Scarring and Cleansing Effect of Crises in Chile

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Abstract

This paper studies the role of productivity on determining which plants exit during the last two crises in the Chilean economy. Using data on manufacturing plants from 1995 to 2011, I find that the process of less efficient plants exiting accentuated during the Asian Crisis. This accentuation is called cleansing effect, which is what creative-destruction theories would predict during an economic downturn. However, I find that during the Great Recession in Chile this process attenuated, i.e. productivity is less important in determining which plants exit the market. The mechanism behind this attenuation is the exposition to international competition faced by sectors. To further understand this, I use Customs data to get indirect evidence to support the idea that sectors more vulnerable also had trade partners that shrunk the most their international demand, and hence were more severely affected by the crisis, so more likely to exit.

Keywords: Cleansing Effect, Scarring Effect, Chile, Asian Crisis, Great Recession

JEL Code: D22, E24, E32, G01, O47

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1 INTRODUCTION

Crises may hamper economies in a variety of ways, such as pushing firms out of the market or creating job losses. However, there might be some mechanisms that can compensate, mainly in the long run, the damage a crisis does to the economy. The usual rationale is that a greater proportion of less productive firms exit, hence the aggregate level of productivity may even rise after a recession. This idea comes, initially, from Schumpeter (1939) who posits the concept of *creative-destruction* as an engine of growth in capitalist economies. Nonetheless, exiting businesses may not necessarily be the less efficient, and this may be due to other mechanisms that play a more active role during recessions, such as market imperfections (e.g. financial constraints) or certain firm characteristics (e.g. export intensity).

The effect of productivity on *deciding* which plants exit and which do not can be interpreted as a *selection process*. When this process accentuates, we observe crises with a *cleansing* effect as the market "gets cleansed" of the least efficient plants, and it might even be observed an increase in aggregate productivity. However, if this process attenuates, we observe crises with a *scarring* effect as the economy is also damaged in the long-run in the aftermath of the crisis. This is given by the fact that not necessarily the most efficient plants are staying in the market. In this later scenario is critical to question what is explaining the exit of establishments.

During the past 20 years, Chile has experienced two crises: the Asian Crisis and the Great Recession. Although, both were international in nature, lasted similar spans of time and affected the Chilean economy similarly (in terms of real GDP growth), they had different implications. The Asian Crisis was mainly a local crisis that affected part of Asia and a handful of countries outside Asia, whereas the Great Recession has been the deepest downturn since the Great Depression, and it has affected almost every country in the world. Additionally, it has been accompanied, either as a cause or as a consequence, by a credit crunch and a trade collapse.[1]

[1] See Iyer, Peydró, da Rocha-Lopes, and Schoar (2014) or Nguyen and Qian (2014) for evidence of the credit crunch in Portugal and Europe, respectively. And see Baldwin (2009) for a revision of the trade collapse around the world.

I assess to what extent, if any, the effects mentioned above are present during the Asian Crisis and the Great Recession in Chile. If one of the crises is *cleansing*, it is good news as that is what is expected under normal functioning of the market or economy. However, if any of them is *scarring*, it is necessary to address the reasons or mechanisms driving the exits, and ultimately, the dynamics in productivity. Thus, if the latter is true, two alternative reasons for it are explored. First, a crisis may restrict or worsen the access to financing, and if within the sectors more subject to external financing, the firms exiting are not necessarily exiting, then this could explain the effect. Secondly, a crisis may affect establishments through their exposition to international competition, given that sectors more vulnerable can be associated with higher levels of productivity as non-exporters usually perform below exporters.[2]

In order to approach these issues, a data panel of Chilean manufacturing plants from 1995 to 2011 is utilized, which is very useful as it has vast and detailed information on plants. Moreover, the time span allows to compare both crises with the same database, and with most plants participating on both events. The empirical strategy permits to identify the Asian Crisis as one where the selection process deepens as it makes inefficient plants more likely to exit the market, i.e. cleansing effect is present. It also allows to find that during the Great Recession, the selection process weakens as inefficient plants are now less susceptible to leave, i.e. scarring effect is present. This can be proposed as a mean for the significant drop in productivity, that has already been documented for the case of Chile in 2009.[3]

The reason lying behind comes from the exposition to international competition. Sectors that tend to export larger shares of their production are the ones where the scarring effect concentrates. Namely, in those sectors there are plants that exit relatively more productive that the ones exiting in other years. In order to better understand this, I use Customs data to get indirect evidence of what is happening. I find that sectors more exposed to international trade are the

[2]For example, see Bernard and Jensen (1999).

[3]See Fuentes and García (2014) and UAI and CORFO (2013) for works with aggregate data on the whole economy and the manufacturing sector as well.

ones more affected, as their trade partners suffer more compared to sectors less vulnerable.

The contribution of this paper is twofold. First, it posits a new mechanism (exposition to international competition) by which firms exit during a crisis and how this can explain productivity dynamics. Second, this study adds to the literature documenting what happens at the firm level during crises, and in particular what has occurred during the last (and even ongoing) major downturn the world economy has experienced since the Great Depression. Specifically, the case of Chile; a small developing country.

2 Related Literature

The theoretical discussion of what happens to firms during the recession starts with Schumpeter (1939), who poses that crises are an opportunity to clean out the market of less efficient businesses. This may suggest the release of resources that can be used for entrants or incumbents, and it is the main rationale of the work in Davis and Haltiwanger (1992), which studies creation and destruction along the cycle. Then, Caballero and Hammour (1994) try to put both together and propound a model to determine if the Schumpeterian premise fulfills, which they coined as a cleansing effect.

Despite this, and up until recently, there were no studies looking at this using microeconomic data. Namely, papers focused on how the relation between productivity and exit compares between a crisis and the rest of the economic cycle. Hallward-Driemeier and Rijkers (2013) study the effect for the Asian Crisis in Indonesia. They define a productivity measure and see how this is related to probability of exit over the cycle. The authors find that the crisis did not have cleansing features as relatively more productive firms closed down. Additionally, when they decompose productivity growth following Foster, Haltiwanger, and Krizan (2001), they find that during this downturn the between component, that captures how more efficient plants gain market power, does not decrease around the crisis. Hence, the dynamics between plants do not play a distinct role during a recession. Similarly, Eslava, Galindo, Hofstetter, and Izquierdo (2011) study the same effect during the same crisis but in Colombia. Again, these authors find that this period is scarring as the selection process attenuates.

One different approach is done by Foster, Grim, and Haltiwanger (2014), who study several downturns from the mid-1970s to 2011 in the United States, and how the relationship between productivity and reallocation fluctuates over time. They identify the Great Recession to differ greatly from other crises where reallocation used to rise and enhance productivity.

Some literature has documented mechanisms that can account for the attenuation effect during a crisis. Hallward-Driemeier and Rijkers (2013) explore financial dependence measured using the calculations from Rajan and Zingales (1998), as plants more reliant on finance should be more affected during the crisis, given that they are more productive and that financing conditions worsen. The authors find this to explain part of what happened in Indonesia. They also propose labor market regulations and connections to the Suharto regime as probable mechanisms. However these variables are found to have no relation to firms exiting. Eslava, Galindo, Hofstetter, and Izquierdo (2011) evaluate the mechanism of credit constraint, which is related to the previous, although these authors use a richer database from a government agency in charge of overseeing large corporations, which is used to measure constraints on an establishment basis, rather than on a sector one. They find that during the Asian crisis, the least productive plants without credit constraints can be as likely to exit as some more productive firms but with credit constraint. Finally, when Foster, Grim, and Haltiwanger (2014) find the Great Recession not to be cleansing, they do not try to find the mechanism behind.

2.1 THE CASE OF CHILE

Although there is no direct study for Chile that investigates the link between productivity and exit at the firm or plant level during crises, there are many studies that shed light on it. Bergoeing and Repetto (2006) study the productivity dynamics between 1980 and 2001 using the same database as in the present paper. They find that between 1997 and 2001 reallocation increases considerably respect to other periods analyzed.

Likewise, Álvarez and Görg (2012) study directly what happens in Asian Crisis regarding to how national and foreign firms respond differently in Chile. The authors find that the latter ones are more likely to exit, but within that group, the surviving ones grow more than the national ones. Finally, there is also documentation about the crisis of 1982, which was the worst since the Great Depression. Liu and Tybout (1996) analyzes continuing and exiting plants in Chile (and Colombia) between 1980 and 1985, and find that there is no relation between productivity and the business cycle in the two groups, and that even exit rates did not increase significantly in 1982.

Similarly, Oberfield (2013) studies productivity and misallocation during the Crisis of 1982. He tries to understand what drove down the productivity around the greatest financial crisis in the Chilean history. To do so, the author measures the misallocation of resources, and finds that the fall is partially explained by a deterioration in allocational efficiency between-industry, where the mechanism is given by the sensitivity to domestic demand, i.e. it is concentrated in sector that produce durable goods and that export less.

3 DATA

The data used comes from the Annual National Industry Survey (ENIA, for its acronym in Spanish) from 1995 to 2011, which is carried out by the National Institute of Statistics (INE, for its acronym in Spanish). The survey contains general characteristics of each establishment, plus information on sales, production, inventories, labor force, capital, material, and other inputs and expenses. This survey is representative for each of the Chilean regions and manufacturing activity, and it is applied to establishments with 10 or more workers (INE, 2013). Therefore, an establishment may not appear either because it was closed, it had less than 10 workers or it did not respond to the survey. In order to overcome this problem, the sample is restricted to plants with 15 or more workers, that sell at least 87,000 US dollars a year.[4] Thus, an exit is flagged as such when the plant appears in year t, but then it does not in year $t+1$.[5] Appendix A shows annual descriptive statistics for the sample.

3.1 PRODUCTIVITY MEASURES

Productivity is difficult to gauge and any measure is subject to different critiques (Van Biesebroeck, 2007). In order to cover all the potential drawbacks, three different measures of productivity are utilized throughout the paper. The first one is labor productivity, which is measured as the logarithm of value added per worker. This measure is less susceptible to measurement error as it does not take into account capital. During the rest of this paper, this productivity measure is denoted by $\ln(V/L)$.

The second measure is the total factor productivity, at the sector level, of the following Cobb-Douglas production function (in logarithm):

$$y_{ijt} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + u_{it} \quad (1)$$

$$\text{with} \quad u_{it} = \omega_{it} + \eta_{it} \quad (2)$$

where y_{it}, l_{it} and k_{it} correspond to value added, labor and capital for plant i in year t, respectively. u_{it} is the total factor productivity that is assumed to have two components: one that is only known by the businessman (ω_{it}) and one that acts as a shock (η_{it}).[6]

Estimating (1) by Least Squares (LS) generates two problems. First, it creates a problem of simultaneity, because one productivity component is only observed by the plant owner or manager (i.e. ω_{it}), and not by the econometrician. So, when there is a positive productivity shock in that component, it is expected a higher use of inputs. Therefore, estimating by LS provides

[4] After a meeting with the INE, it was suggested to work with larger firms where the non-response rate was lower. The threshold corresponds to 2,400 UF, which is a special unit account adjusted to inflation.

