

Imported or Home Grown? The 1992-3 EMS Crisis

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ABSTRACT

Using newly assembled data on foreign exchange market intervention, we construct a daily index of exchange market pressure during the 1992-3 crisis in the European Monetary System. Using this index, we pinpoint when and where the crisis was most severe. Our analysis focuses on a neglected factor in the crisis: the role of the weak dollar in intra-EMS tensions. We provide new evidence of the contribution of a falling dollar-Deutschmark exchange rate to pressure on EMS currencies.³

Keywords: European Monetary System, exchange rates, foreign exchange intervention, currency crisis.

JEL classification: F31, E5, N14, N24

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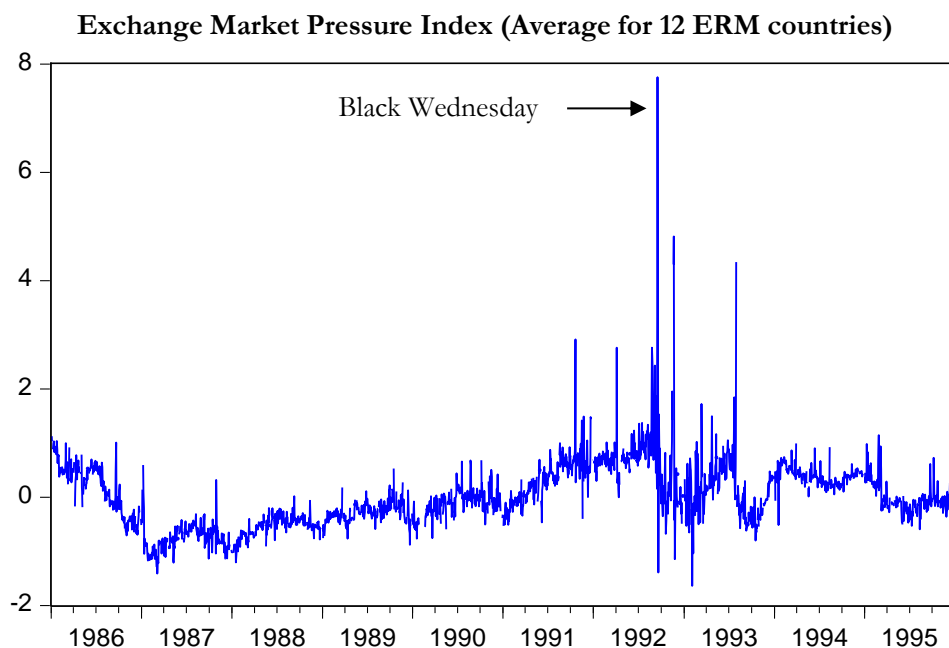
NON-TECHNICAL SUMMARY

The 1992-3 crisis in the European Monetary System was a decisive event in Europe's monetary history. It underscored the fragility of pegged exchange rates between national currencies and, in so doing, reinforced the commitment of members of the European Union to complete the transition to monetary union.

But there is a decided lack of consensus, even now, three decades after the event, about the causes of the crisis and consequently its implications. A first class of explanation, points to problems of economic policy and performance in countries whose currencies were attacked. Sterling was overvalued at the parity at which it entered the Exchange Rate Mechanism (ERM). Italian debts and deficits were too large. Banking systems were insolvent in the Scandinavian countries that shadowed the system.

A second explanation emphasizes the fragility of exchange rate pegs in an environment of high capital mobility. A capital outflow, whatever its causes, can produce the problems of economic policy and performance that cause a currency to come under attack, leading its defense to be abandoned. For example, when Denmark rejected the Maastricht Treaty in a referendum on June 2, 1992, casting doubt on the prospects for monetary union, capital flowed out of other ERM members. In response, Britain was forced to raise interest rates, weakening its housing market and competitiveness. Interest rate rises increased Italy's debt-service costs and weakened the budget. They aggravated Scandinavia's banking crises. The outflow, even if its causes were incidental, increased the costs of maintaining ERM parities, leading governments to throw in the towel.

German interest rates figure in both of these stories. Starting with reunification in 1990, the Federal Republic ran large budget deficits, supplementing the incomes of former East Germans and upgrading infrastructure in the region. The Bundesbank, concerned that those deficits would fuel inflation, raised policy rates in response. This drew funds toward Germany and away from its EMS partners, in turn requiring higher interest rates of the latter to stem the outflow.



Source: Authors' calculations based on data from the archives of the Bank of England and other sources.

By comparison, economists and historians have paid less attention to a third class of explanation that we highlight here. This is that ERM parities were destabilized by events outside Europe. Dollar weakness was associated with flows from the greenback to the Deutschmark, the closest substitute for the U.S. currency as it was offering Europe's largest and most liquid securities market at the time (Giavazzi and Giovannini 1989). The Deutschmark therefore rose against other ERM currencies, placing the latter at risk of breaching their bilateral divergence margins. This phenomenon of a weak dollar leading to a strong Deutschmark and intra-ERM tensions was noticed prior to the crisis; it was known as "dollar-Deutschmark polarization." The implication was that the EMS crisis was imported, at least in part, not home grown.

We use new archival evidence on foreign exchange market intervention recently declassified by the Bank of England and available in its archive. We collect daily data from 14 European countries, summing up to more than 500,000 daily observations spanning the period 1986-1995. While our data offers intervention in various currencies, we mainly focus on interventions in Deutschmark. We use those intervention data, together with exchange rates and interest rates, to construct a daily measure of exchange market pressure, shown above. That series allows us to pinpoint when and where the 1992-3 crisis was most intense. It shows that pressure on EMS currencies started building well before the Danish referendum, usually presented as the starting point of the crisis. It points to a fateful interview by Bundesbank President Schlesinger prior to the September 1992 French referendum on the Maastricht Treaty as the event triggering the most acute phase of the crisis.

Importée ou interne ? la crise du SME de 1992-93

RÉSUMÉ

À l'aide de données nouvellement recueillies sur les interventions des banques centrales sur le marché des changes, nous construisons un indice de pression de marché des changes (EMP) pour la crise du Système Monétaire Européen (SME) de 1992-93. Cet indice nous permet de déterminer quand et où la crise a été la plus grave. Notre analyse se concentre sur un facteur négligé dans la crise du SME: la chute du dollar par rapport au mark allemand créant des tensions à l'intérieur du SME. Nous apportons de nouvelles preuves de la contribution de la baisse du taux de change entre le dollar et le mark allemand à la pression exercée sur les monnaies du SME.

Mots-clés : Système Monétaire Européen, marché des changes, intervention des banques centrales, crise des changes.

Les Documents de travail reflètent les idées personnelles de leurs auteurs et n'expriment pas nécessairement la position de la Banque de France. Ils sont disponibles sur publications.banque-france.fr

1 Introduction

The 1992-3 crisis in the European Monetary System was a decisive event in Europe's monetary history. It underscored the fragility of pegged exchange rates between national currencies and, in so doing, reinforced the commitment of members of the European Union to complete the transition to monetary union.²

But there is a decided lack of consensus, even now, three decades after the event, about the causes of the crisis and consequently its implications. A first class of explanation, inspired by first-generation models of currency crises (e.g. Krugman 1979), points to problems of economic policy and performance in countries whose currencies were attacked. (See e.g. Tietmeyer 1998.) Sterling was overvalued at the parity at which it entered the Exchange Rate Mechanism (ERM). Italian debts and deficits were too large. Banking systems were insolvent in the Scandinavian countries that shadowed the system.³

A second explanation (e.g. Eichengreen and Wyplosz 1993, Ozkan and Sutherland 1995) emphasizes the fragility of exchange rate pegs in an environment of high capital mobility, consistent with so-called second generation models of currency crises (e.g. Obstfeld 1994). In these models, a capital outflow, whatever its causes, can produce the problems of economic policy and performance that cause a currency to come under attack, leading its defense to be abandoned. For example, when Denmark rejected the Maastricht Treaty in a referendum on June 2, 1992, casting doubt on the prospects for monetary union, capital flowed out of other ERM members. In response, Britain was forced to raise interest rates, weakening its housing market and competitiveness. Interest rate rises increased Italy's debt-service costs and weakened the budget. They aggravated Scandinavia's banking crises. The outflow, even if its causes were incidental, increased the costs of maintaining ERM parities, leading governments to throw in the towel.

German interest rates figure in both of these stories. Starting with reunification in 1990, the Federal Republic ran large budget deficits, supplementing the incomes of former East Germans and upgrading infrastructure in the region. The Bundesbank, concerned that those deficits would fuel inflation, raised policy rates in response (James 2020, p.284). This drew funds toward Germany and away from its EMS partners, in turn requiring higher interest rates of the latter to stem the outflow. In the "first-generation" interpretation (e.g. Svensson 1994, Sinn 1996, Soderlin 2000), the result was less investment, less growth, less competitiveness, and higher debt-service costs, culminating in balance-of-payments deficits and, ultimately, a crisis. In the "second-generation" interpretation (Eichengreen 2002, Saqib 2002), having to raise interest rates in order to match the Bundesbank tipped the balance of costs and benefits of defending ERM pegs, leading governments to abandon them.

² We say "reinforced" because the Delors Report and Maastricht Treaty preceded the crisis. The statement in the text could be qualified by adding "most EU members," since the UK and Denmark obtained opt outs.

³ Scandinavian central banks were not members of the EMS, but they pegged their currencies to the Deutschmark or ecu, albeit without the support from other European central banks afforded to formal members of the system. We include them in our analysis because contemporary accounts clearly saw developments in these countries as highly relevant to the fate of the ERM.

By comparison, economists and historians have paid less attention to a third class of explanation that we highlight here. This is that ERM parities were destabilized by events outside Europe. A limited literature points to the weakness of the U.S. dollar as heightening tensions within the EMS.⁴ Dollar weakness was associated with flows from the greenback to the Deutschmark, the closest substitute for the U.S. currency.⁵ The Deutschmark therefore rose against other ERM currencies, placing the latter at risk of breaching their bilateral divergence margins. This phenomenon of a weak dollar leading to a strong Deutschmark and intra-ERM tensions was noticed prior to the crisis; it was known as “dollar-Deutschmark polarization.”⁶ The implication was that the EMS crisis was imported, at least in part, not home grown.

These three classes of explanation are not mutually incompatible, as signaled by the “in part” in the preceding sentence. However, the third explanation was particularly disturbing. It suggests that even if European governments and central banks managed their economic and financial affairs well, the exchange rate system could still be upended by extra-European events. One long-standing motivation for creating a single European currency was to free Europe from the thrall of the dollar.⁷ The 1992-3 EMS crisis, to the extent that it was attributable to dollar weakness, reinforced the perceived urgency of completing the task. This is not the entire explanation for the advent of the euro. But it is an important aspect.

