# Multinational Firms and the International Transmission of Crises: The Real Economy Channel

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**Abstract:** This paper studies investment and employment at a subsidiary located in a non-crisis country if its parent firm also has a subsidiary in a crisis country. It finds that investment is about 18% lower in the subsidiaries of these parents relative to the same-industry, same-country subsidiaries of multinational firms that do not have a subsidiary in a crisis country. Employment growth rate in the affected subsidiaries is zero or negative while it is 1.4% in the subsidiaries of unaffected parents. These results hold for the parents that are unlikely financially constrained and are robust to controlling for subsidiary and parent size, parent cash flow, subsidiary country, industry, year, and parent country, as well as using alternative crisis definitions. The industry-level sales and employment are also negatively impacted in countries of the affected subsidiaries.

**Keywords**: Multinational Companies, MNC, International Contagion, International Co-movement.

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## 1. Introduction

Economic crises and their global spread have attracted much academic and policy attention. Current literature focuses on the role of financial institutions in spreading crises.[1] This paper instead studies the role of non-financial multinational companies (MNCs) in the transmission of negative economic shocks beyond national borders. The MNCs are among the largest companies with subsidiaries operating in many countries, but their role in crises is not well understood.

Consider a hypothetical MNC headquartered in Germany, with subsidiaries in Spain and Finland. When Spain is in crisis, how are the investment and employment at that German firm's Finnish subsidiary affected? In particular, how do they differ from those of the Finnish subsidiary of another German parent firm that does *not* have a subsidiary in Spain or in another country experiencing a crisis that year? In this paper, we study this question using MNCs from 16 countries and their subsidiaries in 24 countries.

There are reasons for both higher and lower investment and employment growth in the Finnish subsidiary of the firm that also has a Spanish subsidiary. For example, if the parent firm shifts production from where the crisis is to a non-crisis country, the investment and employment growth may be higher in the subsidiary located in a non-crisis country. On the other hand, if the Finnish subsidiary is a supplier to the Spanish subsidiary, and if the latter decreases its investment and employment due to the crisis, then the investment and employment in the Finnish subsidiary may also decrease. Furthermore, due to the crisis in the country of one of its subsidiaries, the parent may

[1] See, e.g., Peek and Rosengren (2007, 2010), Khwaja and Mian (2008), Schnabl (2012), Cetorelli and Goldberg (2012), Acemoglu, Ozdaglar, and Tahbaz-Salehi (2012), Kalemli-Ozcan et al. (2013).

have fewer resources to allocate among its other subsidiaries or fewer growth opportunities in general, so the parent may choose to shrink the investment and employment in other countries for this reason. Overall, whether investment of subsidiaries in non-crisis countries increases or decreases is an empirical question and cannot be answered a priori by theoretical arguments alone.

We find that if a MNC has a foreign subsidiary in a crisis country, the investment and employment growth in its foreign subsidiaries in other countries are lower relative to the foreign subsidiaries of another MNC that does not have a subsidiary in a crisis country. Continuing the example of the hypothetical German parent companies above, we find that the Finnish subsidiary of the MNC headquartered in Germany with a subsidiary in Spain during the Spanish crisis has lower investment and employment growth that year, relative to the same-industry Finnish subsidiary of another German MNC that does not have a subsidiary in a crisis country. These results suggest that MNCs transmit negative economic shocks from affected countries to other countries where they operate.

These results are unlikely to be driven by financially constrained parent firms as they also hold for firms that have investment grade credit rating or that are larger than the median parent. The reduction in investment and employment cannot therefore be solely due to financial constraints. These results are also robust to controlling for subsidiary and parent size, parent cash flow, subsidiary industry, subsidiary country, parent country, and year, as well as using alternative definitions of a crisis. We emphasize that the decreases in investment and employment we document are measured only using the subsidiaries and parent firms in non-crisis countries because subsidiaries and parents in crisis countries themselves are not part of the analysis.

The economic magnitude of the international shock transmission by MNCs we estimate is significant. In our sample on average, annual investment of a subsidiary whose parent does not have any subsidiary in a crisis country is about 3.8% of its lagged assets. The non-crisis subsidiaries of a parent with a subsidiary in a crisis country invest, however, about 0.7-0.9 percentage points less depending on the specification. In other words, their investment rate is about 18% lower. Similarly, the average employment growth rate in the subsidiaries of unaffected parents is 1.4%. In the subsidiaries of affected parents, however, the growth rate is lower by about 1.5-2.2 percentage points. In other words, the employment in the subsidiaries of affected parents stagnates or shrinks. Again, it is worth emphasizing that none of these affected subsidiaries or parents are in crisis countries themselves.

One interesting question is whether other firms in the same country and industry increase their economic activity to compensate for the decline in the affected subsidiaries. To explore this issue, we study industry level annual sales and employment in each country. If the other firms can fill the gap, the economy-wide impact of the transmission effect we detect will be limited. However, we find that both the industry-level sales and employment in countries decrease with the size of affected foreign subsidiaries. In other words, the MNCs not only transmit negative shocks to third countries, those shocks have negative effects at the industry level in those countries as well.

Empirical evidence on the transmission of crises through non-financial multinational companies is scarce, perhaps due to data availability and to the literature's focus on financial companies. The most related papers to our study are Desai, Foley, and Hines (2009) who show that the domestic production of non-financial U.S. multinationals

increase when they also increase their activities abroad; and Desai, Foley, and Forbes (2008) who find that foreign subsidiaries of U.S. non-financial multinationals perform better than domestic firms after currency crises in the host countries. Neither paper studies the international transmission of adverse effects from a crisis to other countries, which we demonstrate in this paper.

Our paper is related to the literature on the propagation of shocks through network linkages between firms within an economy as theoretically studied by Acemoglu et al. (2012) and Kelly, Lustig, and van Nieuwerburgh (2013), and empirically examined by Barrot and Sauvagnat (2016), Hertzel, Li, Officer, and Rodgers (2008), Kolay and Lemmon (2011), Kose and Yi (2001), Johnson (2014), and Wu (2016) (see surveys by Acemoglu et al. (2015) and Carvalho (2014)). Our focus, however, is on the propagation of shocks through linkages within firms but across national borders. Boehm, Flaaen, and Pandalai-Nayar (2016) who study the effect of 2011 Tohoku earthquake on the U.S. affiliates of Japanese firms is closer to our paper. Another related paper is Giroud and Mueller (2017) who study the effect of local housing shocks in the U.S. on the employment at establishments owned by the same company but located elsewhere. They find that firms transmit the adverse shocks to other locations. Our focus is international and we study both investment and employment.

Our paper contributes to the literature that examines the origins of macroeconomic fluctuations. As Gabaix (2011), Di Giovanni and Levchenko (2012), and Carvalho and Gabaix (2013) point out, granularity of the economy may lead firm-specific shocks to be propagated through inter firm linkages, creating aggregate macroeconomic fluctuations. Since the MNCs' subsidiaries we study tend to be among the largest firms in

a country, their firm-specific shocks are unlikely to be "averaged out" in the economy. Our results therefore suggest that MNCs can act as the microeconomic channel for international macroeconomic comovement and complement findings in Di Giovanni, Levchenko, and Mejean (2014) who study the implications of firm exports on aggregate fluctuations in a single country setting.

Our paper also contributes to the large literature on MNCs, see Yeaple (2013) and Antras and Yeaple (2014) for surveys. In particular, our paper is close to the literature on the role of MNCs in the international transmission of business cycles as studied by, among others, Burstein, Kurz, and Tesar (2008), Cravino and Levchenko (2016), Menno (2015), and Zlate (2016). Alfaro and Chen (2012) find that MNCs' subsidiaries were affected by the recent global financial crisis less than local firms. Faccio & O'Brien (2017) show that the employment in firms that are part of business groups are less affected by the economic shocks relative to stand-alone firms.

Empirical evidence on the existence of international transmission is available from the financial sector. Peek and Rosengren (1997, 2000) study the reduction in the U.S. lending by the U.S. subsidiaries of Japanese banks after the sharp downturn in the Japanese real estate market in the 1990s, and also document the adverse impact of this reduction on the real economy in the U.S. Khwaja and Mian (2008) and Schnabl (2012) provide evidence for the transmission of bank liquidity shocks to domestic markets in Pakistan and Peru, respectively. Cetorelli and Goldberg (2012) examine international transmission of monetary policy changes through global banks. By focusing on non-financial firms, we demonstrate the direct real effects of the international shock transmission on investment and employment.

This paper is organized as follows. The next section describes our identification strategy and data. The third section presents our main results on subsidiary investment, followed by a section where we present our results on subsidiary employment growth. In the fifth section, we study the robustness of our findings. The conclusion follows.

## 2. Identification Strategy and Data

### 2.1 Identification Strategy

We examine corporate policies of MNCs' subsidiaries located in non-crisis countries. In our analyses, we control for subsidiary country, industry, year, and parent country, and identify the transmission effect only from the parent firm having another subsidiary in a crisis country in the same year. More specifically, consider two multinational parent firms $p_T$ and $p_C$, both located in the same country $m$ (subscripts $T$ and $C$ are mnemonic for 'treated' and 'control' while subscripts $P$ and $S$ are mnemonic for 'parent' and 'subsidiary'). Firm $p_T$ has a foreign subsidiary in a country in crisis that year, as defined below, while firm $p_C$ does not. We match a subsidiary of $p_T$ in industry $i$ and country $n$ to a subsidiary of $p_C$ in the same industry $i$ and the same country $n$. Crucially, we allow neither $m$, the country of the parents, nor $n$, the country of the subsidiaries that are subject to the comparison to be in crisis that year. In other words, $p_T$'s subsidiary located in a crisis country that year only leads to $p_T$ being designated as 'treated', and this subsidiary itself is not part of the comparison of subsidiaries to measure the crisis transmission effect. As a result, any crisis in the parents' locations or the locations of their subsidiaries we analyze is not driving our results.

We use Mahalanobis-metric matching to prepare our comparison sample. In terms of matching estimators terminology, we use *exact matching* on subsidiary country, subsidiary industry, parent country, and year, together with (the nearest neighbor) matching on selected additional continuous variables. This is a very stringent matching requirement that allows us to control for many confounding factors. For example, if we did not require the subsidiary country $n$ to be the same for both the treated and control subsidiary, it would be possible that parent $p_T$'s subsidiary is located in a country whose business cycle is relatively more correlated with the country in crisis that has lead $p_T$ to be designated as treated in the first place. Similarly, requiring the industry and the year to be the same for both treated and control subsidiaries controls for the possibility of differential impact of a crisis on different industries over time. Additionally, by calling for both treated and control parent firms $p_T$ and $p_C$ to be in the same country, we control for the possibly differential impact of a crisis on countries in which the parent firms are located. To increase the precision of sample variance estimates used in the calculation of the Mahalanobis distance measure, we first eliminate stratas of subsidiary country, subsidiary industry, year, and parent country that do not have at least three treatment and three control observations. We then use subsidiary country, subsidiary industry, year, and parent country as variables for exact matching, and subsidiary size and parent size as continuous variables in the nearest neighbor matching based on the Mahalanobis metric.

Notice that we do not claim that MNCs choose the location of their subsidiaries randomly even though such location decisions were likely made well before our sample period starts. In particular, MNCs may have chosen to locate their subsidiaries in countries less prone to economic crises, and the MNCs that are particularly vulnerable to

crises may have done so to a greater extent. In other words, our treated sample of MNCs that have a subsidiary in a crisis country may be composed of MNCs that are less vulnerable to crises than other MNCs. However, this potential self-selection biases our analysis against finding any crisis transmission effect in the treated companies. Therefore, to the extent that this self-selection is important, the crisis transmission effect we document in this paper may be under-estimated. In addition, we also do a placebo analysis where the subsidiaries are randomly assigned to parents as reported in the robustness section.

