO. We allocate national ARC-CO outlays across counties using predetermined base shares, excluding the realized county revenue that determines actual ARC-CO payments. The correlation between simulated and actual ARC-CO payments is 0.52. Adding the simulated series to the dynamic instrument set yields a commodity estimate of 47.1 cents with a standard error of 41.6 cents, close to the baseline estimate but less precise. A static two-stage least squares specification in levels using the simulated instruments yields 28.6 cents with a standard error of 6.1 cents. Retaining actual PLC payments and replacing only the ARC-CO component with its simulated counterpart gives a similar estimate of 30.3 cents with a standard error of 6.7 cents. Both static estimates are smaller than the baseline dynamic estimate but remain positive and statistically significant.

The ad hoc estimate is also similar across alternative specifications. One concern is that crop-year dating assigns ad hoc payments to the year of the compensated loss even when the payments are disbursed later. If rents respond when producers actually receive the payments, this convention could understate that response. Using payment year, which reflects when the payment was disbursed, instead of program year for the six ad hoc programs yields an ad hoc estimate of 8.3 cents per dollar with a standard error of 7.8 cents. The estimate remains statistically insignificant. We retain crop year as the baseline because it links each payment to the crop or loss it compensates, and use payment year as an alternative specification to examine rent responses when payments are disbursed. In addition, the commodity estimate remains positive and statistically significant at 40.5 cents with a standard error of 16.2 cents. Across the control and sample specifications, the ad hoc estimate ranges from -6.4 to -1.7 cents and remains statistically insignificant.

We also construct a simulated ad hoc instrument following the same shift-share logic, interacting county exposure to each program's allocation formula with national program outlays by crop year. Exposure is measured using the official 2019 county payment rates and base acres for MFP, program payment rates and predetermined acreage for CFAP, the 2008–2017 county mean of crop insurance indemnities and base acres for ERP and SDRP, and base-acre shares for ECAP. The first-stage F statistic is 316. Because these exposure measures reflect both program allocation and the underlying losses, we interpret the resulting estimate as the combined effect of the shock and the assistance on rents.

The level of clustering affects the precision of the commodity estimate. To allow for correlation across counties within the same state, Table 5 compares one-step difference GMM estimates with standard errors clustered at the county and state levels. The commodity estimate is unchanged at 48.5 cents, while its standard error increases from 18.9 cents under county clustering to 33.0 cents across 44 state clusters. The estimate is therefore less precise under state clustering, with $z = 1.47$. The static specification using the external instrument remains statistically significant under state clustering, with an estimate of 28.6 cents and a standard error of 6.1 cents. The ad hoc point estimate is also unchanged across the two clustering levels, while its 95 percent upper confidence bound increases from about 7 cents per dollar under county clustering to about 15 cents under state clustering.

6. Discussion and Conclusion

This paper examines how federal farm support is reflected in cash rents and how this relationship differs across payment types. We find that about 45 cents of each marginal ARC/PLC dollar is reflected in rents in the short run. The implied long-run pass-through is about 81 cents, although its 95 percent confidence interval is wide. In contrast, we find no statistically significant same-crop-year pass-through of realized ad hoc payments into rents during our 2019–2024 study period, despite the much larger scale of these payments. This difference is consistent with the information available when leases were negotiated. ARC/PLC program rules and payment formulas were established in advance, while the specific ad hoc programs in our sample were announced after leases for the corresponding crop years had been signed. The difference between the two pass-through rates is statistically significant in the baseline specification. Pooling the two payment types instead produces a small and statistically insignificant estimate that does not reflect their different pass-through rates.

The short-run ARC/PLC estimate of about 45 cents per dollar is close to the 42 percent average reported by Ciaian et al. (2021) for the U.S. rent literature. It is higher than the 12-cent short-run estimate reported by Hendricks et al. (2012) for Kansas and closer to their long-run estimate of 37 cents. The implied long-run estimate also falls within the range reported by O'Neill and Hanrahan (2016) for Pillar 1 payments in Ireland, and the estimated persistence in rents is comparable to that in earlier dynamic-panel studies. Evidence on other forms of support also provides a useful

comparison for the ad hoc results. O'Neill and Hanrahan (2016) find no significant capitalization of Pillar 2 payments into Ireland's short-term conacre rents, while Goodwin et al. (2011) find that disaster payments are negatively associated with cash rents. Our analysis extends this literature by estimating ARC/PLC and ad hoc payments within the same counties and years and directly comparing their pass-through rates.

