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French firms exports during downturns: evidence from past crises[1]

Dimitri Bellas Vincent Vicard[2]
Banque de France

[1] This research was conducted when Dimitri Bellas was intern at the Banque de France. The views expressed in this paper are those of the authors and do not represent the views of the Banque de France.

[2] Corresponding author. E-mail: vincent.vicard@banque-france.fr

Abstract

This paper makes use of detailed French firm level data on a quarterly basis to investigate the impact of past crises on exports and the margins of adjustment. We first detect crises periods using quantitative criteria and classify them into banking crises, currency crises, simultaneous banking and currency crises, and other crises. Our results underline the prevalence of the intensive margin of adjustment to large shocks, i.e. firms reducing their average sales per product while staying on the market. The extensive margin of trade is however dominant in currency crises. On average, a crisis reduces the growth rate of exports over six quarters. Finally, we show that exports overreact to demand variations during crises, and that the extensive margin is more responsive to demand. Other factors, not directly related to demand, mostly affect the intensive margin.

Keywords: financial crisis, international trade, intensive and extensive margins.
JEL classification: F14

Résumé

Cet article utilise des données trimestrielles détaillées de commerce des exportateurs français pour étudier l'impact des crises passées sur les exportations et les marges d'ajustement à des chocs dans les pays de destination. Nous identifions dans un premier temps les périodes de crise à l'aide de critères quantitatifs et les classifions selon leur nature : crises bancaires, crises de change, crises bancaire et de change et autres crises. Nos résultats soulignent la prédominance de la marge intensive dans l'ajustement aux des chocs : les exportateurs réduisent leurs ventes moyennes par produit mais restent actifs sur le marché de destination. La marge extensive du commerce est cependant prédominante dans les épisodes de crise de change. En moyenne, une crise réduit le taux de croissance des exportations durant 6 trimestres. Nous montrons également que les exportations sur-réagissent aux variations de PIB durant les crises, et que la marge extensive s'ajuste plus aux variations de demande. Les autres facteurs, non directement liés aux variations de demande, affectent prioritairement la marge intensive.

Mots clés: crises financières, commerce international, marges intensive et extensive du commerce.
Code JEL: F14

1. Introduction

Together with the unfolding of the 2008/2009 financial crisis, international trade experienced a sudden and global collapse. The volume of world trade plummeted by 20% during the first year of the crisis (from April 2008) before slowly recovering (Eichengreen and O'Rourke, 2010). This collapse of world trade has been mainly driven by the intensive margin of trade, i.e. firms reducing their sales rather than exiting markets (Bricongne et al., 2012), which is presumed to lead to a faster recovery than in case of adjustments on the extensive margin involving sunk costs.

Our line of research is threefold. We are first interested in the dynamics of trade during crisis episodes and ask the question of both the timing and the length of the drop in exports. Our second aim is to disentangle the contribution of the extensive and intensive margins of trade to the drop in exports during different kinds of crises. Finally, we differentiate the responsiveness of the margins of exports to the drop in demand during crises and other factors. We use detailed French firm level data to examine the responses of exports during past crises within a gravity-like framework. Besides being the workhorse econometric model in international trade and its now strong micro-foundation (Anderson and van Wincoop, 2003; Chaney, 2008), a gravity-like framework allows to compare trade performance to the "natural" level of trade predicted by distance, GDPs and other traditional determinants of bilateral trade. Since we are interested in the dynamics of exports, we measure, on a quarterly basis, the deviation of total trade and each margin from their "natural" growth rate, defined by the growth of income and exchange rate movements.

The 2008/2009 crisis has renewed interest in the impact of crises on trade, while the prior literature was focusing mainly on currency crises (Berman, 2009; Campa, 2000). Freund (2009) investigates the impact of global downturns and finds an increased responsiveness of trade to demand during global downturns, with a fall in trade on average 4 times as large as that of income and an equally quick recovery after the crisis. Iacovone and Zavacka (2009) and Berman and Martin (2010) study past banking crises using sectoral trade data, and separate the impact of demand from the financial channel on exports and imports from African countries respectively. We contribute to this literature by differentiating the impact of different crisis on the extensive and intensive margins of exports. Bernard et al. (2010) are an exception and explore the dynamics of US exports to Asian countries during the 1997 crisis.[5] They present evidence that the drop in the level of US exports was mainly driven by a drop in the intensive margin. They also find a longer lasting impact on the number of US exporters to Asian countries, lasting two years after the beginning of the crisis. We extend this analysis in three

[5] Bricongne et al (2012) and Behrens et al (2010) also use firm level data to investigate the trade collapse of 2008/09.

ways: we use infra-annual data to analyze the impact of crisis on export over time, focus on several crisis episodes of different nature and consider their impact within a gravity framework.

Our dataset allows us to investigate the impact of crises in foreign countries on French exports on an infra-annual basis. We use French firm level data on a quarterly basis on the 1995-2006 period. We identify and date 58 crises episodes from quarterly GDP data and distinguish banking and currency crises using qualitative data from Laeven and Valencia (2008). The firm/country/product dimension of our dataset allows us to distinguish the extensive margins at the most detailed level: a product sold by a firm to a given destination market. We are thus able in this paper to investigate econometrically the impact of different crises on the dynamics of exports at the (firm-destination) extensive and intensive margins, and to quantify the demand effect and other factors represented by deviations from the natural level of growth during crises.