To construct our treatment, we use the deviation of a country's real GDP growth that year from that country's long-run average. In our baseline specification, we define a country to be in crisis if its real GDP growth rate that year is 2 standard deviations or more lower than its long-run average, where the long-run average and standard deviation are calculated over a period that does not overlap with our study period as described below. Of course, an economic downturn may not exactly take place within a calendar year and may start in the previous year. Since our identification is based on comparison with the previous year, our construction is conservative and may underestimate the transmission effect. Note also that, based on our definition, whether a country is in crisis or not depends only on its own performance and we do not use any potentially subjective list of crisis countries.

For a parent firm to be in the treatment group, it has to a) have at least one foreign subsidiary located in a crisis country; and b) be itself located in a country not experiencing a crisis that year. Conversely, for a parent firm to be in the control group, it has to a) have no foreign subsidiary located in a crisis country; and b) be itself located in

a country not experiencing a crisis that year. For robustness, we vary the threshold used in the crisis definition from 2 standard deviations to 1.75 and 2.25 standard deviations below that country's long-run average real GDP growth. In deciding whether a parent has a subsidiary in a crisis country, we use all the subsidiaries and their locations available to us. Specifically, to identify subsidiaries in a crisis country, we do not restrict on the subsidiaries for which we have accounting data and consider the full geographical presence available for each parent firm.

## 2.2 Data Sources

Our parent and subsidiary level data come from the Amadeus/Orbis databases compiled by the Bureau van Dijk (BvD). Amadeus/Orbis contain detailed ownership and financial information on public and private firms worldwide. To construct a panel dataset of multinational companies and their subsidiaries, we use two updates of Orbis that provide cross-sectional data on firms' ownership structures as verified by BvD in November 2008 and July 2012.

We define subsidiaries to be incorporated firms that file their own financial statements and have, in a given year, a single ultimate owner. The ultimate owner is a subsidiary's shareholder that satisfies three criteria. First, the shareholder has to have at least 25.01% total stake in the subsidiary. The total stake is the sum of the direct and indirect (i.e., via other firms) voting rights the shareholder has in the subsidiary. Second, the subsidiary has no other (identified or unidentified) shareholder with the total stake higher than 25.00%. Third, the ultimate owner is an incorporated firm that is widely held (i.e., it is not controlled by any other ultimate owner) or an individual/family. We define parent MNCs to be ultimate owners that have at least two cross-border subsidiaries (i.e., the subsidiary's country of incorporation is different from that of the ultimate owner) in at least one year in our sample.

To construct an annual panel of financial data for subsidiaries and their parent multinational firms, we cumulatively combine multiple updates of Amadeus/Orbis in order to add back firm-years deleted from more recent updates. This procedure eliminates survivorship bias inherent in BvD databases.[2] The resulting panel of financial and ownership information gives a unique breadth of coverage in 2005-2012.

We build our sample starting from the overlap of the ownership and financial panels described above and apply the following screens. First, we exclude subsidiaries and parents in financial intermediation (primary two-digit NACE codes 65-67), as well as in public administration and defense, education, health and social work, and other community, social, and personal service activities (primary two-digit NACE codes 65-67, 75, 80, 85, and 90-99). Second, a subsidiary's and parent's legal forms need to entail a limited liability structure. Third, we remove very small and young firms, which tend to be noisy, as well as firms that are likely "shell" firms. Specifically, we drop subsidiary-years and parent-years with total assets less than 1 million Euros and subsidiary-years that are within 3 years of the subsidiary's incorporation date. Throughout the paper, we use unconsolidated financial statements for subsidiaries and consolidated financial statements for parent multinational firms. Finally, we require that all financial variables used in our analysis are non-missing.

We obtain country-level annual real GDP data from the World Bank Data Bank and calculate the natural logarithm of the yearly growth in real GDP for each country. We first use the data for 1971-2000 to calculate long-term average growth rates and standard deviations for each country separately. We then normalize each country's annual real GDP growth rate for 2005-2012 using the long-term mean and standard deviation

2 A firm appears in Amadeus/Orbis as long as it files its financial statements, but is typically kept in the database for only four years after its last filing. Also, each update of Amadeus/Orbis contains only the most recent ten years of financial data for each firm (if available).

calculated for that country from the 1971-2000 period. As mentioned above, in our baseline specification, we define a country to be in crisis in a given year during 2005-2012 if its normalized GDP growth is lower than -2, that is, its growth is 2 standard deviations less than its long-run average or lower. We vary this threshold in our robustness checks.

## 2.3 Summary Statistics

Table 1 Panel A presents the distribution of the subsidiaries across 24 countries and across years in the matched sample. With the exception of Japan, Korea, and Singapore, all of our subsidiaries are from Europe. This is largely due to the fact that these countries have public disclosure requirements for subsidiaries of foreign parents. For example, we have many subsidiaries owned by U.S.-based parents, but do not have any subsidiary located in the U.S. because there is no public disclosure requirements for foreign subsidiaries in the U.S. The number of observations in each country differs, largely based on the country's economic size. Subsidiaries located in France, Germany, Italy, Spain, and UK are well-represented. We have observations in every year from 2008 to 2012 except 2009. Many countries were in crisis in 2009 as defined above, so neither the subsidiaries nor the parents (and their subsidiaries elsewhere) located in those countries were eligible to be treatment or control in 2009 according to our design.

Table 1 Panel B presents the distribution of parent firms across 16 countries and across years in our matched sample. These countries tend to be larger, more economically developed and more geographically widespread, with U.S., France, Germany, Japan, and Sweden being well-represented.

Table 2 presents summary statistics of our outcome and control variables in the matched sample. First, we present simple summary statistics that depend on the number of observations in Panel A; and second, statistics that are independent of the sample size computed as in Imbens and Rubin (2015) in Panel B. Panel A reports the sample statistics separately for both treatment and control subsample, as well as for the full sample. The panel also reports the comparison of means and medians across subsamples. The results of the comparison of means are based on standard errors robust to clustering at the parent firm level, while the comparison of medians is based on the Wilcoxon test where the cluster robust inference is not available.

Both the average and median size for treated parents and their subsidiaries are slightly larger for the treatment group than for the control group. The mean parent cash flow as measured by the operating profit/loss normalized by the parent's lagged total assets is not statistically different between the two groups. These control variables are winsorized at the upper and lower 1% levels. Finally, subsidiary investment one year before the onset of treatment, normalized by the subsidiary's lagged total assets, has subsample averages that are not statistically different across the treatment and control groups.

The statistics reported in Panel A are for the matched sample but they are functions of sample size. Imbens and Rubin (2015) caution against using them in judging covariate balance across the subsamples. Instead, they suggest using mean differences normalized by the standard deviation and the variance ratios to examine covariate balance even though the distribution of these statistics are not known and, therefore, exact cutoff points for any statistical tests cannot be obtained. In Panel B, we provide these statistics

for the 'raw' and matched sample. The raw sample is the sample of treated and non-treated observations before the matching is performed.

The first two columns in Panel B provide differences of means that are standardized by the subsample standard deviations. A well-balanced sample would have these values close to zero. Statistics for the raw sample suggest that there is little balance, especially in the parent size with the mean difference over 1.2 times the subsample standard deviations. After matching, the balance improves with the difference of means in parent sizes halved and all other differences of means being within about 0.2 times their standard deviations.

The last two columns in Panel B provide variance ratios for the two subsamples. A well-balanced sample would have these values close to one. Statistics for the raw sample suggest that there is little balance for any of the continuous variables except for the lagged subsidiary investment. The matched sample, however, is much better balanced with the subsample variances within 15% of each other with the exception of subsidiary size, where the matched sample variance ratio is about 1.38. These statistics suggest that the matched sample is better-balanced than the raw sample and is well-balanced in many, but not all, dimensions.

With the empirical design and covariate balance discussed, Panel C focuses on the first comparison of outcome variables across treatment and control subsamples. We first study the subsidiary investment in the treatment year, that is, the year when the parent has another subsidiary in a crisis country. As the dataset does not provide subsidiary investment explicitly, we construct it as the change in fixed assets plus depreciation and normalize it with lagged book value of assets. To eliminate large acquisitions and

divestments as well as other outliers, we trim the observations whose investment value is at the 5% upper and lower tails. Average investment rate in the control sample is about 3.8% of the lagged total assets of the subsidiary. However, in the treatment subsample, the average investment rate is only 2.9% of the lagged total assets. This difference is significant at the 1% level with standard errors robust to clustering at the parent firm level. In other words, the investment in the treated subsample is more than 23% lower than that in the control subsample.

When we study the difference in investment from the pre-treatment to the first treatment year, we find the difference to be positive for the control sample, which indicates an increase in the investment rate from one year to the next. In the treated sample, however, the difference is negative, which indicates a decrease in the investment rate from the pre-treatment to the first treatment year in the treated sample. The mean change in the investment rate for the full sample is essentially zero at 0.03 percentage points. The next section provides a more detailed analysis of the differences in the outcome across the subsamples.

## 3. Main Result – Investment

As we describe above in detail, we construct a matched sample of subsidiaries using exact matching on the subsidiary country, parent country, subsidiary industry (2 digit NACE), and year together with nearest neighbor matching that we compute using the Mahalanobis metric with the logarithm of subsidiary and parent sizes. A parent firm is 'treated' if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long-term

average. MNCs and subsidiaries located in a crisis country are excluded from both treatment and control groups.

We take advantage of the panel nature of our data in our analysis. Our main outcome variable is the subsidiary investment, normalized by lagged total subsidiary assets in the treatment year, where the treatment year is the year when the parent has a subsidiary in a crisis country. The previous section presented sample statistics that showed a lower investment in the treatment group than in the control group with the difference being statistically and economically significant. This section first presents the Average Treatment Effect on the Treated (ATET) obtained using the matching estimator with robust standard errors as reported in Table 3 Panel A. We adjust the ATET estimate for bias from matching on continuous variables first using only log of lagged subsidiary and log of parent sizes (first column), and then adding the lagged parent profitability and lagged subsidiary investment (second column). The estimated ATET in the former case is -1.2 percentage points 0.9 percentage points with 1% statistical significance in the latter case both with 1% statistical significance..

The economic magnitude of this difference in the investment rate of treated subsidiaries is also significant. To put the estimated effects into context, recall that the average investment as a fraction of lagged assets is 3.8% for the control sample. This means that the investment rate as a fraction of lagged assets in the treatment sample, when adjusted for the bias using all four of the continuous variables, is more than 23% lower than the average annual investment rate for the control sample. We note that more than 56% of the subsidiaries in our sample are in the top 5% of the size distribution in

their country-industry pair. In other words, these subsidiaries are important firms in their countries.

Matching estimators reported above have standard errors that are robust to heteroscedasticity. Since there may be several subsidiaries of the same parent in our sample, ideally, one would like to have standard errors robust to clustering at the parent level to account for any correlation between different subsidiaries of the same parent.[3] However, treatment and control observations belong to different parent firms and, therefore, by construction, a matched pair of observations is not part of the same cluster. To obtain cluster-robust standard errors, we estimate the treatment effect using regressions on the matched sample with match pair fixed effects. Put differently, we use matching to balance our covariates and obtain matched pairs, but we rely on regressions for the estimation of and the inference on the treatment effect.