The difference between the two payment channels is consistent with a role for the timing of payment information in capitalization. Capitalization theory concerns expected payment streams (Alston and James 2002), and the information available when leases are negotiated can affect whether payments are reflected in rents. ARC/PLC payments remain uncertain when leases are signed, but their program rules and formulas are known in advance and provide information about potential payments. In comparison, the specific ad hoc programs, eligibility rules, and payment rates in our sample were generally not known when the corresponding leases were negotiated. The results are therefore consistent with the information available at signing affecting incidence in addition to the way a payment is linked to production. For ARC/PLC, about 45 cents of every marginal payment dollar is reflected in higher cash rents on rented land in the short run. Because about 40 percent of U.S. farmland is rented, this pass-through implies that part of the program benefit accrues to landowners and that the production costs of operators rise, amounting to about one percent of total costs in high-payment years and more in high-payment regions. These effects recur when ARC/PLC payments are triggered. For ad hoc payments, the 2019–2024 estimates reflect a period in which the specific programs were generally announced after leases had been signed. As ad hoc support becomes more recurrent, producers and landowners may begin to form expectations about future assistance even before a specific program is announced.

Our analysis is subject to several limitations. First, the panel is short. Six years identify the short-run response but leave the persistence parameters, and therefore the long-run pass-through, less precisely estimated. The 95 percent confidence interval for the long-run ARC/PLC estimate ranges from 4 to 158 cents, so sharper conclusions about long-run incidence will require longer panels or additional information on rental adjustment. Second, inference on the ARC/PLC effect is sensitive to the level of clustering in the dynamic specification. The point estimate changes little, and the external-instrument specification remains statistically significant under state clustering, but

the dynamic estimate is less precise when standard errors are clustered at the state level. Third, our outcome is the county average cash rent for non-irrigated cropland. County averages cannot match payments to the specific land generating them and obscure variation across lease arrangements, landlord types, and field quality. Field-level studies have found somewhat smaller landlord shares (Kirwan 2009, Kirwan and Roberts 2016), and NASS publication thresholds may also generate selection across counties. Fourth, rents capture only one margin of incidence. Land values can reflect expected payment streams over longer horizons (Ifft et al. 2015), so our analysis does not address the asset-price response to repeated support. The internal instruments also require earlier payments not to affect current rent changes through omitted persistent channels. With a short panel, we cannot fully assess delayed responses operating through liquidity, balance sheets, credit conditions, operator survival, or expectations of future support. Finally, the ad hoc channel remains difficult to identify separately from the shocks that trigger assistance. Exposure to program allocation formulas is often also exposure to the underlying damage, so the simulated-instrument estimates capture the combined effect of the shock and the aid. The alternative timing and program-specific analyses reduce reliance on any single design, but they do not fully eliminate this identification challenge.

Several extensions could strengthen identification and broaden the analysis. Rental data after 2024 would provide evidence on whether repeated ad hoc assistance begins to affect lease negotiations as expectations change. Direct measures of expected payments at lease signing would help separate expected support from realized payments, while administrative thresholds or other discontinuities in program formulas could provide more plausibly exogenous variation. Longer panels could also test delayed responses and whether they are larger in areas where operators face tighter financial constraints. Field- or lease-level data would allow for heterogeneity across rental arrangements and landlord types and would better match payments to the acres that generate them. Extending the analysis to farmland values would also help determine whether repeated assistance appears in asset prices before it appears in annual cash rents. These extensions would help distinguish short-run rental incidence from longer-run land-market adjustment and provide a more complete picture of how farm support is reflected across different margins of the farmland market.

