The Effect of E-Invoicing on Tax Revenue and Compliance in El Salvador

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Abstract

This paper evaluates the early effects of El Salvador's staggered rollout of mandatory e-invoicing on value-added tax (VAT) revenue and compliance. I use published firm-level administrative tax data from 2021 to 2025 and a modern statistical method that compares firms affected by the reform to those not yet treated. I find no significant gains in tax revenue or compliance among larger firms, likely due to preexisting digital adoption and already high baseline compliance. Overall short-run effects are limited, as El Salvador's smallest firms are not yet mandated at the time of writing. These findings suggest that while e-invoicing may not yield immediate fiscal gains, it can support El Salvador's long-term goals of administrative modernization and tax base expansion. This study contributes to growing evidence of mixed results following e-invoicing tax reforms in low-enforcement capacity settings and offers insights for policymakers considering similar reforms.

1. Introduction

Developing countries increasingly turn to digital tools to boost revenue. In El Salvador, where the Ministry of Finance lacks the technical depth of agencies like the United States Internal Revenue Service (IRS), e-invoicing offers a potential substitute for low state capacity by lowering administrative costs, improving responsiveness to taxpayers, and strengthening data security. At the firm-level, e-invoicing lowers compliance costs and increases detection probability, which may improve tax compliance. It may also encourage formalization by capturing previously unregistered firms. Yet staff training, IT upgrades, and public resistance to unfamiliar systems can make adoption difficult.

This paper provides the first firm-level, causal analysis of e-invoicing in El Salvador. To date, no published studies have evaluated this reform in the Salvadoran context, despite its ambitious national rollout. I use the policy's staggered implementation across ten treatment cohorts and apply modern DiD methods to measure its impact on two outcomes: log reported VAT revenue and the probability that a firm remits VAT in a given month.

I find limited short-run effects overall. Larger firms show no significant revenue gains, likely due to preexisting digital systems and high compliance. Small compliance gains may emerge among later cohorts, but these do not translate into meaningful revenue increases. These results suggest that while e-invoicing may not deliver immediate fiscal returns in high-compliance environments, it can still support long-run goals of formalization and administrative modernization.

El Salvador is a promising case study. VAT accounts for 38% of public revenue, yet the tax base is narrow, with two-thirds of the workforce operating informally (Bertelsmann Stiftung, 2024). According to the 2023 World Bank Enterprise Survey, 80% of formal Salvadoran firms already pay taxes electronically—9 percentage points below the Latin American and Caribbean (LAC) average. Only 1% of Salvadoran firms cited tax administration as their biggest obstacle to doing business, compared to 3.6% across LAC countries. Instead, 18.7% of firms identified informal competition as their greatest challenge, well above both the LAC average (13%) and the global average (9%). These patterns suggest taxpayer readiness for digital reforms that promote formalization (World Bank, n.d.-a, n.d.-b).

Prior studies find mixed effects of e-invoicing on revenue collection and compliance. Reported earnings or assessed tax rose significantly in Ecuador (18–25%) (Ramírez et al., 2018, p. 19) and Argentina (up to 10%) (Templado & Artana, 2018). Uruguay saw a more modest 3.7% increase (Bérgolo et al., 2018, p. 14). In contrast, early gains in China faded over time (Fan et al., 2018, as cited by Bellon et al., 2020, p. 3), and one cross-country study found no lasting improvements in VAT revenue or compliance, likely due to limited administrative capacity to support enforcement (Kotsogiannis et al., 2025). These findings suggest that e-invoicing can improve outcomes where evasion is widespread and enforcement is weak, but its effectiveness depends on implementation. However, these studies relied on traditional methods that may suffer from bias due to negative weighting or treatment effect heterogeneity.

Firm-level effects are even more heterogeneous. Peru saw increases greater than 5% in reported value-added tax (VAT) in the first year of its mandatory e-invoicing rollout, and these effects were strongest among small firms and in low-compliance sectors like retail and construction. However, firms in these sectors also experienced temporary declines in survival

rates as increased scrutiny led to firm exits (Bellon et al., 2020). Small and medium firms may face steep adjustment costs and require support, underscoring the importance of gradual rollout (Kaur & Majahar Ali, 2024).

Recent work emphasizes complementarities between technology and human enforcement (Kotsogiannis et al., 2025). Digital tools reduce time spent on routine tasks, allowing tax authorities to focus on audits and investigations (Okunogbe & Tourek, 2024). Combining digital systems with staffing increases and performance incentives is associated with improved tax collection (Basri et al., 2021; Okunogbe & Tourek, 2024). El Salvador's reform builds on this logic, including taxpayer support centers alongside e-invoicing.

The remainder of this paper is structured as follows. Section 2 provides background on the motivations for adopting e-invoicing in El Salvador. Section 3 describes the data and discusses its limitations. Section 4 presents the estimation strategy and inference procedures used to identify treatment effects. Section 5 reports the main results and offers a brief interpretation. Section 6 concludes.

2. Context

2.1 Historical Context

Bukele's rise and consolidation of power enabled a series of state-led modernization efforts, including major reforms aimed at improving fiscal capacity. After the Salvadoran Civil War ended in 1992, the country suffered decades of increasing poverty and gang violence. These conditions preceded the election of President Nayib Bukele in 2019, who campaigned as a "non-party" candidate promising to end corruption and modernize the state. His decisive COVID-19

responses, declaring repeated states of emergency and allocating emergency funds for new hospitals, paved the way for virtually unopposed one-party rule. Within months, the legislative majority replaced Supreme Court judges and the attorney general with Bukele loyalists, eliminating any judicial check on his decrees and even permitting him to seek re-election past the constitutional term limit (Bertelsmann Stiftung, 2024).

Under Bukele's administration, public debt has soared to more than USD 30 billion, or 88% of the country's gross domestic product (GDP), much higher than in neighboring countries (Bergengruen, 2024; World Bank, n.d.). To fund his ambitious infrastructure agenda (e.g., high-speed rail and a new international airport), inherited anti-poverty programs, and sizable COVID-19 relief, Bukele has pursued high-profile technological reforms. One such initiative, the sale of Bitcoin-denominated bonds, failed; another, which this study examines, is the tax authority's rollout of a mandatory e-invoicing program (Bertelsmann Stiftung, 2024)

2.2 E-invoicing

El Salvador's Ministry of Finance identified e-invoicing as a "high impact" project aimed at improving VAT administration and revenue collection (Secretaría de Innovación de la Presidencia, 2020). The standard 13% VAT accounts for 38% of public revenue, yet enforcement is limited by widespread informality (~70%) (Bertelsmann Stiftung, 2024; *El Salvador Country Commercial Guide*, 2024). Prior to the e-invoicing rollout, tax policy had not been overhauled since the 1990s (Bertelsmann Stiftung, 2024).