We develop this argument about the role of the dollar in the EMS crisis with two types of evidence. First, we draw on primary and secondary sources to document that contemporaries were aware and concerned about dollar weakness and dollar-Deutschmark polarization. Second, we show that movements in the dollar-Deutschmark exchange rate explain a significant fraction of the pressure on EMS currencies in this period.

Our statistical analysis is based on new data on foreign-exchange market intervention by EMS central banks between 1986 and 1995, years spanning the crisis. We use them to construct daily measures of exchange-market pressure. This allows for greater precision in distinguishing sources of pressure on ERM exchange rates, compared to previous studies that used monthly or even lower frequency data and/or were forced to neglect foreign-exchange market intervention. Our data were assembled by European central banks on a confidential basis; we are able to access them because of a change in policy governing the delay in making available to researchers material in the British official archives, including those of the Bank of England, which shortened the period of delay from 30 to 20 years.

Section 2 describes the institutional background; it is mainly for readers unfamiliar with the EMS. Section 3 then introduces and describes our data, after which which Section 4 uses them to construct a composite measure of exchange-market pressure. Section 5 provides an analytical

⁴ The contributions developing this point, of which we are aware, include Harmon and Heisenberg (1993), Edison and Kole (1995), Truman (2002), James (2012) and Gros (2014).

⁵ Exactly why the Deutschmark was a closer substitute than other EMS currencies for the dollar need not detain us here. Giavazzi and Giovannini (1989) suggest that the market in DM-denominated securities was larger and more liquid than markets for other European securities, in this respect more closely resembling the dollar. Habib and Stracca (2011) point to low public debt and low external vulnerability as well as to high market liquidity. Contemporaries such as Karl Otto Pohl pointed to the Bundesbank’s commitment to price stability (Mee 2019).

⁶ See for example Brown (1979), Giavazzi and Giovannini (1989), and Haldane and Hall (1991).

⁷ Discussion and references are in Dyson and Featherstone (1999) and James (2012)

narrative of the crisis, informed by the data of Sections 3 and 4. In Sections 6 and 7 we present evidence of the role of dollar weakness in the 1992-3 crisis. Section 8 concludes.

2 Background

The Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) was a system of currency bands established in 1979 to limit currency-related tensions and foster monetary integration.⁸ It succeeded an earlier European arrangement, the Snake, whose operation was less satisfactory.⁹

The ERM committed central banks to maintain central parities surrounded by $2\frac{1}{4}$ per cent fluctuation bands. New members who joined subsequently, such as the UK, Ireland and Portugal, were obliged to keep their currencies within ± 6 per cent bands vis-a-vis those of other members, with the expectation that they would eventually move to narrow $\pm 2\frac{1}{4}$ per cent bands. Although all currencies were formally pegged to the European Currency Unit, or ecu, in practice the Deutschmark was the anchor of the system, since it was the strongest currency and was expected to remain so (Giovannini 1989, Abdelal 1998). The task for other central banks thus became to adjust interest rates and policies to conform to those of the Bundesbank.

When negotiating the EMS agreement in 1978-9, German officials sought to strengthen the incentive for weak-currency countries to adjust their parities and policies, while their French counterparts pushed for more extensive foreign support. Both sides had to compromise. Germany dropped its proposal for obligatory adjustments in domestic policies, while France deferred its proposal for a European Monetary Fund to manage the combined foreign-exchange reserves of the participating countries and intervene in foreign exchange markets.¹⁰ Although the EMS Act of Foundation spoke of foreign support “unlimited in amount,” German officials worried that such support would encourage lax policies and be an engine of inflation. An exchange of letters between the German finance minister and Bundesbank President Otmar Emminger therefore affirmed that the German central bank was entitled to opt out of its intervention obligation in the absence of what it judged to be appropriate adjustments by foreign central banks participating in the system.¹¹

⁸ European officials were keen to limit variability, given their recollections of disruptive exchange rate changes in the 1930s and the perception that haphazard currency adjustments might cause trade-related dislocations within the European Economic Community and fan opposition to the Single Market. There was also the technical and political difficulty of operating the Common Agricultural Policy, with its domestic-currency-denominated support prices, in an environment of variable exchange rates. See Gros and Thygesen (1992).

⁹ The Snake suffered from a variety of problems. Energy and commodity market shocks starting in 1973 affected different currencies differently, given that reliance on imported petroleum and commodities varied by country. Domestic policy adjustments and foreign support for weak-currency countries failed to eliminate the resulting imbalances. As yet, there was no consensus that monetary policy should be directed toward the maintenance of specific goals, price- and exchange-rate stability for example. And the European Monetary Cooperation Fund through which participants in the Snake were supposed to provide mutual assistance possessed limited resources and authority.

¹⁰ Technically, France only deferred its proposal for this institution for two years, but the second oil shock quickly put paid to its ambitions.

¹¹ This note, known as the Emminger Letter, is discussed in Eichengreen and Wyplosz (1993). We return to it below.

No EMS member was forced to abandon the system prior to 1992. Instead, parities were modified periodically to eliminate imbalances and vent the pressure on weak currencies. Parity realignments occurred once every eight months on average in the first four years of the EMS.

This recourse to periodic realignments was facilitated by restrictions on cross-border financial transactions. These capital controls limited the scope for speculators to sell a weak currency if they got wind of a government's realignment intentions. It was therefore possible for governments to discuss and organize realignments without precipitating a crisis.

This changed with the agreement in 1986 to create, within six years, a Single Market with free movement of goods, services, labor and, most consequentially in this context, financial capital. European governments were obliged to relax and remove their controls, consistent with this fourth freedom, which allowed growing volumes of capital to flow across borders.¹² Even raising the possibility of currency realignments became problematic, since such talk might cause capital to flow out of the currency to be realigned downward, producing a self-fulfilling prophecy.

The period from 1987 through 1991 thus saw only two realignments: a last general realignment in January 1987, when capital controls were still prevalent, and a quasi realignment of the Italian lira in January 1990, which really only entailed Italy moving from the wide to the narrow band. This record was seen as evidence of success. It made the EMS attractive as an anchor for additional central banks. Finland, Sweden and Norway adopted pegs to the ecu or the Deutschmark to anchor their monetary policies.¹³

Whether this stability could be maintained in an environment of high capital mobility was uncertain, however, a problem that did not escape the attention of European leaders. Their response was the Delors Committee, which drafted the blueprint for the transition to a single European currency that became the Maastricht Treaty in February 1992, when political leaders endorsed the Committee's vision at a summit in the eponymous Dutch town.¹⁴

According to the treaty, countries had to keep their currencies stable within the ERM, without "undue pressure" and satisfy a set of other criteria in order to qualify for participation in the monetary union to come into existence by 1999. So long as the transition to a single European currency remained on course, governments and central banks, seeking to participate in Europe's signature project, had an incentive to pursue policies, however difficult and painful, designed to hold their currencies stable and gain admission to the club. Conversely, anything casting doubt on the inevitability of that project could raise questions about their commitment to such policies.

It was left only for European publics and their elected representatives to ratify the Maastricht Treaty. But European publics had qualms about replacing their national currencies with a single European unit and ceding control of monetary policy to a European central bank.

¹² There were still a few capital controls in countries with a history of currency weakness, Portugal and Ireland for example, but their presence did little to alter the story.

¹³ They were not, however, formal members of the system, as noted above, and did not stand to receive support, financial or otherwise, from EMS central banks.

¹⁴ More precisely, leaders met in Maastricht in December 1991; the signing session involving leaders, but also in some cases their delegates, was then in February 1992.

These ratification debates took place against the backdrop of German reunification, which occurred in 1990 and was relevant for two reasons. First, reunification implied increases in public spending on infrastructure and income support for the poor, often unemployed residents of Germany's new eastern *lander*. The resulting budget deficits fuelled inflation, causing the Bundesbank to raise its discount rate.¹⁵ In an environment of high capital mobility, other central banks had to follow suit or experience financial outflows and exchange-market pressure.

Second, German reunification created an additional argument for the Maastricht Treaty. A larger, more muscular Germany was perceived as potentially threatening its European neighbors (Berdahl 2005). Monetary unification, as an additional step in deepening the European Union, was a way of locking Germany peacefully into Europe (Bubow 2013). Relatedly, the leaders of other European countries, such as Francois Mitterrand of France, who desired monetary unification on other grounds, were able to secure German support for the initiative in return for acquiescing to reunification.¹⁶

3 Data

To understand what happened next, we should pause and describe the data.¹⁷ Our data on foreign exchange intervention are drawn from the Bank of England archives. We extracted more than 500,000 daily observations spanning the period 1986-1995 for all major European central banks.¹⁸ Interventions were recorded and summarized in daily reports by the dealers of the Bank, who oversaw purchases and sales of foreign exchange and related derivatives.¹⁹ The documents reflect reports received and tabulated of intervention by the Bank of England itself but also other central banks.

We have data for the central banks of the following ERM countries: Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain and the UK. In addition, there are data for four non-EMS countries whose currencies were pegged to the ecu or the DM: Finland, Greece, Norway and Sweden.²⁰ Bank of England records on intervention on the last five days of

¹⁵ It did so in a series of 50-basis-point steps, from 6 per cent at the end of 1989 to 8 per cent at the end of 1991, and then by 75 basis points to 8.75 per cent in July 1992.

¹⁶ There is dispute over the explicitness of this linkage (Sauga, Simons and Wiegrefe 2010).

¹⁷ A fuller description of the data used in this paper is in Appendix A.

¹⁸ Brandner, Grech and Stix (2006) also used data from concertation protocols (these authors were associated with the Austrian financial ministry and central bank, enabling them to access confidential data), but for a shorter period and a smaller set of central banks.

¹⁹ The full reference is 'Foreign Exchange and Gold Markets: Dealers' Regular Internal Reports,' 1986-1995, London, Archives of the Bank of England, references C8/66 to C8/110.

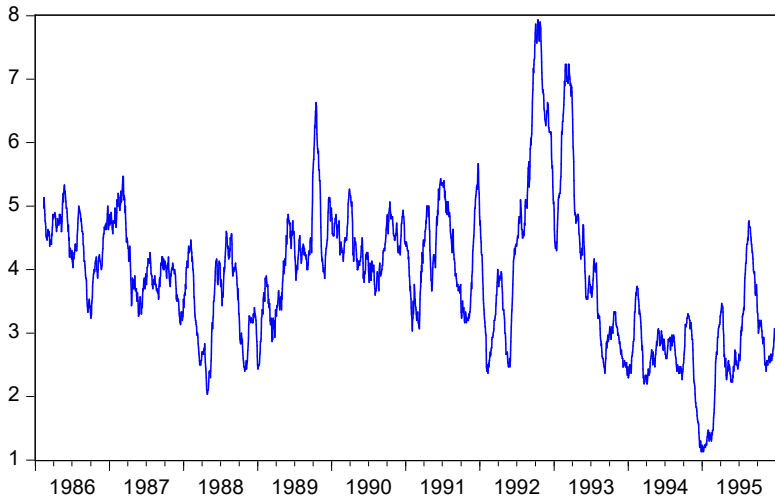
²⁰ Although the concertation data do not distinguish interventions in different currencies by the Bank of England, for all other central banks they do. Other documents released by the British government indicate that most Bank of England intervention was in Deutschmarks. On Black Wednesday for example, other documentation shows that the \$22 billion of reserves expended by the Bank of England were in entirely in Deutschmarks (see http://webarchive.nationalarchives.gov.uk/20130129110519/http://www.hm-treasury.gov.uk/ukecon_eea_index.htm).

the crisis (at the end of July 1993) have not yet been declassified; we fill these in using data from the Bundesbank archives.