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7. Figures and Tables

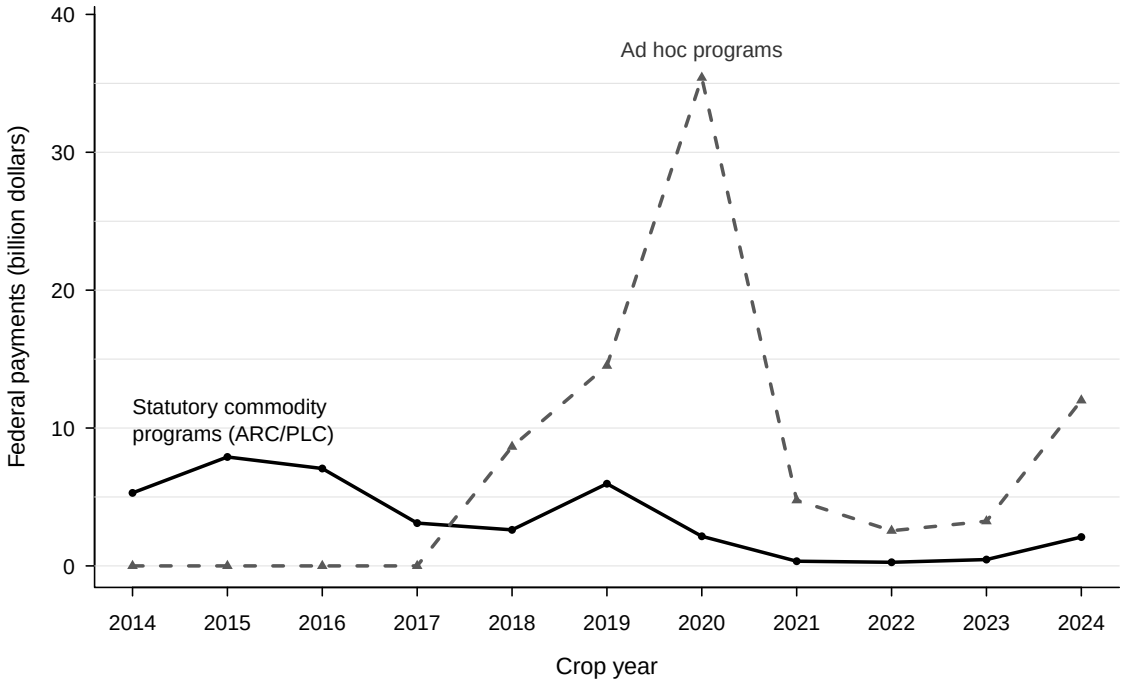


Figure 1: Federal Payments to Crop Producers by Channel

Notes: Statutory commodity payments include ARC-CO and PLC. Ad hoc payments include the six programs listed in Table 1. Payments are county-aggregated FSA administrative payments attributed to crop years and are reported in billions of dollars.