The results of these regressions are presented in Table 3 Panel B. The variable of interest is the Transmission Treatment Dummy variable, which is equal to one for the treated observation in each pair, that is, for the subsidiary whose parent has another subsidiary in a crisis country (we still exclude subsidiaries and MNCs in crisis countries from our sample). The coefficient on this dummy variable provides an estimate for ATET. All regressions in Panel B are estimated with match pair fixed effects, and, crucially, the standard errors are robust to clustering at the parent firm level.

Regression in Column 1 estimates ATET using the outcome variable of the matching estimation from Panel A as the dependent variable, and contains no control

[3] It may also be desirable to cluster the standard errors at the parent country-year level but we have only 41 or fewer such clusters so we opted for clustering at the parent-level only. We repeated the main analysis with double clustering at the levels of parent and parent country-year and present the results in the Online Appendix as discussed in the Robustness section. The results remain robust to this double clustering.

variables. The estimated coefficient on the treatment dummy variable is negative and statistically significant at 5% level. Regressions in Columns 2 and 3 include as control variables the continuous variables used in the bias adjustment of the matching estimate in Panel A . These regressions are comparable to, but not the same as, the bias-adjusted matching estimates. The estimated ATET is -0.7 percentage points or lower and is statistically significant at the 1% level. Although slightly lower than the matching estimates in absolute value, the difference in the investment rate due to treatment is still more than 18% of the annual investment rate for the control sample. With these statistically and economically significant decreases in the subsidiary investment estimated in different ways, we now move to studying the employment growth in these subsidiaries.

## 4. Main Results – Employment

We use the same identification strategy, data sources, and matching procedure to study the effect of having a subsidiary in a crisis country on employment growth at parent firms' other subsidiaries. Since the availability of employment data, on which our employment growth measure is based, is different from that of the investment data, the same matching procedure leads to a slightly different sample than the one described in Table 2. We thus first briefly discuss the summary statistics and the covariate balance in the new sample, then present the estimates of the treatment effect on the subsidiary employment growth.

Table 4 Panel A presents summary statistics of our control variables for the treatment and control subsamples. While the matched sample for the employment analysis is about 11% smaller, the statistics are similar to those of the sample used for the

subsidiary investment analysis. Panel B checks the covariate balance. The covariate balance is also comparable, perhaps with the exception of the lagged rate of employment growth, which has a higher variance ratio compared to the lagged investment rate.

Table 4 Panel C provides initial comparison of the employment outcome variables across the treatment and control subsamples. The focus in the previous section was a flow variable, namely, investment. Similarly, our focus in this section is employment growth. The dataset provides only the total number of employees in a subsidiary. Using these data, we construct the employment growth as ln(total employees(t)) – ln(total employees(t-1)). The average subsidiary employment growth in the control subsample in the event year is about 1.4%, while it is -0.2% in the treatment subsample. Although the magnitude of this difference is large, it is not statistically significant at the convential levels (p=0.107).

The outcome variable studied in this section is the employment growth. Table 5 Panel A presents the matching estimates of ATET. The estimate reported in the first column is bias-adjusted for the logarithm of the subsidiary and parent firm total assets. Estimated ATET is -1.35 percentage points and is statistically significant at the 5% level. When we also use lagged parent profitability and the lagged subsidiary employment growth in adjusting for bias due to matching with continuous variables, the ATET estimate becomes -1.5 percentage points and again statistically significant at the 5% level. Given that the average employment growth rate in the control sample is 1.4%, this is a large difference in the treated subsidiaries.

Analogous to the subsidiary investment analysis, we also estimate regressions with matched pair fixed effects on the matched sample to obtain standard errors robust to

clustering at the parent firm level. We present the results in Table 5 Panel B. Estimated coefficients for the Transmission Treatment Dummy variable range between -1.7 and -2.2 percentage points and are statistically significant at the 1% level.

Again, given that the subsidiaries in the control group have an annual employment growth of 1.4% as indicated in Table 4C, 1.3 to 2.2 percentage points lower employment growth at the treatment subsidiaries is a very economically significant difference. In other words, the employment in the subsidiaries of a parent firm that has a subsidiary in a crisis country that year does not grow on average; if anything, the employment in those subsidiaries shrinks. Notice that any possible decrease in employment we document need not involve massive layoffs. In particular, employment decrease can be achieved by not replacing natural attrition that occurs in employment due to retirement and other reason. Overall, our evidence suggests that there is a strong real economic effect of international crisis transmission by the multinational companies.

## 5. Robustness

### 5.1 Crisis Definition

In the main analysis, we define a country to be in a crisis if its annual real GDP growth rate is at least 2 standard deviations below that country's long-term average. Our treated parent firms have at least one subsidiary in a crisis country while our control parent firms have none. In this section, we first present robustness checks with different crisis threshold levels. We then provide robustness checks with more stringent requirements for the control sample.

In Table 6 Panel A, we change the crisis threshold to 1.75 standard deviations below the long-term average. Column 1 provides the matching estimates for subsidiary investment using bias adjustment with lagged subsidiary size, parent size, parent profitability, and subsidiary investment. Column 2 provides the regression estimates with matched pair fixed effects, the same set of control variables used in the bias adjustment of the matching estimate in Column 1, and standard errors clustered at the parent firm level. We find a lower investment in the treated subsidiaries that is significant at the 1% level. The magnitude of the estimated effect is only slightly lower than in our main analysis with a more severe threshold. Columns 3 and 4 of Panel A repeat the same analysis for the subsidiary employment growth using the same specifications, except that lagged employment growth replaces lagged investment. We again find lower employment in the treated subsidiaries that is significant at the 1% level.

Table 6 Panel B repeats the analysis with the crisis threshold set at 2.25 standard deviations lower than the country's long-term average. We find a negative effect at the treated subsidiaries for both investment and employment growth significant at the 5% level or better. The magnitude of the effects is also similar to those in the main analysis.

In the main analysis, we require a treated parent to have at least one subsidiary in a country experiencing a GDP growth at least 2 standard deviations lower than the long-term average and the control parent to have all its subsidiaries in countries with a GDP growth higher than 2 standard deviations below their long-term averages. According to this definition, a slight change of growth rate around the threshold of 2 standard deviations may cause a parent to be classified as treated instead of a potential control. Since the exact level of this threshold is arguably arbitrary, such large differences in

sample construction caused by small changes in GDP growth around the threshold may not be desirable. In addition, a parent with a subsidiary located in a country with a growth rate only slightly above the threshold may not be a good control observation. To address this concern, Table 6 Panel C presents analysis where the threshold for the treated parent is unchanged, but the control parents are required to have all their subsidiaries in countries with growth rates 1 standard deviation below their long-term averages or higher. This definition leads certain parents to be classified as neither treated, nor control, but a more stringent requirement for a parent to be a control observation may provide a better counterfactual of not experiencing a crisis. We again find lower investment and employment growth in treated subsidiaries at the 5% or better significance levels and comparable magnitudes.

Finally, the effect of a crisis may last longer than a year. In Table 6 Panel D, we repeat the analysis with the restriction that neither treatment, nor control observations have a subsidiary in a crisis country in the previous year. More specifically, an observation in year *t* cannot be a treated observation in year *t-1*. We again find our results to be robust at comparable magnitudes and at significance levels of 5% or better. From these checks, we conclude that our results are robust to different definitions of a crisis, which affects the construction our treatment and control samples.

## 5.2 Geographic Restrictions

Our main analysis does not impose any geographic restrictions other than those related to economic crises. In this subsection, we check the robustness of our results to the exclusion of certain countries. As Table 1 Panel B indicates, parents located in the U.S. form a very important part of the sample so we first check the robustness of our

results to the exclusion of the subsidiaries whose parents are located in the U.S. Table 7 Panel A reports the results of this analysis in the same format as in previous robustness checks. Our sample shrinks substantially when MNCs headquartered in the U.S. are excluded, but our results remain statistically significant at similar magnitudes for the investment and at stronger magnitudes for employment growth.

In Table 7 Panel B, we restrict both subsidiaries and parents to be in the EU. These firms are subject to the same or similar set of regulatory environment in many aspects so this subsample may be more homogeneous compared to our main sample. Our results become stronger in terms of economic magnitudes and, although the sample shrinks by two thirds, the statistical significance weakens only slightly if at all.

Finally, in Table 7 Panel C, we consider only the subsidiaries and parents in the Eurozone. These firms not only have a similar regulatory environment but also use the same currency. Since our sample shrinks by more than 80%, we no longer obtain statistically significant results for employment growth. However, the negative effect on the investment is more than the double compared to that obtained using the main sample and it is statistically significant at the 1% level.

## 5.3 Parent-Firm Financial Constraints

An interesting question is whether our results are driven by financially-constrained parents. For example, financially-constrained parents may be unable to obtain external financing if they have a subsidiary in a crisis country. This restriction might then be reflected in the investment of all the subsidiaries of that parent.[4] To check the role of financial constraints, we repeat the analysis by interacting the transmission treatment

[4] See, however, Kahle and Stulz (2013) who find little evidence for a causal link from reduced bank borrowing to reduced firm investment during the recent financial crisis.

dummy with an indicator for parents that are likely to be financially unconstrained. We use the above-median parent size and parent investment grade credit rating as proxies for not being financially constrained. If our results are due to financial constraints, the decrease we find for investment and employment growth should disappear for the unconstrained parents, which means that the interaction terms should have positive and significant coefficients.

Table 8 Panel A first repeats the main analysis by interacting the transmission treatment dummy with an indicator for the parents that are larger than the median in the sample as large parents are likely to be less financially constrained. The interaction term has a negative and statistically significant sign for subsidiary investment, the opposite of what one might expect if financial constraints were driving our results. The interaction coefficient is positive but not statistically significant for employment growth. When we interact the transmission treatment dummy with the indicator of investment grade credit rating, we do not find any statistically significant effect. In other words, the real economic effect of international crisis transmission is similar for both financially constrained and unconstrained parents; if anything, the effect is stronger for investment for the financially unconstrained parents. These results may not rule out the hypothesis that the financial channel within multinationals is present; however, they do suggest that the financial channel is unlikely to be the only possible explanation for the international transmission of crisis we document.

## 5.4 Majority-Owned Subsidiaries

In the main analysis, we require the parent to be the largest owner with at least 25.01% stake. This definition captures the ability to control a firm by owning less than

the majority of shares in many countries. We now repeat the analysis by restricting the subsidiaries to be majority-owned by their parents and present these results in Table 8 Panel B. Although we do not find lower employment growth in this sample at the conventional levels of statistical significance, we find lower investment rate in treated subsidiaries at stronger magnitudes at the 1% level of statistical significance.

## 5.5 Controlling for Growth Opportunities

It is customary to control for firm's growth opportunities in an analysis of firm investment or employment growth, typically using a measure of Tobin's q. Very few subsidiaries in our sample are publicly listed so that is not a viable choice at the subsidiary level. Many of the parent firms located outside U.S. are also private so we did not include Tobin's q in our main analysis in order to work with a larger sample. In this subsection, we repeat our main analysis while controlling for the parent firms' growth opportunities using Tobin's q. The results presented in Table 8 Panel C are of comparable magnitude to those in the main specification and are statistically significant.

## 5.6 Size-Weighted Estimates

Our sample may include small subsidiaries so it is important to check that our results are not driven by the behavior of small subsidiaries. In Table 8 Panel D, we repeat the main regression analysis by weighting the observations by their size. Our results remain robust at the 1% significance level and at comparable magnitudes.