This information was shared by central banks through a process known as “the concertation.” Concertation means the mutual exchange of information. This exchange was a way for central banks to monitor use of their currency by other members.²¹ Brandner, Grech and Stix (2006) describe the timing as follows. On each day, central banks reported purchases and sales of foreign exchange in four concertation rounds. They tell us that the first round was at 9:30 a.m. and the last round was at 4:00 p.m, coincident with the London market close.²² “The intervention data are therefore cumulated intervention volumes for a time period of 24 h, starting from 4:00 p.m. previous day until 4:00 p.m. today. Interventions undertaken after 4:00 p.m. are reported in the first concertation round the next day at 9:30 a.m. and are included in next day’s intervention figure. At each concertation session, central banks had to supply the volumes of spot interventions in Community and non-Community currencies and other transactions leading to changes in reserves.”²³

Concertation data were meant to be comprehensive. Consistent with Brander, Grech and Stix’s reference to “spot interventions...and other transactions,” we take these figures as capturing interventions on both spot and forward markets. These interventions should be interpreted as sterilized – that is, as offset by liquidity operations so as not to affect interest rates.

Figure 1. 30-Day Moving Average of the Number of Central Banks Intervening per Day



Note: 30-day moving average of the daily count of the number of central banks intervening on a given day. Based on the 12 ERM central banks, so the maximum is 12.

Figure 1 shows a 30-day moving average of the number of central banks intervening. It points to two peak periods: in September 1992 (around the time of the French referendum on the Maastricht Treaty and Black Wednesday, when sterling left the ERM), and in February-March

²¹ It may have also discouraged offsetting interventions and avoided introducing volatility into the market.

²² The Bundesbank Archives tell us that the two mid-day concertations were at 11:30 am and 2:15 pm.

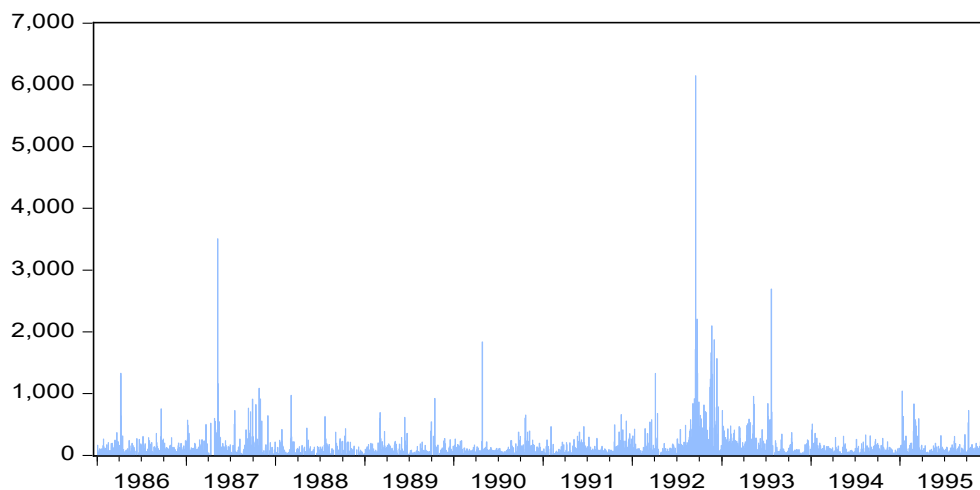
²³ Brandner, Grech and Stix (2006), p.583.

1993, (which saw pressure on the currencies of Belgium, Denmark, Portugal and Spain).²⁴ The final crisis of the system, in late-July-early-August 1993 does not show up in this 30-day moving average, since intervention was concentrated in only a few days.

That final crisis does show up, however, when we consider the value of intervention. Figure 2 plots the daily average of the value of all Deutschmark interventions. The figure highlights the exceptional magnitude of interventions in 1992-1993 compared to the rest of the sample. The first peak was on September 16, 1992, Black Wednesday, when Britain left the ERM, spending \$22 billion, and when the Bank of Italy spent nearly \$6 billion in support of the lira. The second peak, as noted, was in July 1993, just prior to when ERM bands were widened in response to pressure on the French franc and other currencies.

Figure 2 shows the existence of substantial interventions even before the crisis. In particular, there were sizeable interventions by the Bank of France and Bank of England – in both directions – in 1986-7, around the time of the Plaza and Louvre Accords (agreements on the part of G5 countries to weaken and strengthen the dollar, respectively) and the last ERM general realignment, and somewhat smaller ones in 1989-90, an earlier period of dollar stress.²⁵ The Bank of Italy intervened repeatedly to both support and restrain the lira. But those earlier interventions were sporadic, in the French and British cases, or small, in the Italian case, relative to what came later. We then see large, persistent interventions in 1991-2 by Finland, Sweden and Italy, three of the first countries to feel the crisis. We see an even larger number of substantial, persistent interventions in the second quarter of 1992 when the crisis spreads.

Figure 2. Average Deutschmark Intervention by ERM countries, \$ m.



Note: Average size of all interventions in DM on a given day expressed in US dollars. The figure is the sum of the absolute value for intervention for each country and includes DM sales and purchases.

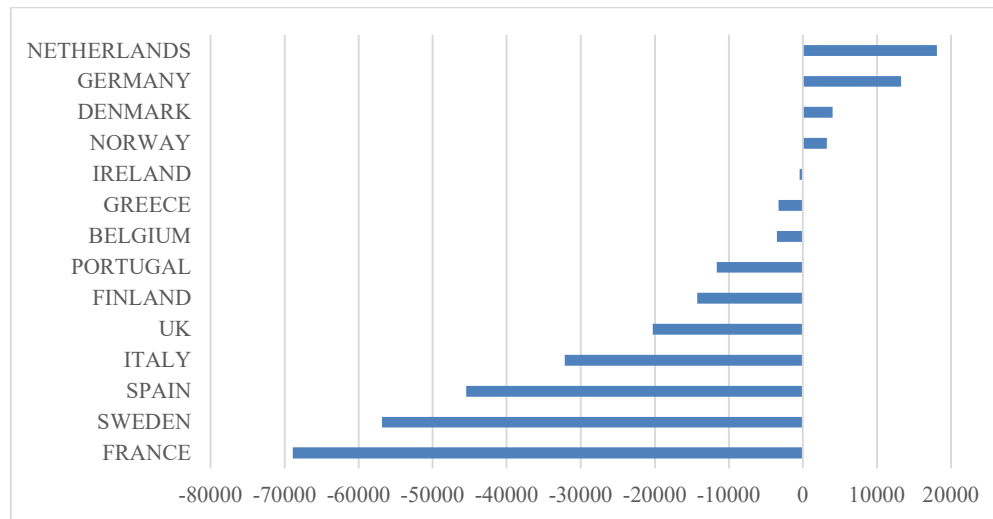
Figure 3 focuses on the crisis period, showing total net interventions by individual central banks. It highlights the magnitude of Sweden’s interventions, not just relative to the size of its

²⁴ The earlier peak in the series, in 1989, marks an episode late in the year when multiple central banks intervened to support their currencies (Galati and Melick 2002).

²⁵ The UK only entered the ERM in 1990. But 1987-88 was when the British government adopted a policy of shadowing the DM at the level of DM3 = £1, which led to some large purchases of DM by the Bank of England.

economy and financial system but also absolutely. It highlights the magnitude of the intervention commitments of France, Italy and Spain. Much has been made of the extent of intervention by the Bank of England in September 1992. Figure 3 reminds us that it was not alone.

Figure 3. Intervention Net Totals, June 2, 1992 –August 2, 1993 (\$ m.)



Source: Authors' calculation based on the Bank of England dealers' reports (C8).

Table 1. Interventions as a Share of Liquid Liabilities

	Liquid Liabilities for 1992-93 (million of 2000 dollars)	Overall intervention during ERM crisis (\$ million)	Ratio
Belgium	256062	-3514	1.4%
Denmark	128698	4022	3.1%
France	1150000	-68892	6.0%
Germany	1900000	13257	0.7%
Ireland	36415	-434	1.2%
Italy	967744	-32184	3.3%
Netherlands	401047	18113	4.5%
Portugal	117334	-11644	9.9%
Spain	553716	-45473	8.2%
UK	885553	-20274	2.3%
Finland	83152	-14272	17.2%
Greece	79567	3255	4.1%
Norway	101909	3255	3.2%
Sweden	141561	-56824	40.1%

Note: Aggregate intervention during the crisis period June 2, 1992 - August 1, 1993. *Data for Germany include DM operations with all other European currencies. The positive numbers for Germany and the Netherlands indicate the amount of purchases of other European currencies for Deutschmarks and guilder. Source: Authors' calculation based on the Bank of England dealers' reports (C8) and FRED for liquid liabilities.

Another perspective is Table 1, which scales crisis-period interventions by domestic financial markets. Sweden’s interventions seem even more extraordinary so scaled. Finland’s interventions also stand out. Smaller by this scale but still extensive were interventions by the central banks of Spain, Portugal, Ireland and Denmark. Interventions by the Bank of Italy, the Bank of England and the Bank of France look more modest when scaled by liquid liabilities.

Table 1 also shows that interventions in support of other ERM currencies by the Bundesbank and the central banks of the Benelux countries were small. The obligations of countries whose currencies were approaching the top of their bands were formally the same as the obligations of central banks whose currencies were approaching the bottom, but the difference in the magnitude of restraining and defending interventions shows that this was not the practice.²⁶

4 Exchange Market Pressure

We now construct an Exchange Market Pressure (EMP) index for each country. These indices combine the change in the exchange rate, the interest rate differential vis-a-vis the core currency, and the change in reserves, captured here by intervention. Using intervention data enables us to increase the frequency of the index and makes conceptual sense. Compared to the change in reserves, intervention better captures actual pressure on the exchange rate, since reserves can change for reasons unrelated to the exchange rate and its management.²⁷ Reserves can be manipulated or window dressed, since central banks are aware that poor reserve data can affect sentiment adversely.²⁸ Intervention data, being confidential, should be relatively free of this problem.