Our results show that, on average, the negative impact of crises on the growth of exports lasts six quarters. The intensive margin drives exports dynamics overall during crisis, and particularly so for banking crisis, but the extensive margin plays a significant role in the case of currency crises. We do find weak evidence of catch-up during recovery along the intensive margin only, suggesting that crises could have a longer-lasting impact on the number of exporters on a destination market. Finally, our results show that the extensive margin of trade responds strongly to demand shocks, while the dynamics of the intensive margin is not fully explained by the dynamics of demand so that additional channels work mainly through the intensive margin.

The paper is organized as follows: section 2 explains the methodology used to identify crises. Section 3 gives some descriptive statistics. Section 4 presents our baseline econometric analysis and section 5 differentiate the impact by type of crises.

2. Identifying crises

We identify and date the occurrence of crises from quarterly GDP data (see appendix for data sources). We remove the seasonal components and trends from the GDP level and use the growth of the residual GDP as an indicator of crisis periods. The Hodrick-Prescott Filter (SAS X11 procedure) is applied to remove seasonal components and trends for each country.[6] To qualify as a crisis, a drop in GDP must

[6] Since IMF data are not deseasonalized while OECD data are, we check for the compatibility of the procedure with the deseasonalization method used by the OECD, by comparing results using the 16 countries for which data are available in both databases, and find no significant differences.

exceed two standard deviations within 10 quarters.[7] This criterion ensures that we identify only significant drops in GDP. The date of the crisis is defined as the quarter after the peak. Figure 1 illustrates our identification strategy in the US case. Two crises are identified in the US according to our criteria between 1990 and 2009: in 2000Q4 and 2008Q1.

Our identification criteria picks, in particular, all crisis episodes related to the 1997 Asian crisis, as well as the 2001 crisis, the two major global crisis episodes over the period. Moreover, we identify all banking crises identified by Laeven and Valencia (2008), with small variations in dates. This evidence makes us confident with the validity of our methodology.