[5] Only continuing plants are considered in the sample. Establishments that enter and exit constantly are excluded from the sample as it is even harder to assume that they actually exit.

[6] Materials are not included, because deflators specific at the 3-digit are not longer available by INE.

parameters for (1) that are overestimated as the error term (i.e. the total factor productivity) correlates with the explanatory variables. This effect augments as the inputs are more flexible, so for instance it would be expected to be more severe for β_l than for β_k. One way to correct this is given by Harrison (1994), who includes fixed effect per plant in a panel. This indeed fixes the problem, however it is not reasonable to assume that a plant keeps the same level of productivity for 17 years (1995 to 2011), as it is the case of the sample utilized. Another way is the method used by Liu (1993), where total factor productivity is modeled as a function of time.[7] Once again, this solves the problem, but the loss of degrees of freedom compromises too much the significance of the estimated parameters.

The second issue is the selection bias generated by the firms' exits, their size and productivity. Thus, when negative productivity shocks occur, larger firms (i.e. with more capital) can withstand better than smaller ones, and hence they have less chances to exit. Therefore, negative productivity shocks are more associated with large firms, which leads to a negative correlation between the error term and the capital variable. Incidentally, LS method delivers an underestimation of the parameter associated with capital. However, the usage of Olley and Pakes (1996), and Levinsohn and Petrin (2003) methodologies overcome the two problems mentioned above.[8,9] During the rest of this paper, this productivity measure is denoted by TFP_{OP}.

Value added and capital are deflated using IPM (which is the Spanish acronym for Wholesaler Price Index) series at the 3-digit. INE constructed IPM series until 2009, so it was necessary to splice them with a different series until 2011. For this purpose IPP series (which is the Spanish acronym for Producer Price Index) were joined following INE (2013).

The third measure is also the total factor productivity at a sector level from (1). In this case I follow Oberfield (2013) and assume constant returns to scale with $\overline{\alpha} := \beta_k = 0.45$, and without heterogeneity among sectors. This does not resolve the problem of deflators or measurement

[7]Specifically, the authors establish the functional form: $TFP_{it} = \alpha_{1i} + \alpha_{2i}t + \alpha_{3i}t^2$.
[8]More technical details are contained in Appendix B.
[9]Production functions as a result of this procedure can be found in Appendix C.

error of capital that are also present in the previous measure. However, it does not rely on all the assumptions in Olley and Pakes (1996) and Levinsohn and Petrin (2003), such as the invertibility of the profit function. During the rest of this paper, this productivity measure is denoted by $TFP_{\overline{\alpha}}$.

3.2 CRISES IN CHILE

Crises are broadly defined as a year when there is annual negative GDP growth and at least one quarter with negative growth. These years correspond to 1998 and 1999 for the Asian Crisis and to 2008 and 2009 for the Great Recession. Alternative criteria could be used in order to define a year as one with crisis. For instance, to also consider the variation in the manufacturing sector. In this case, the only year that did not have negative growth in the manufacturing sector is 2008.

It is worth mentioning that using the variation in the manufacturing sector is not necessarily a good approach as it is less exogenous given that it contains the exit of establishments. Unfortunately and given the data limitation, there is no other way of capturing the shocks if it is not by assuming that the shock is homogeneous to all plants and that it occurs during the whole year.

4 EMPIRICAL STRATEGY

The first stage of the empirical approach consists on identifying the sources of productivity variations. For instance, to know whether they come from within the plants or from their interaction, i.e. between them; or if it is due to the entrance of more productive producers or the exit of less efficient units. Thus, I use the novel decomposition by Melitz and Polanec (2016) which extends the one done initially by Olley and Pakes (1996), as it includes entrants and exiters. The decomposition is as follows:[10]

$$\Delta P_t = \underbrace{\overline{P}^S_t - \overline{P}^S_{t-1}}_{Within} + \underbrace{\sum_{i \in S} \Delta(\theta^S_{it} - \overline{\theta}^S_t)(p_{it} - \overline{P}^S_t)}_{Between} + \underbrace{\theta^E_t(\overline{P}^E_t - \overline{P}^S_t)}_{Entry} + \underbrace{\theta^X_{t-1}(\overline{P}^S_{t-1} - \overline{P}^X_{t-1})}_{Exit}. \quad (3)$$

where p_{it} is the productivity measure, $\overline{P}^j_t$ the unweighted productivity average for each jth group, with $j = \{S, E, X\}$ standing for survivors, entrants and exiters, respectively. The same applies for $\overline{\theta}^j_t$ which is the average of the participation within each group, i.e. $\overline{\theta}^j_t = \frac{1}{n_j}\sum_{i \in j} \theta^j_{it}$, where $\theta^j_{it} = \theta_{it}/\sum_{i \in j} \theta_{it}$, and θ_{it} is the share of year production or labor within a year across all producers.

It is noteworthy, as it happens with other decompositions,[11] that rises in productivity may come from *Within* plants as they get more efficient themselves; from *Between* them as the most (least) productive are also the ones that grow more (less); from the *Entry* of establishments given they are more efficient than the relevant average; and from the *Exit* of plants given they are less productive than the average. Thus, if a crisis has Schumpeterian characteristics, we should observe a higher relative importance of the Between and Exit components.

The second stage is carried out in order to know which effect prevailed during each crisis. Namely, to test how exit and productivity varied during the crisis years. To assess this, the following linear probability model is estimated:

$$z_{ijt} = \alpha p_{ijt} + \sum_{\tau \in \Omega} \beta_\tau p_{ijt} \times d^\tau_t + \gamma W_{ijt} + \delta_t + \mu_j + \varepsilon_{ijt} \quad (4)$$

where z_{ijt} flags the exit and hence it takes the value of 1 if establishment i in sector j is in year t, but not in year $t+1$; p_{ijt} is any of the productivity measures explained in Section 3; Ω are the

[10] It resembles Olley and Pakes (1996) decomposition which is give by: $P_t = \overline{P}_t + \sum_i \Delta\theta_i t \Delta p_{it}$, where $\Delta x_{it} = x_{it} - \overline{X}_t$ and $\overline{X}_t$ is unweighted average of x_{it}'s.

[11] See Foster, Haltiwanger, and Krizan (2001) for alternative decompositions.

set of crisis years[12], d_t^τ takes the value of one if $\tau = t$ and W_{ijt} are controls such as the size of the plant, age and foreign ownership.[13] δ_t and μ_j are year and sector fixed effects.

Crisis in year τ is *cleansing* if $\widehat{\beta}_\tau < 0$ as less efficient plants are more likely to exit during year τ compared to other non-crisis years. Conversely, a crisis in year τ is *scarring* if $\widehat{\beta}_\tau > 0$ as more productive plants are more likely to exit during that year compared to other non-crisis periods.

To better understand this, consider that productivity is the key variable in the *selection process* of whether a plant survives or not, and the mechanics is as expected: higher productivity increases the chances of being *selected* to survive. During a recession, this incidence can increase (cleansing effect), decrease (scarring effect) or stay the same. However, under any of those scenarios the mechanics maintains, but not necessarily its intensity. Econometrically, a cleansing effect corresponds to:

$$\left.\frac{\partial z_{ijt}}{\partial p_{ijt}}\right|_{t \text{ is Crisis}} < \left.\frac{\partial z_{ijt}}{\partial p_{ijt}}\right|_{t \text{ is No Crisis}} < 0, \tag{5}$$

and a scarring effect to:

$$\left.\frac{\partial z_{ijt}}{\partial p_{ijt}}\right|_{t \text{ is No Crisis}} < \left.\frac{\partial z_{ijt}}{\partial p_{ijt}}\right|_{t \text{ is Crisis}} < 0. \tag{6}$$

5 PRODUCTIVITY DYNAMICS

The estimation method described in Section 3 and Appendix B can be joined to see how productivity evolves over the years. Figure 1 shows the productivity dynamics for labor productivity.[14] It starts growing fairly steep until 1999; from then and up to 2004 there is a slight reduction in the slope, plus a small drop in 2005. After that, it grows again until 2008, when it drops

[12]In the baseline scenario there are four years (1998, 1999, 2008 and 20098), which means that there are four interaction terms.

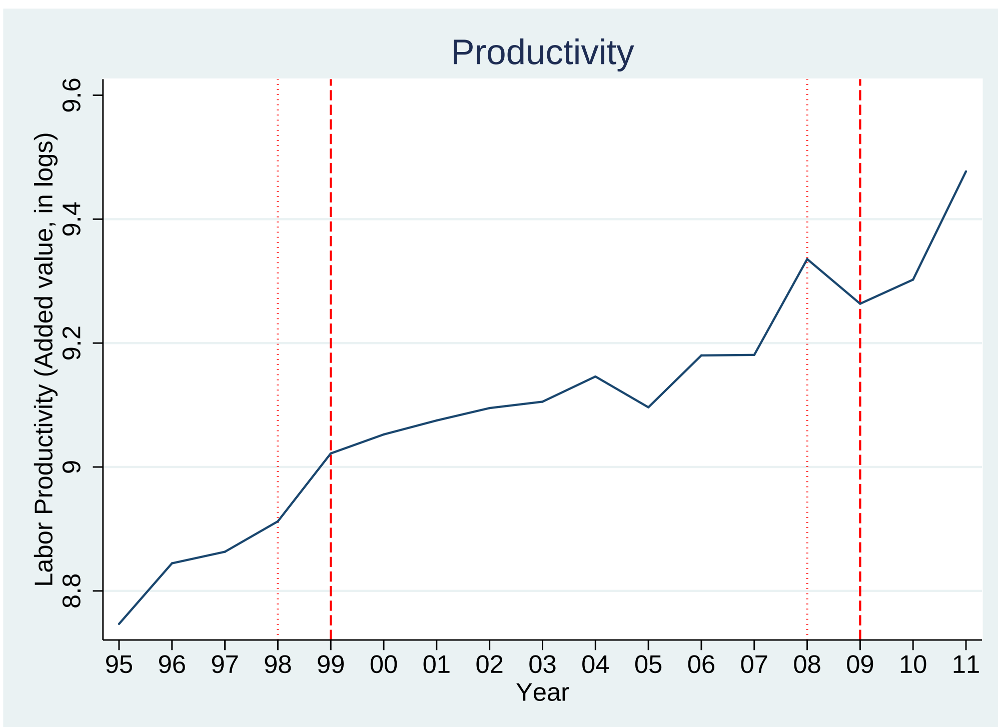
[13]We follow Hallward-Driemeier and Rijkers (2013) and Bernard and Jensen (2007) to select these covariates.

