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

Jan Bena,
University of British Columbia

Serdar Dinc,
Rutgers University

Isil Erel,
The Ohio State University

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Jan Bena, Serdar Dinc, and Isil Erel

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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. Net new hiring of employees in these subsidiaries is also lower in these subsidiaries. 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.

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 an increase and a decrease in the investment and new hiring of employees 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 new hirings may increase 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 new hirings due to the crisis, then the investment and new hirings in the Finnish subsidiary may also decrease. Furthermore, due to the crisis in the country of one of its subsidiaries, the parent may have fewer resources to allocate among its other subsidiaries or fewer growth

[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).

opportunities in general, so the parent may choose to shrink the investment and new hirings 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 new hirings 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 new hirings 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 are larger than the median parent. The reduction in investment and new hirings 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 relative decreases in investment and new hirings we document are measured only using the subsidiaries and parent firms in non-crisis countries, because subsidiaries and parents in crisis countries 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 assets. The non-crisis subsidiaries of a parent with a subsidiary in a crisis country invest, however, about 0.4-0.7 percentage points less depending on the specification. In other words, their investment rate is about 11-18% lower. Similarly, the net new hirings as a fraction of employment is on average about 1.4% in the subsidiaries of parents that do not have a subsidiary in a crisis country. However, the net new hirings in the subsidiaries of parents with a subsidiary in a crisis country is about 1.6-1.8 percentage points lower. In other words, the employment in these subsidiaries shrinks on average.

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.

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 new hirings of employees. 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. Note 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 from financial intermediation (primary two-digit NACE codes 65-67), as well as subsidiaries and parent firms from 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.

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).

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 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 change in the subsidiary investment, normalized by lagged total subsidiary assets, between the treatment year and the year immediately before, 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 decrease in investment in the treatment group and an increase in investment 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

0.44 percentage points with 5% statistical significance and is 0.9 percentage points with 1% statistical significance in the latter case.

The economic magnitude of this decrease 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 decrease in the investment due to treatment, when adjusted for the bias using all four of the continuous variables, is about 18% of 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 to estimate the treatment effect.

[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.

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 variables. The estimated coefficient on the treatment dummy variable is negative and statistically significant at 5% level. Regression in Column 2 adds the continuous variables used in the bias adjustment of the matching estimate in Panel A Column 2 as control variables. This regression is comparable to, but not the same as, the bias-adjusted matching estimates. The estimated ATET is -0.7 percentage points and is statistically significant at the 1% level. Although slightly lower than the matching estimates in absolute value, the decrease in the investment rate due to treatment is still more than a fifth of the annual investment rate for the full sample. With these statistically and economically significant decreases in the subsidiary investment estimated in different ways, we now move to studying the net new hiring of employees 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 the new employee hirings of parent firms' other subsidiaries. Since the availability of employment data, on which our

net new hirings 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 new hirings.

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 new hirings, 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 net new employee hirings. The dataset provides only the total number of employees in a subsidiary. Using these data, we construct the rate of net new employee hirings as ln(total employees(t)) – ln(total employees(t-1)). The average subsidiary rate of new hirings in the control subsample in the event year is about 1.4%, while it is -0.3% in the treatment subsample. This difference is statistically significant at the 10% level with standard errors robust to clustering at the parent firm level.

Similar to the analysis of subsidiary investment, we again take advantage of the panel data and study how new hirings change in the event year. The outcome variable studied in this section is the change in the rate of new employee hirings. 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 -1.8 percentage points and is statistically significant at the 5% level. When we also use lagged parent profitability and the lagged subsidiary new hirings in adjusting for bias due to matching with continuous variables, the ATET estimate becomes -1.6 percentage points and again statistically significant at the 5% level. Given that the average rate of new employee hirings in the control sample is 1.4%, this is a large decrease 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 -1.3 and -2.2 percentage points and are statistically significant at the 10% or 1% levels depending on the specification.

Given that the subsidiaries in the control group have an annual new hirings rate of 1.4% as indicated in Table 4C, 1.3 to 2.2 percentage points lower new hirings at the treatment subsidiaries is a very economically significant decrease. 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 new hirings using the same specifications, except that lagged new hirings replaces lagged investment. We again find lower rate of new hirings 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 new hirings 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 new hirings 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 new hirings.

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 new hirings. 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 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 new hirings 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 sign for both investment and new hirings and it is statistically significant for the former. 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

[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.

investment in for the financially unconstrained parents. These results may not rule out the hypothesis that the financial channel within multinationals is present; however, they do rule out that the financial channel is 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 a decrease in new hirings in this sample at the conventional levels of statistical significance, we find that the investment rate decrease in treated subsidiaries to be greater in this sample and statistically significant at the 1% level.

5.5 Controlling for Growth Opportunities

It is customary to control for firm's growth opportunities in an analysis of firm investment or new hirings, 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 significant at the 1% level.