## 5.7 Alternative Outcome Measures

The outcome variables studied in the analysis above are the investment rate and the employment growth rate. As a robustness check, we also use the change in the investment rate and change in the employment growth rate. In other words, the analysis based on these outcome variables has the flavor of difference-in-differences analysis. We repeat matching estimates of Tables 3 and 5 and report the results in the Online Appendix in Table OA-2,. The results remain robust at the 5% level of statistical significance or better.

## 5.8 Placebo Tests – Random Assignment of Parent Firms as 'Treated'

Parent firms do not establish foreign subsidiaries randomly. Therefore, a plausible concern with our analysis is that unobservable time-varying firm characteristics between the treatment and control firms might lead to a differential selection into treatment. As discussed in Section 2.1, this self-selection is likely to bias our analysis against finding any effect. However, to alleviate this selection concern further, we also conduct a placebo test by randomly assigning firms into the 'placebo treatment' group, matching the treatment dummy to an equal number of all parent-years as in our main sample, and then repeating our baseline analysis. We repeat this procedure 100 times and estimate the 'placebo treatment' effect. We report the distribution of the obtained estimates in the Online Appendix Figure OA-1. For specification in Column 2 of Table 3 Panel A, we find that the average of the coefficients obtained using the placebo treatment samples is -0.0004 and the standard deviation of these coefficients is 0.0014. We also find that all

100 placebo coefficients are higher than the true coefficient estimate of -0.009. We obtain analogous results for the specification in Column 2 of Table 3 Panel B (the average and standard deviation of the placebo test coefficients is -0.0004 and 0.0014, respectively). For the analysis of employment growth, repeating the specification reported in Column 2 of Table 5 Panel A, we obtain the average and standard deviation of the placebo test coefficients 0.0005 and 0.0052, respectively), and using Column 2 of Table 5 Panel B, the average and standard deviation of the placebo test coefficients are 0.0005 and 0.0051, respectively. These results show that our estimated true coefficients are always in the very left tail of the generated distributions, suggesting that non-random location of subsidiaries across countries is unlikely to explain our findings.

## 5.9 Alternative Matching and Clustering Techniques

We also check the robustness of our results to alternative matching techniques. In Table 9 Panel A, we construct the matched sample using not only subsidiary and parent size measures in computing the Mahalanobis metric, but also the parent profitability and lagged investment (lagged employment growth in the employment analysis). We continue to use exact-matching on subsidiary country, parent country, subsidiary industry, and year. Our results remain robust at the 1% significance level.

In Table 9 Panel B, we estimate propensity scores and use linearized propensity scores to match treated observations to control observations. Although the propensity scores are estimated using the full sample, we restrict the matches to be in the same parent country, subsidiary country, year, and industry. In other words, we match exactly on parent country, subsidiary country, year, and industry as in the main analysis but use linearized propensity score instead of continuous variables in Mahalanobis matching. Our

results are robust for both investment and employment growth usually at the 1% significance level.

In Table 9 Panel C, we use Coarsened Exact Matching to study investment. This matching technique only provides a matched sample; the estimates are obtained using regression analysis on the matched sample. Our sample size drops drastically but, with the exception of the most restrictive specification that leads to the smallest sample size, the results remain robust at the 5% statistical significance level or better.

Finally, we repeat the main regression analyses of Tables 3 and 5 by clustering the standard errors not only at the parent level but also at the parent country-year level even though there are only 41 or fewer parent country-year clusters. The results with this double clustering are presented in the Online Appendix Table OA-1. Our results remain robust at the 1% level of statistical significance to this alternative clustering approach.

## 6. Aggregate Effects

Previous sections showed the international transmission effect of having a 'sibling' subsidiary in a crisis country on investment and employment. Although these effects are substantial for the subsidiaries of the multinational companies themselves, if other firms in that industry in that country, can quickly fill the gap, this international transmission effect on the aggregate real economy will be limited. In this section, we study industry-level aggregate effects when some of the firms in that industry in that country are owned by multinational firms that also have subsidiaries in crisis countries.

We use industry-level annual data from Eurostat's Structural Business Statistics for each country in our sample to construct country-industry level panels. Eurostat has industry-level data on total employment but, unfortunately, not on investment. Instead,

we use total industry sales at NACE 3-digit level. We construct country-industry-level annual growth for sales and employment, which are the main outcome variables we study. To measure the exposure of each country-industry pair to transmission effects in a given year, we calculate, as of total lagged industry sales in that country in that year, the share of multinational subsidiaries that have at least one sibling subsidiary in a crisis country that year.

We present the sample statistics in Table 10 Panel A. The mean annual industry sales growth during 2008-2012, our sample period, is -0.9%. The mean annual industry employment growth is also negative at -2.8% during the same period. The medians for both of the variables are comparable. We construct the *Transmission_share* variable as follows. For each country *c* and industry *i*, we first identify the subsidiaries of multinational companies that also have subsidiaries in (other) countries that are in crisis in year *t*. We then find the share of these subsidiaries in total aggregate sales in that country *c* and industry *i* as of year *t-1*. This gives the value of *Transmission_share* variable for country *c*, industry *i*, and year *t*. This variable has a sample mean of 4.3% with median at 0%.

Our regression analysis is based on the variations of the following specification

$$y_{ict} = \beta Transmission\_share_{ict} + \delta X_{ic,t-1} + \theta_{ct} + \lambda_i + \varepsilon_{ict}, \quad (1)$$

where $y_{ict}$ is growth in total sales or employment in industry *i*, country *c*, and year *t*, *Transmission_share* is as defined above, $X_{ic,t-1}$ are additional control variables, $\theta_{ct}$ is country-year fixed effects, and $\lambda_i$ is industry fixed effects.

Table 10 Panel B presents the regression analysis for industry sales growth. The dependent variable is annual log sales growth at the country-industry level and the

explanatory variable of focus is *Transmission_share*, that captures the importance of multinational subsidiaries whose parents also have subsidiaries in crisis countries. The first regression has only *Transmission_share* with country, year, and industry fixed effects. The second regression has instead country-industry (interaction) and year fixed effects; this is the usual within estimator of panel regressions although we have a short panel. The third regression has country-year and industry fixed effects, which control for country-level macroeconomic factors as well as worldwide common industry factors. The fourth regression adds the logarithm of lagged industry sales in that country as a control for size, while the fifth regression further adds the square of that term. Finally, the sixth regression adds two control variables: the sale share of all foreign subsidiaries and the sale share of foreign subsidiaries whose parents are located in crisis countries, both as of year *t-1*. The coefficient of *Transmission_share* is negative and statistically significant at the 5% level or better in all the regressions.

The economic magnitude of the transmission effect on the aggregate industry sales is also significant. Regression coefficients indicate that this effect ranges from 6.9 to 26 percentage points decrease in the sales growth. To put this into context, the decrease of 6.9 percentage points estimated in the third regression implies that one standard deviation increase in the share of affected multinationals in that country-industry pair implies a 0.88 percentage point decrease in the aggregate industry sales in that country-year; which is comparable to the absolute value of the unconditional average industry sales growth in the sample.

Panel C repeats the analysis for industry employment growth. We find that *Transmission_share* has a negative and statistically significant coefficient at the 5% level

or better in all specifications except the second regression where the significance is at the 10% level. The economic magnitude of the transmission effect on the industry employment is also significant. Based on the third specification, one standard deviation increase in the *Transmission_share* implies 0.46 percentage points decrease in the annual employment growth, which implies a 16% decrease of the unconditional average of industry-level employment growth.

This country-industry level analysis of aggregate sales and employment growth suggests that the subsidiary-level real economy transmission of crises through multinationals has an aggregate effect. That is, other firms, domestic or multinationals, cannot increase their sales and employment to compensate for the decreases in the subsidiaries of affected multinationals. In other words, the international crisis transmission through the real economy channels of multinational companies adversely affects the whole industry in the transmitted country.

## 7. Conclusion

In this paper, we study how multinational companies transmit large negative economic shocks from one country to another. By focusing on MNCs that have a subsidiary in a crisis country, we compare their subsidiaries in non-crisis countries to the foreign subsidiaries of parents that do not have a subsidiary in a crisis country. Holding constant countries where subsidiaries and parents are located, we find that the subsidiaries owned by parents that also have a subsidiary in a crisis country invest and hire less. These effects are economically large. The subsidiaries of affected parents have an investment rate about 18% lower. Furthermore, while the average employment growth in the subsidiaries of unaffected parents is about 1.4%, the employment growth in the

subsidiaries of affected parents is 1.5-2.2 percentage points, which implies that the employment stagnates or shrinks in the latter subsidiaries.

Our paper suggests new avenues for future research. For example, our paper has not yet fully explored potential channels through which this transmission takes place. One possible avenue is that MNCs have internationally-integrated production and the disruption or low demand in one country affects the investment and employment in another country, although Ramondo, Rapaport, and Ruhl (2016) find that most affiliates of U.S. MNCs do not sell to the rest of the firm. Another possible avenue is through internal capital markets within the MNC where the diminished resources at the parent level affect the subsidiaries in non-crisis countries. Our analysis controls for parent-level cash flow, and the fact that we find similar effects for financially unconstrained firms suggests that channels other than the financial channels must also be present. Unfortunately, the proper empirical design to test for the presence of these channels require within firm data on production or capital transfers, which we lack.

Another interesting question this paper does not address is whether and how MNCs transmit positive economic shocks. Our methodology applies to the study of positive shocks as well. However, few countries had a positive shock during our sample period of 2008-2012.

The fact that MNCs help transmit crises from one country to another should not be viewed only in a negative way. Because of their ability to spread the effect of a crisis over multiple countries, MNCs probably shrink their operations less in the crisis countries as compared to local standalone firms and thus provide some international risk sharing. We plan to examine this issue later in more detail.

Our paper also shows the limits of international diversification as a corporate risk management strategy for a MNC; so another line of research will help understand the exact reasons behind this limiation. One possible explanation is that a firm may only operate in a limited number of countries before operational constraints become binding. Another reason might be the firms' desire to capture operational synergies from operating in many countries. This aim may lead to a tight integration of subsidiaries in different countries with one another, which may then lead the parent to transmit shocks from one country to another.

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## Table 1 - Distribution of Subsidiary and Parent Firms' Countries across Years

We present the distribution of subsidiaries across 24 countries and years in the matched sample for our *treatment/control* sample. A parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long-term average. To construct our control sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes, as measured by the natural logarithm of their total assets. We require our main dependent variable of interest, subsidiary investment, which is defined as the change in fixed assets plus depreciation, normalized by lagged total assets, as well as other main continuous variables of interest (i.e., parent cash flow and lagged subsidiary investment) to be non-missing to be in the final sample.