We combine our data on foreign exchange intervention with readily available series on exchange rates and interest rates. Exchange rates are for the end of the trading day. Interest rates are central bank policy rates (rates for marginal lending operations.) The formula is:

$$EMP = \frac{\Delta e_t - \mu_e}{\sigma_e} - \frac{\nabla r_t - \mu_r}{\sigma_r} - \frac{int - \mu_{int}}{\sigma_{int}}$$

where Δe_t is the change in exchange rate, ∇r_t the differential between the interest rate in a given country and in Germany, and int is intervention. μ and σ are means and standard deviations of the respective variables. Pressure (EMP) increases when the exchange rate depreciates, the central bank has to raise its policy interest rate relative to Germany (the ERM anchor country) and/or intervention is extensive. Following standard practice, each constituent

²⁶ Recall our discussion of the Emminger Letter in Section 2 above.

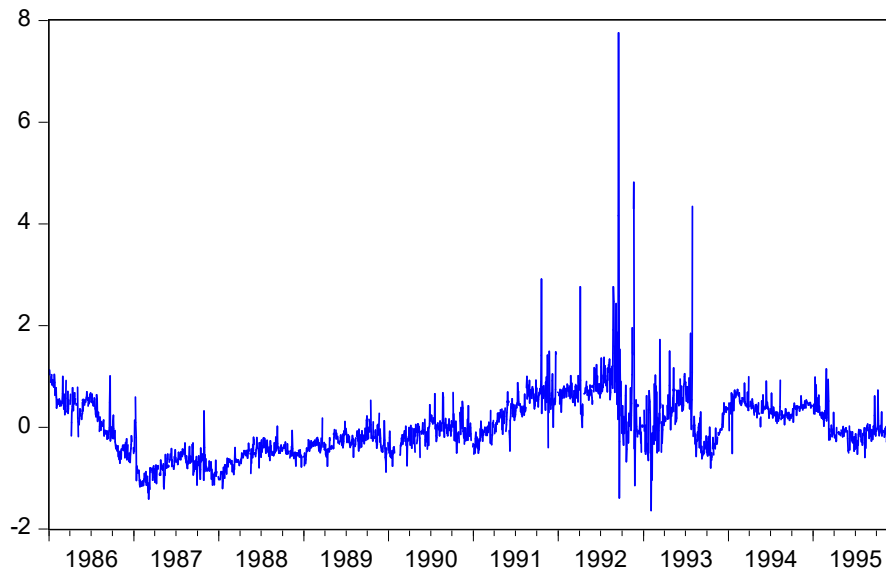
²⁷ It is conceivable that some reported interventions reflected efforts to rebalance the currency composition of the reserve portfolio (to rebuild foreign currency reserves after a period of exchange rate weakness had passed) or efforts to assist other central banks in their efforts to rebuild their reserves, as opposed to attempts to actively influence the direction or rate of change of the exchange rate. Brander, Grech and Stix mention this as well. These operations would entail mainly sales of local currency, which we refer to as restraining intervention, and not the sale of foreign currencies, referred to as defending interventions, where most scholarly and popular interest centers on the latter.

²⁸ See Naef (2019) on window dressing.

of the pressure index is expressed relative to its average (to account for different scales) and normalized by its standard deviation (to account for different average volatilities).

Figure 4 shows the average of EMP for the 12 countries: 9 ERM countries excluding Germany (the Deutschmark being the reference currency in the constructions of the EMP index) plus the three Nordics shadowing the system. It suggests a progressive buildup of pressure, which peaks on 16 September, 1992, Black Wednesday. Pressure then drops, although there are subsequent spikes linked to crises in different countries.²⁹ The individual country figures (in Appendix B) confirm that the spikes in pressure in 1991 reflect problems in Finland, Sweden and Portugal (more on which below). In 1992, exchange market pressure is evident in a number of different countries, although the case of the UK stands out. The further spike in 1993 was a French phenomenon.

Figure 4. Exchange Market Pressure Index (Average for 12 ERM countries)



Source: Authors' calculations

5 Analytical Narrative of the Crisis

We now use these indices to construct a new analytical narrative of the EMS crisis.³⁰ Table 2 lists the ten highest Europe-wide values for EMP over the period. The first column shows the average Europe-wide value, subsequent columns individual country levels.

²⁹ The negative spike in February 1993 reflects a large obligatory intervention supporting the Danish krone by the Netherlands Bank (see below).

³⁰ Earlier narratives are based on official reports from central banks and international organizations and on newspaper accounts. Our narrative is based instead on our daily indices of exchange market pressure.

Table 2. Top Ten Daily Values of EMP Index, Europe-Wide Average

Average	BELGIUM	DENMARK	FINLAND	FRANCE	IRELAND	ITALY	NETHERLANDS	NORWAY	PORTUGAL	SPAIN	SWEDEN	UK	
April 3, 1992	2.8	1.5	0.3	15.2	0.5	1.0	2.8	-0.3	0.6	-0.4	0.9	10.6	0.7
August 25, 1992	2.8	1.6	0.7	4.7	0.7	2.5	5.6	0.0	1.0	2.6	3.3	7.6	2.9
August 26, 1992	2.5	1.6	0.7	3.3	0.7	-1.0	5.1	0.0	1.6	6.4	1.3	7.7	2.2
September 15, 1992	4.2	1.6	0.6	-2.7	0.6	1.1	8.3	0.1	-3.4	8.7	11.7	20.8	2.5
September 16, 1992	7.8	0.9	0.5	-2.5	0.4	2.3	30.6	-19.2	3.3	22.9	5.6	-1.4	49.7
September 17, 1992	2.6	1.5	9.4	-2.8	10.1	28.0	-0.6	-0.4	3.2	8.5	1.1	-27.3	0.2
November 19, 1992	4.3	2.1	0.9	-0.9	2.0	3.1	0.0	1.2	14.6	0.7	14.1	13.3	0.4
November 20, 1992	4.8	-0.3	-4.2	-0.7	1.1	10.3	0.1	0.3	36.5	5.3	9.6	-0.5	0.4
July 30, 1993	4.3	31.6	20.0	-0.5	14.3	0.0	0.6	-40.6	-0.6	11.3	16.3	-1.1	0.8
August 2, 1993	4.5	18.8	-4.2	-0.3	34.9		0.6	1.8	-0.2	-0.7	-1.0	-1.1	0.8

highest pressure lowest pressure
50th percentile

Most narratives date the start of the crisis as June 2nd, 1992, when Denmark rejected the Maastricht Treaty in a referendum.³¹ Our indices, in Table 2, suggest that exchange rates already came under strain two months earlier. April 3, 1992 saw some of the highest levels of exchange market pressure prior to Black Wednesday, when the Bank of Finland and the Sveriges Riksbank intervened heavily. Finland had experienced a bank-led credit boom in the 1980s, following years of financial deregulation.³² Monetary policy turned restrictive in 1989, when the central bank grew worried about financial excesses. With the collapse of the Soviet Union, exports to Russia then dropped by 70 per cent (Honkapohja and Koskela 1999). Combined with reunification-related increases in German interest rates (imported into Finland as a result of the exchange rate peg), boom turned to bust, precipitating a banking crisis in the autumn of 1991 and devaluation in December. But doubts about the stability of the banks remained, compounded by fears that devaluation only worsened banking-sector problems owing to the presence of currency mismatches on household and bank balance sheets. Hence the pressure in early 1992.

In Sweden, exchange market pressure in early April, while not as intense, was still noticeable. Sweden was thought, rightly or wrongly, to compete with Finland on international markets and to suffer from some of the same problems. Sweden too had deregulated its financial markets, experienced a credit boom, and saw a sharp rise in nonperforming loans as that boom turned to bust. There was also noticeable exchange market pressure on Italy, where concern centered not on the banking system but on macroeconomic imbalances. Italy was the major industrial country with the largest general government budget deficit and highest inflation³³

Conventional narratives point to the Danish “nej” on June 3rd as a major shock. The outcome had not been forecast by opinion polls. It cast into doubt the transition to the Single Currency, raising questions about whether Italy had adequate incentive to implement the restrictive policies needed for the stability of the lira. Our evidence suggests downplaying the importance of the Danish referendum. Doubts already existed earlier. Moreover, June 3, 1992, following the Danish referendum, does not rank as one of our top 10 exchange market pressure

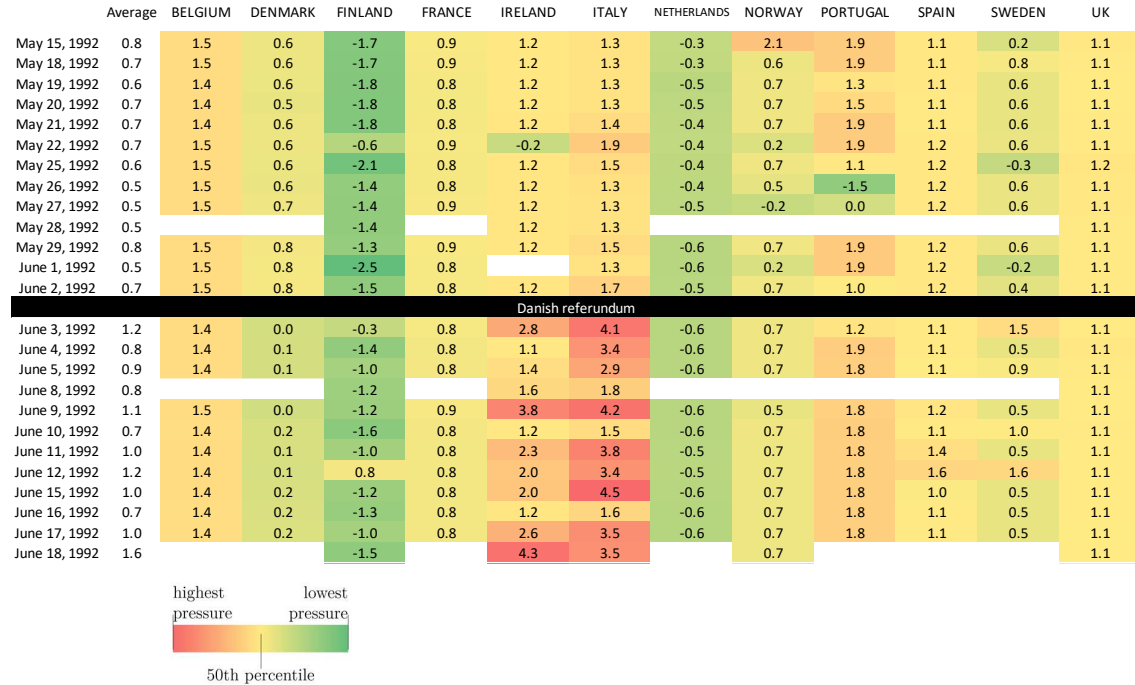
³¹ Denmark was one of two countries, along with Ireland, required to hold a referendum on the Maastricht Treaty. France also held a referendum, although it had the option of treaty ratification by parliamentary vote, which would have required a three-fifth majority in both the Assembly and Senate.