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 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 is the change in the investment rate and the change in the rate of new employee hirings. As a robustness check, we also use the investment rate and new employee hiring rate, that is, the levels of these variables as outcome measures. We repeat both matching estimates and the regression analyses of Tables 3 and 5 and report the results in the Online Appendix in Tables OA-1 and OA-2, respectively. The results remain robust and further facilitate the interpretation of the economic magnitude of our findings. For example, the magnitude of the estimated treatment effect for employment is between -0.015 and -0.022. This implies a reduction in subsidiary employment between 1.5 and 2.2 percentage points relative to the control group where the latter has an unconditional average employment growth of only 1.4%. In other words, these results show that the employment shrinks in treated subsidiaries not only relative to the control group but also in absolute terms.

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 new hirings, 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 new hirings 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 or better.

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. Our results on investment are robust with similar magnitudes at 1% significance level. Our results on new hirings are statistically weaker and significant only in the case of regression-based estimates at the 10% 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-3. Our results remain robust to this alternative clustering approach.

6. 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 have a subsidiary in a crisis country invest and hire less. These effects are economically large. The decrease in the investment rate is about 25%. Furthermore, while the average rate of new employee hirings in control subsidiaries is about 1.4%, the implied rate of new hirings in the subsidiaries owned by parents that have a subsidiary in a crisis country is such that the employment growth is close to zero or negative.

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.

References

Acemoglu, Daron, Vasco M. Carvalho, Asuman Ozdaglar, and Alireza Tahbaz-Salehi, 2012, The Network Origins of Aggregate Fluctuations, *Econometrica* 80(5), 1977-2016.

Acemoglu, Daron, Vasco M. Carvalho, Asuman Ozdaglar, and Alireza Tahbaz-Salehi, 2015, Networks, Shocks, and Systemic Risk, *Handbook on the Economics of Networks*.

Acemoglu, Daron, Asuman Ozdaglar, and Alireza Tahbaz-Salehi, 2012, Systemic Risk and Stability in Financial Networks, *American Economic Review* 105, 564-608.

Alfaro, Laura, and Maggie Xiaoyang Chen, 2012, Surviving the Global Financial Crisis: Foreign Ownership and Establishment Performance, *American Economic Journal: Economic Policy* 4(3), 30-55.

Antrás, Pol, and Stephen R. Yeaple, 2014, Multinational Firms and the Structure of International Trade, *Handbook of International Economics* 4, 55-130.

Barrot, Jean-Noel, and Julien Sauvagnat, 2016, Input Specificity and the Propagation of Idiosyncratic Shocks in Production Networks, *The Quarterly Journal of Economics* 131(3), 1543-1592.

Boehm, Cristoph, Aaron Flaaen, and Nitya Pandalai-Nayar, 2016, Input Linkages and the Transmission of Shocks: Firm-Level Evidence from the 2011 Tōhoku Earthquake, *Working Paper*.

Burstein, Arial, Christopher Kurz, and Linda Tesar, 2008, Trade, Production Sharing, and the International Transmission of Business Cycles, *Journal of Monetary Economics* 55(4), 775-795.

Carvalho, Vasco M., 2014, From Micro to Macro via Production Networks, *The Journal of Economic Perspectives* 28(4), 23-47.

Carvalho, Vasco, and Xavier Gabaix, 2013, The Great Diversification and its Undoing, *American Economic Review* 103(5), 1697-1727.

Cetorelli, Nicola and Linda S. Goldberg, 2012, Banking Globalization and Monetary Transmission, *Journal of Finance* 67, 1811-1843.

Cravino, Javier, and Andrei A. Levchenko, 2016, Multinational Firms and International Business Cycle Transmission, *CEPR Discussion Paper*.

Desai, Mihir A., C. Fritz Foley, and Kristin J. Forbes, 2008, Financial Constraints and Growth: Multinational and Local Firm Responses to Currency Depreciations, *Review of Financial Studies* 21, 2857-2888.

Desai, Mihir A., C. Fritz Foley, and James R. Hines, 2009, Domestic Effects of the Foreign Activities of US Multinationals, *American Economic Journal: Economic Policy* 1, 181-203.

Di Giovanni, Julian, and Andrei A. Levchenko, 2012, Country Size, International Trade, and Aggregate Fluctuations in Granular Economies, *Journal of Political Economy* 120(6), 1083-1132.

Di Giovanni, Julian, Andrei A. Levchenko, and Isabelle Méjean, 2014, Firms, Destinations, and Aggregate Fluctuations, *Econometrica* 82(4), 1303-1340.

Erel, Isil, Yeejin Jang, and Michael S. Weisbach, 2015, Do Acquisitions Relieve Target Firms' Financial Constraints? *Journal of Finance* 70, 289-328.

.

Forbes, Kristin J., 2004. The Asian flu and Russian virus: the international transmission of crises in firm-level data. *Journal of International Economics*, *63*(1), pp.59-92.

Gabaix, Xavier, 2011, The Granular Origins of Aggregate Fluctuations, *Econometrica* 79(3), 733-772.

Giroud, X., and H. Mueller, 2017, "Redistribution of Local Labor Market Shocks through Firms' Internal Networks," working paper.

Hertzel, Michael G., Zhi Li, Micah S. Officer, and Kimberly J. Rodgers, 2008, Inter-firm Linkages and the Wealth Effects of Financial Distress Along the Supply Chain, *Journal of Financial Economics* 87, 374-387.