Like most countries, El Salvador levies VAT at each stage of production and distribution. Producers pay VAT on sales to retailers, who in turn apply the same rate to consumer sales. Certain sectors, such as public, financial, and insurance services, are exempt (Bloomberg Tax,

2025; PwC, 2025). By contrast, U.S. states typically rely on a single-stage retail sales tax. While both systems can raise equivalent revenue, VAT's invoicing trail and detailed reporting mechanisms enhance real-time enforcement (Bloomberg Tax, 2025).

By 2025, more than a dozen countries in Latin America and the Caribbean had implemented e-invoicing, including Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru, and Uruguay; others, such as the Dominican Republic, Panama, and Paraguay, have begun to implement the system (Barreix and Zambrano, eds, 2018, as cited in Bellon et al., 2020; Pires, 2025). Peru is one of the few countries with firm-level evidence on e-invoicing impacts in a developing country. Its rollout, like El Salvador's, required significant upgrades to tax administration and IT systems. Implementation was gradual, starting with larger firms and giving smaller firms more time to comply (Bellon et al., 2020).

Prior to El Salvador's reform, tax enforcement relied on paper-based invoicing and ex-post audits, with limited cross-checking and no real-time monitoring. Tax and customs inspections were slow and paper-intensive, reflecting low administrative capacity (Calderon Ramirez, 2024). Mandatory e-invoicing introduced real-time monitoring of commercial transactions, aiming to improve transparency and enforcement efficiency.

In 2019, El Salvador launched a voluntary e-invoicing pilot with approximately 50 large VAT taxpayers, but the program was delayed by the COVID-19 pandemic (Auxadi, 2024; Caragher, 2024; EDICOM, 2024). In July 2023, the government mandated e-invoicing for the first rollout group, replacing paper invoices with fully electronic ones via the Finance Ministry's eFacturaSV system. Suppliers generate invoices through the Ministry's web portal or approved accounting software, producing a standardized, machine-readable file. The platform verifies the format, credentials, and VAT calculation before issuing an authorization. Once approved, the

supplier forwards the invoice to the buyer. The system is government-controlled and operates in real time, so tax authorities can monitor compliance in real time (Dirección General de Impuestos Internos, 2021; European Commission, n.d.). Unlike more decentralized European models, El Salvador's system is fully state-mediated and archives every VAT invoice upon issuance (European Commission, n.d.).

Notifications began in February 2023, five months before the initial mandate, and the ten-group rollout remains incomplete at the time of writing. Firms may opt-in early but must comply by their assigned date. A USD 30 million loan from the Inter-American Development Bank (IADB) to modernize tax administration supported key e-invoicing components, including a mobile app, website, and six support centers that trained over 50,000 users. The reform may have contributed to a USD 2 billion increase in VAT revenue from 2022 and 2023, reduced evasion, and shortened service times. By September 2024, e-invoicing saved 29,157 trees and 208.6 million liters of water, according to the IADB (Calderon Ramirez, 2024).

This ten-group rollout allowed tax authorities to onboard firms in manageable batches, test the eFacturaSV system and support centers, and tailor training for each wave (Dirección General de Impuestos Internos, 2021). Phasing by cohort size concentrated resources, prevented system overload, and eased the transition for small firms unfamiliar with e-invoicing, mirroring approaches in other Latin American countries (Bellon et al., 2020; Pires, 2025).

Alongside the e-invoicing mandate, El Salvador adopted additional tax measures that may influence VAT outcomes. As of January 2025, e-tickets became mandatory for business-to-consumer transactions, expanding digital traceability in retail (Ministerio de Hacienda, El Salvador, 2024). Unlike e-invoices, which govern business-to-business transactions and require stricter documentation, e-tickets are simplified digital receipts designed for high-volume, lower-

value sales. The termination of tax amnesty in late 2024 may also signal a broader shift toward stricter enforcement (Auxadi, 2024). While this study isolates the effects of staggered e-invoicing, concurrent reforms likely reinforce compliance trends and may amplify treatment estimates. Still, because e-invoicing defines the core mechanism for recording VAT, it remains the most consequential reform and an appropriate focus of analysis.

3. Data

3.1 Data Sources and Panel Construction

This study uses monthly firm-level tax remittance data from 2021 to 2025, publicly available through El Salvador's Fiscal Transparency Portal, maintained by the Ministry of Finance (Ministerio de Hacienda, El Salvador, 2025). Each dataset contains de-identified records on monthly payments, tax types, economic activity codes, and municipality identifiers.

Analysis focuses on VAT revenue, identified using tax codes from the Portal's official public dictionary, including:

- VAT Internal Transactions

- VAT on Imports

- VAT Transactions via Withholding and Collection

- VAT Withholding Non-Residents

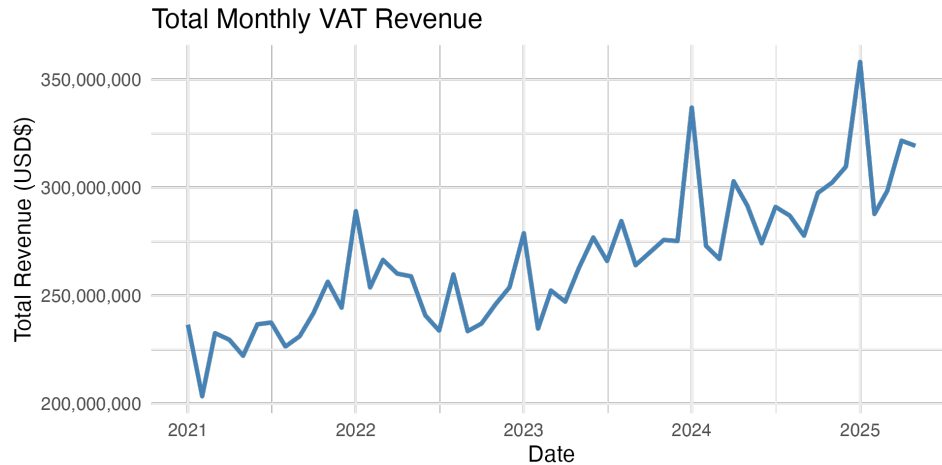- VAT Advance Payment (e.g., 2% on credit card purchases)

Figure 1. *Total Monthly VAT Revenue in El Salvador (2021-2025)*

The data, filtered on VAT revenue, closely aligns with published figures. For 2022, the panel yields an estimate of 3.034 billion USD in VAT revenue for El Salvador. The OECD reports a slightly lower figure of 2.944 billion USD (OECD et al., 2025). A rough calculation—applying the OECD's reported VAT share of total tax revenue to the World Bank's total tax revenue estimate—yields a somewhat lower figure of approximately 2.698 billion USD (OECD et al., 2025; World Bank, n.d.). These comparisons suggest that the panel provides a credible and reasonably accurate representation of national VAT revenue.