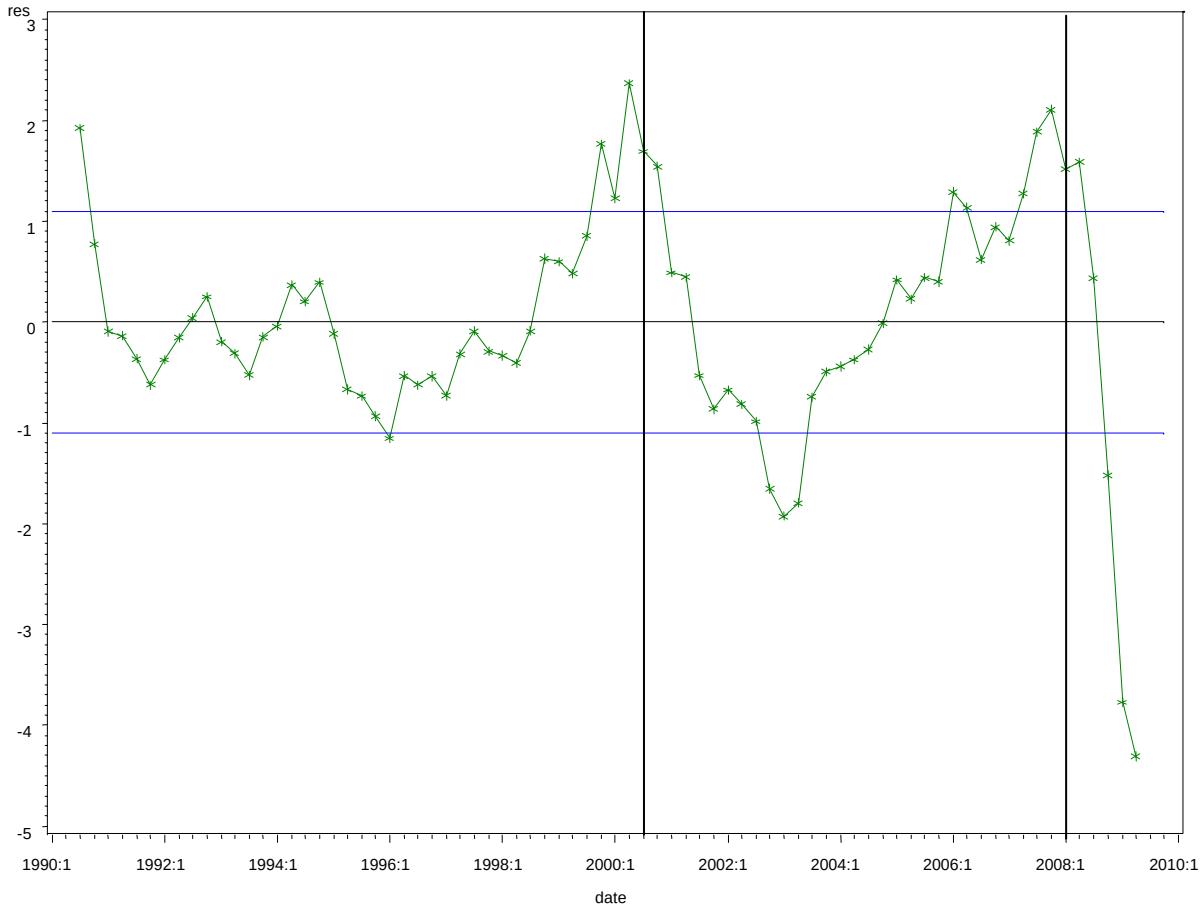


Figure 1: evolution of the American GDP residual

[7] Applying a criteria of 1.5 standard deviation, we identify 7 additional crisis episodes (compared to Table 1): Finland (2011Q1), Hungary (1995Q2), Japan (2001Q2), Luxembourg (1996Q1), Chili (2001Q2), Croatia (2004Q2) and Russia (2001Q4). On the contrary, increasing the requirement to 2.5 s.d, we identify 5 crisis less: New-Zealand (2000Q2), Slovak Republic (1999Q2), Sweden (2000Q4), Costa Rica (2000Q2) and Norway (2005Q3).

Overall, we identify 58 crisis episodes over the period 1995/2006. We then classify them as crises, and banking and/or currency crises. Banking crises are identified from Laeven and Valencia (2008). According to their definition, to qualify as a banking crisis, many financial institutions have to experience defaults and have to face important difficulties in paying back contracts. This broad definition of a systemic banking crisis combines both quantitative data and some subjective assessments of specific situations. In order to validate previous findings, they examine macroeconomic variables such as the fiscal balance, public debt, inflation, deposits, GDP growth, but also qualitative data such as creditor rights, deposit freezes, bank interventions, or liquidity assistance. Laeven and Valencia (2008) also provide information on combined banking and currency crises. Other currency crises are identified using the criteria defined by Frankel and Rose (1996). They define a currency crash as a larger than 25 percent drop in the nominal exchange rate against the euro, together with a substantial acceleration in the rate of depreciation (10 percent).

Our methodology identifies 58 crises, of which 7 are banking crises, 8 are combined banking and currency crises and 3 are pure currency crises (see Table 1).

Table 1: identified crises episodes

BANKING CRISES	
Columbia	Q3 1998
Croatia	Q1 1998
Czech Republic	Q1 1996
Jamaica	Q4 1996
Japan	Q4 1997
Thailand	Q3 1997
Turkey	Q4 2000

BANKING + CURRENCY CRISES	
Argentina	Q4 2001
Bulgaria	Q1 1996
Ecuador	Q3 1998
Indonesia	Q4 1997
Korea	Q3 1997
Malaysia	Q3 1997
Philippines	Q3 1997
Russia	Q3 1998

CURRENCY CRISES	
Belarus	Q1 1997 / Q1 1999
Brazil	Q1 1999

REAL CRISES	
Australia	Q4 2000
Austria	Q2 2001
Belgium	Q1 2001
Canada	Q1 2001
Chile	Q4 1998

Costa Rica	Q2 2000
Cyprus	Q4 2001
Denmark	Q1 2001
Finland	Q2 2001
Greece	Q2 2000
India	Q1 2000
Ireland	Q1 1998 / Q3 2004
Iceland	Q1 2002
Jordan	Q4 1996
Kyrgyzstan	Q4 2001 / Q1 2005
Lithuania	Q1 1999
Malta	Q1 1998 / Q1 2001
Mauritius	Q4 2001 / Q3 2004
Mongolia	Q2 2002 / Q3 2004
Norway	Q2 2001 / Q3 2002 / Q3 2005
Netherlands	Q2 2001
New Zealand	Q2 2000
Peru	Q2 2000
Poland	Q1 2001
Portugal	Q3 2002
Romania	Q1 1999 / Q2 2001
Singapore	Q1 1998
Slovak Republic	Q2 1999
Sweden	Q4 2000
Switzerland	Q1 2001
Tunisia	Q3 2001
United States	Q4 2000

3. Descriptive statistics

Using infra-annual trade data, entries and exits at the firm/destination/product level are particularly significant in the dynamics of French exports. To keep track of all flows and compute the contribution of the extensive and intensive margins to total exports growth, we cannot rely on traditional growth rate. For a firm *i* exporting a value x_{ijkt} of a product *k* to country *j* at quarter *t*, we define the following growth rate (Davis and Haltiwanger, 1992):

$$g_{ijkt} = \frac{x_{ijkt} - x_{ijk(t-4)}}{\frac{1}{2}(x_{ijkt} + x_{ijk(t-4)})}.$$

g_{ijkt} accounts for the possibility of entry and exit at the firm/destination/product level and provides an easy decomposition of French exports into the extensive margin and the intensive margin. Indeed, $g_{ijkt} = 2$- when a firm starts exporting to a destination market or an incumbent exporter adds a product in a destination, , and $g_{ijkt} = -2$ when it stops.

Since French exports are affected by seasonality, we use yearly growth rates of quarterly exports.