Imbens, Guido and Jeffrey Wooldridge, 2009, Recent Developments in the Econometrics of Program Evaluation, *Journal of Economic Literature* 47:1, 1–81

Jang, Yeejin, 2013, Does International Corporate Diversification Improve Access to Capital? *Ohio State University Working Paper*.

Johnson, Robert C., 2014, Trade in Intermediate Inputs and Business Cycle Comovement, *American Economic Journal: Macroeconomics* 6(4), 39-83.

Kahle, Kathy and René Stulz, 2013, Access to Capital, Investment, and the Financial Crisis, *Journal of Financial Economics* 110, 280-299.

Kalemli-Ozcan, Sebnem, Papaioannou, E. and Peydró, J. L., 2013. Financial regulation, financial globalization, and the synchronization of economic activity. *The Journal of Finance*, *68*(3), pp.1179-1228.

Kelly, Bryan, Hanno Lustig, and Stijn Van Nieuwerburgh, 2013, Firm Volatility in Granular Networks, *NBER Working Paper No. 19466*.

Khwaja, Asim, and Atif Mian, 2008, Tracing the impact of bank liquidity shocks: Evidence from an emerging market, *American Economic Review* 98, 1413–1442.

Kolay, Madhuparna, and Michael L. Lemmon, 2011, Spillover Effects in the Supply Chain: Evidence from Chapter 11 Filings, *University of Utah Working Paper*.

Kose, M. Ayhan, and Kei-Mu Yi, 2001, International Trade and Business Cycles: Is Vertical Specialization the Missing Link? *The American Economic Review* 91(2), 371-375.

Menno, Dominik, 2015, Multinational Firms and Business Cycle Transmission, *Working Paper*.

Peek, Joe, and Eric Rosengren, 1997, The international transmission of financial shocks: The case of Japan, *American Economic Review* 87, 495–505.

Peek, Joe, and Eric Rosengren, 2000, Collateral damage: Effects of the Japanese bank crisis on real activity in the United States, *American Economic Review* 90, 30–45.

Ramondo, Natalia, Veronica Rappaport, and Kim J. Ruhl, 2016, Intrafirm Trade and Vertical Fragmentation in U.S. Multinational Corporations, *Journal of International Economics* 98, 51-59.

Schnabl, Philipp, 2012, Financial globalization and the transmission of bank liquidity shocks: Evidence from an emerging market, *Journal of Finance* 67, 897-932.

Wu, Di, 2016, Shock Spillover and Financial Response in Supply Chain Networks: Evidence from Firm-Level Data, *Working Paper*.

Yeaple, Stephen Ross, 2013, The Multinational Firm, *Annual Review of Economics* 5, 193-217.

Zlate, Andrei, 2016, Offshore Production and Business Cycle Dynamics with Heterogeneous Firms, *Journal of International Economics* 100, 34-49.

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	243	139	139	187
Czech Republic	65	53	43	
Denmark	90	58	60	5
Finland	53	28	26	22
France	239	116	109	350
Germany	302	177	110	111
Greece	35			
Hungary	22	10	8	
Italy	373	226	201	
Japan			3	
Korea	20	20	15	51
Luxembourg	3			
Netherlands	29	13	7	
Norway	92	49	53	32
Poland	66	81	63	14
Portugal	42	21	21	
Romania			9	
Singapore	9			
Slovakia		6	16	
Slovenia	4			
Spain	321	221	211	
Sweden	102	59	60	20
United Kingdom	448	260	204	571
Total	2611	1555	1373	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	116	39	20	75
Switzerland	66	83	81	
United Kingdom	195	121	113	87
United States of America	1,510	795	713	845
Total	2611	1555	1373	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	3.325	3.025***	3.175
	Median	3.133	2.872***	2.985
	Std. Dev.	1.570	1.336	1.466
Parent Size (t-1)	Mean	9.484	8.576***	9.030
	Median	9.567	8.702***	9.184
	Std. Dev.	1.503	1.403	1.523
Parent Cash Flow (t-1)	Mean	0.138	0.125	0.131
	Median	0.131	0.117***	0.123
	Std. Dev.	0.071	0.069	0.070
Subsidiary Investment (t-1)	Mean	0.031	0.035	0.033
	Median	0.012	0.014***	0.013
	Std. Dev.	0.058	0.061	0.059
	N	6902	6902	13804

Panel B: Covariate Balance

Variables	Standardized Difference		Variance Ratio	
	Raw	Matched	Raw	Matched
Subsidiary Size (t-1)	0.351	0.206	1.351	1.382
Parent Size (t-1)	1.246	0.625	0.690	1.148
Parent Cash Flow (t-1)	0.223	0.176	0.723	1.034
Subsidiary Investment (t-1)	-0.029	-0.075	0.901	0.902

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	0.070	0.064
Change in Subsidiary Investment (from (t-1) to (t))	Mean	-0.002	0.002	0.000
	Median	-0.0003	0.000**	0.000
	Std. Dev.	0.069	0.072	0.070
	N	6902	6902	13804