VAT revenue follows clear seasonal patterns. By law, firms report VAT monthly and remit it by the 10th business day of the following month (PwC, 2025). As a result, holiday-season consumption and public/private contract spending concentrated at the start of the fiscal year drive expected first-quarter spikes in collections.

With the reliability of VAT data established, I construct a balanced monthly panel from January 2021 to May 2025. Of the approximately 37,000 firms notified, 30,167 appear in the panel, likely due to delayed entry. Because firm identifiers are not provided, I approximate firms using unique combinations of four-digit municipality codes and six-digit economic activity

codes. This assumes that, within each municipality, entities sharing the same economic activity code represent distinct firms. After generating firm identifiers, I merge in classification variables such as industry, baseline entry status, and treatment group. Misclassification risks are discussed in Section 3.3.

3.2 Treatment Assignment

Rollout dates and cohort sizes were not published and were instead obtained through direct contact with El Salvador's Ministry of Finance and the Transparency Portal support offices. In El Salvador, firms were privately notified approximately five months before their assigned implementation date.

Firms with no reported revenue in the month before the first notification are excluded to ensure comparability and valid dynamic treatment estimation under Callaway and Sant'Anna (2021).

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
Notification Date	2/1/2023	5/1/2023	8/1/2023	12/1/2023	2/1/2024	5/1/2024	8/1/2024	12/1/2024	2/1/2025	5/1/2025
Treatment Date	7/1/2023	10/1/2023	1/1/2024	4/1/2024	7/1/2024	10/1/2024	1/15/2025	4/1/2025	7/1/2025	10/1/2025
Firm Count	233	239	249	345	657	701	704	4982	14286	15000

Table 1. *El Salvador E-invoicing Cohort Rollout Dates and Sizes*

Although the official assignment criteria are undisclosed, increasing cohort sizes and the 2019 pilot program targeting large firms strongly suggest assignment based on pre-treatment

taxpayer size. I assign firms into treatment cohorts by descending average pre-treatment VAT revenue.

3.3 Assignment Strategy and Limitations

El Salvador's phased e-invoicing rollout most closely resembles Chile's and may even be modeled after it (Caragher, 2024; EDICOM, 2024). In 2003, Chile became the first Latin American country to introduce e-invoicing (EDICOM, 2025) Chile initially offered a voluntary system and launched a free web portal to encourage adoption among small and medium firms (Calderón, 2008). By 2008, the largest 1,000 taxpayers accounted for 48% of the documents issued, while 75% of the 7,000 taxpayers authorized to issue e-invoices were small or medium firms using the portal (Calderón, 2008).

In 2014, Chile made e-invoicing mandatory, first for large and medium firms, followed by staggered deadlines for smaller firms based on size and location (Ministerio de Hacienda, Chile, 2014).

	Group 0	Group 1	Group 2	Group 3	Group 4
Group Classification	Large and Medium Firms	Urban Small Firms	Rural Small Firms	Urban Microenterprises	Rural Microenterprises
Treatment Date	10/31/2014	7/31/2016	1/31/2017	1/31/2017	1/31/2018

Table 2. *Chile E-invoicing Cohort Rollout Dates*

I assign treatment cohorts equal in size to official groups (See Table 1) by descending order of pre-treatment VAT revenue, following a rationale consistent with Chile's rollout strategy. Chile began with larger taxpayers, fewer in number but responsible for a

disproportionate share of transactions, before extending mandates to smaller firms. Both Chile's free web portal and El Salvador's e-invoicing help centers target smaller taxpayers who typically require more time and guidance. In the absence of official criteria, this cross-country precedent reinforces the credibility of my assignment strategy. Further support comes from Section 5.4, where industry- and municipality-level results appear more heterogeneous and less precise, validating firm size as a more reliable basis for treatment assignment.

Implementing this strategy requires careful identification of firms in the data. Misclassification risk is greatest among smaller firms, who are more numerous and operate in crowded sectors. This asymmetry may introduce noise into control groups, weakening treatment effects. To mitigate this, I restrict the main event studies to firms with sufficient pre-treatment observations, define taxpayer size groups using pre-treatment revenue, and exclude post-baseline entrants from identification. I also estimate an alternative specification that aggregates outcomes by treatment cohort, industry, and month, eliminating firm-level misclassification by relying solely on observed group and sector identifiers.

A known limitation is an under-reporting error affecting October 2023 (the second cohort's treatment month); this month is excluded from the sample. Other limitations include the absence of firm-level covariates (e.g., age, digital readiness, tax history) and the inability to identify firms that voluntarily adopted e-invoicing before the mandate.

4. Methods

To estimate the causal effects of e-invoicing on firm tax behavior, I apply a difference-in-differences (DiD) event study design proposed by Callaway and Sant'Anna (2021), exploiting

the staggered rollout. Identifying these effects is challenging because firms were assigned to

treatment cohorts based on undisclosed non-random criteria. At each point in time, firms that

have not yet been treated serve as the control group for estimating treatment effects. However, as

the rollout progresses, the number of untreated firms shrinks, limiting inference for the final

cohort. Since the final group had not yet been mandated at the time of writing, this constraint

does not affect my analysis. DiD addresses the issue of randomization by comparing changes in

outcomes over time between treated and control groups, assuming similar pre-treatment trends.

Since e-invoicing was the primary tax-related change affecting VAT revenue during this period,

post-treatment differences are attributed to the reform.

Standard DiD methods using two-way fixed effects (TWFE) can produce biased

estimates under staggered treatment timing. As Callaway and Sant'Anna (2021) show, TWFE

may yield incorrect signs when treated units serve as controls for later-treated units, leading to

invalid comparisons.