[14]Appendix D.1 shows the dynamics for both TFP measures, OP and $\beta_k = 0.45$, as well as Figure 1 measured as an index.

substantially. It then recovers in 2010 and 2011. This pattern has already been documented in the literature for the case of Chile.[15] The vertical lines represent crisis periods. The dotted-line is a year with one quarter of negative GDP growth, and the discontinuous-line is a year with negative GDP growth.

Productivity grows 4.56 on average (see Table 2), with 2005 and 2009 as the only drops in productivity. The largest of these two is during the Great Recession where from 2008 to 2009, it falls 7 percent, which is close to the 5 percent documented in UAI and CORFO (2013) for the manufacturing sector using aggregate data.

Figure 1: Productivity Evolution



For the question this paper studies, it is necessary to see how does this dynamic behaves for plants staying compared to plants exiting the economy. Figure 2 illustrates this, where it can be seen that exiters are consistently less productive than stayers for every year. Having a closer

[15] See Fuentes and García (2014) and UAI and CORFO (2013) for works with aggregate data on the whole economy and the manufacturing sector as well.

look at what happens during recessions, it can be seen that in 1998 the average productivity of exiters is lower than in 1997, but the average productivity of stayers is higher. This suggests that a cleansing process is characterizing part of this crisis. Conversely, in 2009, average productivity grows for exiters and drops for stayers. This means that exiters are more productive that the previous year, but also that the ones staying are less productive in the previous year too. This suggests a scarring effect, because even though the plants exiting are less productive, this *selection* process seems to be milder in the sense that it now selects establishments that would have not closed in other periods. This is consistent with Figure 1 as it seems the drop in productivity can be potentially explained by the exit of some efficient units.

Another way of looking at this stems from Table 1 that shows from which quintiles the exiters come from. As it is expected, in general, there are more firms exiting from lower quintiles of productivity compared to higher ones. However, for 2009 this has some sort of reversion with Q1 having the least share among all years, and Q5 having the highest. When analyzing 1998, 1999 or 2008, it can be observed that even though they are also crisis years, there is no such pattern as it happened in 2009.

Figure 2: Average productivity of firms staying and exiting

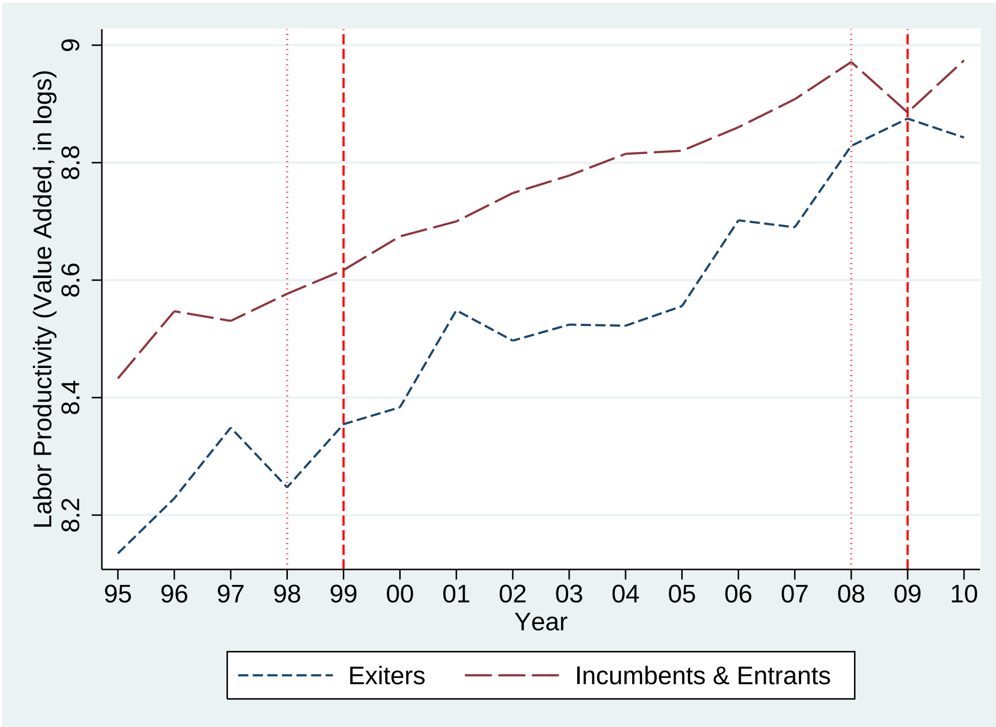


Table 1: Origin of exiters by quintiles

	Q1	Q2	Q3	Q4	Q5
1995	30.6	20.8	13.0	20.8	14.8
1996	32.1	19.5	17.0	17.0	14.5
1997	28.4	17.1	15.8	18.9	19.7
1998	33.4	16.9	18.5	18.2	13.1
1999	28.7	22.0	15.2	18.0	16.2
2000	29.8	19.1	22.1	14.0	14.9
2001	26.1	20.9	14.2	18.0	20.9
2002	33.0	18.7	16.1	15.2	17.0
2003	26.9	19.4	22.5	16.3	15.0
2004	27.8	21.8	23.5	13.2	13.7
2005	28.9	20.6	21.1	16.7	12.7
2006	28.8	19.8	18.5	15.8	17.1
2007	27.3	20.0	16.3	20.8	15.5
2008	22.6	19.3	20.4	20.0	17.8
2009	23.8	17.2	18.8	19.2	21.1
2010	25.4	18.4	20.3	16.4	19.6

6 RESULTS

6.1 PRODUCTIVITY GROWTH DECOMPOSITION

Table 2 displays the figures for the growth decomposition explained above. The exit term is positive for every year, which means that exiters are always below survivors in terms of their productivity. In year 1999, it can be noted that the between term is high and that it explains more than half of the productivity growth in that year. The exit component is also high and it explains approximately a third of the growth. Both components are above the sample average, although not the highest. Once again, this indicates that the Asian Crisis is characterized by a cleansing effect.

Looking at the years during the Great Recession, it can be seen that 2008 does not seem to be very different to the rest of the years, apart from the fact that the exit component is below the average. The large drop in 2009 seems to be driven mainly by lower productivity within the plants. However, the between component is negative, which is the contrary of what is expected to happen during a crisis, as it means that most (least) productive units have obtained less (more) market share. Again, the exit component does not have more importance as it is expected to be if the crisis is characterized by a scarring effect.

Table 2: Productivity Growth Decomposition (in percentage)

	Within	Between	Entry	Exit	Growth
1996	11.80	-0.60	-3.40	1.99	9.78
1997	-3.30	3.08	-0.57	2.65	1.86
1998	1.13	0.96	0.14	2.67	4.91
1999	2.46	5.69	-0.83	3.65	10.96
2000	2.90	-3.55	0.24	3.48	3.06
2001	0.70	1.36	0.05	0.14	2.26
2002	2.74	0.19	-2.88	1.96	2.00
2003	0.68	0.12	-2.50	2.73	1.03
2004	0.04	2.72	-0.71	2.01	4.06
2005	-2.02	-6.64	-1.17	4.86	-4.97
2006	2.78	5.91	-0.69	0.37	8.37
2007	1.89	-3.66	0.18	1.67	0.08
2008	3.98	12.17	-2.48	1.80	15.47
2009	-8.76	-1.39	0.58	2.36	-7.21
2010	5.91	-2.10	-0.28	0.36	3.89
2011	10.79	3.27	-2.75	6.17	17.47
Average	2.11	1.10	-1.07	2.43	4.56

6.2 MAIN RESULTS

Table 3 shows the main results for the specification in (4). There are three pairs of columns, each pair for each productivity measure. Each calculated productivity is estimated with and without controls. Analyzing the first year of the Asian Crisis, it can be noted that the *selection process* is stronger now, as the effect that productivity has on the exit likelihood in 1998 is now 1.2 points higher (in absolute terms) (1.0 points if we consider TFP_{OP} and 2.1 points if we use $TFP_{\overline{\alpha}}$). The sign and even the magnitude are very close when I exclude the controls. In 1999, this effect is still negative, but not significant, i.e. plants do not change their relation between productivity and likelihood of exiting during this year.

The opposite happens during the Great Recession. Even though during 2008 the interaction term is not significant, it is positive under five of the six columns displayed. In 2009, the effect is 2.2 points smaller (in absolute terms) (0.9 points if we consider TFP_{OP}). This finding implies the presence of a scarring effect during the Great Recession, which is consistent with what was shown in the previous section regarding the productivity and exit dynamics.

Table 3: Main Results using a Linear Probability Model

	(1) Exit	(2) Exit	(3) Exit	(4) Exit	(5) Exit	(6) Exit
Year98 $\times \ln(V/L)$	-0.0120**	-0.0131**				
	(-1.97)	(-2.15)				
Year99 $\times \ln(V/L)$	-0.00456	-0.00588				
	(-0.75)	(-0.96)				
Year08 $\times \ln(V/L)$	0.00717	0.00854				
	(1.15)	(1.36)				
Year09 $\times \ln(V/L)$	0.0218***	0.0225***				
	(2.98)	(3.05)				
Year98 $\times TFP_{OP}$			-0.0103**	-0.0111**		
			(-2.16)	(-2.32)		
Year99 $\times TFP_{OP}$			0.00191	0.00124		
			(0.40)	(0.26)		
Year08 $\times TFP_{OP}$			-0.00000449	0.000415		
			(-0.00)	(0.09)		
Year09 $\times TFP_{OP}$			0.00909*	0.00905*		
			(1.89)	(1.88)		
Year98 $\times TFP_{\overline{\alpha}}$					-0.0208**	-0.0245***
					(-2.35)	(-2.76)
Year99 $\times TFP_{\overline{\alpha}}$					-0.0117	-0.0152*
					(-1.34)	(-1.72)
Year08 $\times TFP_{\overline{\alpha}}$					0.0102	0.0139
					(1.13)	(1.52)
Year09 $\times TFP_{\overline{\alpha}}$					0.0145	0.0173*
					(1.62)	(1.93)
Size	-0.0181***		-0.0156***		-0.0199***	
	(-12.24)		(-10.05)		(-13.96)	
Foreign	0.0153***		0.0102*		0.00876*	
	(2.91)		(1.95)		(1.70)	
Age	-0.00591***		-0.00603***		-0.00610***	
	(-12.20)		(-12.43)		(-12.53)	
Observations	48025	48025	46592	46592	46592	46592

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < 0.01$

The results for the two crises are both in line with what I have documented in the previous sections and sizable, in terms of how important they are compared to the baseline effect. To see this, Table 4 displays the marginal effects for the productivity measures of the same six columns of Table 3. The first column shows that the baseline effect in any period without crisis is -0.0196, i.e. a one-percent increase in productivity reduces the likelihood of exit by 1.96% (or 1.8% if we take any of the TFP measures). The next row has the marginal effect of productivity in 1998, which in the first column is 3.16%. This is 1.2 points higher (in absolute terms) compared to a non-crisis period.[16] Namely, the role played by productivity in *selecting* units to exit the economy is 61% (=1.20/1.96) higher in 1998. Something similar happens in year 1999, however this is not significant.