Table 3 – Matching and Regression Estimates for Subsidiary Investment

Panel A reports average treatment effect on the treated (ATET) with robust *z-statistics* 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. In Panel A, ATET is bias-adjusted by using subsidiary and parent sizes in Column (1) and then by all these continuous control variables of interest in Columns (2). In Panel B, we report regression estimates with *p-values* in parentheses, where we again use the Change in 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

	Change in Subsidiary Investment (from (t-1) to (t))	
	(1)	(2)
ATET		
Transmission Treatment Dummy (1 vs. 0)	-0.0044**	-0.009***
z-stat	(-2.06)	(-4.38)
N (Observations)	15350	15350
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 Investment (t-1)

Panel B: Regression Estimates

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))
Transmission Treatment Dummy	-0.004**	-0.007***
	(0.025)	(0.001)
Subsidiary Size (t-1)		0.001
		(0.743)
Parent Size (t-1)		-0.000
		(0.735)
Parent Cash Flow (t-1)		0.030*
		(0.084)
Subsidiary Investment (t-1)		-0.649***
		(0.000)
Fixed Effects	Match pair	Match pair
N (Observations)	13804	13804
R^2	0.511	0.654
N (Firms)	5713	5713
N (Clusters/Parents)	1152	1152

Table 4 - Summary Statistics for the Analysis of Subsidiary New Hirings

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 New Hirings* is defined as the natural logarithm of the subsidiary's employment over its lagged employment. 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	3.338	3.121**	3.229
	Median	3.202	2.988***	3.074
	Std. Dev.	1.471	1.272	1.379
Parent Size (t-1)	Mean	9.528	8.679***	9.104
	Median	9.588	8.723***	9.208
	Std. Dev.	1.466	1.336	1.465
Parent Cash Flow (t-1)	Mean	0.138	0.127	0.132
	Median	0.131	0.118***	0.124
	Std. Dev.	0.072	0.069	0.071
Subsidiary New Hirings (t-1)	Mean	0.015	0.019	0.017
	Median	0.000	0.000	0.000
	Std. Dev.	0.228	0.195	0.212
	N	6142	6142	12284

Panel B: Covariate Balance

Variables	Standardized Difference		Variance Ratio	
	Raw	Matched	Raw	Matched
Subsidiary Size (t-1)	0.275	0.158	1.290	1.338
Parent Size (t-1)	1.230	0.605	0.722	1.205
Parent Cash Flow (t-1)	0.219	0.156	0.726	1.074
Subsidiary New Hirings (t-1)	0.018	-0.019	1.126	1.365

Panel C: Summary Statistics of Outcome Variables

Variables	Stats	Treatment Sample	Control Sample	All
Subsidiary New Hirings (t)	Mean	-0.003	0.014*	0.005
	Median	0.000	0.000	0.000
	Std. Dev.	0.230	0.200	0.215
Change in Subsidiary New Hirings (from (t-1) to (t))	Mean	-0.018	-0.005	-0.012
	Median	0.000	0.000	0.000
	Std. Dev.	0.316	0.268	0.293
	N	6142	6142	12284

Table 5 – Matching and Regression Estimates for Subsidiary New Hirings

Panel A reports average treatment effect of the treated (ATET) with robust *z-statistics* 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. In Panel A, ATET is bias adjusted first by using subsidiary and parent sizes in Column (1) and then by all these continuous control variables of interest. In Panel B, we report regression estimates, where we again use the Change in New Hirings 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

	Change in Subsidiary New Hirings (from (t-1) to (t))	
	(1)	(2)
ATET		
Transmission Treatment Dummy (1 vs. 0)	-0.018**	-0.016**
z-stat	(-2.17)	(-2.23)
N (Observations)	13630	13630
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 New Hirings (t-1)

Panel B: Regression Estimates

	(1) Change in Subsidiary New Hirings (from (t-1) to (t))	(2) Change in Subsidiary New Hirings (from (t-1) to (t))
Transmission Treatment Dummy	-0.013*	-0.022***
	(0.067)	(0.001)
Subsidiary Size (t-1)		-0.001
		(0.822)
Parent Size (t-1)		0.006
		(0.149)
Parent Cash Flow (t-1)		0.062
		(0.349)
Subsidiary Empl. Growth (t-1)		-0.962***
		(0.000)
Fixed Effects	Match pair	Match pair
N (Observations)	12284	12284
R^2	0.502	0.738
N (Firms)	5068	5068
N (Clusters/Parents)	1053	1053

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) with robust *z-statistics* in the parentheses in Columns (1) and (3) and regression estimates with *p-values* in parentheses in Columns (2) and (4). 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 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. 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) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.008***	-0.006***	-0.026***	-0.024***
z-stat / p-value	(-3.41)	(0.004)	(-3.40)	(0.003)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	13075	15686	11923	14392
R^2		0.607		0.518
N (Firms)		5806		5176
N (Clusters/Parents)		1372		1260