³² Blank cells are holidays when the market was closed.

³³ Among all industrial countries, as distinct from the “major” industrial countries, only Greece had a larger budget deficit (a larger general government financial deficit including social insurance). The major-other country distinction follows the IMF’s World Economic Outlook (May 1993), from where these data are taken.

days. This is evident in Table 3, a heat map for the period around the Danish referendum. This is not to deny the relevance of the referendum, but to put in context its immediate impact on financial markets.

Table 3. EMP Heat Map around the June 2, 1992 Danish Referendum



Still, the referendum reminded investors that monetary union and the exchange rate stability required to participate were not guaranteed, causing the Italian lira to fall to its lower limit and forcing the Bank of Italy to intervene.³⁴ The lira, as we have already seen, was perceived as a weak link. This made sense: Italy’s weaknesses were macroeconomic in nature, something that the Maastricht Treaty’s convergence criteria were tailored to address. We also see pressure on the Portuguese escudo and Irish punt around the time of the Danish referendum.

In contrast, the pound sterling, which retrospective accounts assert was significantly overvalued coming into the summer of 1992, does not appear to have experienced significant exchange-market pressure at this point in time.³⁵ In contrast, the Irish punt came under pressure, perhaps reflecting the fact that Ireland was the next place where a referendum was scheduled and fears, if the Irish voted no, that the punt would come untethered from the ERM.³⁶ When we run Bai-Perron tests for structural breaks in individual country EMP series in 1992, June 2nd is a

³⁴ Pressure on the lira, as we measure it, tripled on June 3rd from the previous day. The Danish krone itself does not appear to have been perceived as a vulnerable currency.

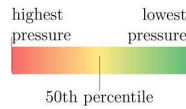
³⁵ The absence of exchange market pressure but also worries about overvaluation at this time are noted by James (2020), p.287.

³⁶ There were also worries about the systematic implications: the *Financial Times* wrote that if “the Irish follow the Danes and vote ‘no’, there would seem little alternative to scrapping the treaty.” “One in four Irish voters undecided about Maastricht”, *Financial Times* (18 June 1992), p.1.

significant break for both Italy and Ireland (the only such breaks before their devaluations later in the year).³⁷

Table 4. EMP Heat Map around the June 18, 1992 Irish Referendum

	Average	BELGIUM	DENMARK	FINLAND	FRANCE	IRELAND	ITALY	NETHERLANDS	NORWAY	PORTUGAL	SPAIN	SWEDEN	UK
June 2, 1992	0.7	1.5	0.8	-1.5	0.8	1.2	1.7	-0.5	0.7	1.0	1.2	0.4	1.1
June 3, 1992	1.2	1.4	0.0	-0.3	0.8	2.8	4.1	-0.6	0.7	1.2	1.1	1.5	1.1
June 4, 1992	0.8	1.4	0.1	-1.4	0.8	1.1	3.4	-0.6	0.7	1.9	1.1	0.5	1.1
June 5, 1992	0.9	1.4	0.1	-1.0	0.8	1.4	2.9	-0.6	0.7	1.8	1.1	0.9	1.1
June 8, 1992	0.8			-1.2		1.6	1.8						1.1
June 9, 1992	1.1	1.5	0.0	-1.2	0.9	3.8	4.2	-0.6	0.5	1.8	1.2	0.5	1.1
June 10, 1992	0.7	1.4	0.2	-1.6	0.8	1.2	1.5	-0.6	0.7	1.8	1.1	1.0	1.1
June 11, 1992	1.0	1.4	0.1	-1.0	0.8	2.3	3.8	-0.5	0.7	1.8	1.4	0.5	1.1
June 12, 1992	1.2	1.4	0.1	0.8	0.8	2.0	3.4	-0.5	0.7	1.8	1.6	1.6	1.1
June 15, 1992	1.0	1.4	0.2	-1.2	0.8	2.0	4.5	-0.6	0.7	1.8	1.0	0.5	1.1
June 16, 1992	0.7	1.4	0.2	-1.3	0.8	1.2	1.6	-0.6	0.7	1.8	1.1	0.5	1.1
June 17, 1992	1.0	1.4	0.2	-1.0	0.8	2.6	3.5	-0.6	0.7	1.8	1.1	0.5	1.1
June 18, 1992	1.6			-1.5		4.3	3.5		0.7				1.1
Irish referendum													
June 19, 1992	0.7	1.4	0.2	-1.5	0.8	1.2	1.2	-0.6	0.7	1.8	1.1	0.7	1.1
June 22, 1992	0.7	1.5	0.2	-1.5	0.8	1.2	1.2	-0.6	0.7	1.8	1.1	0.5	1.1
June 23, 1992	0.7	1.4	0.3	-1.5	0.8	1.2	1.4	-0.6	0.7	1.8	1.1	0.5	1.1
June 24, 1992	0.9	1.4	0.4	-1.6	0.8	1.2	3.3	-0.6	0.7	1.8	1.1	0.8	1.1
June 25, 1992	0.6	1.4	0.4	-1.4	0.8	1.1	1.2	-0.6	0.7	1.1	1.4	0.5	1.1
June 26, 1992	0.7	1.4	0.5	-1.3	0.8	1.2	1.4	-0.7	0.7	1.8	1.4	0.6	1.1
June 29, 1992	0.6	1.4	0.4	-1.4	0.8	1.1	1.2	-0.7	0.7	0.3	1.5	0.5	1.1
June 30, 1992	0.7	1.5	0.5	-1.4	0.8	1.1	1.2	-0.8	0.7	1.8	1.3	0.5	1.1
July 1, 1992	0.7	1.5	0.4	-1.6	0.8	1.1	1.4	-0.8	0.6	1.8	1.1	0.5	1.0
July 2, 1992	1.2	1.4	0.4	-1.5	0.8	1.1	8.2	-0.8	0.7	1.8	1.4	-0.4	1.1
July 3, 1992	1.4	1.4	0.5	-1.3	0.8	1.1	8.3	-0.8	1.6	1.3	1.5	0.7	1.0
July 6, 1992	0.7	1.4	0.5	-1.3	0.9	1.1	1.3	-0.8	1.0	1.8	1.2	0.5	1.0
July 7, 1992	0.7	1.4	0.5	-1.4	0.8	1.9	0.9	-0.8	0.7	1.8	1.2	0.5	1.1
July 8, 1992	0.7	1.4	0.4	-1.5	1.1	1.9	0.9	-0.9	0.6	1.8	1.1	0.5	1.1



June 18th, the date of the Irish referendum, is another high pressure day, although more than two-thirds of Irish voters backed the treaty. Table 4 shows how pressure mounted in the run-up to the referendum but dissipated with the results. What was true for Ireland – lower exchange market pressure than before – was not also true for Italy, however, where prior EMP levels were exceeded in early July. Italy, it would seem, was a major casualty of the unsettled conditions surrounding the two referenda.³⁸

Pressure on the lira, but now also on the peseta and escudo, mounted over the course of August. On September 3-4, Germany stepped in with its largest intervention of the crisis, spending over \$4 billion to support the lira. The Bank of Italy increased its interest rate by 1.75 percentage points, the largest increase in 11 years. These actions set the stage for an acrimonious Economic and Financial Affairs Council (ECOFIN) meeting on September 4-5, at which British Chancellor Norman Lamont harangued Bundesbank President Helmut Schlesinger for further reductions in German rates. The most Schlesinger was prepared to concede was that there was no immediate

³⁷ It is a break for these two countries but no others. These tests are run with 5 breaks as a maximum, 15% and a 5% significance level (which are standard settings). The EMP is regressed against a constant to see for changes in average levels of pressure. The data range is the whole of 1992. Many countries do not yield any breaks.

³⁸ Italy was also in a constitutional crisis, with a new government to be formed on June 19th. The timing of movements in the column of Table 4 for Italy suggests that this was not the major factor affecting foreign exchange markets.

need for German rates to increase.³⁹ Lamont, in his post-meeting press briefing, characterized the German position as a firm promise not to raise rates.

While this assertion reassured investors about ERM currencies such as the lira that might also receive support from the system's strong currency countries, it heightened their worries about non-ERM currencies that were shadowing the Deutschmark or the ecu that could look for no formal support.⁴⁰ Pressure on the markka had died down following the Bank of Finland's massive interventions in early April. In July and August, however, it returned, forcing the Bank to intervene to support its ecu peg. After spending \$5.4 billion in just five days, the government abandoned the peg on September 8th. Once more, Italy was collateral damage: Germany, the Netherlands and Belgium all intervened to prevent the lira from breaking through its bilateral fluctuation bands.

Currency traders again trained their attention on Sweden. The Riksbank defended the krona by raising interest rates to stratospheric levels and, like its neighbour, by intervening in the foreign exchange market. As was seen in Table 1, Sweden spent \$56 billion on intervention in the crisis, the most of any European country. But there were serious problems in the banking system: the government had been forced to inject capital into two banks in late 1991 and then, in early September 1992, to issue a blanket guarantee of the obligations of Gota Bank, a systemically significant institution. Whether the banking system and, hence, the currency could withstand the strain of triple-digit interest rates was, at best, uncertain.

With Sweden mounting this stout defense, currency traders turned once more to the lira. On Friday, 11 September, the currency felt unprecedented levels of pressure. On Saturday, the German finance ministry and the Bundesbank agreed that the German central bank would refrain from further intervention on behalf of the lira, invoking its authority under the Emminger letter. The Bundesbank immediately conveyed the news to a shocked Bank of Italy governor Carlo Ciampi.⁴¹

Italy was left with no choice. On Sunday, European policy makers announced a 3.5 per cent devaluation of the lira and 3.5 per cent revaluation of other ERM currencies (a cosmetic way of devaluing the lira by 7 per cent). Other countries, including the UK, refused to follow, making this a less than general realignment. As its contribution, the Bundesbank cut interest rates (the discount rate by 50 basis points, the Lombard rate by 25).