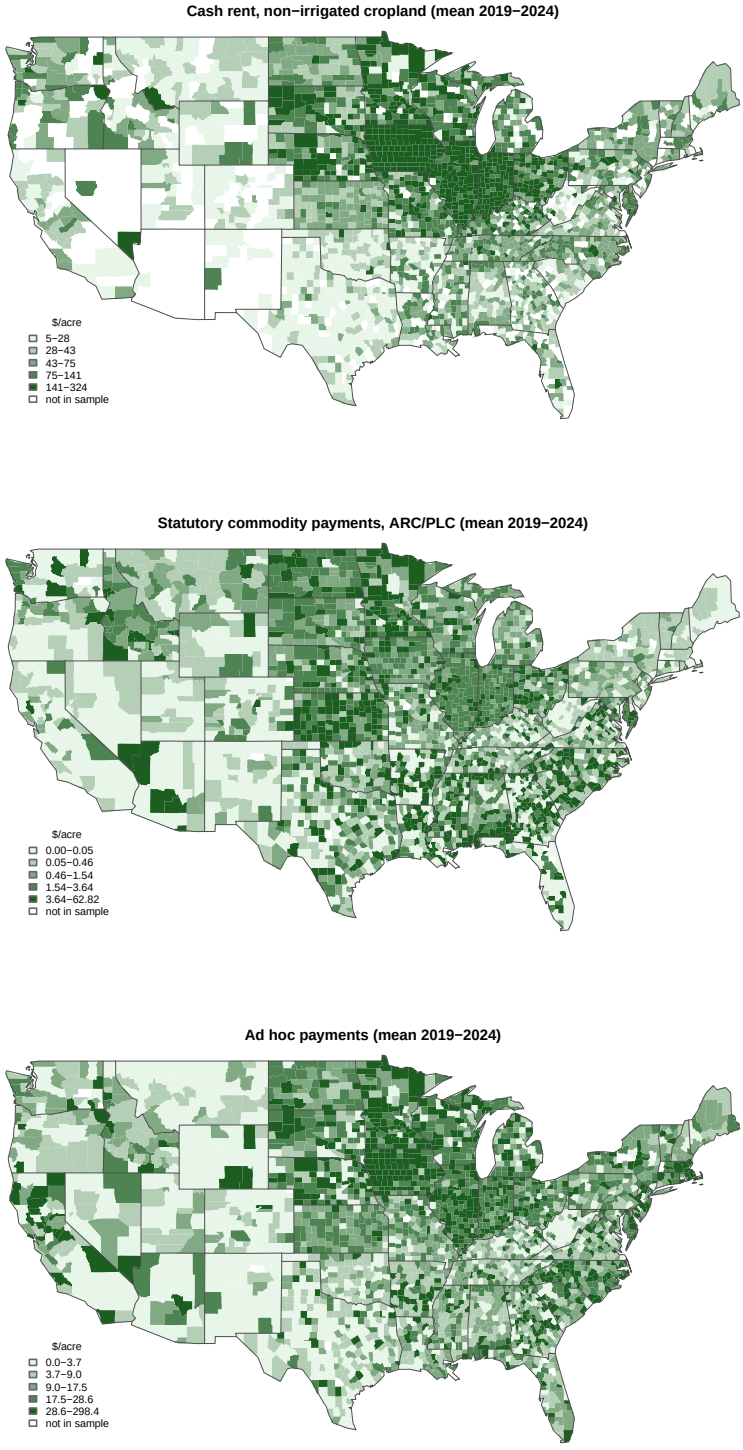


Figure 2: County Geography of Rents and Payments

Notes: Maps show county-level sample means over 2019–2024. Shading assigns counties to quintiles on a common green scale, with light green indicating the lowest quintile and dark green the highest. Rents are shown for counties with published NASS estimates, while payments are shown for all counties with 2007 Census acreage. Statutory payments reflect historical base acres and reference-price crops, whereas ad hoc payments reflect trade and disaster exposure. Both payment geographies differ from the geography of rents.

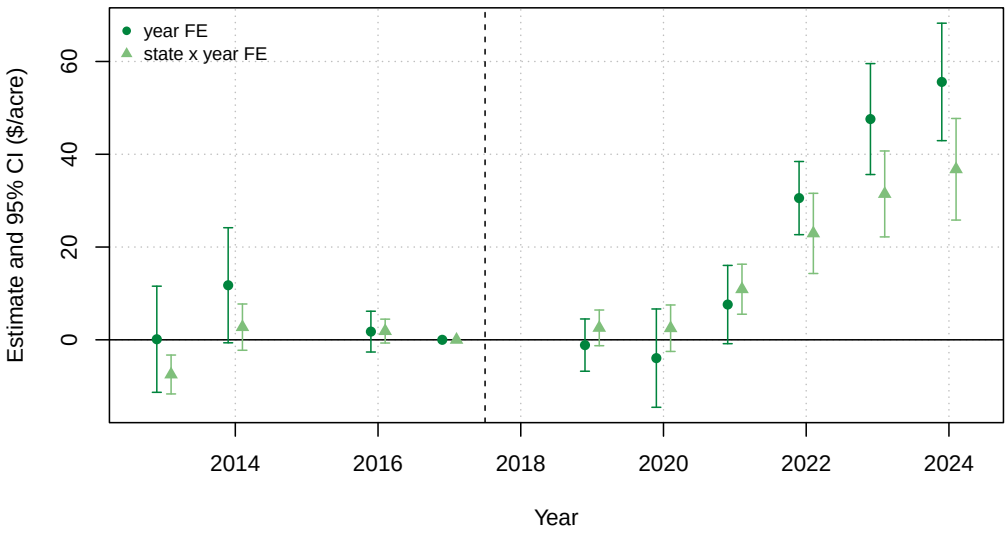


Figure 3: Event-Study Estimates for the Trade-War Ad Hoc Channel

Notes: The figure reports year-specific coefficients on pre-period soybean exposure, relative to 2017, in dollars per acre. Dark circles condition on year effects, while light triangles condition on state-by-year effects. Bars indicate 95 percent confidence intervals clustered by state and year. Rents in soybean-exposed counties remain relatively flat through the 2020 crop year and begin to rise in 2021, when the commodity price boom that began in late 2020 entered newly signed leases.