Panel A: Subsidiary Firms' Country Distribution

| Country Name | 2008 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| Austria | 53 | 18 | 15 | |
| Belgium | 237 | 139 | 139 | 187 |
| Czech Republic | 64 | 51 | 43 | |
| Denmark | 85 | 58 | 55 | 5 |
| Finland | 53 | 28 | 26 | 22 |
| France | 231 | 105 | 109 | 350 |
| Germany | 296 | 171 | 110 | 111 |
| Greece | 35 | | | |
| Hungary | 22 | 10 | 8 | |
| Italy | 359 | 218 | 200 | |
| Japan | | | 3 | |
| Korea | 20 | 20 | 15 | 51 |
| Netherlands | 25 | 13 | 7 | |
| Norway | 88 | 49 | 53 | 32 |
| Poland | 62 | 81 | 63 | 14 |
| Portugal | 42 | 21 | 21 | |
| Romania | | | 9 | |
| Singapore | 9 | | | |
| Slovakia | | 6 | 16 | |
| Slovenia | 4 | | | |
| Spain | 318 | 219 | 211 | |
| Sweden | 100 | 53 | 60 | 20 |
| United Kingdom | 421 | 236 | 203 | 571 |
| Total | 2524 | 1496 | 1366 | 1363 |

Panel B: Parent Firms' Country Distribution

| Country Name | 2008 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| Australia | | | | 3 |
| Belgium | | | | 6 |
| Canada | | | | 5 |
| Denmark | 23 | 8 | 6 | 22 |
| Finland | 7 | | | |
| France | 291 | 268 | 216 | 73 |
| Germany | 184 | 165 | 165 | 41 |
| Ireland | | | | 13 |
| Japan | 139 | 38 | 21 | 193 |
| Korea, Republic of | 3 | | | |
| Netherlands | 74 | 38 | 38 | |
| Spain | 3 | | | |
| Sweden | 109 | 39 | 20 | 75 |
| Switzerland | 66 | 83 | 81 | |
| United Kingdom | 195 | 121 | 113 | 87 |
| United States of America | 1,430 | 736 | 706 | 845 |
| Total | 2524 | 1496 | 1366 | 1363 |

**Table 2 - Summary Statistics for the Analysis of Subsidiary Investment**

This table presents summary statistics for control variables (Panel A), covariate balance (Panel B), and outcome variables (Panel C). Results are presented for the treatment sample and control sample as well as for the full sample. A parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our *control* sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. Parents and subsidiaries located in a crisis country are excluded from both treatment and control groups. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets in millions of Euros *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. *Subsidiary Investment (t)* is defined as the change in fixed assets from (t-1) to (t) plus depreciation (t) of the subsidiary, normalized by total assets (t-1). In Panels A and C, symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively, using mean difference test (adjusting for clustering of observations at the parent company level) for the difference in means and Wilcoxon Ranksum Test for the difference in medians in Treatment vs. Control Samples.

Panel A: Summary Statistics of Control Variables

| Variables | Stats | Treatment Sample | Control Sample | All |
|---|---|---|---|---|
| Subsidiary Size (t-1) | Mean | 3.320 | 3.015*** | 3.168 |
| | Median | 3.122 | 2.852*** | 2.975 |
| | Std. Dev. | 1.566 | 1.335 | 1.463 |
| Parent Size (t-1) | Mean | 9.458 | 8.547*** | 9.002 |
| | Median | 9.544 | 8.661*** | 9.170 |
| | Std. Dev. | 1.493 | 1.396 | 1.515 |
| Parent Cash Flow (t-1) | Mean | 0.138 | 0.127 | 0.133 |
| | Median | 0.131 | 0.118*** | 0.125 |
| | Std. Dev. | 0.071 | 0.068 | 0.069 |
| Subsidiary Investment (t-1) | Mean | 0.031 | 0.035 | 0.033 |
| | Median | 0.019 | 0.014*** | 0.013 |
| | Std. Dev. | 0.058 | 0.060 | 0.059 |
| | N | 6749 | 6749 | 13498 |

Panel B: Covariate Balance

| Variables | Standardized Difference | | Variance Ratio | |
|---|---|---|---|---|
| | Raw | Matched | Raw | Matched |
| Subsidiary Size (t-1) | 0.350 | 0.210 | 1.353 | 1.377 |
| Parent Size (t-1) | 1.254 | 0.630 | 0.697 | 1.143 |
| Parent Cash Flow (t-1) | 0.239 | 0.183 | 0.725 | 1.038 |
| Subsidiary Investment (t-1) | -0.027 | -0.070 | 0.899 | 0.918 |

Panel C: Summary Statistics of Outcome Variables

| Variables | Stats | Treatment Sample | Control Sample | All |
|---|---|---|---|---|
| Subsidiary Investment (t) | Mean | 0.029 | 0.038** | 0.033 |
| | Median | 0.011 | 0.015*** | 0.013 |
| | Std. Dev. | 0.059 | 0.069 | 0.064 |
| Change in Subsidiary Investment (from (t-1) to (t)) | Mean | -0.002 | 0.003 | 0.001 |
| | Median | -0.0003 | 0.000** | -0.0001 |
| | Std. Dev. | 0.069 | 0.071 | 0.070 |
| | N | 6749 | 6749 | 13498 |

## Table 3 – Matching and Regression Estimates for Subsidiary Investment

Panel A reports average treatment effect on the treated (ATET) with Abadie-Imbens (AI) robust *standard errors* in the parentheses. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. The statistic is calculated for the *Subsidiary Investment* (*t*), which is defined as the change in fixed assets plus depreciation, normalized by lagged total assets. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. In Panel A, ATET is bias-adjusted by using subsidiary and parent sizes in Column (1), by also parent cash flow in Columns (2), and additionally by lagged subsidiary investment in Column (3). In Panel B, we report regression estimates with *standard errors* in parentheses, where we again use the Subsidiary Investment as dependent variables. We include match-pair fixed effects in all specifications. Errors are corrected for clustering of observations at the parent level. All outcome variables are trimmed at the upper and lower 5% level. All control variables are winsorized at the upper and lower 1% level and are included in the tests with one lag. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: Matching Estimates

| | Subsidiary Investment | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| ATET | | | |
| Transmission Treatment Dummy (1 vs. 0) | -0.012*** | -0.013*** | -0.009*** |
| AI robust *standard errors* | (0.002) | (0.002) | (0.002) |
| N (Matched Observations) | 13498 | 13498 | 13498 |
| Bias-adj variables | Subsidiary Size (t-1), Parent Size (t-1) | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1) | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Subsidiary Investment (t-1) |

Panel B: Regression Estimates

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Investment |
|---|---|---|---|
| Transmission Treatment Dummy | -0.009*** | -0.009*** | -0.007*** |
| | (0.002) | (0.003) | (0.002) |
| Subsidiary Size (t-1) | | 0.001 | 0.000 |
| | | (0.002) | (0.002) |
| Parent Size (t-1) | | 0.000 | -0.000 |
| | | (0.001) | (0.001) |
| Parent Cash Flow (t-1) | | 0.046** | 0.033* |
| | | (0.021) | (0.018) |
| Subsidiary Investment (t-1) | | | 0.348*** |
| | | | (0.032) |
| Fixed Effects | Match pair | Match pair | Match pair |
| N (Matched Observations) | 13498 | 13498 | 13498 |
| $R^2$ | 0.538 | 0.539 | 0.588 |
| *N* (Firms) | 5600 | 5600 | 5600 |
| *N* (Clusters/Parents) | 1145 | 1145 | 1145 |

**Table 4 - Summary Statistics for the Analysis of Subsidiary Employment Growth**

This table presents summary statistics for control variables (Panel A), covariate balance (Panel B), and outcome variables (Panel C). Results are presented for the treatment sample and control sample as well as for the full sample. A parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our *control* sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. Parents and subsidiaries located in a crisis country are excluded from both treatment and control groups. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets in millions of Euros. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. *Subsidiary Employment Growth* is defined as ln(employment(t) / employment(t-1)) of the subsidiary. In Panels A and C, symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively, using mean difference test (adjusting for clustering of observations at the parent company level) for the difference in means and Wilcoxon Ranksum Test for the difference in medians in Treatment vs. Control Samples.

Panel A: Summary Statistics of Control Variables

| Variables | Stats | Treatment Sample | Control Sample | All |
|---|---|---|---|---|
| Subsidiary Size (t-1) | Mean | 3.336 | 3.117** | 3.227 |
| | Median | 3.197 | 2.977*** | 3.064 |
| | Std. Dev. | 1.473 | 1.273 | 1.381 |
| Parent Size (t-1) | Mean | 9.499 | 8.650*** | 9.074 |
| | Median | 9.567 | 8.693*** | 9.200 |
| | Std. Dev. | 1.451 | 1.324 | 1.453 |
| Parent Cash Flow (t-1) | Mean | 0.140 | 0.128 | 0.134 |
| | Median | 0.134 | 0.119*** | 0.126 |
| | Std. Dev. | 0.070 | 0.068 | 0.070 |
| Subsidiary Employment Growth (t-1) | Mean | 0.016 | 0.018 | 0.017 |
| | Median | 0.000 | 0.000 | 0.000 |
| | Std. Dev. | 0.226 | 0.191 | 0.210 |
| | N | 5980 | 5980 | 11960 |

Panel B: Covariate Balance

| Variables | Standardized Difference | | Variance Ratio | |
|---|---|---|---|---|
| | Raw | Matched | Raw | Matched |
| Subsidiary Size (t-1) | 0.272 | 0.159 | 1.294 | 1.339 |
| Parent Size (t-1) | 1.237 | 0.612 | 0.727 | 1.201 |
| Parent Cash Flow (t-1) | 0.240 | 0.170 | 0.745 | 1.082 |
| Subsidiary Employment Growth (t-1) | 0.023 | -0.009 | 1.099 | 1.389 |

Panel C: Summary Statistics of Outcome Variables

| Variables | Stats | Treatment Sample | Control Sample | All |
|---|---|---|---|---|
| Subsidiary Employment Growth (t) | Mean | -0.0024 | 0.0144 | 0.006 |
| | Median | 0.000 | 0.000 | 0.000 |
| | Std. Dev. | 0.225 | 0.200 | 0.213 |
| Change in Subsidiary Employment Growth (from (t-1) to (t)) | Mean | -0.018 | -0.003 | -0.011 |
| | Median | 0.000 | 0.000 | 0.000 |
| | Std. Dev. | 0.310 | 0.264 | 0.286 |
| | N | 5980 | 5980 | 11960 |

**Table 5 – Matching and Regression Estimates for Subsidiary Employment Growth**

Panel A reports average treatment effect of the treated (ATET) with Abadie-Imbens (AI) robust *standard errors* in the parentheses. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. The statistic is calculated for the *Subsidiary Employment Growth* (*t*), defined as ln(employment(t) / employment(t-1)) of the subsidiary. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. In Panel A, ATET is bias-adjusted by using subsidiary and parent sizes in Column (1), by also parent cash flow in Columns (2), and additionally by lagged subsidiary investment in Column (3). In Panel B, we report regression estimates with *standard errors* in parentheses, where we again use the *Subsidiary Employment Growth* as dependent variables. We include match-pair fixed effects in all specifications. Errors are corrected for clustering of observations at the parent level. All outcome variables are trimmed at the upper and lower 5% level. All control variables are winsorized at the upper and lower 1% level and are included in the tests with one lag. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: Matching Estimates

| | Subsidiary Employment Growth | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| ATET | | | |
| Transmission Treatment Dummy (1 vs. 0) | -0.0135** | -0.015** | -0.0154** |
| AI robust *standard errors* | (0.0065) | (0.0065) | (0.0065) |
| N (Matched Observations) | 11960 | 11960 | 11960 |
| Bias-adj variables | Subsidiary Size (t-1), Parent Size (t-1) | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1) | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Subsidiary Employment Growth (t-1) |