This package was criticized as inadequate for the small size of the German interest rate cut and the fact that no other countries accompanied Italy in realigning. In addition, the outcome was reached irregularly, without a formal meeting of the Monetary Committee of the European Council or the ECOFIN. Other governments were reluctant to convene such a meeting for fear that they could come under pressure from Germany and the Netherlands to accompany Italy in devaluing against the Deutschmark. Table 5, a heat map for the period around Black Wednesday, suggests that the others that should have accompanied Italy were Spain and Portugal, two

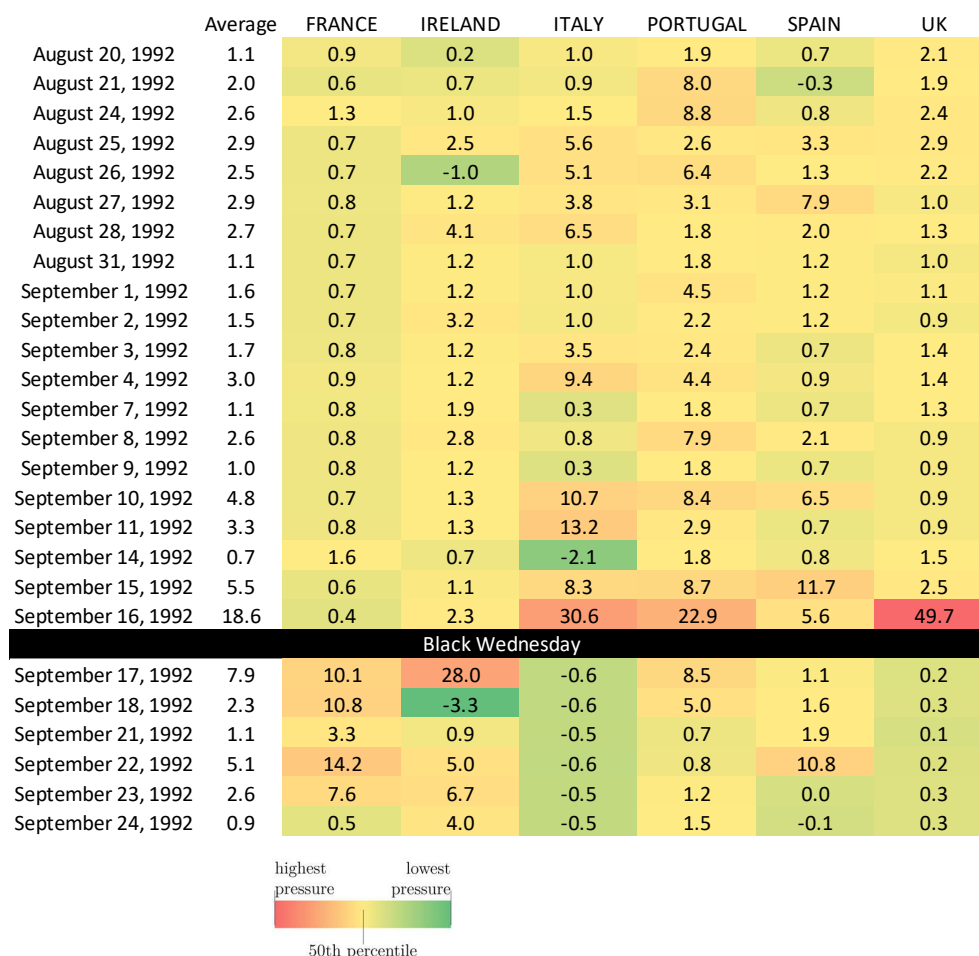
³⁹ James (2012), p.352.

⁴⁰ James (2020), pp.293-4.

⁴¹ James (2012), p.356.

countries that, more than the UK, competed in the same product space and saw their competitiveness negatively affected by the lira's devaluation.

Table 5. EMP Heat Map around Black Wednesday, September 16, 1992



The French referendum on the Maastricht Treaty was looming on September 20th, and opinion polls suggested that the outcome would be razor thin (Lewis-Beck and Morey 2007). The Bank of England and UK Treasury were preparing to mount a defense of sterling when the markets opened on Monday, September 21st (Keegan, Marsh and Roberts 2017).⁴² But they were not prepared for some out-of-school remarks by Bundesbank President Helmut Schlesinger, to reporters from *Handelsblatt* and the *Wall Street Journal* on September 15th and published the following day. Schlesinger observed that a more comprehensive realignment would have been more effective and that further exchange market pressure could not be ruled out. Schlesinger's comments evidently planted doubts in the minds of investors about whether the Bundesbank was prepared

⁴² Preparations would have entailed prearranging purchases of sterling, since transactions were still conducted by mainly by telephone and were therefore limited by the number of phone lines in the Bank of England's dealers' room. Reuters had launched a matching server in London some months earlier to trade dollar/sterling, dollar/mark and dollar/yen but as yet had only a limited number of bank customers (Eichengreen 2020).

to engage in unlimited interventions to prevent the Deutschmark from breaching its bilateral limits against other currencies.

There is some dispute about the intent and impact of the Schlesinger interview.⁴³ Schlesinger may have been unaware that he would be quoted; alternatively, he may have been responding to Lamont's earlier provocation. Some commentators downplay the remarks as disclosing nothing that investors did not already know and attribute the subsequent crisis to macroeconomic and financial imbalances, not to the statements of the Bundesbank president. Table 5 is consistent with the view that Schlesinger's statements were a wake-up call that changed investors' views of the prospects for central bank cooperation. While sterling had been in the news for weeks, pressure on the currency was still only moderate as measured by our EMP index. There was then relatively limited pressure on sterling (and for that matter on the French franc) on the first two days following the Italian realignment, but the pressure on sterling exploded with the publication of Schlesinger's interview.

Black Wednesday saw the Bank of England raise interest rates and expend \$22.6 billion in reserves, but also the Treasury suspend the country's membership in the ERM and allow the pound to depreciate. While intervention, the change in interest rates and the change in the exchange rate all contribute arithmetically to the high level of exchange market pressure recorded that day (the highest in our sample, some 35 standard deviations above the sample mean), the largest contributor is intervention.⁴⁴ In part, this reflects a reluctance to raise interest rates (in contrast to other cases, such as that of the Swedish Riksbank, where there was no such reluctance, as noted above, and where interest rates contributed more, arithmetically, to our measure of exchange market pressure). The Bank of England announced two rate rises that day (and second of which was rescinded), but the extent of the increases were modest by the standards of other countries whose currencies were under pressure. Normally, a rate hike would have been announced at 9:45 in the morning; on 16 September the announcement was delayed until 11:00, indicative of internal debate. Household mortgages bore variable rates, and a higher Bank Rate meant pain for the Conservative Government's core constituency. (Recall that the Bank of England was not independent of the government at this time.) As one author has put it, "The economic distress of homeowners translated into political sustainability problems of the ERM peg for the ruling Conservative party, not least since the spread of homeownership was central to its project of socio-economic reform."⁴⁵

In addition to Britain exiting the ERM, Italy announced to the Monetary Committee that evening that the inadequacy of its reserves forced it to float the lira. While the Portuguese escudo was successfully defended, the Spanish peseta was devalued by 5 per cent. The contrast is striking, in that the pressure applied to the escudo was nearly four times as intense by our measure. Also noticeable is how the pressure on sterling died down after Black Wednesday, when the currency was floated; evidently, market participants were confident that the Bank would develop a plan for

⁴³ See for example Connolly (1992), Kaltenthaler (1998) and James (2012) for a representative sampling. A contemporary account is Whitney (1992).

⁴⁴ Recall that what matters for our measure is not the absolute level of intervention but that level normalized by its standard deviation.

⁴⁵ Hassdorf (2007), p.144.

managing inflation and the currency in the absence of an exchange rate anchor. (As it in fact did; that plan came to be known as inflation targeting.)

The French referendum on the Maastricht Treaty was still looming on September 20th. Our measure shows little pressure on the franc prior to Black Wednesday but sharp intensification thereafter. That the “oui” side squeaked to victory with a 51 per cent vote share was plausibly a factor in the pressure on the franc staying up, forcing the Bank of France to intervene to support the franc against the Deutschmark. Another spike in our index was on September 22nd, when the Bank of France spent \$10.9 billion. After that, the franc recovered; Intervention fell to low levels, and the Bank of France was able to rebuild its reserves.

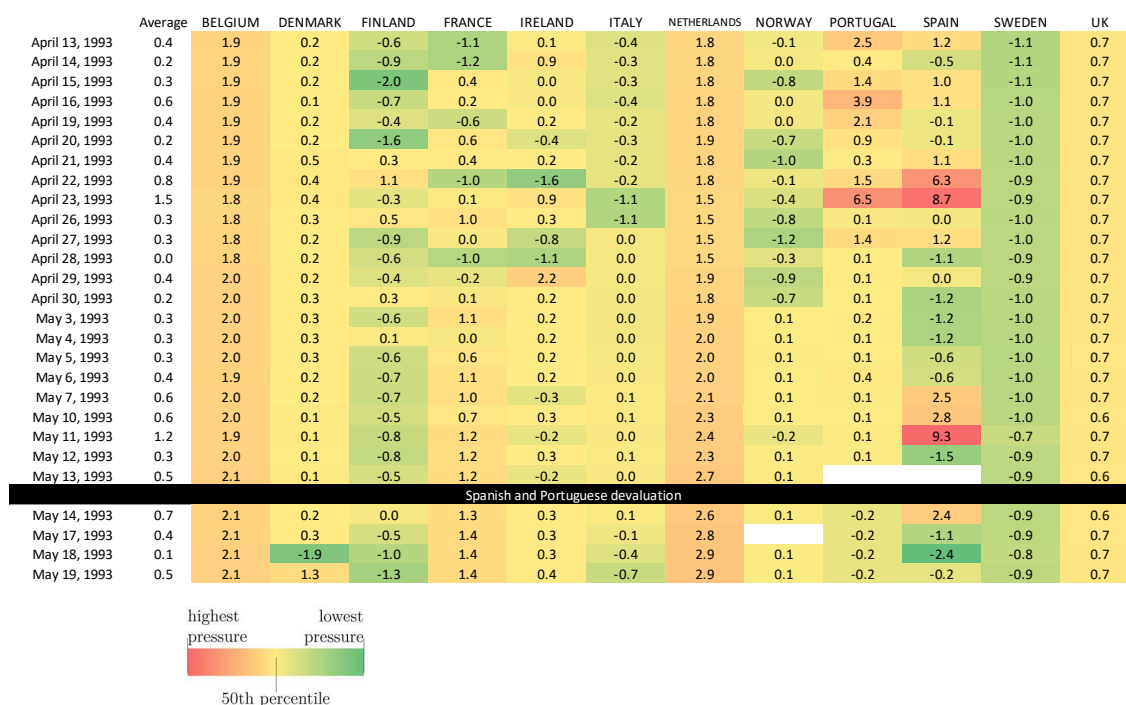
In November, Sweden finally abandoned its ecu peg, high interest rates having taken their toll. Spain devalued again, and this time Portugal followed. Sweden’s troubles and generalized EMS turmoil also infected Norway. Our EMP index for Norway peaked on November 20th at 36.5 (26 standard deviations above the mean), the second highest value in the sample after the UK on Black Wednesday. The Norges Bank abandoned its ecu peg on December 10th. The Irish punt, which had come under pressure following Black Wednesday (Table 7 above), was devalued by 10 per cent on January 30, 1993.