The fourth and fifth rows display the final effect during the years of the Great Recession. In the first column it can be observed that effects in year 2008 and 2009 are both smaller in absolute terms. This is a direct consequence of the last two interaction terms in Table 3. In 2008, the effect is still negative and significant, i.e. a one-percent increase in productivity diminishes the chances of exiting the economy by 1.24% (or 1.74% when using TFP_{OP} and 0.81% when using $TFP_{\overline{\alpha}}$). One year after, the effect is no longer significant and not even negative. The incidence played in 2009 on determining which plants were to exit is none, or in the best scenario very modestly. Column 3 is the exception if we only consider specifications with controls.

[16]Given the linearity of the model, this 1.2 figure is the same as the interaction coefficient in Table 3.

Table 4: Marginal Effects for the main equation

	(1) Exit	(2) Exit	(3) Exit	(4) Exit	(5) Exit	(6) Exit
Productivity						
No Crisis	-0.0196***	-0.0244***	-0.0175***	-0.0244***	-0.0183***	-0.0181***
	(-9.28)	(-12.03)	(-7.54)	(-11.43)	(-7.12)	(-7.01)
Year 98	-0.0316***	-0.0375***	-0.0278***	-0.0355***	-0.0391***	-0.0426***
	(-5.25)	(-6.27)	(-5.58)	(-7.24)	(-4.56)	(-4.96)
Year 99	-0.0242***	-0.0303***	-0.0156***	-0.0231***	-0.0300***	-0.0333***
	(-4.02)	(-5.05)	(-3.13)	(-4.70)	(-3.52)	(-3.89)
Year 08	-0.0124**	-0.0158***	-0.0175***	-0.0240***	-0.00810	-0.00421
	(-2.02)	(-2.58)	(-3.57)	(-4.97)	(-0.93)	(-0.47)
Year 09	0.00219	-0.00187	-0.00842*	-0.0153***	-0.00382	-0.000856
	(0.30)	(-0.26)	(-1.68)	(-3.13)	(-0.44)	(-0.10)
N	48025	48025	46592	46592	46592	46592

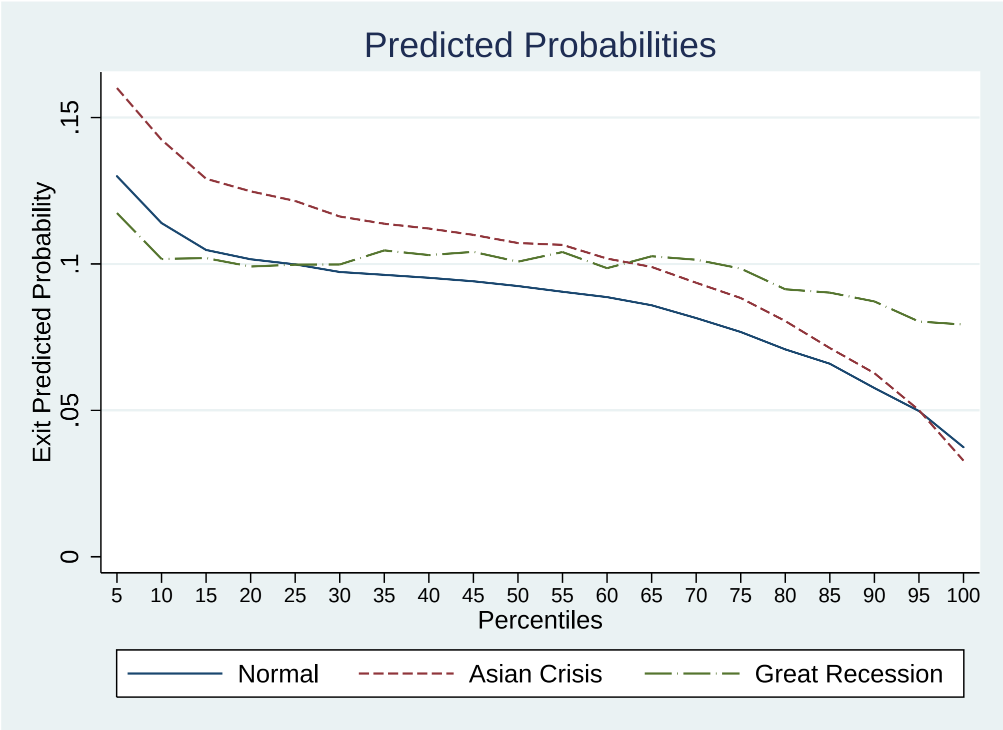
t statistics in parentheses
* $p < .10$, ** $p < .05$, *** $p < 0.01$

In order to have a better interpretation of the results, Figure 3 shows the predicted probabilities of exit for any given percentile of productivity. On average, a plant that belongs to the percentile 25 of productivity (where percentile 100 is the most efficient cluster) has a predicted probability of 10%. In the Asian Crisis, this probability increases to 12%. More interestingly, this difference narrows as productivity grows and at the last percentiles, there is even a slight reversion. This once again supports the idea of a cleansing effect. The negative effect of a crisis increases with productivity, and at the extreme there can even be an improvement.

Despite this, it does not happen the same during the Great Recession. The plants in the percentile 25 now have the same chances they have at any other year without crises. Actually, the likelihood has dropped for some of the least productive firms. The relation between likelihood and productivity is now less clear, although negative. Before, the higher the productivity, the least the plant was affected by the downturn, in comparison to the baseline situation (i.e. initial predicted probability). Now, the higher the productivity, the most the plant is affected, as the wider the gap between the baseline years and the years in the Great Recession is.[17]

[17] Appendix D.2 contains the same graphs when using TFP measures of productivity.

Figure 3: Predicted probabilities according to period and productivity



The following section aims at checking if the results above are not driven by the specification and variables used up to this point.

6.3 ROBUSTNESS CHECKS

The first robustness exercise is to reestimate (4) replacing the left-hand side by $\Phi(z_{ijt})$ and thus estimate a Probit model. So far it has only been considered a linear probability model, given that the specification in (4) is improved if a dichotomic dependent variable model (such as Probit or Logit) is considered. However, the use of fixed effects brings in the incidental parameters problem (Lancaster, 2000) that generates biased standard errors.[18] Despite this, Table 5 displays the results under this new specification. The three columns vary only according to the productivity measure considered. The magnitude and level of significance has now changed, but the results

[18]The econometric literature has already dealt with this problem using a bias correction developed by Fernández-Val (2009).

from last section hold.

The second exercise concerns what we understand by productivity. Up to this point, three measures have been considered to account for this. Additionally, I now reestimate (4) replacing contemporaneous productivity by one- and two-period lagged productivity. The aim is to solve the problems such as labor hoarding or future expectations the firms may have with regards to the crisis, because in both cases, plants can hire more (less) workers or buy more (less) inputs, and make themselves artificially less (more) productive. Hence, biasing the measure of a more intrinsic productivity. Tables 6 and 7 present these results.

Again, columns in both tables only differ by the relevant productivity measure utilized. Table 6 improves the significance in 2009 for the Great Recession, even though the magnitudes change slightly. It has a worst fit for 1998 as it is no longer significant when using $TFP_{\overline{\alpha}}$. Table 7 improves the fit overall, but mainly for the Great Recession. This is despite that the number of observations diminishes considerably. The improvement is no surprise, in the sense that is a more exogenous measure and therefore it is a better indication of the *true* productivity of the establishment.

Table 5: Main Results using a Probit Model

	(1) Exit	(2) Exit	(3) Exit
Year98 $\times \ln(V/L)$	-0.0709*		
	(-1.68)		
Year99 $\times \ln(V/L)$	-0.0126		
	(-0.33)		
Year08 $\times \ln(V/L)$	0.0452		
	(1.13)		
Year09 $\times \ln(V/L)$	0.141***		
	(3.33)		
Year98 $\times TFP_{OP}$		-0.0616*	
		(-1.91)	
Year99 $\times TFP_{OP}$		0.0244	
		(0.84)	
Year08 $\times TFP_{OP}$		-0.00404	
		(-0.13)	
Year09 $\times TFP_{OP}$		0.0592*	
		(1.83)	
Year98 $\times TFP_{\overline{\alpha}}$			-0.113**
			(-2.06)
Year99 $\times TFP_{\overline{\alpha}}$			-0.0493
			(-0.99)
Year08 $\times TFP_{\overline{\alpha}}$			0.0600
			(1.14)
Year09 $\times TFP_{\overline{\alpha}}$			0.0923*
			(1.69)
Size	-0.121***	-0.106***	-0.133***
	(-12.26)	(-10.23)	(-13.49)
Foreign	0.0951***	0.0607*	0.0507
	(2.65)	(1.65)	(1.40)
Age	-0.0328***	-0.0347***	-0.0351***
	(-12.87)	(-13.15)	(-13.25)
Observations	48025	46592	46592

t statistics in parentheses
* $p < .10$, ** $p < .05$, *** $p < 0.01$

Table 6: Results using One-Period Lagged Productivity

	(1) Exit	(2) Exit	(3) Exit
Year98 × $\ln(V_{t-1}/L_{t-1})$	-0.0106*		
	(-1.65)		
Year99 × $\ln(V_{t-1}/L_{t-1})$	-0.00684		
	(-1.08)		
Year08 × $\ln(V_{t-1}/L_{t-1})$	0.00939		
	(1.53)		
Year09 × $\ln(V_{t-1}/L_{t-1})$	0.0172**		
	(2.42)		
Year98 × $TFP_{OP,t-1}$		-0.0118**	
		(-2.31)	
Year99 × $TFP_{OP,t-1}$		0.000512	
		(0.10)	
Year08 × $TFP_{OP,t-1}$		-0.000111	
		(-0.02)	
Year09 × $TFP_{OP,t-1}$		0.0107**	
		(2.13)	
Year98 × $TFP_{\overline{\alpha},t-1}$			-0.0152
			(-1.60)
Year99 × $TFP_{\overline{\alpha},t-1}$			-0.00983
			(-1.08)
Year08 × $TFP_{\overline{\alpha},t-1}$			0.00891
			(1.01)
Year09 × $TFP_{\overline{\alpha},t-1}$			0.0224**
			(2.44)
Size	-0.0213***	-0.0203***	-0.0235***
	(-13.29)	(-11.92)	(-15.18)
Foreign	0.0183***	0.0130**	0.0130**
	(3.15)	(2.25)	(2.28)
Age	-0.00499***	-0.00516***	-0.00526***
	(-9.10)	(-9.34)	(-9.49)
Observations	41416	40304	40296

t statistics in parentheses
* $p < .10$, ** $p < .05$, *** $p < 0.01$

Table 7: Results using Two-Period Lagged Productivity

	(1) Exit	(2) Exit	(3) Exit
Year98 × $\ln(V_{t-2}/L_{t-2})$	-0.0119*		
	(-1.85)		
Year99 × $\ln(V_{t-2}/L_{t-2})$	0.000520		
	(0.08)		
Year08 × $\ln(V_{t-2}/L_{t-2})$	0.00650		
	(1.09)		
Year09 × $\ln(V_{t-2}/L_{t-2})$	0.0279***		
	(3.90)		
Year98 × $TFP_{t-2,OP}$		-0.00931*	
		(-1.86)	
Year99 × $TFP_{t-2,OP}$		0.00289	
		(0.54)	
Year08 × $TFP_{t-2,OP}$		-0.000300	
		(-0.06)	
Year09 × $TFP_{t-2,OP}$		0.0128**	
		(2.51)	
Year98 × $TFP_{t-2,\overline{\alpha}}$			-0.0155*
			(-1.70)
Year99 × $TFP_{t-2,\overline{\alpha}}$			0.00681
			(0.72)
Year08 × $TFP_{t-2,\overline{\alpha}}$			0.00695
			(0.78)
Year09 × $TFP_{t-2,\overline{\alpha}}$			0.0287***
			(2.98)
Size	-0.0228***	-0.0223***	-0.0241***
	(-13.17)	(-12.10)	(-14.53)
Foreign	0.0178***	0.0149**	0.0149**
	(2.87)	(2.40)	(2.45)
Age	-0.00457***	-0.00444***	-0.00464***
	(-7.17)	(-6.92)	(-7.19)
Observations	35525	34597	34603