To address these concerns, I implement the doubly robust event study estimator

developed by Callaway and Sant'Anna (2021). This method estimates group-time average

treatment effects (ATTs), defined as:

$$ATT(g, t) = \mathbb{E}[Y_t(1) - Y_t(0) \mid G = g],$$

which is the expected outcome difference at time t for units in treatment group g. By fixing

firms to a group and varying time, the method traces treatment effects over time. Each group is

compared only to units not yet treated at time t, ensuring that control groups remain untreated

and avoiding invalid comparisons.

Identification in Callaway and Sant'Anna (2021) relies on several assumptions. First, I

evaluate the parallel trends assumption with a visual check (treated and not-yet-treated firms

follow similar trends in the absence of treatment). Second, I use the unconditional parallel trends assumption, avoiding the use of covariates in my model; this is due to limitations in my dataset, which does not include firm-level characteristics such as age, digital readiness, or tax history. Unconditional parallel trends rests on the assumption that firms are homogenous across groups in characteristics that affect VAT reporting trends, such as size, sector, and baseline compliance behavior, even if unobserved. This is not implausible in this setting, as my sample is limited to formal tax-filing firms, and outcomes are measured in log terms which helps normalize revenue differences. Third, I account for the limited treatment anticipation assumption by incorporating the five-month gap between notification and implementation in the model.

Treatment effects are measured using the log of firms' monthly VAT revenue. This log specification allows for interpreting effects as percentage changes, which is appropriate and necessary because treatment groups contain firms with different sizes and baseline revenue levels. Because some firms do not remit every month, resulting in zero values, I apply a standard $log(x + 1)$ transformation. This approach follows guidance from Chen & Roth (2024) and preserves zero observations while enabling logarithmic comparisons across firms and time. Although the adjustment introduces minor bias for small values, it avoids losing data or excluding firms with valid zero outcomes.

In addition to firm-level analysis, I estimate treatment effects using a balanced panel of 189 group-industry-month units, where each unit represents all firms within a taxpayer size group and industry in a given month. This aggregation smooths irregular reporting, reducing noise, particularly among smaller firms. Compared to the firm-level panel defined by industry and municipality, the group-industry aggregation sacrifices granularity for greater stability and

interpretability in fiscal behavior. These results are more informative for policymakers evaluating

the mandate's impact across economic sectors.

To examine how treatment effects evolve over time, I construct an event study that re-

indexes outcomes relative to each group's treatment date. Here, G is the period when a firm is

first treated, g indexes treatment groups, t is time, and T is the final period of the panel. Letting

$e = t - g$ denote event time (i.e., months relative to the treatment date), I estimate the average

treatment effects at each event time:

$$\theta_{es}(e) = \sum_{g} \mathbf{1}\{g + e \leq T\}P(G = g|G + e \leq T)ATT(g, g + e).$$

This is the average treatment effect e time periods after the treatment, calculated by aggregating

ATT estimates from all groups observed at event time e and weighting them by group size. The

indicator function, $\mathbf{1}\{g + e \leq T\}$, limits estimation to groups that still have observations at a

given event time. Weights given by the relative size of each group, written $P(G = g|G + e \leq$

$T)$, ensure that each $ATT(g, g + e)$ is proportionally represented in the average (Callaway &

Sant'Anna, 2021, p. 15)

The immediate average treatment effect occurs for $e = 0$. Plotting $\theta_{es}(e)$ across values

of e reveals dynamic treatment patterns. Negative values of e reflect pre-treatment periods used

to assess parallel trends, while positive values capture post-treatment effects (Callaway &

Sant'Anna, 2021, p. 15).

I implement this estimator using the *did* package in R. The Callaway and Sant'Anna

(2021) event study provides more credible estimates under staggered rollout. Unlike the TWFE

estimator, the event study framework explicitly models treatment dynamics and restricts

comparisons to untreated units. As a result, the Callaway and Sant'Anna (2021) method avoids

common biases, such as negative weighting and inappropriate comparisons between early- and late-treated units and offers a clearer view of the policy's timing and impact.

5. Results

The Callaway and Sant'Anna (2021) event study model fits the data well and visually confirms parallel pre-treatment trends. I find no evidence that El Salvador's e-invoicing mandate significantly or rapidly increased VAT remittance or compliance during the initial rollout period. However, long-term effects, particularly among smaller firms, remain uncertain and may strengthen as firms adapt and enforcement scales. These results do not support the claim that the mandate produced immediate gains in public revenue collection.

5.1 Effects on VAT Revenue

I estimate treatment effects on log monthly VAT revenue at the firm level using the Callaway and Sant'Anna (2021) event study model. Figure 3 plots group-time ATT estimates, and the results confirm parallel pre-treatment trends. Through the end of 2024, there is no statistically significant increase in VAT revenue following e-invoicing adoption. The overall average treatment effect on the treated (ATT) is 7% (SE = 5.6%), with a 95% confidence interval of [-4%, 18.7%]. These ranges are consistent with mixed findings in the literature, and the flat post-treatment path visually reinforces the null result.

These findings suggest that the mandate did not raise reported VAT revenue in the short run, potentially due to firm adaptation lags, limited enforcement, or transitional frictions. High preexisting compliance among larger firms may also limit measurable short-run effects. This

event study model accounts for staggered rollout and avoids cohort contamination, lending

credibility to the null result. While short-term effects are limited, longer-run gains remain

plausible, especially for smaller firms slower to adopt digital reporting.

5.2 Changes in Compliance

To test whether e-invoicing affected firms' compliance, I estimate its effect on the

probability of remitting VAT in a given month. The estimated ATT is 0.3% (SE = 0.5%), with a

95% confidence interval of [–0.8%, 1.3%], indicating no statistically significant change. The

confidence interval is relatively narrow, suggesting that even moderate changes in compliance

behavior are unlikely. These results are plotted in Figure 4.

The sample excludes firms with no reported revenue prior to the first notification date, so

estimates reflect compliance behavior among firms already filing VAT returns. Since the sample

is limited to formal firms, and only large and medium firms have been mandated at the time of

writing, high baseline compliance is expected. These findings suggest that e-invoicing had little

short-run effect on the extensive margin of compliance: firms that previously remitted continued

to do so, while non-remitting firms largely remained noncompliant. This reinforces the earlier

result of no significant revenue gains.