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

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.009***	-0.007***	-0.016**	-0.021***
z-stat / p-value	(-4.43)	(0.001)	(-2.17)	(0.002)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	15322	13728	13596	12574
R^2		0.590		0.516
N (Firms)		5703		5222
N (Clusters/Parents)		1152		1071

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) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.009***	-0.007***	-0.017**	-0.021***
z-stat / p-value	(-3.97)	(0.002)	(-2.17)	(0.002)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	14506	13176	13076	11854
R^2		0.586		0.514
N (Firms)		5464		4905
N (Clusters/Parents)		1042		993

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

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.007***	-0.006**	-0.021**	-0.030***
z-stat / p-value	(-2.55)	(0.040)	(-2.27)	(0.000)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	6666	7142	5963	6470
R^2		0.657		0.723
N (Firms)		4480		4075
N (Clusters/Parents)		1058		974

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 the average treatment effect of the treated (ATET) with robust *z-statistics* in the parentheses in Columns (1) and (3) and regression estimates with *p-values* in the parentheses in Columns (2) and (4). 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 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. 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) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.010***	-0.006*	-0.022**	-0.033***
z-stat / p-value	(-3.36)	(0.063)	(-1.99)	(0.001)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	6804	6078	5503	5098
R^2		0.633		0.733
N (Firms)		2657		2244
N (Clusters/Parents)		639		543

Panel B: Subsidiaries and their Parents are in the EU

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.013***	-0.009**	-0.024*	-0.038***
z-stat / p-value	(-3.37)	(0.040)	(-1.90)	(0.001)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	4745	4540	3948	3842
R^2		0.622		0.730
N (Firms)		1882		1581
N (Clusters/Parents)		425		368

Panel C: Subsidiaries and their Parents are in the Eurozone

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.022***	-0.019***	-0.018	-0.015
z-stat / p-value	(-3.31)	(0.010)	(-1.04)	(0.278)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	1913	2114	1573	1738
R^2		0.567		0.777
N (Firms)		811		657
N (Clusters/Parents)		166		130

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 the average treatment effect of the treated (ATET) with robust *z-statistics* in the parentheses in Columns (1) and (3) and regression estimates with *p-values* in the parentheses in Columns (2) and (4). 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 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. 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

	Change in Subsidiary Investment (from (t-1) to (t))			Change in Subsidiary Net Hirings (from (t-1) to (t))		
Transmission Dummy	-0.007***	-0.004*	-0.005*	-0.022***	-0.022**	-0.025**
	(0.001)	(0.086)	(0.056)	(0.001)	(0.005)	(0.017)
Transmission × Larger Than Median Parent Size		-0.010***			-0.001	
		(0.002)			(0.921)	
Investment Rated			-0.011***			-0.019*
			(0.003)			(0.097)
Transmission × Investment Rated			-0.003			0.006
			(0.423)			(0.650)
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 (Observations)	13804	13804	13804	12284	12284	12284
R^2	0.590	0.591	0.593	0.515	0.515	0.515
N (Firms)	5713	5713	5713	5068	5068	5068
N (Clusters/Parents)	1152	1152	1152	1053	1053	1053

Panel B: Majority-Owned Subsidiaries Only

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.0114***	-0.010***	-0.010	-0.011
z-stat / p-value	(-2.09)	(0.000)	(-1.17)	(0.147)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	12113	10406	10629	9304
R^2		0.661		0.721
N (Firms)		4350		3895
N (Clusters/Parents)		991		915

Panel C: Controlling for Parent's Growth Opportunities

	(1) Change in Subsidiary Investment	(2) Change in Subsidiary New Hirings
Transmission Treatment Dummy	-0.009***	-0.020**
	(0.000)	(0.011)
Subsidiary Size (t-1)	-0.000	-0.003
	(0.969)	(0.650)
Parent Size (t-1)	0.000	0.008
	(0.891)	(0.107)
Parent Cash Flow (t-1)	-0.011	-0.138
	(0.665)	(0.137)
Subsidiary Investment/ Empl. Growth (t-1)	-0.653***	-0.977***
	(0.000)	(0.000)
Parent Q (t-1)	0.004**	0.023***
	(0.045)	(0.000)
N (Observations)	11918	10756
R^2	0.678	0.765
N (Firms)	4871	4387
N (Clusters/Parents)	852	805

Panel D: Size-Weighted Estimation

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method: Regression		
ATET / Transmission Treatment Dummy	-0.007***	-0.022***
p-value	(0.001)	(0.001)
Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)	
Fixed Effects	Match pair	Match pair
N (Observations)	13804	12284
R^2	0.677	0.761
N (Firms)	5713	5068
N (Clusters/Parents)	1152	1053

Table 9 – Robustness – Alternative Matching

This table provides robustness tests for our main tests presented in Tables 3 and 5 to different matching metrics. We report average treatment effect of the treated (ATET) with robust *z-statistics* in the parentheses in Columns (1) and (3) and regression estimates with *p-values* in the parentheses in Columns (2) and (4). 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)/New Hirings (t-1) as well as Parent country, Subsidiary country, Industry, and Year fixed effects. Results are reported 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. 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) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.010***	-0.005***	-0.0244***	-0.026***
z-stat / p-value	(-6.07)	(0.008)	(-4.02)	(0.000)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	15350	13804	13630	12284
R^2		0.633		0.708
N (Firms)		5861		5181
N (Clusters/Parents)		1197		1091