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < 0.01$

The final robustness check has to do with the role played by controls and interactions. First, the variable age is proxied by how many years the establishment has continuously been in the sample.[19] This is, of course, an imperfect measure. Therefore, we reestimate (4) without the age variable. Column 1 in Table 8 shows that the results associated to the interaction terms are maintained. Second, I consider two variables which are proposed by Hallward-Driemeier and Rijkers (2013) to check the strength of the results. These are capital intensity and export status. Capital Intensity is measure by $\log(K/L)$ and Export status by a dummy variable. The results using these two variables are displayed in columns 2 and 3 in Table 8. In column 4, all variables are put together. These modifications bear the same conclusions as the main results.[20]

Table 8: Results using different controls (Labor Productivity)

	(1) Exit	(2) Exit	(3) Exit	(4) Exit
Year98 $\times \ln(V/L)$	-0.0124**	-0.0114*	-0.0120**	-0.0114*
	(-2.04)	(-1.84)	(-1.97)	(-1.84)
Year99 $\times \ln(V/L)$	-0.00529	-0.00718	-0.00457	-0.00718
	(-0.87)	(-1.18)	(-0.75)	(-1.18)
Year08 $\times \ln(V/L)$	0.00893	0.00614	0.00717	0.00615
	(1.43)	(0.99)	(1.15)	(0.99)
Year09 $\times \ln(V/L)$	0.0233***	0.0246***	0.0218***	0.0246***
	(3.18)	(3.40)	(2.98)	(3.40)
Size	-0.0204***	-0.0183***	-0.0180***	-0.0181***
	(-13.95)	(-12.03)	(-11.18)	(-11.04)
Foreign	0.0163***	0.0146***	0.0154***	0.0149***
	(3.09)	(2.74)	(2.92)	(2.78)
Age		-0.00607***	-0.00591***	-0.00607***
		(-12.44)	(-12.21)	(-12.44)
Capital Intensity		0.00359**		0.00362**
		(2.56)		(2.57)
Export			-0.000488	-0.00137
			(-0.14)	(-0.39)
Observations	48025	46659	48025	46659

t statistics in parentheses
* $p < .10$, ** $p < .05$, *** $p < 0.01$

Third, so far I have assumed that the only explanatory variable that is subject to change

[19] This has been done before when using the ENIA survey. See Benavente and Ferrada (2004) or Álvarez and Görg (2012) for examples in Chile with the same dataset.
[20] Table 8 is replicated in Appendix D.3 using TFP_{OP} and $TFP_{\overline{\alpha}}$.

during the crises is the productivity. To account for the fact that this assumptions plays no role in driving the results, Table 9 shows what happens when the three control variables are interacted with years of crises. The three columns only differ in the productivity measure utilized. Under these three, the main results still hold. The Asian Crisis is characterized by a cleansing effect, mainly during 1998, and the Great Recession by a scarring effect, mainly during 2009. It is worth mentioning that none interaction of the crisis years with the controls is significant, apart from age in 1998 for all measures and the foreign variable in that year too when using TFP_{OP}. This is important, because it tells us that most variables the literature has considered as relevant when explaining the exit of establishments do not normally fluctuate during recessions, though there seems to be exceptions. Age in 1998 can be explained as it is highly correlated with productivity, and therefore it also produces the interaction term of 1998 with productivity to drop compared to the main results. The interaction of the foreign dichotomous variable in 1998 can be understood by the work of Álvarez and Görg (2012), who find that multinationals are more likely to exit during the Asian Crisis.

Table 9: Results using control interactions

	(1) Exit		(2) Exit		(3) Exit	
Year98 × $\ln(V/L)$	-0.0120*	(-1.74)				
Year99 × $\ln(V/L)$	-0.00309	(-0.46)				
Year08 × $\ln(V/L)$	0.00783	(1.10)				
Year09 × $\ln(V/L)$	0.0257***	(3.13)				
Year98 × TFP_{OP}			-0.0108**	(-2.17)		
Year99 × TFP_{OP}			0.00343	(0.69)		
Year08 × TFP_{OP}			-0.00140	(-0.27)		
Year09 × TFP_{OP}			0.00996*	(1.90)		
Year98 × $TFP_{\overline{\alpha}}$					-0.0197**	(-2.23)
Year99 × $TFP_{\overline{\alpha}}$					-0.0106	(-1.18)
Year08 × $TFP_{\overline{\alpha}}$					0.0106	(1.14)
Year09 × $TFP_{\overline{\alpha}}$					0.0160*	(1.76)
Year98 × Size	0.00768	(1.32)	0.00817	(1.42)	0.00620	(1.12)
Year98 × Age	-0.0125*	(-1.66)	-0.0141*	(-1.77)	-0.0150*	(-1.85)
Year98 × Foreign	-0.0300	(-1.59)	-0.0342*	(-1.82)	-0.0309	(-1.61)
Year99 × Size	-0.000146	(-0.02)	-0.00180	(-0.27)	-0.000270	(-0.04)
Year99 × Age	-0.00648	(-1.13)	-0.00446	(-0.76)	-0.00488	(-0.82)
Year99 × Foreign	-0.0124	(-0.57)	-0.0213	(-0.98)	-0.0180	(-0.84)
Year08 × Size	0.00544	(0.90)	0.00791	(1.37)	0.00779	(1.41)
Year08 × Age	0.00131	(0.98)	0.00160	(1.21)	0.00144	(1.08)
Year08 × Foreign	-0.0292	(-1.38)	-0.0123	(-0.57)	-0.0105	(-0.48)
Year09 × Size	-0.00258	(-0.43)	0.000133	(0.02)	0.00375	(0.67)
Year09 × Age	0.000954	(0.71)	0.00139	(1.06)	0.00183	(1.39)
Year09 × Foreign	-0.0342	(-1.49)	-0.0201	(-0.93)	-0.0196	(-0.91)
Observations	48025		46592		46592	

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < 0.01$

7 SCARRING EFFECT IN THE GREAT RECESSION

This sections attempts to understand why the effect of productivity on firm survival does not accentuate, and even attenuates during the Great Recession. Two mechanisms are proposed in order to account for this finding. First, I inspect if the financing needs play a role. Second, I explore whether the international exposure, and specifically the exposition to international competition, is related to the attenuation documented here.

7.1 FINANCING CONSTRAINTS

The literature has usually focused on the financing needs or constraints plants face[21] in general, but specially during a crisis, to explain the non-Schumpeterian features of a recession. The explanation for this mechanism is based on the assumption that a crisis generates financial shortages and instability. Therefore, plants with higher technological needs encounter larger constraints during a crisis, hence making those establishments more likely to exit. Moreover, if this set of plants are not the least efficient, as it might be the case at any given economy or market studied; productive units may be exiting more likely given their financial connection.

Hallward-Driemeier and Rijkers (2013) also focus on the technological financing needs faced by establishments. They use the measures proposed by Rajan and Zingales (1998). The advantage of this measure is its exogeneity, since it is calculated using data from the U.S. and it is sector- and not plant-specific. Additionally, it is an index that captures only *technological* requirements in each sector in their relation to cash flow and financing. Rajan and Zingales' (RZ) indexes are measured monotonically, i.e. the higher the index is, the higher the needs are.

Iyer, Peydró, da Rocha-Lopes, and Schoar (2014) study the credit market for firms in Portugal in the aftermath of the Great Recession. They find that the major reduction of loans is for small businesses, which in turn do not have many other financial sources. Our estimation already controls for size and the interaction exercise with crisis years in Table 9 did not result in significant coefficients.

To study the potential effect financing needs may have, I use a triple interaction that allows to capture the relation between the three variables at stake: a recessionary period, productivity and financing needs. Table 10 displays the results of adding a triple interaction to (4), plus all the subsequent double interactions. For a matter of presentation, only new interactions are presented. The difference between the columns is solely given by the different measures utilized.

[21] See Section for further details. See also Hallward-Driemeier and Rijkers (2013) and Eslava, Galindo, Hofstetter, and Izquierdo (2011).

As RZ is defined monotonically, a positive and significant coefficient for the triple interaction in year 2009 would be in line with the argument given above. However, for the three productivity measures this is not the case, although they are all positive. It can be noted too, that it is not significant for the years in the Asian Crisis, which is expected as productivity itself is the leading explanation for the exit of plants during that period. However, the last column is positive and significant for a year without any of the effects. The interpretation of this is that, although the selection process of productivity did not attenuate, a certain set of plants that exit in 2008 have high financing needs and are relatively more productive under $TFP_{\overline{\alpha}}$.