The Danish krone and Belgian franc also came under pressure in early 1993. Our indices do not indicate extensive intervention by either country’s central bank. In fact, however, support operations for the Danish krone were extensive. On February 3rd, 1993, the Netherlands Bank undertook \$2.4 billion of purchases to support the Danish krona, which had hit the lower band limit of its bilateral band.⁴⁶ This is one of the negative spikes in the overall EMP index in Figure 4 above; it was a relatively rare instance of international cooperation. This finding supports the conclusion of Straumann (2010), who argues that support from other ERM countries helped Denmark stay in the ERM, unlike Sweden and Norway, which had given up their pegs a few months earlier.

The center of attention now was Iberia. The release in mid-February of disappointing unemployment figures for the fourth quarter of 1992 intensified selling pressure, and elections on April 12th introduced further uncertainty about the intentions of the Spanish government. Reserve losses forced another 8 per cent devaluation on May 13th, and the spillover forced neighboring Portugal to devalue by an additional 6 ½ per cent. Table 6, a heat map for this period, suggests that this was a specifically Iberian problem, not a generalized EMS crisis. In May 1993, Denmark then ratified the Maastricht Treaty in a second vote, and the Bundesbank lowered interest rates, partly to reduce pressure on other ERM countries. The French franc rallied in response, and French inflation showed signs of dropping below German inflation. The Bank of France responded by cutting interest rates in a bid to fight unemployment and in the hope of demonstrating its leadership of the EMS (in other words, in the hope Germany would follow its example).

⁴⁶ In addition, there were purchases of \$145 million of Danish krone by the Bundesbank and \$580 million by the Central Bank of Ireland.

Table 6. Heat Map for Spring 1993 Iberian Crisis



These hopes were disappointed. French officials, led by Finance Minister Edmond Alphandéry, had been lobbying, via radio programs and in face-to-face meetings with their German counterparts, for interest rate cuts by the Bundesbank to relieve pressure on the franc and obviate the need for an uncomfortable increase in French interest rates. When it became known that French and German officials were unable to agree, pressure on the franc intensified. Table 7 suggests that as late as Wednesday July 28 this was a purely French phenomenon.⁴⁷ The Bundesbank's failure to cut its discount rate on Thursday July 29 was then the final straw, and what had been a French crisis morphed into a European crisis.⁴⁸ Figures from the Bundesbank's archives show that the German central bank spent approximately DM47 billion supporting the French franc on July 29-30.⁴⁹

This got governments to the weekend. With little expectation that the pressure would subside, members agreed on August 2, 1993 to broaden their ERM bands from 2 ¼ to 15 percent. The initial German proposal had been to broaden them to +/-6 per cent, the old wide bands operated by Italy, Spain and Portugal. Evidently the lesson that doing too little was worse than doing nothing at all had been learned. France and others now insisted on more radical steps.⁵⁰ Wider bands created more scope for exchange rates to move in both directions, creating two-way risk and discouraging investors from all lining up on one side of the market (Ayuso Perez-Jurado and Restoy 1994, Walsh 1995, Garretsen, Knot and Nijse 1998). It gave European monetary policy makers a window of time in which to contemplate the transition to the single currency.

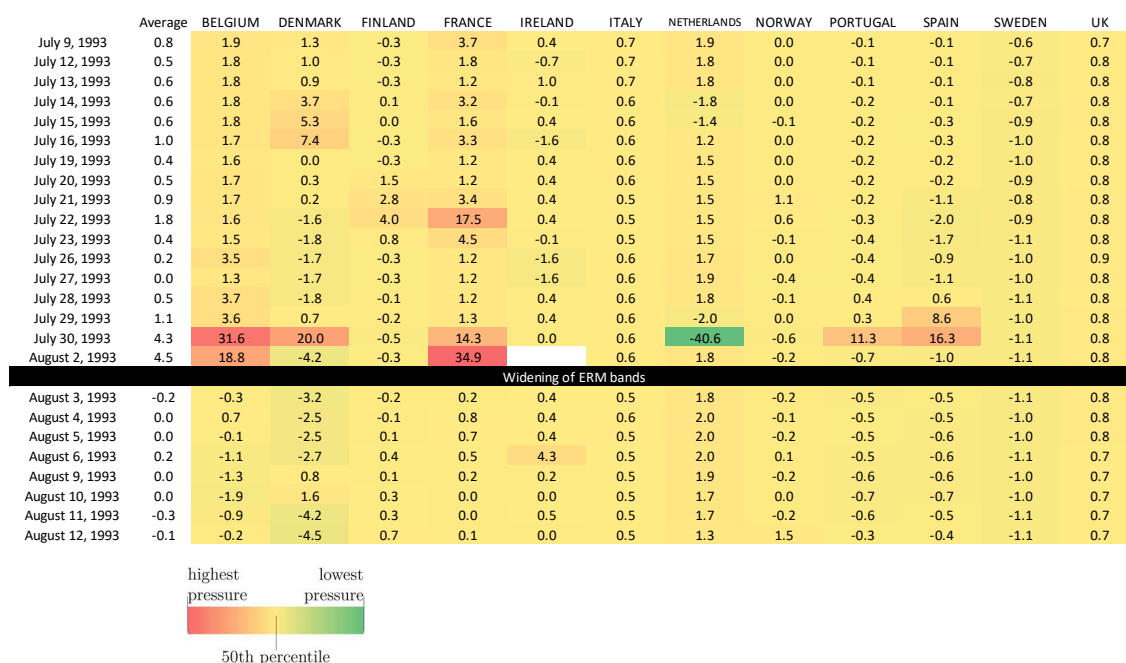
⁴⁷ Faint echoes in Belgium notwithstanding.

⁴⁸ The Bundesbank did cut the Lombard rate by 50 basis points, but this made little difference.

⁴⁹ DM47 billion on the two days combined. James reports large interventions by other central banks as well.

⁵⁰ The initial French proposal was for +/-20 per cent. +/-15 per cent was the eventual compromise.

Table 7. Heat Map for July 1993 EMS Crisis



6 The Role of the Dollar

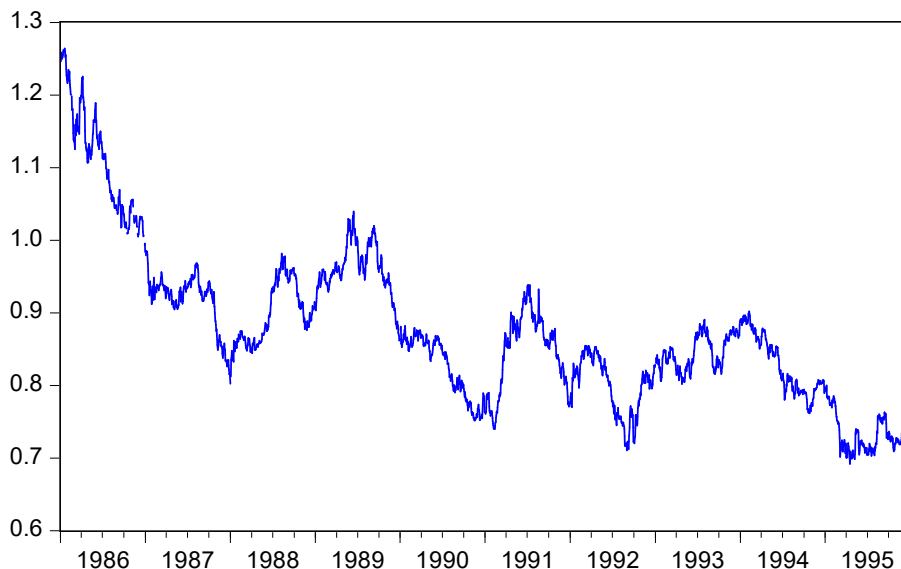
The literature on the crisis, summarized in Section 1, focuses on events in Europe, unsurprisingly since the crisis manifested itself in tensions between European currencies and changes in intra-European exchange rates. The prominent political events were European, such as the Danish and French referenda. The economic developments that attracted most attention, such as changes the level of German interest rates, were similarly European. The crisis meetings were of European officials. Statements moving the foreign exchange market were statements by European officials. Steps taken to calm the markets were by European central banks and governments. Thus, when blame for the crisis was apportioned, analysts pointed to economic imbalances in Europe (inadequate British competitiveness, excessive Italian deficits, Bundesbank interest rates that were excessive from the point of view of other European countries), European political events that raised or reduced the likelihood of eventually transitioning to a single currency, and the limits of unlimited support. The analytical narrative of the preceding section reflects this emphasis.

What this narrative misses is the role of the dollar. As far back as 1979, when the EMS was founded, commentators had observed that dollar depreciation created strains in the Exchange Rate Mechanism, insofar as flows out of the greenback went disproportionately into the Deutschmark, perennially the strong European currency (see for example Brown 1979 and James 2012). These issues arose again in the early 1990s. The U.S. had entered a recession in July 1990.⁵¹ Weak domestic demand dampened U.S. imports and created a need to switch U.S. production

⁵¹ This is the date identified by the NBER Business Cycle Dating Committee.

toward exports; these current account trends made for a weaker dollar (see Figure 5). In addition, the onset of the recession led the Federal Reserve to cut interest rates (Figure 6). Together, these developments caused funds to flow out of U.S. fixed-income markets and into higher-yielding European assets and into DM assets in particular. This tendency was reinforced by the fact that the Bundesbank was meanwhile raising rates to counter the inflationary pressures created by German reunification and attendant deficit spending. The resulting shift in the capital account of the balance of payments meant additional downward pressure on the dollar. Reflecting these forces, the bilateral dollar/DM rate depreciated by nearly 20 per cent between its peak in July 1991 and trough in September 1992.

Figure 5. Dollar Deutschmark exchange rate



The time series for the dollar/DM exchange rate in Figure 5 is consistent with a role for the greenback in the crisis. Several major episodes of intra-ERM tension and not just that in 1992 are consistent with the hypothesis. The dollar had depreciated against the DM in the run-up to the 1987 general realignment, and it depreciated in the period leading up to the 1990 realignment of the lira. Figure 6 speaks less loudly for a role for the interest differential. No trend was evident in the period prior to the 1987 realignment, and the January 1990 realignment of the lira took place prior to recession-induced interest-rate cuts in the United States.