Table 1: The ad hoc programs, 2018–2024 crop years

Program	Crop years	First announced	Outlays ($B)
Market Facilitation Program (MFP)	2018, 2019	Jul. 2018, May 2019	23.2
Coronavirus Food Assistance Program (CFAP)	2020	Apr. 2020, Sep. 2020	31.6
Emergency Relief Program (ERP)	2020–2022	May 2022, Oct. 2023	11.0
Pandemic Assistance Revenue Program (PARP)	2020	Jan. 2023	0.2
Supplemental Disaster Relief Program (SDRP)	2023, 2024	Jul. 2025	5.9
Emergency Commodity Assistance Program (ECAP)	2024	Mar. 2025	9.4

Notes: Outlays are county-aggregated Farm Service Agency payments attributed to the listed crop years, from the administrative data described in Section 3. Announcement dates are the first USDA announcement of each program or tranche. In every case the announcement postdates the fall in which leases for the earliest compensated crop year were negotiated. ECAP and SDRP were authorized by legislation passed in December 2024, after the 2024 harvest.

Table 2: Summary statistics, estimation sample 2019–2024

Panel A. County-year observations

	Mean	SD	P10	P90
Cash rent, non-irrigated cropland ($/acre)	91.1	71.9	22.0	209.0
Statutory commodity payments C ($/acre)	3.0	8.2	0.0	9.1
Ad hoc payments A ($/acre)	18.5	27.9	0.2	54.6
CRP payments, $t-1$ ($/acre)	1.0	2.7	0.0	2.6
Insurance indemnities, $t-1$ ($/insured acre)	45.6	109.1	3.6	100.9
Mean temperature (°C)	13.2	4.4	7.2	19.2
Mean monthly precipitation (mm)	84.9	32.1	40.4	126.1

Panel B. Sample means by crop year ($/acre)

	Cash rent	C	A
2019	87.2	9.8	24.6
2020	86.7	4.0	56.2
2021	86.8	0.8	6.2
2022	91.4	0.2	3.1
2023	96.5	0.5	4.5
2024	97.8	3.7	19.0
Observations	13,406		
Counties	2,601		

Notes: Payments are county FSA totals attributed to crop years, divided by 2007 Census cropland plus pastureland acres. Statutory payments are positive in 64 percent of county-years, and ad hoc payments in 97 percent.

Table 3: Federal payments and county cash rents, 2019–2024

	(1) Pooled	(2) Baseline	(3) Revenue control
Total federal payments ($/acre)	0.0006 (0.0005)		
Statutory commodity C ($/acre)		0.0049** (0.0021)	0.0050** (0.0023)
Ad hoc A ($/acre)		−0.0007 (0.0008)	−0.0007 (0.0007)
CRP payments, $t-1$	0.0047* (0.0027)	0.0057** (0.0029)	0.0057** (0.0029)
Crop revenue, $t-1$			0.00000 (0.00002)
Indemnities, $t-1$	−0.00004 (0.00005)	−0.00007 (0.00006)	−0.00007 (0.00006)
Temperature	−0.0077 (0.0074)	−0.0059 (0.0077)	−0.0059 (0.0076)
Precipitation	−0.0005* (0.0003)	−0.0007** (0.0003)	−0.0007** (0.0003)
ln rent, $t-1$ (γ)	0.602*** (0.204)	0.794*** (0.205)	0.792*** (0.201)
Spatial lag (ρ)	−0.033 (0.303)	−0.350 (0.339)	−0.351 (0.357)
County and year effects	yes	yes	yes
Instruments	14	16	18
Hansen p / AR(2) p	0.068 / 0.52	0.63 / 0.45	0.75 / 0.45
Panel observations / counties		13,406 / 2,601	
SR pass-through, cents per $1			
statutory commodity	5.8 (4.7), n.s.	44.9 (19.1)	45.2 (20.9)
ad hoc		−6.1 (7.6)	−6.4 (6.6)
difference $C-A$ [p]		51.1 (24.5) [0.037]	51.6 (26.3) [0.050]

Notes: Two-step difference GMM in logs with collapsed instruments and Windmeijer-corrected standard errors, clustered by county, in parentheses. Every payment variable is instrumented with its own lags 3–4 in levels. Because county rents are published continuously only from 2019, the differenced equations use 5,955 observations from 2,182 counties over 2022–2024, with earlier years entering through the lagged instruments. Column (3) adds lagged county crop revenue, instrumented with its own lags 3–4. Crop revenue is county production of corn, soybeans, wheat, sorghum, rice, and cotton valued at state prices received, divided by the same 2007 acreage denominator, and set to zero where production is not reported. Pass-through rates convert semi-elasticities at the sample mean rent ($91.1). * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table 4: Estimator selection and instrument depth