For each destination country, the growth of French exports can then be computed as:

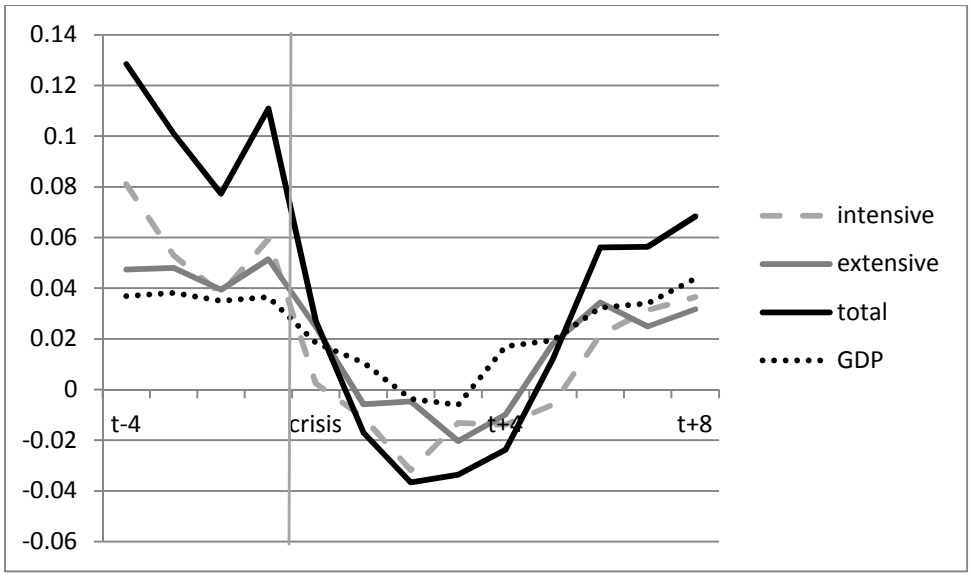
$$G_{jt} = \sum_{ik} s_{ijkt} g_{ijkt}$$

where s_{ijkt} is the weight of each flow: $s_{ijkt} = \frac{x_{ijkt}+x_{ijk(t-4)}}{\sum_i \sum_k x_{ijkt}+\sum_i \sum_k x_{ijk(t-4)}}$. G_{jt} provides a good approximation of the log change of aggregate French exports to a country *j*, and so of the growth rate of French exports.

We can decompose G_{jt} into the contribution of each margin, G_{jt}^{ext} and G_{jt}^{int}, to the growth of French exports to a country *j*. G_{jt}^{ext} represents the contribution of entering/exiting firms on market *j* and addition/suppression of products by incumbent exporters on market *j*.

Figures 2 and 3 present descriptive statistics on the French export growth on a window of 4 quarters before crises and 8 quarters after. We plot medians of the total growth of French exports and both intensive and extensive margins for all crises (Figure 2) and for banking and currency crises (Figure 3).

Figure 2: Median growth during crises

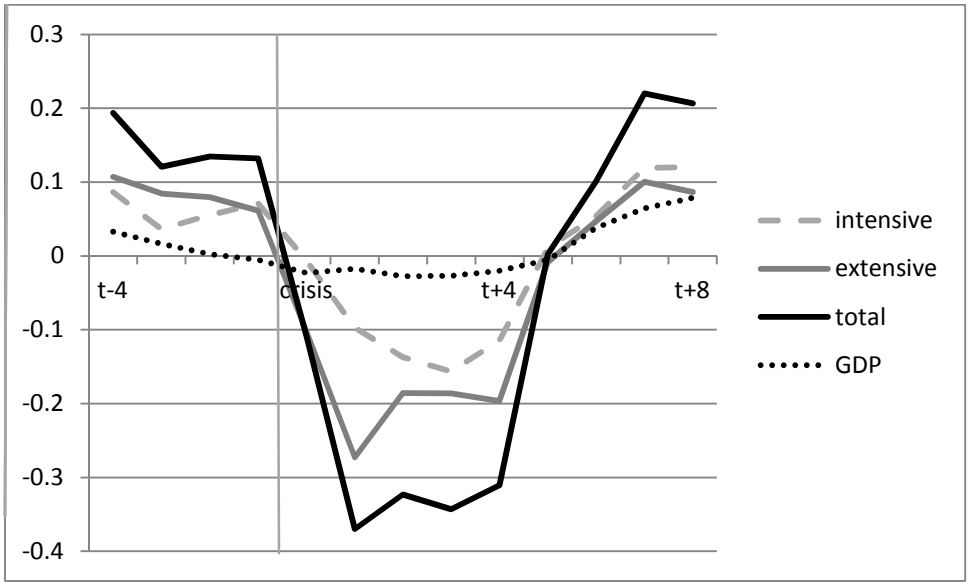


Exports start falling on the quarter preceding the crisis. The median growth rate of exports remains negative during four quarters following the crisis, and then quickly recovers close to its initial level after 6 quarters. The median drop in the growth rate of French exports is large and sudden, reaching more than 10 percentage points from peak-to-trough. In line with Freund (2009),; the drop in French exports is two to three times larger than the drop in GDP. The intensive and extensive margins of exports contribute evenly to the drop of French exports.