Table 10: Triple interactions with Rajan and Zingales

	(1) Exit	(2) Exit	(3) Exit
Year98 $\times$ $\ln(V/L)$ $\times$ RZ	0.0333		
	(1.02)		
Year99 $\times$ $\ln(V/L)$ $\times$ RZ	-0.0153		
	(-0.65)		
Year08 $\times$ $\ln(V/L)$ $\times$ RZ	0.0270		
	(1.05)		
Year09 $\times$ $\ln(V/L)$ $\times$ RZ	0.0302		
	(1.17)		
Year98 $\times$ TFP_{OP} $\times$ RZ		0.0332	
		(1.33)	
Year99 $\times$ TFP_{OP} $\times$ RZ		-0.00772	
		(-0.44)	
Year08 $\times$ TFP_{OP} $\times$ RZ		0.0313	
		(1.33)	
Year09 $\times$ TFP_{OP} $\times$ RZ		0.0128	
		(0.66)	
Year98 $\times$ $TFP_{\overline{\alpha}}$ $\times$ RZ			0.00636
			(0.17)
Year99 $\times$ $TFP_{\overline{\alpha}}$ $\times$ RZ			-0.00503
			(-0.15)
Year08 $\times$ $TFP_{\overline{\alpha}}$ $\times$ RZ			0.0726*
			(1.85)
Year09 $\times$ $TFP_{\overline{\alpha}}$ $\times$ RZ			0.00918
			(0.23)
Size	-0.0195***	-0.0172***	-0.0218***
	(-11.39)	(-9.76)	(-13.24)
Foreign	0.0183***	0.0120**	0.0100*
	(2.98)	(1.98)	(1.66)
Age	-0.00488***	-0.00507***	-0.00527***
	(-7.55)	(-7.82)	(-8.08)
Observations	44317	43011	43025

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

7.2 INTERNATIONAL EXPOSURE

The origin of the Great Recession was completely alien regarding the Chilean economy. Moreover, it created one of the greatest trade collapses seen in the world economy. Baldwin (2009) do a thorough revision of causes and consequences of the collapse occurring in the aftermath of the Great Recession. On their own words "*the collapse was caused by the sudden, recession-induced postponement of purchases, especially of durable consumer and investment goods*". They show, using data from the World Trade Organization that exports and imports of the 10 largest economies plus the European Union shrunk by 40% quarter-on-quarter (Figure 3 in the book). Eichengreen and O'Rourke (2009) compare the trade dynamics after the Great Depression and Great Recession. They find that the drop in trade that this crisis exhibited in 9 months, the crisis of the last century attained it in 30 months.

Taking this context into account, exporters can be more likely to finish their operations, and hence exit, as they receive a larger shock compared to their non-exporting counterparts. Additionally, it is well-studied in the international trade literature that exporting establishments perform better that non-exporters.[22] Therefore, productive units may be exiting more likely given their connection to the international markets.

The methodology is identical to the one used above regarding financial needs. In this case, I measure exposure to international competition by the share of production that is exported. To avoid endogeneity issues, the variable is used with one lag as the contemporaneous share captures what we are actually trying to study. Table 11 shows the results. Again, the three columns only differ in their productivity measures. It can be appreciated that in the three columns, exposure to international competition at the sector-level is playing a role in explaining the exit of plants in 2009 and even 2008. The positive coefficients indicate the presence of a cleansing effect in sectors with low exposure, as lower levels of productivity increase the probability of exiting during the Great Recession. Conversely, within sector with high levels of exposure, the more productive the plant is the higher its exit probability is, compared to its level without the crisis.

Figure 4 shows the predicted probabilities for all the plants in normal years, for all the plants in the Asian Crisis, for all the plants with low exposure to international competition and with

[22] For evidence on it see Bernard and Jensen (1999), Bernard and Jensen (2007). See Bravo-Ortega, Benavente, and González (2014) for Chilean evidence.

high exposure, separately. The relation between normal times and the Asian Crisis is indistinguishable to what is pictured in Figure 3. The curve for the Great Recession has now been splitted and shows that the scarring effect is no longer present in plants with low exposure to international competition. Actually, it seems as the relationship does not change compared to normal times. The long-dash-dotted line resembles the Great Recession in Figure 3, but more importantly, it informs about where the scarring effect observed in 2009 is concentrated.

Table 11: Triple interactions with Exposure to International Competition

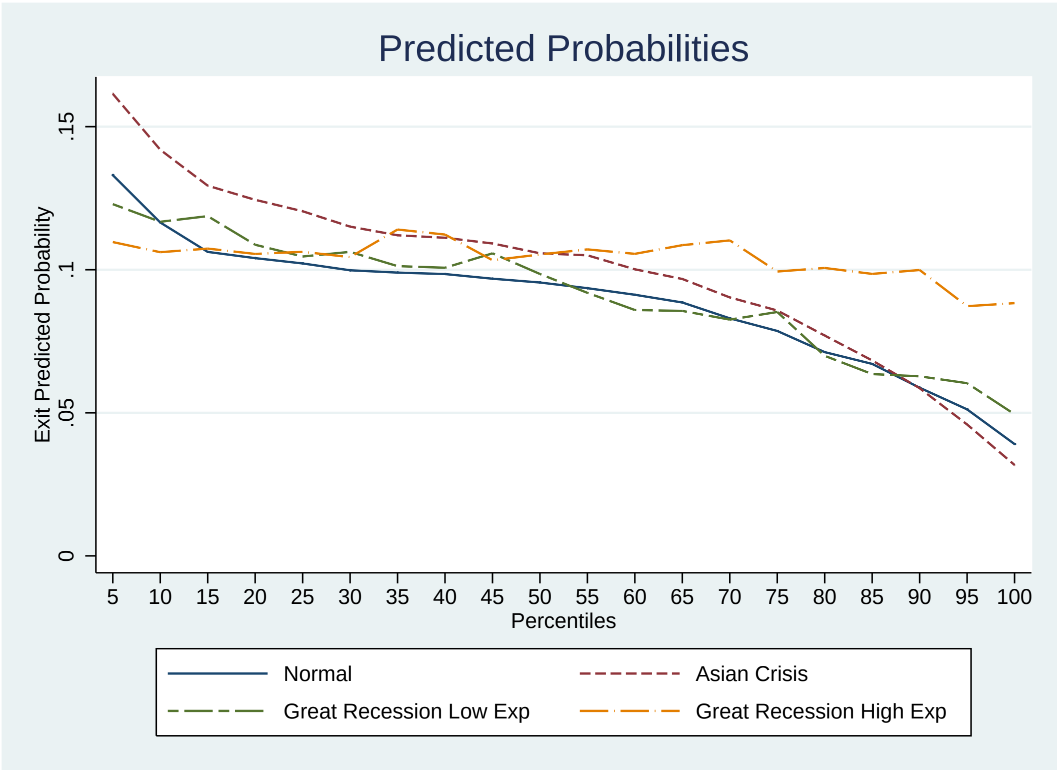
	(1) Exit	(2) Exit	(3) Exit
Year98 × $\ln(V/L)$ × Exp.Exp.	-0.000100		
	(-0.00)		
Year99 × $\ln(V/L)$ × Exp.Exp.	0.104**		
	(2.09)		
Year08 × $\ln(V/L)$ × Exp.Exp.	0.0684**		
	(2.35)		
Year09 × $\ln(V/L)$ × Exp.Exp.	0.0918***		
	(3.37)		
Year98 × TFP_{OP} × Exp.Exp.		0.00690	
		(0.21)	
Year99 × TFP_{OP} × Exp.Exp.		0.0540	
		(1.44)	
Year08 × TFP_{OP} × Exp.Exp.		0.0119	
		(0.62)	
Year09 × TFP_{OP} × Exp.Exp.		0.0315*	
		(1.65)	
Year98 × $TFP_{\overline{\alpha}}$ × Exp.Exp.			0.0617
			(0.92)
Year99 × $TFP_{\overline{\alpha}}$ × Exp.Exp.			0.0334
			(0.46)
Year08 × $TFP_{\overline{\alpha}}$ × Exp.Exp.			0.0795**
			(2.09)
Year09 × $TFP_{\overline{\alpha}}$ × Exp.Exp.			0.110***
			(3.01)
Size	-0.0208***	-0.0175***	-0.0221***
	(-13.04)	(-10.42)	(-14.47)
Foreign	0.0187***	0.0131**	0.0128**
	(3.25)	(2.29)	(2.27)
Age	-0.00499***	-0.00507***	-0.00513***
	(-9.14)	(-9.28)	(-9.39)
Observations	41346	40271	40297

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To be sure about the strength of these last results, I extended this analysis to other two aspects of the international exposure, as a whole, that may have had an incidence during the crisis in the last decade. First, the international exposure measured by the share of imports plus exports over all the production in a sector. Second, the exposure on the import side only, i.e. the share of imports over all the production. These variables are studied to figure out if the export relation just found is not a mere consequence of the international connection itself rather than a relation through the exposure to international competition.

Appendix D.4 shows the results. The coefficients in Table 15 display the results for the first measure. The relevant coefficiente are expected as they indirectly contain what has just been documented above. However, the results in Table 16 for the import-side tell us that part of the exit in 2009, though not in 2008, is also explained by the connection plants have as importers. This mechanism is less intuitive than the relation with exports. Bown (2011) points out that importers may be affected by the rise of trade barrier in the aftermath of the Great Recession. Despite this, Chile has not erected barriers to trade during the past decades, hence it does not seem as a plausible means.[23]

Figure 4: Predicted exit probabilities according to period, productivity and exposure



[23]The Office of the United States Trade Representative elaborated a report on the actual state of Chilean trade barriers (link), where they state this are almost non-existent. Likewise, the International Trade Aministration, which depends on the Department of Commerce of the United States wrote a similar report, where they give the details about importing and exporting in Chile (link).

7.3 EXPOSURE TO INTERNATIONAL TRADE

Finally, to understand the exporting link, I briefly explore Customs data on exports from Chile to obtain indirect evidence on what happens to sectors highly exposed to international trade. This database has every export that any business did in Chile during 2005 and 2006. Hence, all exports in the ENIA sample I use are contained within this dataset. However, data cannot be merged as identifiers differ. Each entry has the type of product using Harmonized System Code (HS), the date of the export itself, an establishment identifier, the value of exports and the destination. Given this data limitation, only aggregate conclusions by sector can be made. Additional data is merged. Import percent change for years 2008 and 2009 per country (i.e. destination) is added, plus the measures of exposure to international trade calculated in ENIA in the previous subsection.