5.3 Aggregate Revenue and Compliance Effects

To validate firm-level findings using a more aggregated approach, I estimate event

studies at the group-industry-month level, where each unit includes all firms within a taxpayer

size group and industry code. This approach reduces noise from firm-level reporting and

mitigates concerns about firm identifier misclassification. Figure 5 reports effects on log total

VAT revenue; Figure 6 shows the probability that any firm in the unit remits VAT. All ATT

estimates are calculated using not-yet-treated group-industries as controls.

For log revenue, the estimated ATT is 2.7% (SE = 12.5%), with a 95% confidence

interval of [–21.8%, 27.3%]; the event study plot shows no post-treatment increase. For

remittance probability, the ATT is 2.4% (SE = 2.5%), with a 95% confidence interval of [-2.5%,

7.3%], also statistically insignificant. The revenue estimate is smaller than the firm-level result,

while the compliance estimate is larger, though both are relatively small and carry wider

confidence intervals due to aggregation. Overall, the findings corroborate the null effects

identified in the firm-level models.

5.4 Industry- and Municipality-Specific Firm-Level Treatment Effects

Industry and municipality firm-level event studies support assigning treatment cohorts by

firm size, where effects are less heterogeneous and more precisely estimated. Among the top 20

sectors, only one—agriculture, livestock, forestry and fishing—exhibits statistically significant

post-treatment effects on both log VAT revenue and the probability of remitting. The late stage

estimated effects are substantial: VAT revenue increases by over 200%, and remittance

probability rises by more than 20% (Figures 7 and 8). Although no significant pre-trends are

observed, large standard errors, even in the pre-treatment period, suggest the event studies are

only moderately powered.

Geographic results are similarly mixed. San Salvador, the capital and most populous city,

shows modest positive effects, while Mejicanos, a large neighboring municipality, shows

negative effects. Among rural areas, Ilobasco shows positive effects, while San Francisco

Menéndez shows negative effects. As with industries, confidence intervals are wide (Figure 9),

and no municipality exhibits statistically significant changes on the probability of remitting.

Taken together, these findings reaffirm the decision to assign treatment cohorts by firm

size, which produces more consistent and interpretable estimates than assignment by industry or

geography.

5.5 Recent Cohorts and Possible Late-Stage Treatment Effects

While later cohorts show potential increases in VAT remittance, I do not interpret these

results as causal due to potential administrative changes in firm classification and reporting

practices in 2025. The validity of the event study depends on stable unit definitions (units

consistently representing the same firm), which may not hold in the final months of the panel. I

therefore present this analysis descriptively.

Though not causal, firm-level results suggest modest long-run compliance gains: the ATT

on remittance probability is 0.9% (SE = 0.4%), significant at the 5% level (Figure 11). However,

this does not translate into meaningful revenue growth: VAT revenue increases by 4.7% (SE =

3.6%), which is not statistically significant (Figure 10). If accurate, these findings imply that e-

invoicing may help bring more small firms into the tax net, though their aggregate fiscal impact

remains limited.

Given possible firm misclassification, more reliable aggregate group-industry-month

studies show no significant improvements in revenue or compliance (Figures 12 and 13). These

early results also show null effects for long-run impacts on larger firms and short-run impacts on

smaller ones. While VAT revenue collection is unlikely to shift, compliance may improve as

enforcement attention moves from already-compliant large firms to newly mandated small firms.

6. Conclusion

This paper examines the early effects of El Salvador's e-invoicing mandate on reported VAT revenue and compliance, using public firm-level data and correspondence with the Ministry of Finance. I find no significant revenue increase for large firms, likely due to their existing digital infrastructure and already high compliance. These results, more limited than expected given the investment in e-invoicing help centers, suggest the early impact of the mandate was administrative rather than behavioral.

As in Peru's rollout, treatment effects may emerge gradually and strengthen over time (Bellon et al., 2020). The Ministry of Finance plans to expand the mandate beyond the current ten cohorts and has invested in in-person help centers (Calderon Ramirez, 2024). However, my results show no measurable compliance gains for large or medium firms, even with these complementary efforts, indicating that such investments may yield greater returns when targeted to smaller or digitally inexperienced taxpayers.

These findings highlight the need to tailor tax digitalization efforts to local administrative and technological conditions. In countries where digital uptake is already high among the largest revenue-contributing firms, the marginal benefit of mandating e-invoicing may be limited in the short run. Greater gains may come from supporting smaller or informal firms that remain outside the tax net. Still, e-invoicing may offer long-term gains through improved audit targeting, data availability, and administrative modernization.

Future research should revisit outcomes once the rollout is complete to more accurately estimate effects among smaller firms, who remain unmandated at the time of writing. Researchers should also examine potential impacts on administrative efficiency, cost savings,

and broader patterns of economic formalization, where e-invoicing may deliver longer-term gains even in the absence of immediate revenue growth.

This study is among the first to apply modern difference-in-differences methods to evaluate firm- and group-level responses to staggered e-invoicing rollout in a low-capacity tax administration. By using the Callaway and Sant'Anna (2021) estimator, I ensure valid group comparisons and avoid biases common to traditional DiD. While e-invoicing may be less effective as an enforcement tool in settings with widespread digital adoption, it can still inform policy in middle-income or administratively capable countries seeking long-term gains in economic formalization and state modernization, rather than short-term revenue growth.

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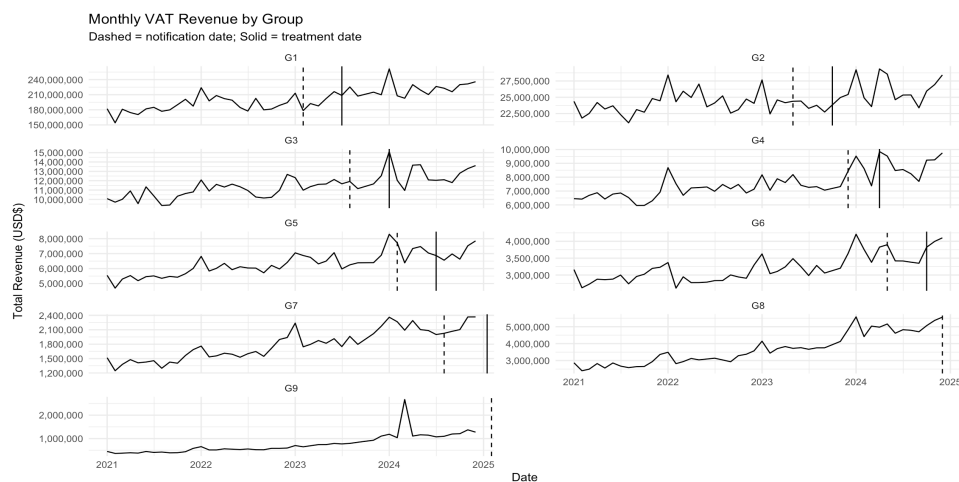
Figures