The extensive margin contributes more in case of banking and currency crises, as shown by Figure 3. The magnitude of the drop in exports as well as its relative magnitude compared to GDP variations, are also larger in case of more severe crises such as banking and currency crises.

An econometric analysis is however necessary to investigate further the determinants of the trade response to crisis episodes, and to disentangle the supply and demand determinants of the margins of adjustment during different types of crises.

Fig 3 : Median growth during banking and currency crises



4. Econometrics

In this section, we investigate the response of total export to demand shocks and other determinants related to crises, and the contribution of the intensive and extensive margins respectively. We estimate the following gravity-like equation in growth rate for a given destination country *j*:

$$G_{jt}^{m} = \alpha + \beta_1 \Delta \log GDP_{jt} + \beta_2 \Delta \log GDP_{jt} \times DT_{jt} + \beta_3 \Delta \log ER_{jt} + CU_{jt} + RTA_{jt} + \gamma_t + \sum_{t=crisis-4}^{crisis+8} crisis_{jt} + \varepsilon \qquad (1)$$

where ER_{jt} is the nominal exchange rate, CU_{jt} and RTA_{jt} are dummies for currency union and regional trade agreements respectively, and γ_t represents time dummies. Demand shocks are measured by the log change of GDP in the destination country. We also control for any specific trade response to demand shocks during crisis times by including an interaction between the log change of GDP and a downturn dummy (DT_{jt}), equal to one during quarters of negative growth after a crisis. Finally, we add a full set of lags (8 quarters) and forwards (4 quarters) of the crisis dummy to estimate any additional

impact not directly related to demand, that may be related to liquidity shortage or restriction of credit on the importer side, or risk aversion.

Results are presented in Table 2. The responsiveness of French exports to demand variations in the country of destination is much larger during crisis episodes than during times of growth. The elasticity of trade to GDP almost trebles, from 1.42 to 3.83. This result is in line with Freund (2009) finding on aggregate world exports during global downturns. The different composition of GDP and exports are likely to play a significant role in explaining this "overreaction" of export to GDP during crisis, the demand for heavily traded goods like durable or intermediate goods being more responsive in times of crisis (see e.g. Eaton et al. (2011) for evidence of composition effects during the 2008/09 trade collapse).

We also find an additional impact of crises on trade, not related to the drop in demand, beginning two quarters before our crisis dating. The crisis dummies contemporaneous to the crisis and after are insignificant. Figure 4 plots the predicted average growth rate of exports over all crises, and differentiates the growth related to GDP variations and additional factors. Predicted trade growth becomes positive again only 4 quarters after the beginning of the crisis.

Fig 4: Total trade response during crises

Differentiating the growth of French exports into the contribution of the extensive and intensive margins yields additional interesting results (see Table 2). Both margins respond significantly more to GDP variations during downturns than during periods of growth. The elasticity of the extensive margin to GDP is however larger than the elasticity of the intensive margin, suggesting that decisions of firms to enter/exit the market or add/drop products on that destination are more responsive to demand than their level of sales by product on that destination. Additional factors explain the response

of firms to crisis episodes along their intensive margin: crisis dummies are negative and significant for the intensive margin from two quarters ahead of the crisis date to one quarter after. The intensive margin of firms' exports does not only react to the drop in demand during a crisis, but also to a large extent to other dimensions of crisis not directly related to demand (see Figure 6). Overall, Figures 5 and 6 show that the intensive margin contributes more to the drop in French exports than the extensive margin.

Our results provide limited evidence of faster trade growth in the aftermath of crisis along the intensive margin only: the lagged crisis dummy for quarter 8 is positive and significant. It would suggest that trade partly catch-up to pre-crisis level trends, instead of only returning to its pre-crisis growth pace. The absence of such a catching-up process along the extensive margin of French exports suggests that missing flows - firms that exited the market or dropped products on that market, or decided not to enter because of the crisis – do not fully recover. Crises may therefore have a long run negative impact on the level of exports due to the exit of firm/product over a long period of time.