Panel B: Regression Estimates

| | (1) Employment Growth | (2) Employment Growth | (3) Employment Growth |
|---|---|---|---|
| Transmission Treatment Dummy | -0.017*** | -0.022*** | -0.022*** |
| | (0.006) | (0.007) | (0.007) |
| Subsidiary Size (t-1) | | -0.001 | -0.002 |
| | | (0.006) | (0.006) |
| Parent Size (t-1) | | 0.005 | 0.005 |
| | | (0.004) | (0.004) |
| Parent Cash Flow (t-1) | | 0.081 | 0.074 |
| | | (0.068) | (0.068) |
| Subsidiary Employment Growth (t-1) | | | 0.053* |
| | | | (0.029) |
| Fixed Effects | Match pair | Match pair | Match pair |
| N (Matched Observations) | 11960 | 11960 | 11960 |
| $R^2$ | 0.510 | 0.510 | 0.511 |
| *N* (Firms) | 4943 | 4943 | 4943 |
| *N* (Clusters/Parents) | 1038 | 1038 | 1038 |

## Table 6 – Robustness – Alternative Crisis Definitions

This table provides robustness tests for our main tests presented in Tables 3 and 5 to different crisis definitions. We report average treatment effect of the treated (ATET) in Columns (1) and (3) and regression estimates in Columns (2) and (4) with robust *standard errors* in the parentheses. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with different definitions of crisis as given in each panel title. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. Results are reported for the *Subsidiary Investment (t)*, defined as the change in fixed assets plus depreciation, normalized by lagged total assets, and *Subsidiary Employment Growth* (*t*), defined as ln(employment(t) / employment(t-1)) of the subsidiary. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. ATETs, reported in Columns (1) and (3) are bias adjusted by all the continuous control variables of interest. Regressions, reported in Columns (2) and (4), include match-pair fixed effects in all specifications. Errors are corrected for clustering of observations at the parent-firm level. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: Crisis cutoffs set to -1.75 standard deviations below long-term country averages for both Treatment and Control samples

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.008*** | -0.006*** | -0.029*** | -0.027*** |
| *Standard Errors* | (0.002) | (0.002) | (0.006) | (0.007) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 15168 | 15168 | 13900 | 13900 |
| $R^2$ | | 0.606 | | 0.522 |
| *N* (Firms) | | 5676 | | 5057 |
| *N* (Clusters/Parents) | | 1356 | | 1242 |

Panel B: Crisis cutoffs set to -2.25 standard deviations below long-term country averages for both Treatment and Control samples

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.009*** | -0.007*** | -0.015** | -0.022*** |
| *Standard Errors* | (0.001) | (0.002) | (0.007) | (0.007) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 13430 | 13430 | 11862 | 11862 |
| $R^2$ | | 0.587 | | 0.512 |
| *N* (Firms) | | 5592 | | 4931 |
| *N* (Clusters/Parents) | | 1146 | | 1038 |

Panel C: Crisis cutoff set to 1 standard deviation below long-term country average for the Control sample (Treatment sample uses the default (2 standard deviations below))

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.009*** | -0.007*** | -0.016** | -0.021*** |
| *Standard Errors* | (0.002) | (0.002) | (0.007) | (0.007) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 12870 | 12870 | 11528 | 11528 |
| $R^2$ | | 0.585 | | 0.512 |
| *N* (Firms) | | 5354 | | 4777 |
| *N* (Clusters/Parents) | | 1034 | | 978 |

Panel D: No Crisis in the Previous Year (Lagged Transmission Treatment Dummy Equals Zero)

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.007*** | -0.006** | -0.021** | -0.029*** |
| *Standard Errors* | (0.003) | (0.003) | (0.0084) | (0.008) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 6968 | 6968 | 6292 | 6292 |
| $R^2$ | | 0.593 | | 0.509 |
| *N* (Firms) | | 4382 | | 3994 |
| *N* (Clusters/Parents) | | 1047 | | 966 |

Panel E: Placebo Tests with Lagged Dependent Variable; No Crisis in the Previous Year (Lagged Transmission Treatment Dummy Equals Zero)

| | (1) Lagged Subsidiary Investment | (2) Lagged Subsidiary Investment | (3) Lagged Subsidiary Employment Growth | (4) Lagged Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.003 | -0.002 | 0.008 | 0.006 |
| *Standard Errors* | (0.0025) | (0.002) | (0.0074) | (0.009) |
| Bias-adj Variables/Controls | | Subsidiary Size (t-1), Parent Size (t-1), And Parent Cash Flow (t-1) | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 6968 | 6968 | 6292 | 6292 |
| $R^2$ | | 0.527 | | 0.515 |
| *N* (Firms) | | 4382 | | 3994 |
| *N* (Clusters/Parents) | | 1047 | | 966 |

## Table 7 – Robustness – Geographic Subsamples

This table provides robustness tests for our main tests presented in Tables 3 and 5 in different geographic subsamples. We report average treatment effect of the treated (ATET) in Columns (1) and (3) and regression estimates in Columns (2) and (4) with robust *standard errors* in the parentheses. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. Results are reported for the *Subsidiary Investment (t)*, defined as the change in fixed assets plus depreciation, normalized by lagged total assets, and *Subsidiary Employment Growth* (*t*), defined as ln(employment(t) / employment(t-1)) of the subsidiary. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. ATETs, reported in Columns (1) and (3) are bias adjusted by all these continuous control variables of interest. Regressions, reported in Columns (2) and (4), include match-pair fixed effects in all specifications. Errors are corrected for clustering of observations at the parent-firm level. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: U.S. Parents Excluded

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.010*** | -0.006* | -0.022** | -0.034*** |
| *Standard Errors* | (0.003) | (0.006) | (0.010) | (0.010) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 6064 | 6064 | 5082 | 5082 |
| $R^2$ | | 0.593 | | 0.522 |
| *N* (Firms) | | 2644 | | 2230 |
| *N* (Clusters/Parents) | | 634 | | 536 |

Panel B: Subsidiaries and their Parents are in the EU

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.013*** | -0.009** | -0.025** | -0.039*** |
| *Standard Errors* | (0.004) | (0.004) | (0.011) | (0.011) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 4532 | 4532 | 3826 | 3826 |
| $R^2$ | | 0.584 | | 0.518 |
| *N* (Firms) | | 1874 | | 1565 |
| *N* (Clusters/Parents) | | 421 | | 361 |

Panel C: Subsidiaries and their Parents are in the Eurozone

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.022*** | -0.019** | -0.0174 | -0.016 |
| *Standard Errors* | (0.007) | (0.007) | (0.013) | (0.014) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 2114 | 2114 | 1738 | 1738 |
| $R^2$ | | 0.589 | | 0.510 |
| *N* (Firms) | | 811 | | 657 |
| *N* (Clusters/Parents) | | 166 | | 130 |

Panel D: U.S. Parents Only

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.007*** | -0.007*** | -0.013 | -0.015* |
| *Standard Errors* | (0.003) | (0.003) | (0.009) | (0.008) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 7434 | 7434 | 6878 | 6878 |
| $R^2$ | | 0.584 | | 0.505 |
| *N* (Firms) | | 2967 | | 2728 |
| *N* (Clusters/Parents) | | 530 | | 510 |

## Table 8 – Robustness – Subsamples and Alternative Specifications

This table provides robustness tests for our main tests presented in Tables 3 and 5 in different subsamples. We report average treatment effect of the treated (ATET) in Columns (1) and (3) and regression estimates in Columns (2) and (4) with robust *standard errors* in the parentheses. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. Results are reported for the *Subsidiary Investment (t)*, defined as the change in fixed assets plus depreciation, normalized by lagged total assets, and *Subsidiary Employment Growth* (*t*), defined as ln(employment(t) / employment(t-1)) of the subsidiary. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. ATETs, reported in Columns (1) and (3) are bias adjusted by all these continuous control variables of interest. Regressions, reported in Columns (2) and (4), include match-pair fixed effects in all specifications. Errors are corrected for clustering of observations at the parent-firm level. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: Financial Constraints

| | Subsidiary Investment | | | Subsidiary Net Hirings | | |
|---|---|---|---|---|---|---|
| Transmission Dummy | -0.007*** | -0.004* | -0.005* | -0.022*** | -0.023*** | -0.026** |
| | (0.002) | (0.002) | (0.003) | (0.007) | (0.008) | (0.010) |
| Transmission × Larger Than Median Parent Size | | -0.009*** | | | 0.002 | |
| | | (0.003) | | | (0.011) | |
| Investment Rated | | | -0.012*** | | | -0.021* |
| | | | (0.004) | | | (0.012) |
| Transmission × Investment Rated | | | -0.002 | | | 0.009 |
| | | | (0.004) | | | (0.013) |
| Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1) | | | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Net Hirings (t-1) | | |
| Fixed Effects | Match pair | | | | | |
| N (Matched Observations) | 13498 | 13498 | 13498 | 11960 | 11960 | 11960 |
| $R^2$ | 0.588 | 0.589 | 0.590 | 0.511 | 0.511 | 0.512 |
| *N* (Firms) | 5600 | 5600 | 5600 | 4943 | 4943 | 4943 |
| *N* (Clusters/Parents) | 1145 | 1145 | 1145 | 1038 | 1038 | 1038 |

Panel B: Majority-Owned Subsidiaries Only

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.0114*** | -0.010*** | -0.0094 | -0.011 |
| *Standard Errors* | (0.002) | (0.002) | (0.0074) | (0.008) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 10178 | 10178 | 9060 | 9060 |
| $R^2$ | | 0.583 | | 0.519 |
| *N* (Firms) | | 4258 | | 3786 |
| *N* (Clusters/Parents) | | 982 | | 897 |

Panel C: Controlling for Parent's Growth Opportunities

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| ATET / Transmission Treatment Dummy | -0.009*** | -0.008*** | -0.013* | -0.017** |
| *Standard Errors* | (0.002) | (0.002) | (0.007) | (0.007) |
| Subsidiary Size (t-1) | | 0.352*** | | 0.031 |
| | | (0.036) | | (0.032) |
| Parent Size (t-1) | | -0.000 | | -0.005 |
| | | (0.002) | | (0.005) |
| Parent Cash Flow (t-1) | | 0.000 | | 0.006 |
| | | (0.002) | | (0.005) |
| Subsidiary Investment/ Empl. Growth (t-1) | | -0.020 | | -0.107 |
| | | (0.024) | | (0.084) |
| Parent Q (t-1) | | 0.004*** | | 0.016*** |
| | | (0.002) | | (0.006) |
| Bias-adj Variables | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Parent Q (t-1), Subsidiary Investment (t-1) | | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Parent Q (t-1), Subsidiary Employment (t-1) | |
| N (Matched Observations) | 10742 | 10742 | 9922 | 9922 |
| $R^2$ | | 0.582 | | 0.511 |
| *N* (Firms) | | 4353 | | 3988 |
| *N* (Clusters/Parents) | | 790 | | 763 |

Panel D: Size-Weighted Estimation

| | (1) Subsidiary Investment | (2) Subsidiary Employment Growth |
|---|---|---|
| Estimation Method: Regression | | |
| Transmission Treatment Dummy | -0.006*** | -0.021*** |
| *Standard Errors* | (0.002) | (0.007) |
| Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | |
| Fixed Effects | Match pair | Match pair |
| N (Matched Observations) | 13498 | 11960 |
| $R^2$ | 0.593 | 0.525 |
| *N* (Firms) | 5600 | 4943 |
| *N* (Clusters/Parents) | 1145 | 1038 |