To have a measure of how much each sector was affected by the trade collapse, I calculate a weighted change of imports from destinations faced by each sector. First, I obtain the relative importance each destination has within each sector for year. Specifically,

$$\alpha_{ijt} = \frac{\sum_p X_{eijt}}{\sum_i \sum_p X_{eijt}},$$

where X_{eijt} stands for all exports done by establishment e in sector j to destination i y year t. Then, a weighted aggregate effect (WAE$_j$) is computed by adding the relative importance each destination has in terms of their change in external demand, i.e. imports, during the Great Recession (ΔImp$_i$),

$$\text{WAE}_j = \sum_i \alpha_{ijt} \times \Delta\text{Imp}_i \tag{7}$$

Figure 5: Effect of the Trade Collapse per Sector

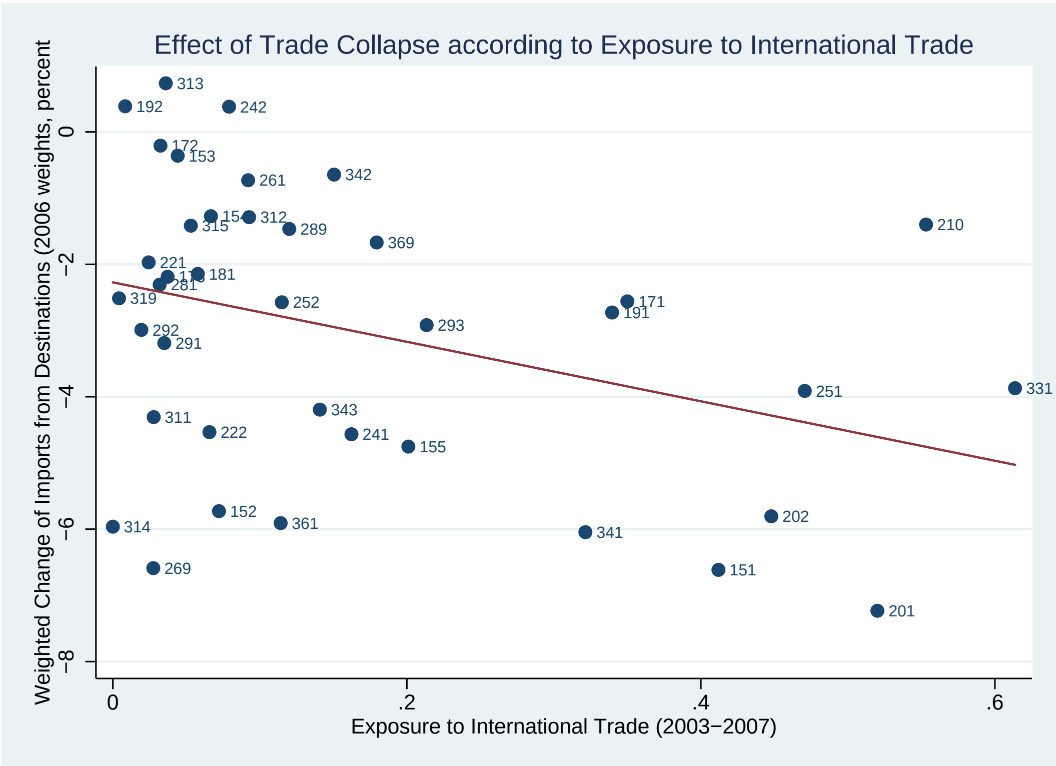


Figure 5 shows WAE_j for all j in our original dataset against their average exposure. The number on the right of each observation corresponds to the ISIC 3-digit code. This graph uses 2006 weights since they are the more recent and available to us. Exposure is measured as the average during five years previous to the Great Recession (as we have understood it) in order to have a more exogenous calculation.[24] Figure 5 clearly shows a negative relation, which can be read as follows. Sectors with higher exposure are more associated to countries that suffered the most during the Great Recession. This is in line with our finding related to a scarring effect concentrated at highly exposed sector. Although, this does not fully account for the actual exit of firms, it sheds light on what is happening.

[24] Appendix D.5 replicates the same graph when using a different way to gauge exposure and different weights. The results from Figure 5 are maintained.

8 CONCLUSIONS

Crises have a history of profoundly damaging the economies in many respects. They destroy labor, stop investment and even provoke a larger exit of firms. However, this can be desirable, given that these businesses are lacking behind in terms of pushing the economy forward. Namely, if they are creating inefficiencies that in the long-run would affect the development itself, the fact that they are closing down is good news.

Using Chilean manufacturing data from 1995 to 2011, I find that this is what happens during the Asian Crisis and specifically during 1998. Moreover, even though there was negative GDP growth, this accelerated process was accompanied by a rise in productivity. Regardless of this, the opposite occurred during the Great Recession, and mainly during 2009. If in 1998 the most productive plants were not even affected at all, in 2009 this set of units was, at least, as affected as the least efficient establishments.

The mechanism that accounts for part of this aftermath of the Great Recession is the export exposure that sectors have. Sectors where more production is sent abroad are more vulnerable to external demand shocks. Hence, a trade collapse as the one occurring between 2008 and 2009 should make plants in these categories more likely to exit. To inspect this, Customs data is used, which allows to assert that sectors with higher exposure are related to economics that diminished the most their external demand during the Great Recession.

This last piece of results permits to better, not yet fully, understand what has happened in the first global crisis of the millennium. Further data of imports and exports merged with plants in the ENIA can enrich the analysis and, possibly, permit us to completely comprehend what is underlying firm dynamics during this recession.

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A DESCRIPTIVE STATISTICS

Table 12: Descriptive Statistics

	Plants	Firms	Exit rate (%)	Workers	% Exporters	% Importers	% Foreign	RZ
1995	3407	3206	6.75	93.91	25.39	27.59	10.07	0.27
1996	3595	3397	10.65	88.27	24.17	28.12	6.01	0.26
1997	3419	3213	11.44	90.69	24.57	29.13	6.84	0.26
1998	3172	2989	10.56	90.08	24.59	27.30	6.56	0.26
1999	2996	2819	11.11	86.29	23.87	23.53	6.94	0.26
2000	2828	2666	8.38	89.43	23.59	23.16	7.07	0.26
2001	2706	2540	7.65	92.67	24.61	25.72	6.84	0.27
2002	2825	2658	7.82	90.32	24.99	25.20	7.19	0.27
2003	2924	2756	7.46	89.59	25.00	25.72	6.77	0.28
2004	3000	2826	13.20	90.26	25.00	25.97	7.13	0.28
2005	2812	2633	7.97	105.24	27.45	26.21	7.29	0.28
2006	2745	2555	7.61	109.28	28.01	26.74	7.72	0.28
2007	2603	2416	9.03	119.23	28.24	26.78	7.41	0.28
2008	2716	2525	10.05	111.22	27.87	29.49	7.66	0.27
2009	2585	2404	9.83	111.49	27.89	30.21	7.78	0.28
2010	2438	2265	16.94	116.47	26.91	31.05	8.33	0.27

B TOTAL FACTOR PRODUCTIVITY CALCULATION PROCEDURE

Following Olley and Pakes (1996) to estimate productivity, there are three stages that allow to estimate productivity consistently. The first consists in approximating the productivity no observed by the econometrician as a function of capital and energy. This is suggested by Levinsohn and Petrin (2003) that replaces investment for energy. The reason is due to the fact that investment is lumpy, whereas energy is not.Thus, unobserved productivity can be written as,

$$\omega_{it} = h(e_{it}, k_{it}) \tag{8}$$

where e_{it} is the logarithm of energy consumption.[25] Then, replacing (8) into (2), and this into (1), the production function can be rewritten as,

$$y_{it} \quad = \quad \beta_l l_{it} + \beta_m m_{it} + \phi(e_{it}, k_{it}) + \eta_{it} \tag{9}$$

where $\phi(e_{it}, k_{it}) = h(e_{it}, k_{it}) + \beta_0 + \beta_k k_{it}$, which is approximated by a second-degree polynomial that includes its interactions. This, (9) is estimated by LS and consistent estimators are obtained for materials and labor, which are solely affected by the simultaneity bias.

The second stage builds up the predicted probability of exiting the market ($\widehat{z}_{it} = 1$) as follows:

$$\Pr(z_{it} = 1) = \Phi(e_{i,t-1}, k_{i,t-1}, e^2_{i,t-1}, k^2_{i,t-1}, e_{i,t-1} \times k_{i,t-1}),$$

from where $\widehat{z}_{it}$ is obtained and latter used in the third phase.

[25] This comes from the theoretical model in Olley and Pakes (1996), where investment is explained as a function of capital and productivity, and thanks to the monotonicity of the latter, the investment function can be inverted allowing to rewrite the unobserved productivity like in (8)

The third and last stage includes $\widehat{z}_{it}$ into a modified version of (9), and it then estimates by non-linear LS the following equation:

$$\tilde{y}_{it} = \beta_k k_{it} + g(\widehat{\phi}_{p,t-1} - \beta_k k_{p,t-1}, \widehat{z}_{it}) + \eta_{it}$$

where $\tilde{y}_{it} = y_{it} - \widehat{\beta}_l l_{it} - \widehat{\beta}_m m_{it}$ and $g(\cdot)$ is an unknown function that is approximated by a second-degree polynomial that includes its interactions. Finally with this, parameters for the capital are correctly estimated.

C PRODUCTION FUNCTIONS USING OLLEY AND PAKES PROCEDURE

ISIC rev.3	15	17	18	19	20	21	22	24
Labor	0.466***	0.634***	0.649***	0.784***	0.508***	0.640***	0.495***	0.602***
	(15.87)	(8.48)	(11.25)	(16.73)	(9.51)	(9.87)	(10.21)	(9.80)
Capital	0.234***	0.293***	0.264***	0.191*	0.380***	0.235***	0.120*	0.257***
	(6.57)	(4.50)	(4.13)	(2.57)	(8.43)	(3.75)	(2.14)	(4.25)
N	15325	2577	2787	1540	3566	1681	2123	3183

ISIC rev.3	25	26	28	29	31	33	34	36
Labor	0.506***	0.369***	0.574***	0.677***	0.473***	0.944***	0.974***	0.761***
	(10.30)	(5.84)	(14.05)	(12.29)	(3.56)	(5.65)	(8.29)	(15.53)
Capital	0.285***	0.301**	0.311***	0.322***	0.450**	0.205	0.220	0.199*
	(3.47)	(2.63)	(7.09)	(4.13)	(3.09)	(1.40)	(1.01)	(2.45)
N	3496	2445	3921	3021	903	203	673	2446

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

D FURTHER RESULTS

D.1 DYNAMICS FOR OTHER MEASURES OF PRODUCTIVITY

Figure 6: Productivity Evolution (Olley and Pakes, 1995=100)

Figure 7: Productivity Evolution (Olley and Pakes)

Figure 8: Productivity Evolution ($\beta_k = 0.45$)

D.2 PREDICTED PROBABILITIES FOR OTHER MEASURES OF PRODUCTIVITY

Figure 9: Predicted probabilities (Olley and Pakes)