Fig 5: Extensive margin response during crises

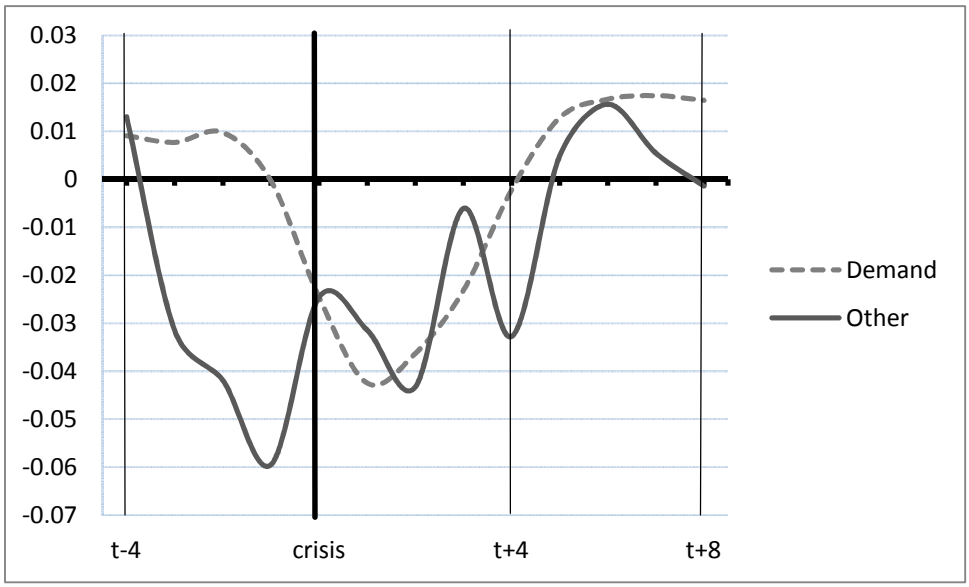


Fig 6: Intensive margin response during crisis

Table 2 : Baseline results

Variables	Total Growth	Extensive margin	Intensive margin
dlog_gdp	1.412***	0.948***	0.464***
	(0.290)	(0.293)	(0.082)
dlog_gdp * downturn	2.418***	1.363*	1.055***
	(0.798)	(0.722)	(0.373)
crisis - 4	0.023	0.002	0.021
	(0.047)	(0.043)	(0.021)
crisis - 3	-0.048	-0.040	-0.008
	(0.053)	(0.045)	(0.017)
crisis - 2	-0.076*	-0.053	-0.024*
	(0.046)	(0.042)	(0.014)
crisis - 1	-0.081*	-0.060	-0.020
	(0.043)	(0.043)	(0.019)
crisis	-0.052	0.004	-0.056***
	(0.062)	(0.058)	(0.017)
crisis + 1	-0.027	0.018	-0.045*
	(0.068)	(0.062)	(0.024)
crisis + 2	-0.021	0.009	-0.029
	(0.057)	(0.053)	(0.022)
crisis + 3	0.016	0.037	-0.021
	(0.059)	(0.051)	(0.028)
crisis + 4	-0.007	-0.018	0.010
	(0.065)	(0.058)	(0.023)
crisis + 5	-0.014	-0.001	-0.012
	(0.062)	(0.058)	(0.017)
crisis +6	0.010	-0.001	0.011
	(0.052)	(0.051)	(0.021)
crisis + 7	-0.000	-0.012	0.012
	(0.055)	(0.053)	(0.021)
crisis + 8	0.028	-0.018	0.046**
	(0.049)	(0.046)	(0.021)
dlog_exchange	0.127***	0.090**	0.037*
	(0.043)	(0.037)	(0.020)
CU	0.001	-0.002	0.003
	(0.013)	(0.012)	(0.005)
RTA	0.000	-0.006	0.006
	(0.019)	(0.017)	(0.008)
observations	2344	2344	2344
R^2	0.12	0.06	0.17

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

5. Differentiating crises

The aim of this section is to analyze further how crisis related factors beyond demand contribute to export growth . To this end, we differentiate crises by type, i.e. banking crises, currency crises, banking and currency crises and other crises, and focus on their impact, beyond demand variations, on each margin of trade. We estimate the following equation:

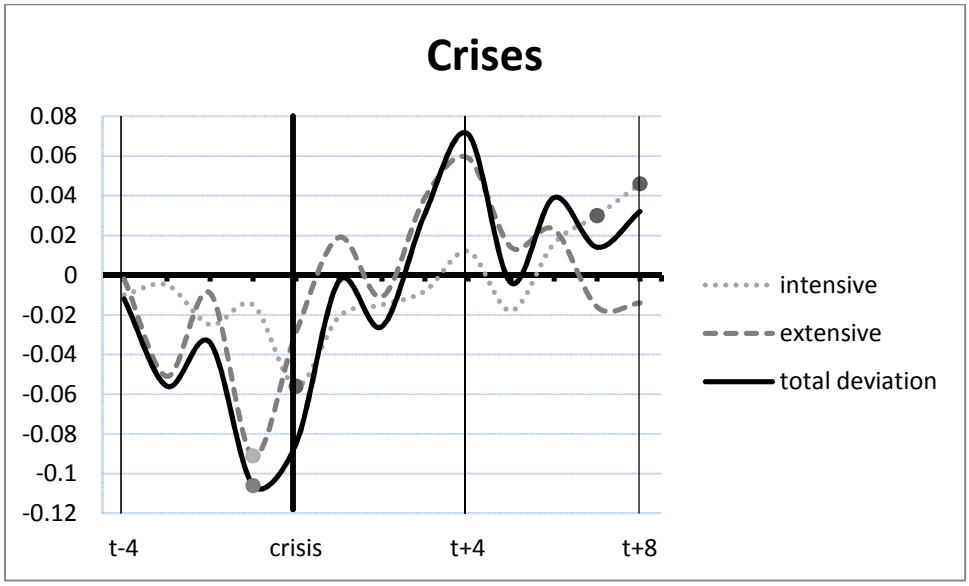
$$G_{jt}^{m} = \alpha + \beta_1 \Delta \log GDP_{it} + \beta_2 \Delta \log ex\_rate_{it} + com\ curr_{it} + reg\ agr_{it} + \gamma_t + \sum_{t=crisis-4}^{crisis+8} crisis_{it} + \sum_{t=crisis-4}^{crisis+8} banking_{it} + \sum_{t=crisis-4}^{crisis+8} currency_{it} + \varepsilon_{it} \quad (2)$$

where $banking_{it}$ and $currency_{it}$ are dummies equal to 1 in case of banking and currency crises respectively.