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

	(1) Change in Subsidiary Investment (from (t-1) to (t))	(2) Change in Subsidiary Investment (from (t-1) to (t))	(3) Change in Subsidiary New Hirings (from (t-1) to (t))	(4) Change in Subsidiary New Hirings (from (t-1) to (t))
Estimation Method	Matching	Regression	Matching	Regression
ATET / Transmission Treatment Dummy	-0.009***	-0.006***	-0.008	-0.015*
z-stat / p-value	(-3.92)	(0.001)	(-0.80)	(0.068)
Bias-adj Variables/Controls	Subsidiary Size (t-1), Parent Size (t-1), Parent Cash Flow (t-1), and Subsidiary Investment (t-1)/New Hirings (t-1)			
Fixed Effects		Match pair		Match pair
N (Observations)	15350	13804	13630	12284
R^2		0.629		0.729
N (Firms)		5442		4865
N (Clusters/Parents)		1069		999

Panel C: Coarsened Exact Matching

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in Subsidiary Investment (from (t-1) to (t))			Change in Subsidiary New Hirings (from (t-1) to (t))		
ATET	-0.001	-0.004**	-0.006***	-0.007	-0.024***	-0.018***
p-value	(0.632)	(0.029)	(0.001)	(0.530)	(0.001)	(0.005)
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), New Hirings (t-1)		
Fixed Effects	Match strata	Match strata, Parent Country × Year	Match strata	Match strata	Match strata, Parent Country × Year	Match strata
N (Observations)	1931	5836	6837	1782	5267	6342
R^2	0.474	0.430	0.302	0.401	0.357	0.206
N (Firms)	1483	4016	4101	1366	3616	3829
N (Strata)	724	1761	1172	661	1591	1092
N (Clusters/Parents)	592	1177	1015	542	1090	942
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

Online Appendix to

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

Jan Bena
University of British Columbia

Serdar Dinc
Rutgers University

Isil Erel
Ohio State University

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Table OA-1 – Alternative Outcome Measures: Subsidiary Investment

The outcome/dependent variable is subsidiary investment in year t, where subsidiary investment is defined as the change in fixed assets plus depreciation, normalized by lagged total assets. Panel A reports average treatment effect on the treated (ATET) with robust *z-statistics* 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. *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) and then by all these continuous control variables of interest in Columns (2). In Panel B, we report regression estimates with *p-values* in parentheses, where we again use the Change in Subsidiary Investment or the level of 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)
ATET		
Transmission Treatment Dummy (1 vs. 0)	-0.013***	-0.009***
z-stat	(-6.34)	(-4.63)
N (Observations)	15350	15350
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 Investment (t-1)

Panel B: Regression Estimates

	(1) Subsidiary Investment	(2) Subsidiary Investment
Transmission Treatment Dummy	-0.009***	-0.007***
	(0.000)	(0.001)
Subsidiary Size (t-1)		0.001
		(0.743)
Parent Size (t-1)		-0.000
		(0.735)
Parent Cash Flow (t-1)		0.030*
		(0.084)
Subsidiary Investment (t-1)		-0.649***
		(0.000)
Fixed Effects	Match pair	Match pair
N (Observations)	13804	13804
R^2	0.539	0.613
N (Firms)	5713	5713
N (Clusters/Parents)	1152	1152

Table OA-2 – Alternative Outcome Measures: Employment Growth

The outcome/dependent variable is subsidiary net new hiring rate in year t, which is the rate of growth in subsidiary employment. Panel A reports average treatment affect of the treated (ATET) with robust *z-statistics* 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. *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 first by using subsidiary and parent sizes in Column (1) and then by all these continuous control variables of interest. In Panel B, we report regression estimates, where we again use the Change in New Hirings or its level 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

	New Hiring Rate	
	(1)	(2)
ATET		
Transmission Treatment Dummy (1 vs. 0)	-0.015**	-0.016***
z-stat	(-2.38)	(-2.61)
N (Observations)	13630	13630
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 New Hirings (t-1)

Panel B: Regression Estimates

	(1) New Hiring Rate	(2) New Hiring Rate
Transmission Treatment Dummy	-0.017***	-0.022***
	(0.002)	(0.001)
Subsidiary Size (t-1)		-0.001
		(0.822)
Parent Size (t-1)		0.006
		(0.149)
Parent Cash Flow (t-1)		0.062
		(0.349)
Subsidiary Empl. Growth (t-1)		-0.962***
		(0.000)
Fixed Effects	Match pair	Match pair
N (Observations)	12284	12284
R^2	0.502	0.515
N (Firms)	5068	5068
N (Clusters/Parents)	1053	1053