	$\hat{\gamma}$	C (cents/\$1)	A (cents/\$1)	Hansen p	AR(2) p
Pooled OLS	0.830	5.9 (1.8)	2.1 (0.6)	—	—
Within (LSDV)	0.070	3.9 (1.9)	−2.3 (0.8)	—	—
Difference GMM, lags 2–4	0.362	7.7 (3.7)	−5.9 (2.4)	0.031	0.24
Difference GMM, lags 3–4 (baseline)	0.794	44.9 (19.1)	−6.1 (7.6)	0.63	0.45
Difference GMM, lags 3–5	0.745	42.4 (20.0)	−10.0 (6.6)	0.58	0.44
System GMM, lags 3–4	0.33	1.6 (12.9)	1.8 (5.4)	<0.001	0.89
System GMM, lags 2–4	0.34	5.1 (3.3)	−3.1 (2.2)	<0.001	0.39

Notes: Identical sample, variables, and collapsed instrument construction throughout. Cents per dollar at the sample mean rent. Windmeijer-corrected county-clustered standard errors in parentheses for the GMM rows and county-clustered robust standard errors for the least squares benchmarks. Difference-in-Hansen tests give a second-lag increment of $C = 16.4$ (df 5, $p = 0.006$), a fifth-lag increment of $C = 5.1$ (df 5, $p = 0.404$), and a level-moment statistic for system GMM of $C = 46.6$ (df 8, $p < 0.001$). Both system variants imply $\hat{\gamma} + \hat{\rho} \approx 1.08$, outside the stationary region. The channel difference $C - A$ is 51.1 cents ($p = 0.037$) at lags 3–4 and 52.4 cents ($p = 0.042$) at lags 3–5.

Table 5: Robustness of the baseline estimates

	C (cents/\$1)	A (cents/\$1)	Hansen p	AR(2) p
Baseline (Table 3, col. 2)	44.9 (19.1)	−6.1 (7.6)	0.63	0.45
Ad hoc payments dated by disbursement year	40.5 (16.2)	8.3 (7.8)	0.79	0.45
Controls and sample				
No CRP control	43.7 (18.3)	−6.4 (7.5)	0.66	0.50
No spatial lag	32.0 (13.5)	−1.7 (6.8)	0.42	0.68
Missing indemnities set to zero ($n = 13{,}850$)	39.3 (17.6)	−4.1 (6.9)	0.58	0.51
External instruments				
Internal + simulated-payment IVs	47.1 (41.6)	−6.4 (6.5)	0.21	0.70
Simulated IV only, static 2SLS, levels ($n = 13{,}298$)	28.6 (6.1)	−32.8 (4.9)†	—	—
Actual PLC + simulated ARC-CO, static 2SLS, levels ($n = 13{,}298$)	30.3 (6.7)	−33.3 (4.9)†	—	—
Inference				
One-step GMM, county-clustered	48.5 (18.9)	−8.6 (7.8)	—	—
One-step GMM, state-clustered (44 states)	48.5 (33.0)	−8.6 (11.8)	—	—

Notes: Entries are short-run pass-through rates in cents per payment dollar, evaluated at the sample mean rent of \$91.1 per acre, with standard errors in parentheses. Unless noted otherwise, each row re-estimates the baseline two-step difference GMM specification of Table 3, column (2), on the same sample of 13,406 county-year observations, with Windmeijer-corrected standard errors clustered by county. The dating row re-dates the six ad hoc programs by the year of disbursement while keeping statutory payments on the crop-year convention. The static 2SLS rows instrument both payment variables in a levels specification with county and year fixed effects and standard errors clustered by state, using the fully simulated payments in the first row and, in the second, an instrument for statutory payments that retains actual PLC payments and replaces only the simulated ARC-CO component. Dashes indicate statistics that are not applicable to the estimator. †The coefficient on ad hoc exposure in the shift-share design is a bound on the combined effect of the shock and the aid, not a capitalization estimate, because exposure to the aid formula is exposure to the triggering damage (Section 5.1).