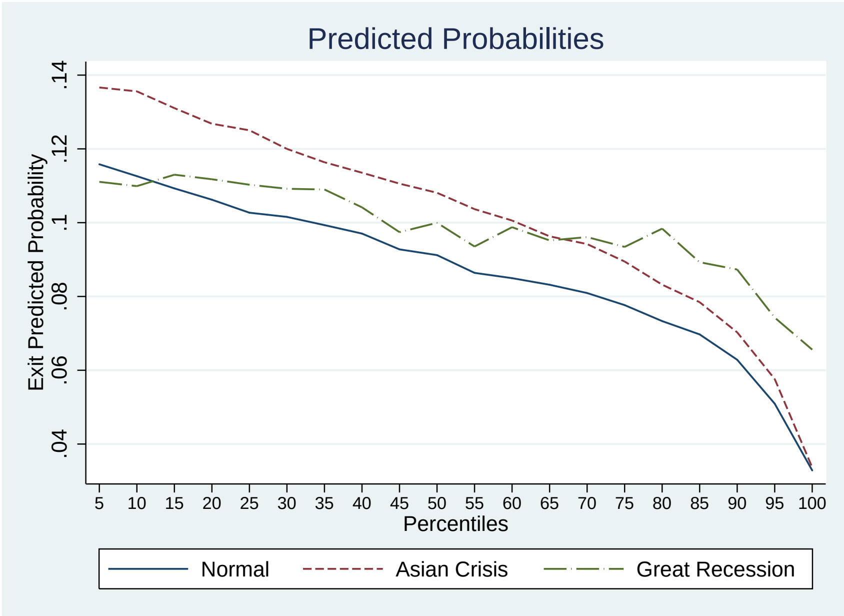
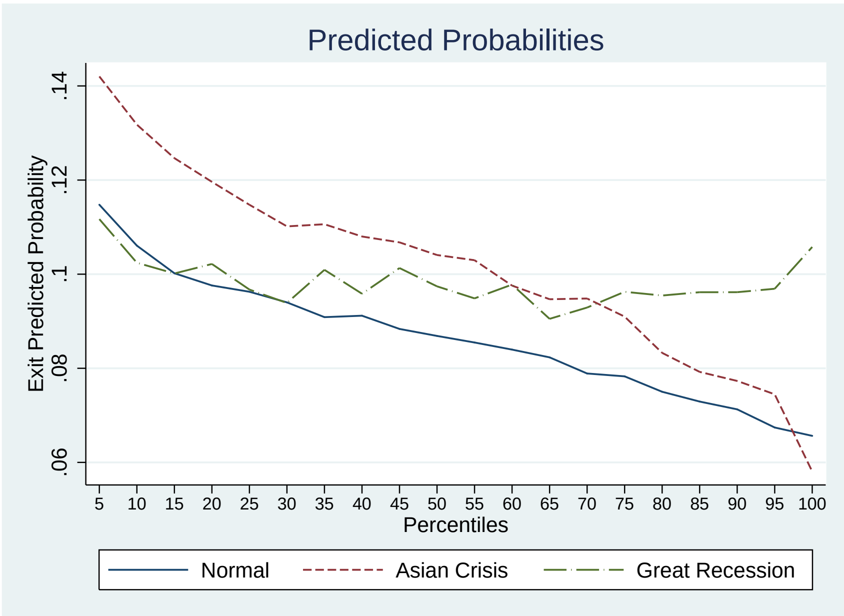


Figure 10: Predicted probabilities ($\beta_k = 0.45$)



D.3 CONTROLS

Table 13: Results using different controls (LP's Total Factor Productivity)

	(1)	(2)	(3)	(4)
	Exit	Exit	Exit	Exit
Year98 × TFP_{OP}	-0.0106**	-0.0104**	-0.0103**	-0.0104**
	(-2.21)	(-2.17)	(-2.16)	(-2.17)
Year99 × TFP_{OP}	0.00142	0.00180	0.00189	0.00180
	(0.29)	(0.37)	(0.39)	(0.37)
Year08 × TFP_{OP}	0.000242	0.0000484	-0.00000205	0.0000482
	(0.05)	(0.01)	(-0.00)	(0.01)
Year09 × TFP_{OP}	0.00943**	0.00911*	0.00906*	0.00909*
	(1.97)	(1.90)	(1.89)	(1.89)
Size	-0.0184***	-0.0148***	-0.0150***	-0.0145***
	(-12.04)	(-9.30)	(-8.97)	(-8.56)
Foreign	0.0111**	0.0125**	0.0110**	0.0129**
	(2.11)	(2.36)	(2.09)	(2.42)
Age		-0.00592***	-0.00602***	-0.00592***
		(-12.19)	(-12.41)	(-12.19)
Capital Intensity		-0.00303**		-0.00294**
		(-2.53)		(-2.43)
Export			-0.00365	-0.00212
			(-1.03)	(-0.60)
Observations	46592	46592	46592	46592

t statistics in parentheses
* $p < .10$, ** $p < .05$, *** $p < 0.01$

Table 14: Results using different controls (Total Factor Productivity)

	(1)	(2)	(3)	(4)
	Exit	Exit	Exit	Exit
Year98 $\times TFP_{\overline{\alpha}}$	-0.0230***	-0.0211**	-0.0207**	-0.0211**
	(-2.59)	(-2.38)	(-2.35)	(-2.38)
Year99 $\times TFP_{\overline{\alpha}}$	-0.0140	-0.0120	-0.0117	-0.0120
	(-1.59)	(-1.36)	(-1.33)	(-1.36)
Year08 $\times TFP_{\overline{\alpha}}$	0.0137	0.0103	0.0102	0.0103
	(1.51)	(1.14)	(1.14)	(1.14)
Year09 $\times TFP_{\overline{\alpha}}$	0.0174*	0.0144	0.0145	0.0144
	(1.95)	(1.61)	(1.63)	(1.61)
Size	-0.0223***	-0.0178***	-0.0190***	-0.0176***
	(-15.86)	(-11.83)	(-12.01)	(-10.85)
Foreign	0.00983*	0.0145***	0.00996*	0.0147***
	(1.90)	(2.75)	(1.91)	(2.78)
Age		-0.00593***	-0.00609***	-0.00593***
		(-12.19)	(-12.51)	(-12.19)
Capital Intensity		-0.00650***		-0.00643***
		(-5.33)		(-5.19)
Export			-0.00534	-0.00135
			(-1.52)	(-0.38)
Observations	46592	46592	46592	46592

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < 0.01$

D.4 INTERNATIONAL EXPOSURE: AGGREGATE AND IMPORTS

Table 15: Triple interactions with International Exposition

	(1) Exit	(2) Exit	(3) Exit
Year98 $\times \ln(V/L) \times$ Int.Exp.	-0.00572		
	(-0.12)		
Year99 $\times \ln(V/L) \times$ Int.Exp.	0.100**		
	(2.09)		
Year08 $\times \ln(V/L) \times$ Int.Exp.	0.0500**		
	(2.27)		
Year09 $\times \ln(V/L) \times$ Int.Exp.	0.0789***		
	(3.78)		
Year98 $\times TFP_{OP} \times$ Int.Exp.		0.0255	
		(0.79)	
Year99 $\times TFP_{OP} \times$ Int.Exp.		0.0646*	
		(1.79)	
Year08 $\times TFP_{OP} \times$ Int.Exp.		0.0127	
		(0.82)	
Year09 $\times TFP_{OP} \times$ Int.Exp.		0.0443***	
		(2.92)	
Year98 $\times TFP_{\overline{\alpha}} \times$ Int.Exp.			0.0593
			(0.91)
Year99 $\times TFP_{\overline{\alpha}} \times$ Int.Exp.			0.0259
			(0.37)
Year08 $\times TFP_{\overline{\alpha}} \times$ Int.Exp.			0.0684**
			(2.30)
Year09 $\times TFP_{\overline{\alpha}} \times$ Int.Exp.			0.0983***
			(3.60)
Size	-0.0210***	-0.0176***	-0.0221***
	(-13.13)	(-10.51)	(-14.52)
Foreign	0.0191***	0.0134**	0.0130**
	(3.30)	(2.34)	(2.30)
Age	-0.00498***	-0.00506***	-0.00509***
	(-9.11)	(-9.26)	(-9.33)
ObserVtions	41346	40271	40297

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Triple interactions with Exposition to Imports

	(1) Exit	(2) Exit	(3) Exit
Year98 $\times \ln(V/L) \times$ Imp.Exp	0.0331		
	(0.32)		
Year99 $\times \ln(V/L) \times$ Imp.Exp	0.0166		
	(0.16)		
Year08 $\times \ln(V/L) \times$ Imp.Exp	0.0456		
	(0.82)		
Year09 $\times \ln(V/L) \times$ Imp.Exp	0.125***		
	(2.61)		
Year98 $\times TFP_{OP} \times$ Imp.Exp		0.141*	
		(1.69)	
Year99 $\times TFP_{OP} \times$ Imp.Exp		0.00412	
		(0.05)	
Year08 $\times TFP_{OP} \times$ Imp.Exp		0.00263	
		(0.06)	
Year09 $\times TFP_{OP} \times$ Imp.Exp		0.129***	
		(3.26)	
Year98 $\times TFP_{\overline{\alpha}} \times$ Imp.Exp			0.0250
			(0.19)
Year99 $\times TFP_{\overline{\alpha}} \times$ Imp.Exp			-0.0503
			(-0.36)
Year08 $\times TFP_{\overline{\alpha}} \times$ Imp.Exp			0.123
			(1.53)
Year09 $\times TFP_{\overline{\alpha}} \times$ Imp.Exp			0.187***
			(2.90)
Size	-0.0208***	-0.0175***	-0.0221***
	(-13.08)	(-10.47)	(-14.49)
Foreign	0.0189***	0.0133**	0.0127**
	(3.27)	(2.34)	(2.26)
Age	-0.00501***	-0.00508***	-0.00512***
	(-9.16)	(-9.28)	(-9.36)
ObserVtions	41346	40271	40297

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D.5 EFFECT OF THE TRADE COLLAPSE (ALTERNATIVE MEASURES)

Figure 11: Effect of the Trade Collapse per Sector (2005 weights)

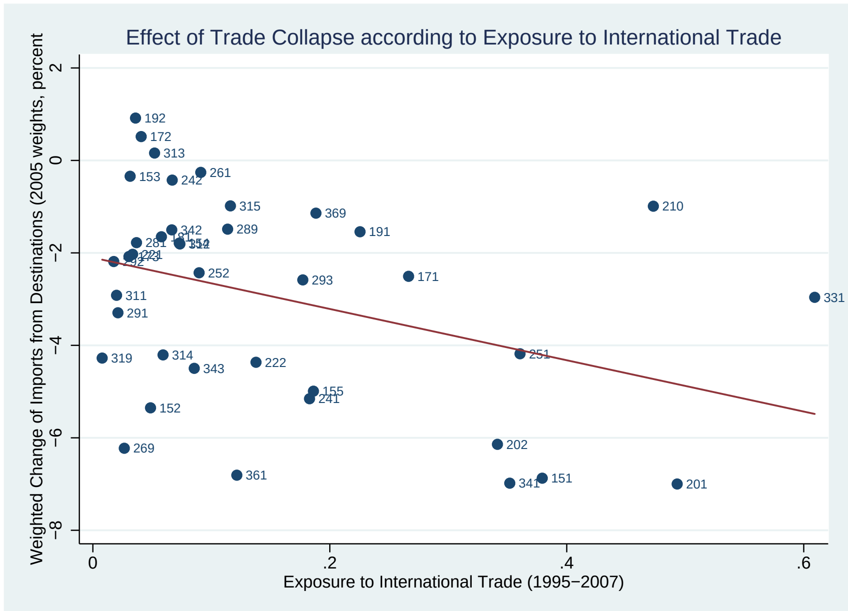


Figure 12: Effect of the Trade Collapse per Sector (overall weights)