Table OA-3 – 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. 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. We report regression estimates with *p-values* in parentheses, where we again use the Change in Subsidiary Investment or the Change in Subsidiary New Hirings. 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) Change in Subsidiary Investment	(2) Change in Subsidiary Investment	(3) Change in Subsidiary New Hirings	(4) Change in Subsidiary New Hirings
Transmission Treatment Dummy	-0.004*	-0.007***	-0.013**	-0.022***
	(0.089)	(0.001)	(0.023)	(0.001)
Subsidiary Size (t-1)		0.001		-0.001
		(0.798)		(0.802)
Parent Size (t-1)		-0.000		0.006
		(0.728)		(0.167)
Parent Cash Flow (t-1)		0.030		0.062
		(0.145)		(0.322)
Subsidiary Investment/ Empl. Growth (t-1)		-0.649***		-0.962***
		(0.000)		(0.000)
N (Observations)	13804	13804	12284	12284
R^2	0.511	0.654	0.502	0.738
N (Firms)	5713	5713	5068	5068
N (Clusters/Parents)	41	41	39	39

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)

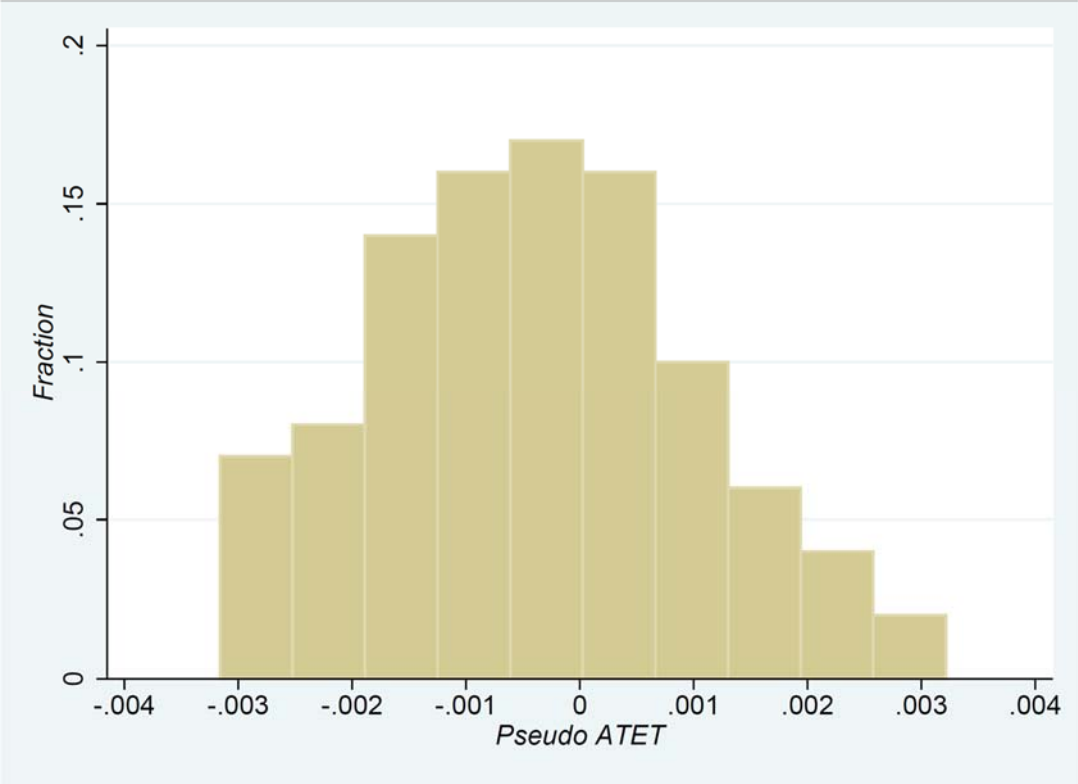

Fig. OA-1b Investment Growth – Regression Estimate based on Table 3B, Column (2)