Due to the large number of dummies, we present the results in Figures 7 to 10, in which we plot the deviation from the natural level of growth of total export and the extensive and intensive margins, over a window period of 12 quarters around crises.

Figure 7 presents the case of crises episodes identified but involving neither banking nor currency crises. As expected, the additional impact of the crisis is low, with a significant negative impact on the intensive margin contemporaneous to the crises only, and a significant anticipated impact on total exports and on the contribution of the extensive margin one quarter ahead of the crisis. In the aftermath of the crisis, trade quickly follows demand variations. In the last two quarters of the window period, we identify a catching-up along the intensive margin of trade.

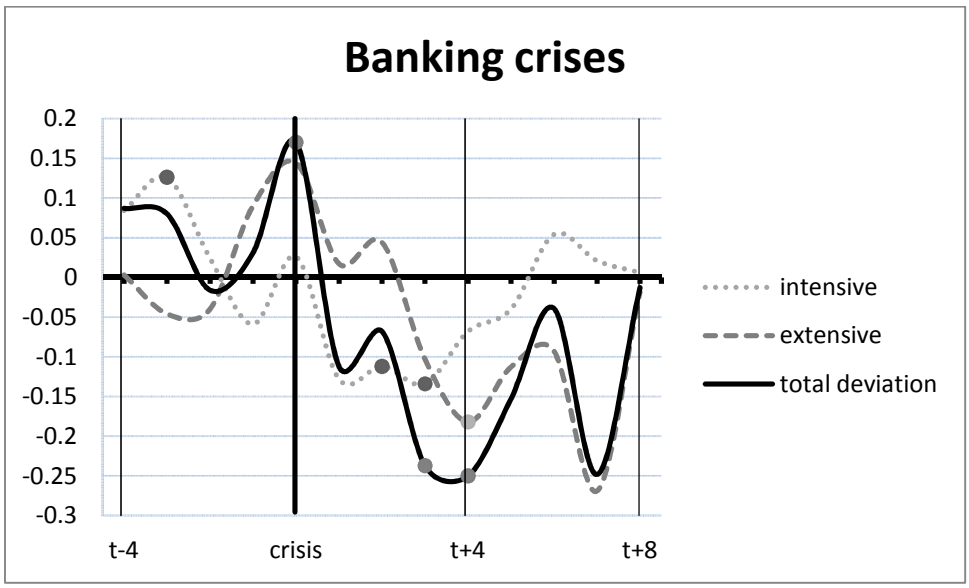
Fig 7: average export margin deviations during crises



Note: bullets indicate the significance of the estimated coefficients.

Figure 8 shows that banking crises have a large impact on French exports, and that their additional negative impact not related to demand variations is delayed, beginning 2 quarters after the beginning of the crisis only. Moreover, banking crises have a significant additional impact on total exports as well as along both margins of exports.

Fig 8: Average deviations from natural growth of trade during banking crises



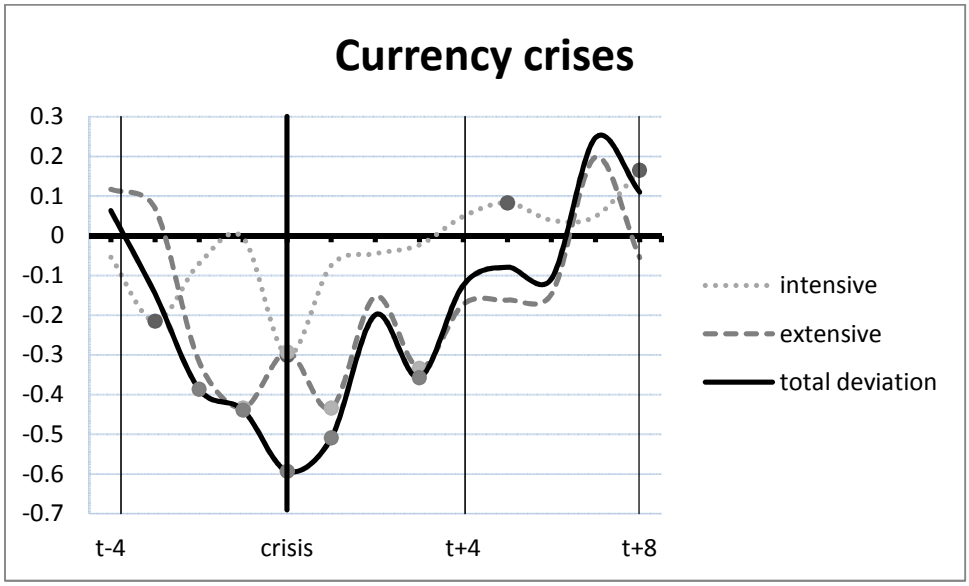
Note: bullets indicate the significance of the estimated coefficients.