Figure 2. *Monthly VAT Revenue (USD) by Group, 2021-2024*
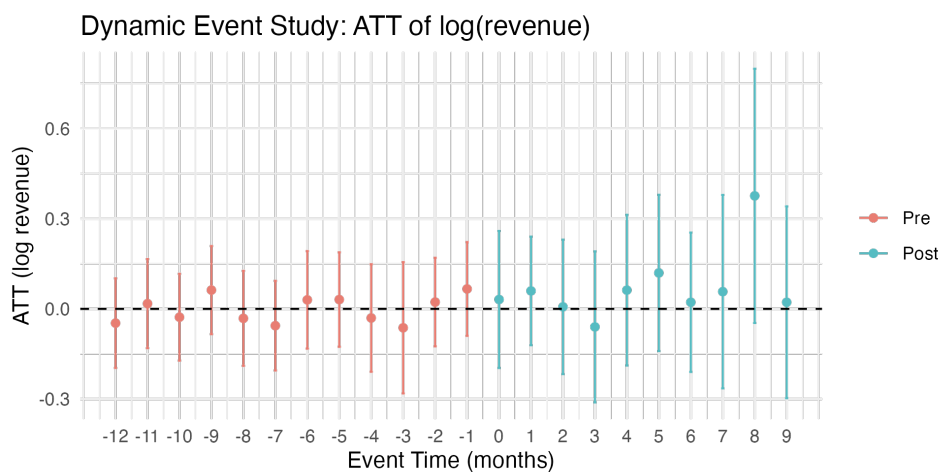
Figure 3. *Dynamic Event Study: Average Treatment Effect on the Treated (ATT) for Log Reported VAT Revenue, by Months Since Treatment*
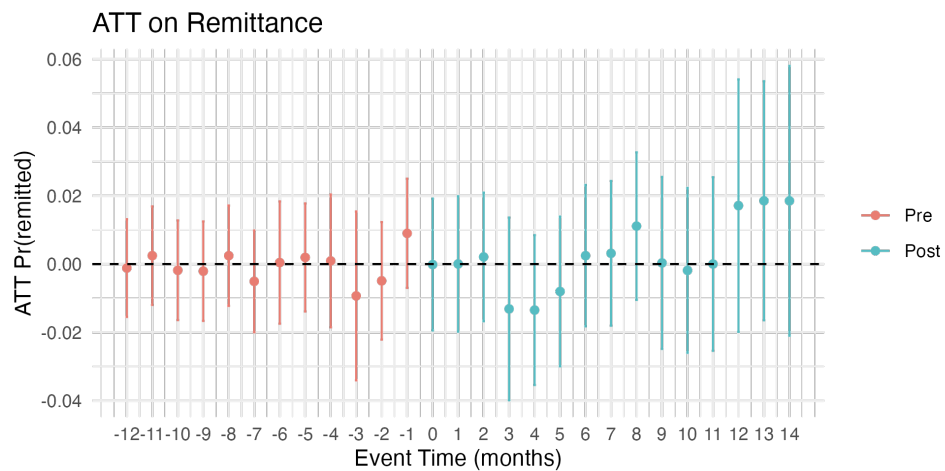
Figure 4. *Dynamic Event Study: Average Treatment Effect on the Treated (ATT) for VAT*

Remittance Probability, by Months Since Treatment
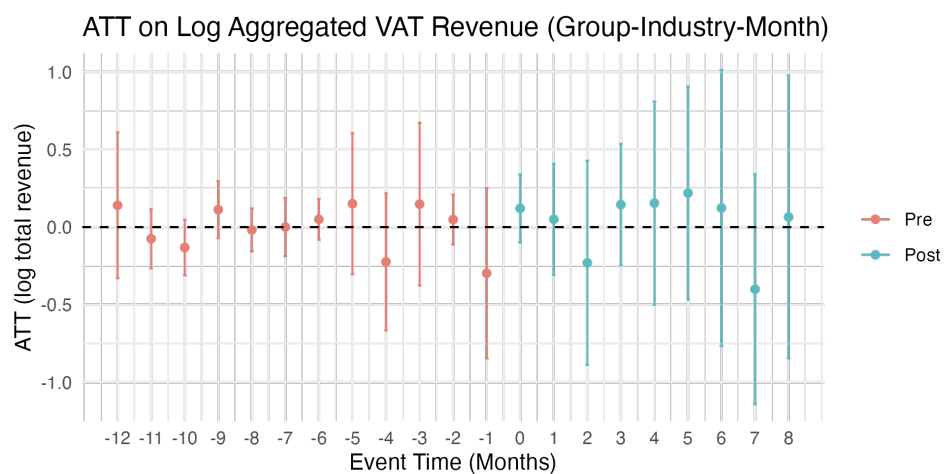
Figure 5. *Dynamic Event Study: ATT for Log Reported VAT Revenue at the Group-Industry-*