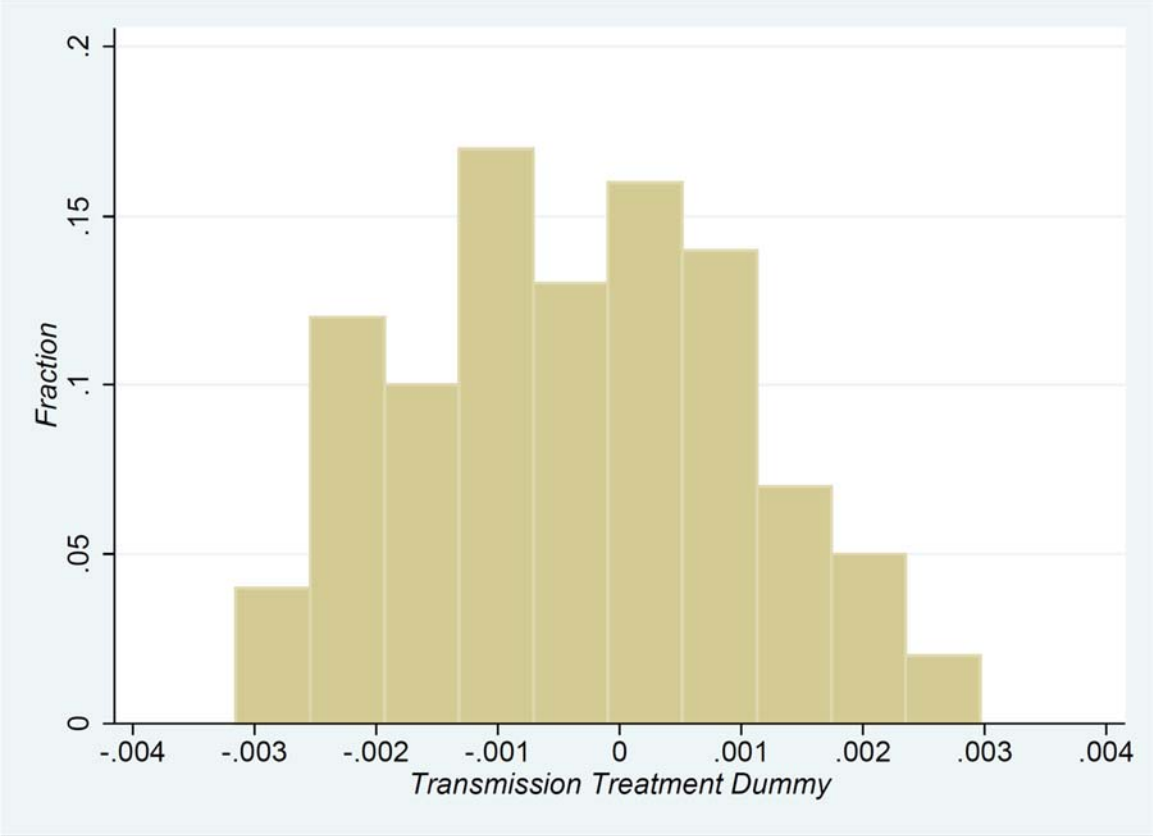

Fig. OA-1c Change in New Hirings – Matching Estimate based on Table 5A, Column (2)

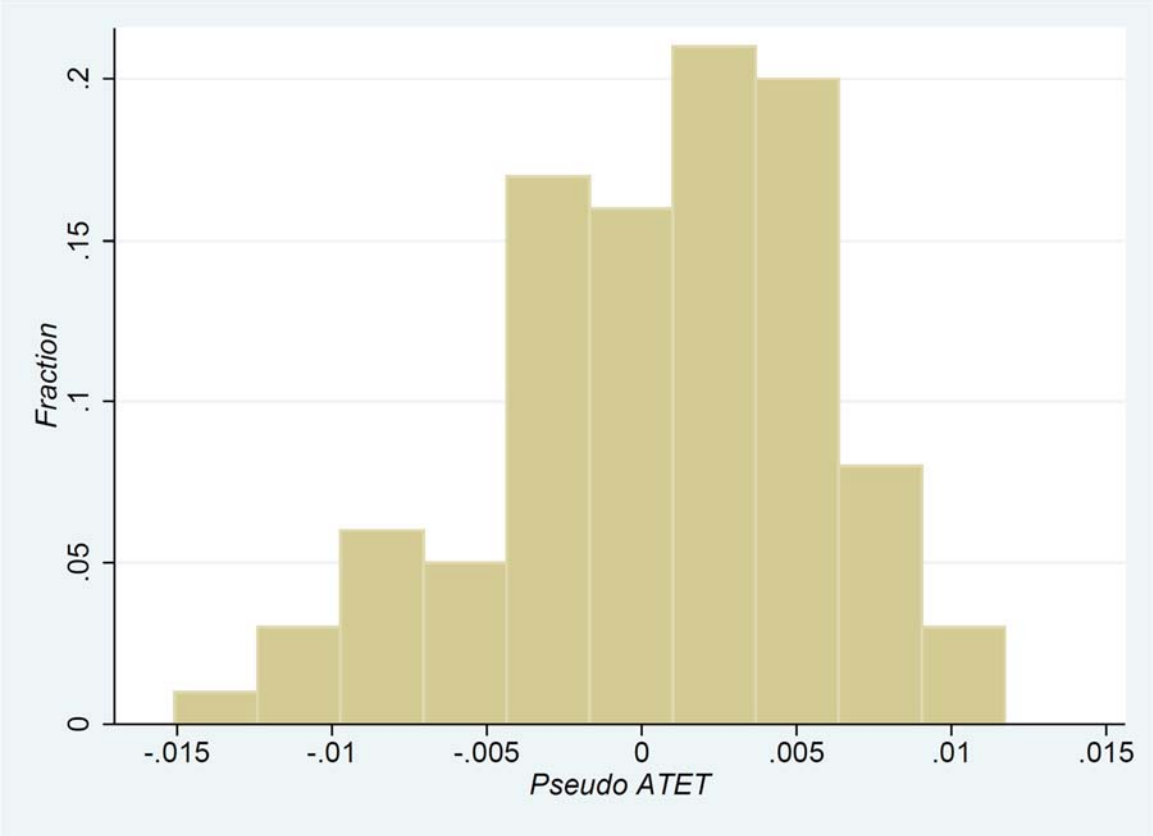

Fig. OA-1d Change in New Hirings – Regression Estimate based on Table 5B, Column (2)