Currency crises have a sudden and severe impact on exports, mainly driven by the extensive margin of exports. Large currency fluctuations mainly hit exporters through their extensive margin, i.e. firms exiting the market or dropping products on that market. French exports begin plumetting three quarters before the actual date of the crisis, but the largest additional impact is contemporaneous to the crisis. French exports then slowly recover, with some catch-up on the intensive margin at the end of the period, i.e. firms remaining on the market increasing their average sales more beyond demand growth.

Finally, joint banking-and-currency crises have the largest and most lasting impact on exports (Figure 10). They combine the severe impact of the currency devaluation on the extensive margin and the lasting impact of banking crises on the intensive margin. We identify a significant additional impact of banking and currency crises on French exports during 8 quarters, reaching a more than -45% yearly growth rate.

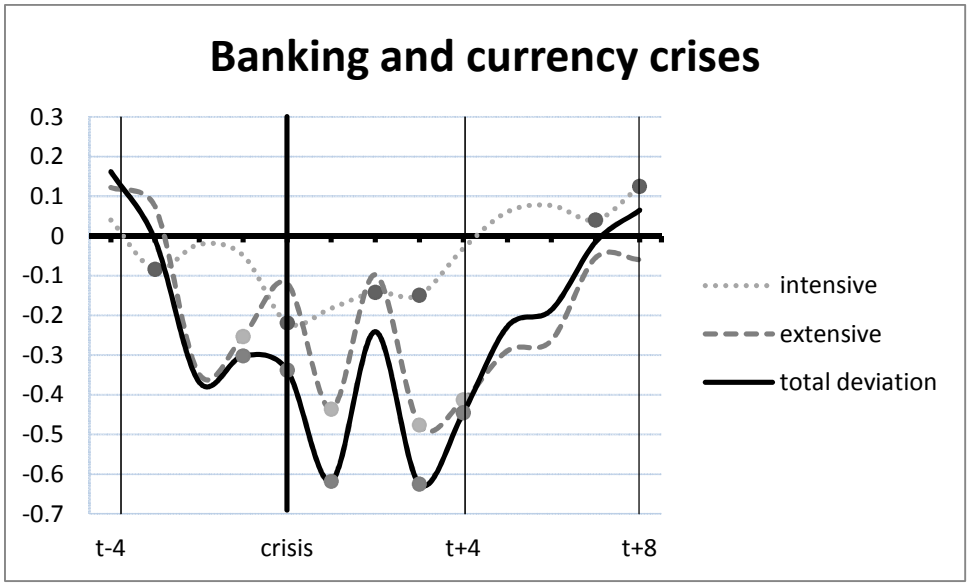
The impact of crises on exports not directly explained by demand variations depends crucially on the nature of the crisis. As expected, it is stronger and longer lasting for more severe crises. Currency crises mainly have a significant additional impact on the extensive margin, while banking crises mainly hit the intensive margin of exports.

Fig 9: Average deviations from natural growth of trade during currency crises



Note: bullets indicate the significance of the estimated coefficients.

Fig 10: Average deviations from natural growth of trade during banking and currency crises



Note: bullets indicate the significance of the estimated coefficients.

6. Conclusion

This paper analyzes the impact of past crises on exports. We differentiate the margin of adjustment of exporters using a very detailed French firm level dataset on a quarterly basis. Our quarterly data allow us to precisely estimate the timing and impact of the crisis. First, we use quantitative criteria to detect crisis periods, and classify them into real crises, banking crises, currency crises and simultaneous banking and currency crises. Then we investigate the impact of different crises on French firms' exports along the extensive and intensive margins of trade, and distinguish responses to demand variations from other factors.

Our analysis underlines the prevalence of the intensive margin of adjustment to large shocks, i.e. firms reducing their average sales per product while staying on the market. The extensive margin of trade is however dominant in currency crises. On average, a crisis reduces the growth rate of exports over six quarters. Finally, we show that exports overreact to GDP variations during crises, and that the extensive margin is more responsive to demand. Other factors not directly related to demand weight significantly on the extensive margin in case of currency crisis and on the intensive margin in case of banking crisis.

Appendix: data

Trade data are from the French customs and report export flows by firm, country of destination and product (Combined Nomenclature 8 digits) for all individual French exporters on a quarterly basis. The period covered is 1995Q1 to 2006Q4. Two different declaration thresholds apply to individual firms. When exporting to non-EU countries, firms have the legal obligation to declare all flows exceeding 1000€. When exporting to EU countries, firms have to declare their exports when the cumulated value of their exports exceeds 150.000€ over the year. Since the latter threshold as well as the number of EU member states have changed between 1995 and 2006, we apply the 150.000€ threshold to all 24 other EU member states as of end 2006.

Quarterly data for GDP (volume) and exchange rates over the considered period is provided by the IMF International Financial Statistics (55 countries) and by the OECD (30 countries). GDP data from the IMF are not deseasonalized as is the case of the OECD data. Problems of homogeneity might appear as a result; we therefore compare both datasets on 16 common countries and confirm that the variations are similar.

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