Month Level, by Months Since Treatment
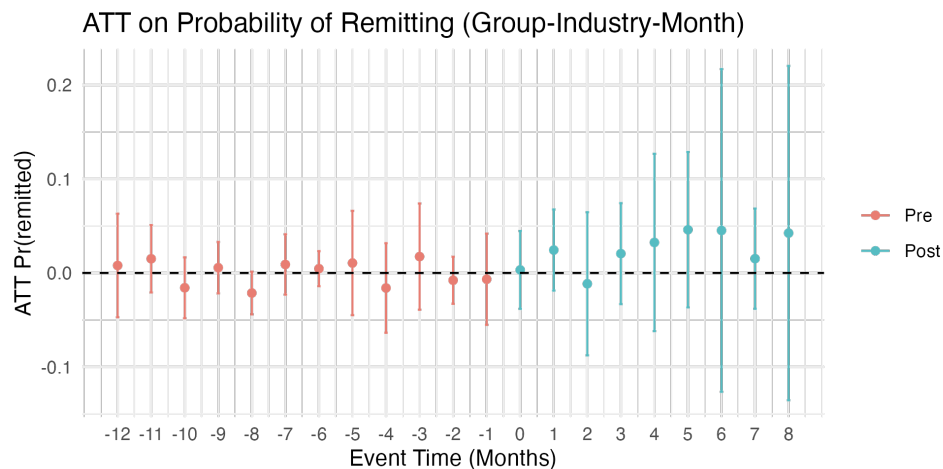
Figure 6. *Dynamic Event Study: ATT for Probability of VAT Remittance at the Group-Industry-Month Level, by Months Since Treatment*
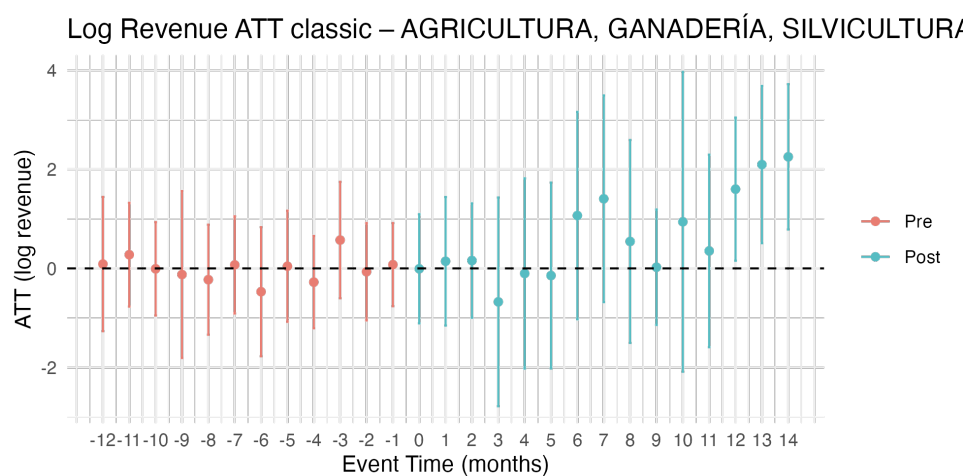
Figure 7. *Dynamic Event Study: ATT for Log Reported VAT Revenue in Agriculture, Livestock, Forestry, and Fishing, by Months Since Treatment*
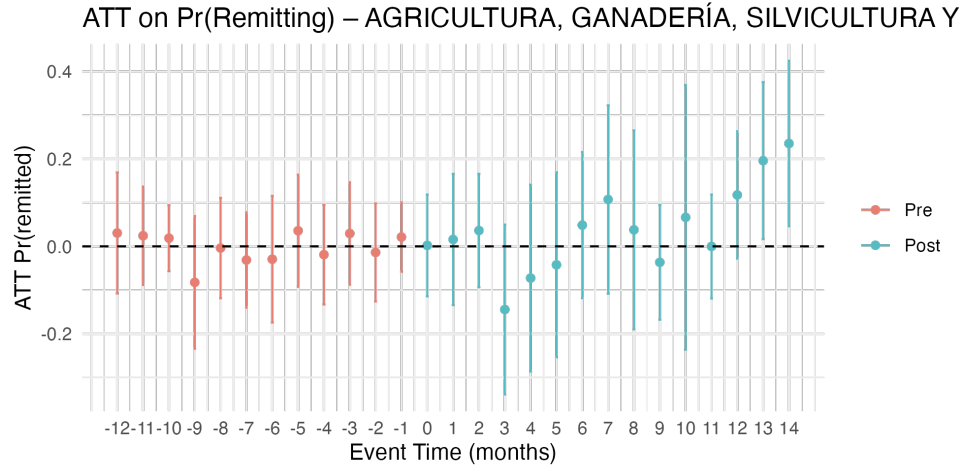
Figure 8. *Dynamic Event Study: ATT for Probability of VAT Remittance in Agriculture, Livestock, Forestry, and Fishing, by Months Since Treatment*
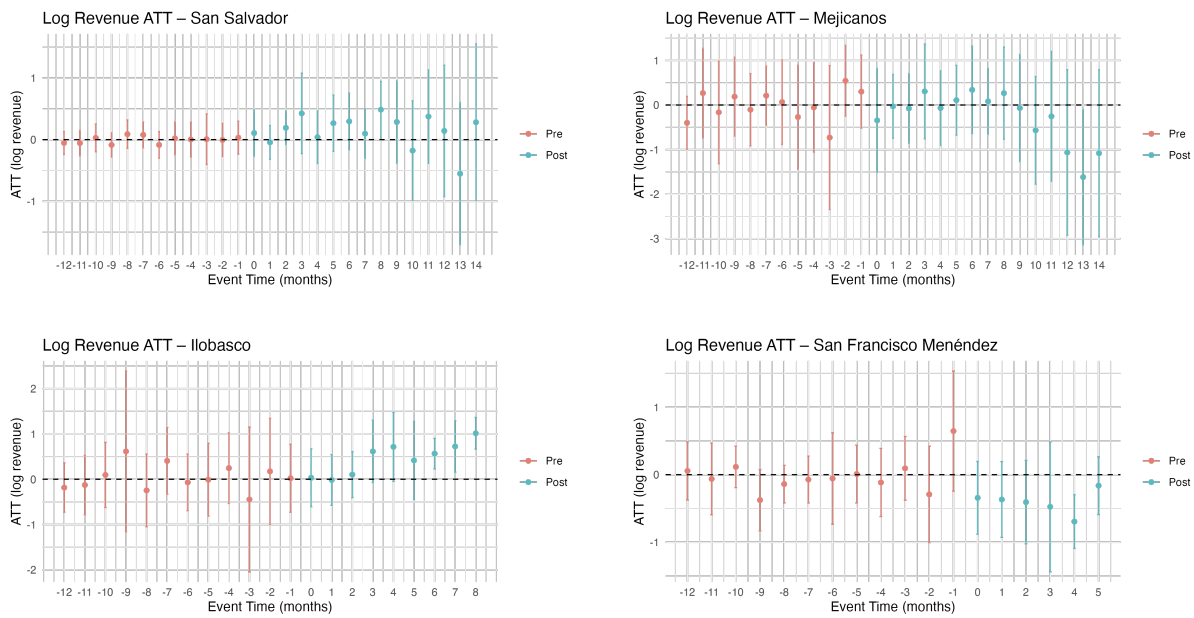
Figure 9. *Dynamic Event Studies: Log VAT Revenue by Municipality*
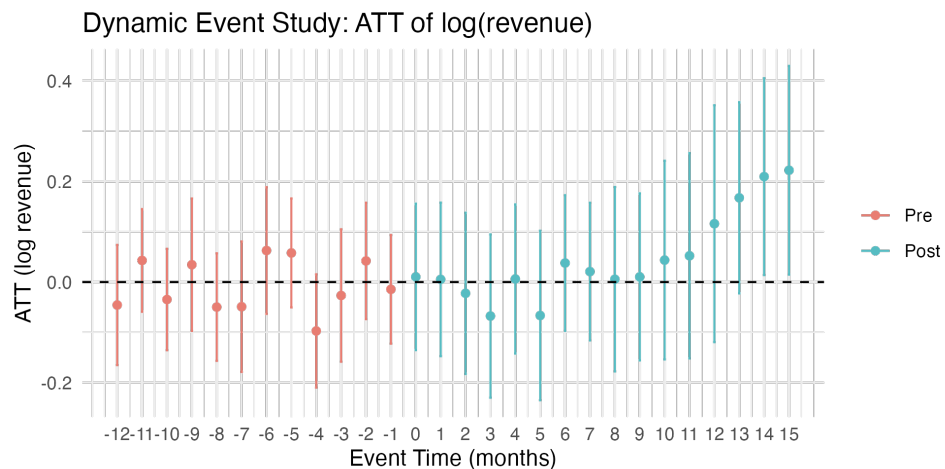
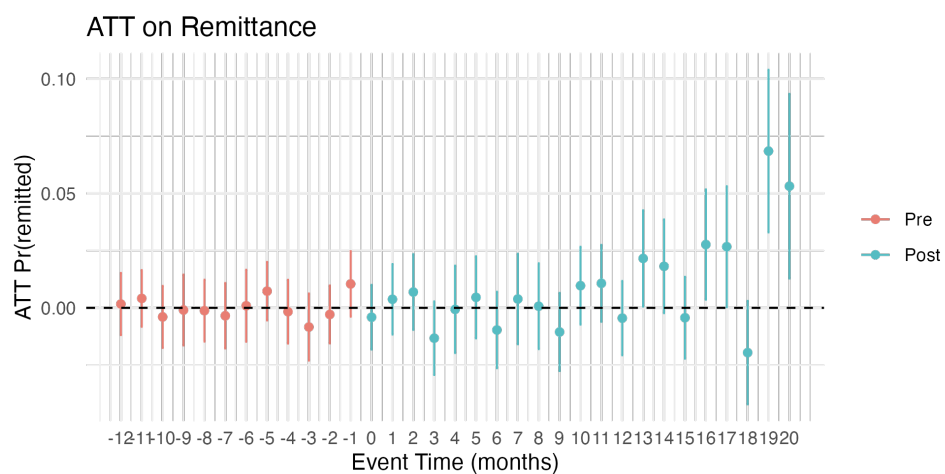**Figure 10.** *Dynamic Event Study: ATT for Log Reported VAT Revenue, by Months Since Treatment, Through 2025*