## Table 9 – Robustness – Alternative Matching

This table provides robustness tests for our main tests presented in Tables 3 and 5 to different matching metrics. In Panels A and B, we report average treatment effect of the treated (ATET) in Columns (1) and (3) and regression estimates in Columns (2) and (4) with robust *standard errors* in the parentheses. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on our continuous variables of interest in Panels A and B as well as Coarsened Exact Matching in Panel C. Linearized Propensity Scores (LPS) in Panel B are calculated as the natural logarithm of the ratio of the estimated propensity score over (1-estimated propensity score), running a logistic regression of Transmission Treatment Dummy on Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1). Results are reported for the *Subsidiary Investment (t)*, defined as the change in fixed assets plus depreciation, normalized by lagged total assets, and *Subsidiary Employment Growth* (*t*), defined as ln(employment(t) / employment(t-1)) of the subsidiary. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. ATETs, reported in Columns (1) and (3) are bias adjusted by all these continuous control variables of interest. Regressions, reported in Columns (2) and (4), include match-pair fixed effects in all regressions in Panels A and B. All regressions include strata fixed effects in Panel C. Errors are corrected for clustering of observations at the parent-firm level. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: Mahalanobis Matching using All Control Variables

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.010*** | -0.005*** | -0.024*** | -0.026*** |
| *Standard Errors* | (0.002) | (0.002) | (0.006) | (0.007) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | | Match pair | | Match pair |
| N (Matched Observations) | 13498 | 13498 | 11960 | 11960 |
| $R^2$ | | 0.565 | | 0.528 |
| *N* (Firms) | | 5737 | | 5057 |
| *N* (Clusters/Parents) | | 1189 | | 1076 |

Panel B: Mahalanobis Matching using Linearized Propensity Scores (LPS)

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Estimation Method | Matching | Regression | Matching | Regression |
| ATET / Transmission Treatment Dummy | -0.012*** | -0.008*** | -0.012* | -0.017*** |
| *Standard Errors* | (0.0024) | (0.002) | (0.0074) | (0.006) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/Employment Growth (t-1) | | | |
| Fixed Effects | Match pair | | | Match pair |
| Matching | | | | |
| Exact | Subsidiary Country, Parent Country, Year, Industry | | | |
| Mahalanobis-proximity | Linearized Propensity Score | | | |
| N (Matched Observations) | 13498 | 13498 | 11960 | 11960 |
| $R^2$ | | 0.580 | | 0.515 |
| *N* (Firms) | | 5332 | | 4745 |
| *N* (Clusters/Parents) | | 1056 | | 997 |

Panel C: Coarsened Exact Matching

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Subsidiary Investment | | | Subsidiary Employment Growth | | |
| Transmission Treatment Dummy | -0.0024 | -0.004** | -0.007*** | -0.005 | -0.023*** | -0.017** |
| *Standard Errors* | (0.003) | (0.002) | (0.002) | (0.011) | (0.007) | (0.007) |
| Controls | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Subsidiary Investment (t-1) | | | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Employment Growth (t-1) | | |
| Fixed Effects | Match strata | Match strata, Parent Country × Year | Match strata | Match strata | Match strata, Parent Country × Year | Match strata |
| N (Matched Observations) | 1859 | 5675 | 6653 | 1707 | 5103 | 6126 |
| $R^2$ | 0.481 | 0.432 | 0.305 | 0.403 | 0.387 | 0.189 |
| *N* (Firms) | 1431 | 3913 | 4003 | 1314 | 3501 | 3713 |
| *N* (Strata) | 702 | 1714 | 1149 | 637 | 1548 | 1061 |
| *N* (Clusters/Parents) | 582 | 1158 | 1007 | 532 | 1063 | 933 |
| Exact Matching Variables | Parent Country, Sub Country, Year, Sub Industry | Subsidiary Country, Year, Industry | Parent Country, Sub Country, Year, Sub Industry | Parent Country, Sub Country, Year, Sub Industry | Subsidiary Country, Year, Industry | Parent Country, Sub Country, Year, Sub Industry |
| Continuous Matching Variables | Subsidiary Size & Parent Size | Subsidiary Size & Parent Size | Parent Size | Subsidiary Size & Parent Size | Subsidiary Size & Parent Size | Parent Size |

**Table 10 – Aggregate Analysis**

Table reports regression estimates of industry growth on transmission share obtained using country-industry panel that we construct using the sample of foreign subsidiaries located in non-crisis countries in 2008-2012 period. The crisis is defined as a real GDP growth at least two standard deviations less than the country's long term average. *Transmission Share* is measured by the sum of lagged sales of foreign subsidiaries of *treated* parent firms in each country, industry, and year scaled by the total country-industry-year level turnover from the Eurostat's Structural Business Statistics. In constructing the *Transmission Share* variable, a parent is treated if it is located in a non-crisis country and has a subsidiary in a crisis country that year. The dependent variable is industry sales growth in Panel B and industry employment growth in Panel C. *Industry Sales* is measured by the natural logarithm of the total country-industry-year level turnover from the Eurostat's Structural Business Statistics. *Industry Sales Growth* is computed as the logarithmic annual growth of total sales in the industry. *Industry Employment* is measured by the natural logarithm of the total country-industry-year level employment from the Eurostat's Structural Business Statistics. *Industry Employment Growth* is computed as the logarithmic annual growth of total employment in the industry. Panel A shows descriptive statistics of the main variables based on Panel B and Panel C column (3) specifications. Industries are defined at the NACE 3-digit level. The dependent variables are winsorized at the upper and lower 1% level. Control variables are included in the tests with one lag. Heteroskedastic-consistent standard errors are reported in parentheses. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

Panel A: Descriptive Statistics

| | Mean | Std. Dev. | Pctile 10 | Median | Pctile 90 |
|---|---|---|---|---|---|
| Transmission Share | 0.043 | 0.127 | 0.000 | 0.000 | 0.118 |
| Industry Sales Growth | -0.009 | 0.200 | -0.272 | 0.012 | 0.210 |
| Industry Employment Growth | -0.028 | 0.111 | -0.152 | -0.020 | 0.076 |

| | Country | Industry | Year | Country × Industry | Country × Year |
|---|---|---|---|---|---|
| N | 25 | 103 | 4 | 1,248 | 96 |

Panel B: Industry Sales Growth

| | (1) Industry Sales Growth | (2) Industry Sales Growth | (3) Industry Sales Growth | (4) Industry Sales Growth | (5) Industry Sales Growth | (6) Industry Sales Growth |
|---|---|---|---|---|---|---|
| Transmission Share | -0.069*** | -0.069** | -0.069*** | -0.075*** | -0.075*** | -0.260*** |
| | (0.024) | (0.029) | (0.024) | (0.024) | (0.024) | (0.047) |
| Industry Sales *(t-1)* | | | | -0.018*** | -0.019 | -0.021* |
| | | | | (0.004) | (0.012) | (0.012) |
| Industry Sales$^2$ *(t-1)* | | | | | 0.111 | 0.240 |
| | | | | | (0.807) | (0.796) |
| Sales Share of Foreign Subs *(t-1)* | | | | | | 0.213*** |
| | | | | | | (0.039) |
| Sales Share of Foreign Subs with Parents in Crisis *(t-1)* | | | | | | -0.219** |
| | | | | | | (0.105) |
| Fixed Effects | | | | | | |
| Country × Year | No | No | Yes | Yes | Yes | Yes |
| Country × Industry | No | Yes | No | No | No | No |
| Industry | Yes | No | Yes | Yes | Yes | Yes |
| Country | Yes | No | No | No | No | No |
| Year | Yes | Yes | No | No | No | No |
| *N* (Observations) | 4,673 | 4,620 | 4,673 | 4,673 | 4,673 | 4,673 |
| $R^2$ | 0.350 | 0.286 | 0.384 | 0.388 | 0.388 | 0.396 |

Panel C: Industry Employment Growth

| | (1) Industry Employment Growth | (2) Industry Employment Growth | (3) Industry Employment Growth | (4) Industry Employment Growth | (5) Industry Employment Growth | (6) Industry Employment Growth |
|---|---|---|---|---|---|---|
| Transmission Share | -0.036** | -0.038* | -0.036** | -0.039** | -0.039** | -0.083*** |
| | (0.017) | (0.020) | (0.017) | (0.017) | (0.017) | (0.021) |
| Industry Employment *(t-1)* | | | | -0.010*** | -0.009 | -0.007 |
| | | | | (0.003) | (0.014) | (0.014) |
| Industry Employment$^2$ *(t-1)* | | | | | -0.053 | -0.168 |
| | | | | | (0.728) | (0.724) |
| Employment Share of Foreign Subs *(t-1)* | | | | | | 0.102*** |
| | | | | | | (0.028) |
| Employment Share of Foreign Subs with Parents in Crisis *(t-1)* | | | | | | -0.333*** |
| | | | | | | (0.128) |
| Fixed Effects | | | | | | |
| Country × Year | No | No | Yes | Yes | Yes | Yes |
| Country × Industry | No | Yes | No | No | No | No |
| Industry | Yes | No | Yes | Yes | Yes | Yes |
| Country | Yes | No | No | No | No | No |
| Year | Yes | Yes | No | No | No | No |
| *N* (Observations) | 4,735 | 4,688 | 4,735 | 4,735 | 4,735 | 4,735 |
| $R^2$ | 0.158 | 0.128 | 0.237 | 0.241 | 0.241 | 0.246 |

# Online Appendix to

# "Multinational Firms and the International Transmission of Crises: The Real Economy Channel"

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August 31, 2017

## Table OA-1 – Alternative Clustering of Standard Errors

Table reports main regression results correcting for double clustering of observations at the parent company as well as parent country-year levels. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. Results are reported for the *Subsidiary Investment (t)*, defined as the change in fixed assets plus depreciation, normalized by lagged total assets, and *Subsidiary Employment Growth* (*t*), defined as ln(employment(t) / employment(t-1)) of the subsidiary. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. We report regression estimates with *standard errors* in parentheses. We include match-pair fixed effects in all specifications. All outcome variables are trimmed at the upper and lower 5% level. All control variables are winsorized at the upper and lower 1% level and are included in the tests with one lag. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

| | (1) Subsidiary Investment | (2) Subsidiary Investment | (3) Subsidiary Employment Growth | (4) Subsidiary Employment Growth |
|---|---|---|---|---|
| Transmission Treatment Dummy | -0.009*** | -0.007*** | -0.017*** | -0.022*** |
| | (0.002) | (0.002) | (0.005) | (0.006) |
| Subsidiary Size (t-1) | | 0.000 | | -0.002 |
| | | (0.002) | | (0.005) |
| Parent Size (t-1) | | -0.000 | | 0.005 |
| | | (0.001) | | (0.004) |
| Parent Cash Flow (t-1) | | 0.033 | | 0.074 |
| | | (0.021) | | (0.065) |
| Subsidiary Investment/ Empl. Growth (t-1) | | 0.348*** | | 0.053* |
| | | (0.029) | | (0.030) |
| *N (Matched Observations)* | 13498 | 13498 | 11960 | 11960 |
| $R^2$ | 0.538 | 0.588 | 0.510 | 0.511 |
| *N* (Firms) | 5600 | 5600 | 4943 | 4943 |
| *N* (Clusters/Parents Country-Year) | 41 | 41 | 39 | 39 |