Figure 11. *Dynamic Event Study: ATT for Probability of Remitting, by Months Since Treatment, Through 2025*
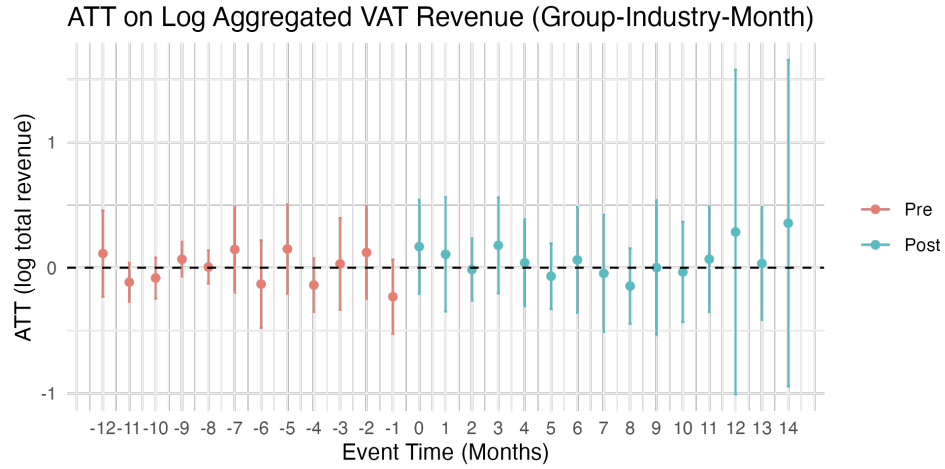
Figure 12. *Dynamic Event Study: ATT for Log VAT Revenue by Group-Industry-Month, by Months Since Treatment, Through 2025*
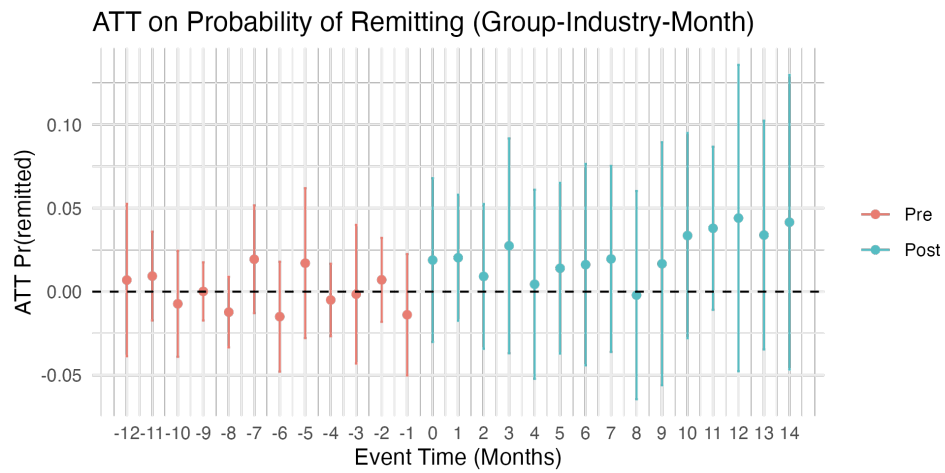

Figure 13. *Dynamic Event Study: ATT for Probability of Remitting by Group-Industry-Month, by Months Since Treatment, Through 2025*