**Table OA-2 – Matching Estimates for Changes in Subsidiary Investment and Employment Growth**

Table reports average treatment effect on the treated (ATET) with Abadie-Imbens (AI) robust *standard errors* in the parentheses.. In constructing the *Transmission Treatment Dummy* variable, a parent is *treated* if it has a subsidiary in a crisis country that year with the crisis defined as a real GDP growth at least two standard deviations less than the country's long term average. To construct our sample, we use Mahalanobis matching with exact matching for subsidiary country, subsidiary 2-digit industry classification, parent country, and year in addition to (nearest neighbor) matching on parent and subsidiary sizes. The statistic is calculated for the change in subsidiary investment from (t-1) to t, where subsidiary investment is defined as the change in fixed assets plus depreciation, normalized by lagged total assets. *Subsidiary (Parent) Size* is measured by the natural logarithm of the subsidiary (parent) total book assets. *Parent Cash Flow* is defined as its Operating profit/loss plus depreciation, over total assets. ATET is bias-adjusted by using subsidiary and parent sizes in Columns (1) and (3) and then by all these continuous control variables of interest in Columns (2) and (4). All outcome variables are trimmed at the upper and lower 5% level. All control variables are winsorized at the upper and lower 1% level and are included in the tests with one lag. Symbols $^{*}$, $^{**}$, $^{***}$ denote significance at the 10%, 5%, and 1% respectively.

| | (1)<br>Change in Subsidiary Investment (from (t-1) to (t)) | (2)<br>Change in Subsidiary Investment (from (t-1) to (t)) | (3)<br>Change Subsidiary Employment Growth (from (t-1) to (t)) | (4)<br>Change in Subsidiary Employment Growth (from (t-1) to (t)) |
|---|---|---|---|---|
| | Matching | Matching | Matching | Matching |
| ATET<br>Transmission Treatment Dummy (1 vs. 0) | -0.0044** | -0.009*** | -0.018** | -0.016** |
| AI robust *standard errors* | (0.002) | (0.002) | (0.008) | (0.007) |
| Bias-adj Variables/Controls | Subsidiary Size (t-1), Parent Size (t-1) | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Subsidiary Investment (t-1) | Subsidiary Size (t-1), Parent Size (t-1) | Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), Subsidiary Employment Growth (t-1) |
| *N (Matched Observations)* | 13804 | 13804 | 12284 | 12284 |

**Figure OA-1 – Distribution of Estimated Pseudo Treatment Effect from 100 Randomized Runs**

The figures are based on constructing peudo-treatment groups to which parent firms are assigned randomly. The figures give the distribution of estimated pseudo-treatment effect after repeating this random assignment and estimation 100 times. The outcome variable and the estimation procedure used are as stated below.

Fig. OA-1a Investment Growth – Matching Estimate based on Table 3A, Column (2)

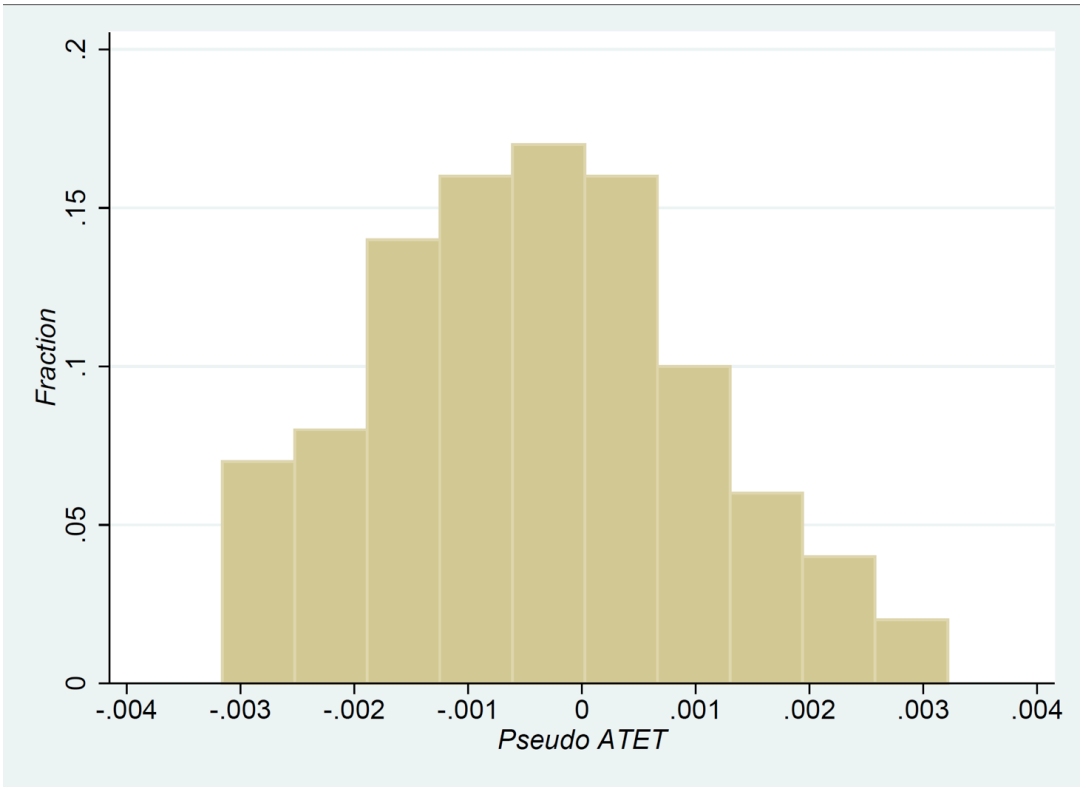

Fig. OA-1b Investment Growth – Regression Estimate based on Table 3B, Column (2)

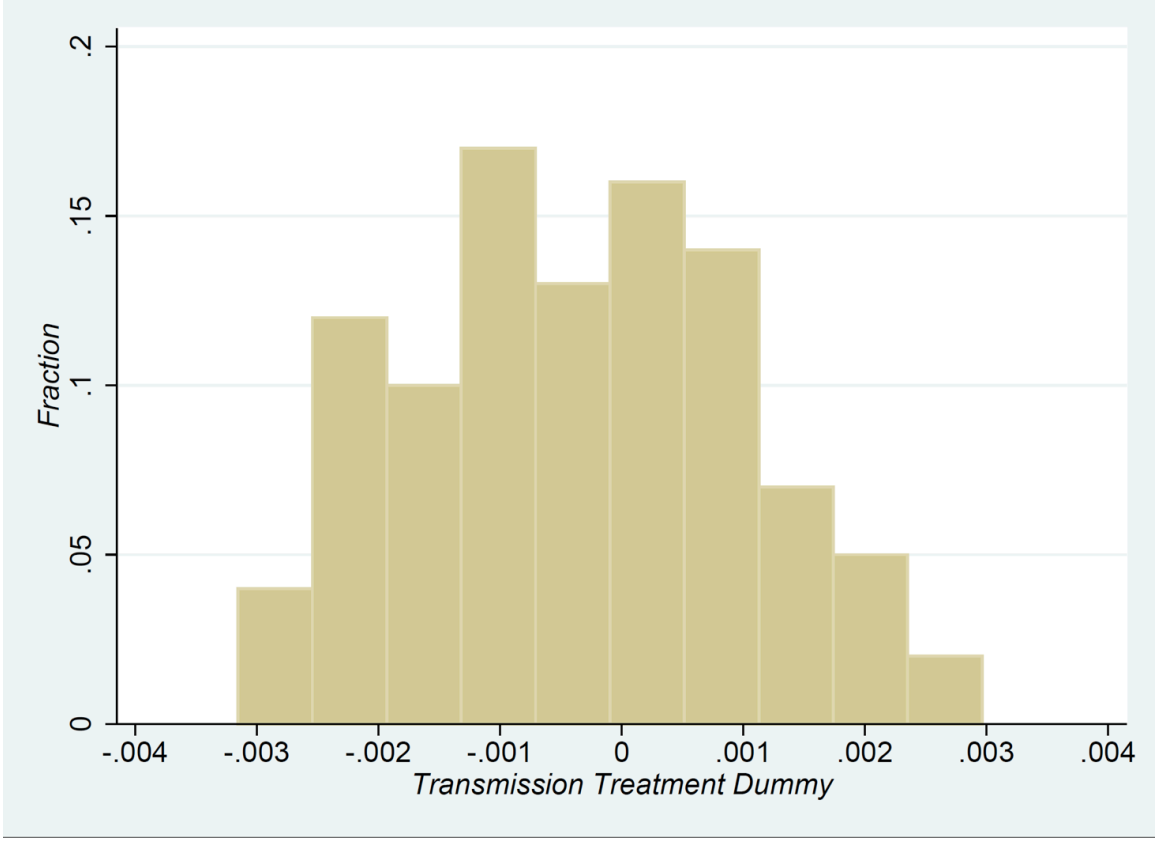

Fig. OA-1c Change in Employment Growth – Matching Estimate based on Table 5A, Column (2)

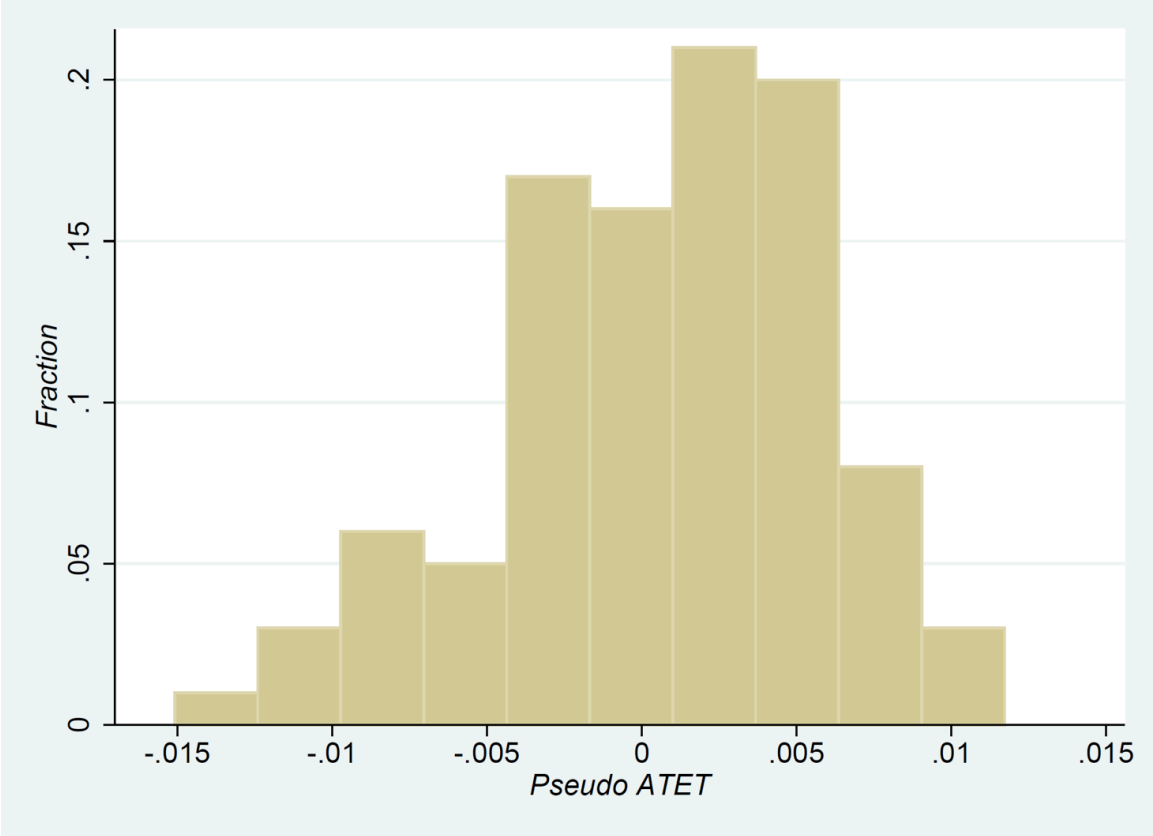

Fig. OA-1d Change in Employment Growth – Regression Estimate based on Table 5B, Column (2)