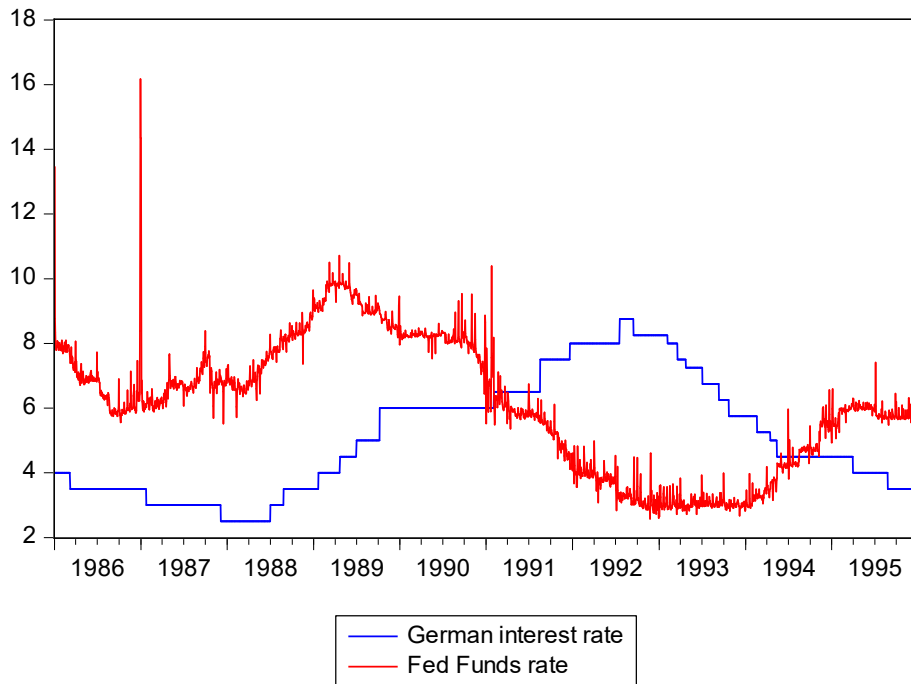
Movements in our exchange market pressure index are consistent with this emphasis on dollar depreciation. We showed above how EMP began rising already before the Danish referendum to which much attention is paid in conventional narratives. The dollar had begun depreciating earlier, already in the second half of 1991, and its depreciation continued through the first four months of 1992 (prior to the Danish referendum), consistent with this observation.

Contemporary reports noted the dollar's role. When the dollar hit a low against the Deutschmark at the outset of the September crisis, the *Financial Times* observed that "Traders reported widespread selling of dollars for D-Marks from international currency investors, particularly large fund management groups. Such investors have recently bought D-Marks in

volume because of the big difference between German and US interest rates.”⁵² In early September 1992 the dollar hit a record low. The *FT* noted that dollar depreciation was “depressing several of the weaker currencies against the D-Mark and pushing both sterling and the Italian lira closer to their ERM floors.”⁵³ Likewise, the *Economist* noted on August 29th that “[a]s investors rushed out of the American currency into D-marks, first sterling and then the lira were dragged down within Europe’s exchange rate mechanism.”⁵⁴

Policy makers similarly noted a role for the dollar. Meeting at the Bank for International Settlements on June 15, 1992, central bank governors complained that Italian measures to counter the pressure on the lira were “blunted by the weakening of the US dollar and the consequent strengthening of the Deutschmark.”⁵⁵ A month later, they were concerned that the “downward trend of the dollar was gaining momentum following the discount rate cut by the Federal Reserve in early July and the lack of supporting action from the G-7 countries.”⁵⁶ Bank of Italy Governor Ciampi argued that the explanation for the weak lira was to be found in the “market’s intention of testing the strength of the Italian government, in the weakness of the US dollar and in the expectation that the Deutsche Bundesbank Council would raise German rates further.”⁵⁷

Figure 6. Fed funds rate and German official discount rate



⁵² Financial Times, “Dollar Hits New Low against D-Mark”, 2 September 1992, p.1.

⁵³ Financial Times, “Dollar Hits New Low against D-Mark”, 2 September 1992, p.1.

⁵⁴ The Economist, “Forever falling?” 29 August 1992, Volume 324, Issue 7774.

⁵⁵ Minutes of the 267th meeting of the Committee of Governors of the Central Banks of the Member States of the European Economic Community held in Basel on Monday, 15 the June 1992 at 9.00 am

⁵⁶ Minutes of the 268th meeting of the Committee of Governors of the Central Banks of the Member States of the European Economic Community, held in Basel on Tuesday, 14th July 1992 at 9.30 a.m.

⁵⁷ Minutes of the 268th meeting of the Committee of Governors of the Central Banks of the Member States of the European Economic Community, held in Basel on Tuesday, 14th July 1992 at 9.30 a.m.

The Bundesbank was conscious of an effect of the strong dollar. It wrote in its annual report for 1992 how “lower interest rates in the United States induced a drop in the dollar which was an additional cause for tension” in the ERM.⁵⁸ The OECD, in a report published in November 1992, criticized the United States for “benign neglect” of the dollar exchange rate and observed that this fanned tensions within the EMS.⁵⁹ The IMF, in its January 1993 “Interim Assessment of the World Economic Outlook,” published midway between the September 1992 and July 1993 spikes in exchange market pressure, observed that intra-European exchange rate tensions were aggravated by “the weakness of the U.S. economy, the marked decline in U.S. interest rates, and the associated shift of funds into assets denominated in the strong European currencies, especially the deutsche mark.” The BIS, in its 1992-3 annual report, published in August, concurred. “It is sometimes suggested that the weakness of the dollar during much of the spring and summer of last year was an important causal factor in the European crisis which followed. And it is certainly true that previous episodes of dollar weakness had been accompanied by strains in the ERM as capital flowed into the Deutschmark. In the present case it also seems likely that the unprecedented interest differential between the United States in Germany, with its attendant transatlantic exchange rate pressures, played at least a subsidiary role.”⁶⁰

The role of the dollar has featured in a small handful of scholarly accounts of the crisis, insofar these accounts are informed by the same reports and documents just cited (see e.g. James 2012, Scheherazade 1997 and Eichengreen 2002, James 2020). But aside from this handful of mentions, the point is neglected, perhaps because systematic evidence has been lacking.

7 Evidence

We now conduct a regression analysis, taking as dependent variables the number of central banks intervening, the value of their interventions, and exchange market pressure. We estimate ordinary least squares regressions and vector autoregressions both and conduct a counterfactual analysis. All three approaches point to the same conclusion.

7.1 Ordinary Least Squares Analysis

Our specification is of the form:

$$Y_t = \beta_0 + \beta_1(Fx_{t-1} - Fx_{t-2}) + \beta_2R_{t-1}^{GER} + \beta_3X + \epsilon_t$$

⁵⁸ German original: “Die gleichzeitige zinsinduzierte Kursrückgang des US-Dollars wirkte als ein zusätzlicher Spannungsaullöser.” 1992 Annual Report of the Bundesbank, 1 April 1993, p.81.

⁵⁹ Cited in Carl Gewitz, “ERM Works but System is Flawed, OECD Says,” *New York Times* (9 November 1992), <https://www.nytimes.com/1992/11/09/business/worldbusiness/IHT-erm-works-but-system-is-flawed-oecd-says.html>

⁶⁰ BIS (1993), pp.193-4. It then suggests that the resulting flows occurred in two stages, first from the dollar to high-yielding European currencies and then, when stability worries arose, from those high-yielding currencies to the DM. “In addition, the prolonged easing of US monetary policy (before 1992), with its accompanying tendency to dollar weakness, had probably been one reason for capital to flow out of the dollar. Some of this outflow had no doubt gone into high-yielding European currencies and other assets denominated in the same currencies. In mid-1992, however, the situation suddenly reversed itself, and holders of high-yielding currencies were very quickly beginning to try to get out of them.” BIS (1993), p.194.

where Y_t is one of the three dependent variable on day t , $Fx_{t-1} - Fx_{t-2}$ is the lagged change in the exchange rate, R_{t-1}^{GER} is the lagged level of German interest rates, and X are day of the week, month and year fixed effects. We lag the change in the exchange rate and the interest rate by one day to mitigate timing issues.⁶¹

In Table 8, all coefficients have their expected signs and differ significantly from zero. Dollar depreciation increases the pressure on ERM countries, is associated with additional central banks intervening, and raises the amount of intervention. Note that our intervention variable registers a positive number when a country is buying deutschmarks – building up reserves – and negative when it is selling deutschmarks and intervening to defend its currency.

Daily deutschmark intervention rises by \$11 million for every 10 daily basis point depreciation of the dollar. By comparison, total daily intervention over the 1986-1995 sample averaged \$66 million. It averaged \$72 million when we exclude days with zero intervention from the average. The comparison suggests that even limited moves of the dollar/DM exchange rate could trigger interventions on the scale typical of the 1986-95 period.⁶²

Table 8. Impact of change in dollar/DM exchange rate and German interest rate

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Lagged change in exchange rate	-4.69*** (1.61)	-1.63*** (0.30)	10640.11*** (3419.70)
Lagged German interest rate	0.24*** (0.03)	0.04*** 0.006	-87.70** (44.24)
Day, month and year controls	yes	yes	yes
N	2342	2575	2575
R squared	0.63	0.25	0.09

Standard errors in parentheses are robust to heteroscedasticity and autocorrelation. They are estimated using heteroscedasticity and autocorrelation-consistent (HAC) estimators with a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above \$15 billion.

⁶¹ Since the exchange rate is a rate at the close, it is more likely to influence the pressure the following day. Interest rates in principle could influence both same-day and next-day pressure depending on when they are announced, but for consistency we use the previous day's rates. Using instead same-day rates do not affect the results.

⁶² There were also atypical interventions, most obviously on Black Wednesday, when the value of intervention peaked at roughly \$6 billion on average for ERM countries. There being no corresponding 500 basis move in the dollar, this points to the possibility of nonlinearities – which is of course precisely what models of speculative attacks on currency pegs would lead one to expect.

In addition, a higher German interest rate is associated with more exchange market pressure, more central banks intervening, and more extensive intervention.

The significant coefficients on the lagged change in the exchange rate are not sensitive to the inclusion or exclusion of the interest rate variable. They are robust to the omission of the day, week and month fixed effects (see Appendix C). Focusing exclusively on the crisis period from June 1992 through July 1993 again produces consistent results, although standard errors are larger, reflecting the smaller sample size.

Table 9. Impact of change in dollar/DM exchange rate and German interest rate

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Lagged change in exchange rate	-5.71*** (1.68)	-1.80*** (0.32)	11039.84*** (3383.64)
Lagged change in German interest rate	0.40*** (0.11)	0.04 (0.03)	-304.35** (127.09)
Day, month and year controls	yes	yes	yes
N	2342	2575	2575
R squared	0.59	0.22	0.08

Standard errors reported in parentheses are robust to heteroscedasticity and autocorrelation. They are estimated using a heteroscedasticity and autocorrelation-consistent (HAC) estimators with a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above 15\$ billion.

One concern is that the level of German interest rates is not stationary, since the Bundesbank had been raising its rate since 1988 and again following reunification, and then reducing it steadily starting in 1993 (Figure 6). This may introduce spurious correlation between the interest rate and the dependent variables and otherwise bias the coefficient estimates. In Table 9 we therefore substitute the lagged *change* in the interest rate, which is stationary. The results are the same, with the exception of a now insignificant coefficient on the number of countries intervening.⁶³

Alternatively, we may wish to consider the interest rate differential between the U.S. and Germany, on the grounds that exchange market pressure is associated with the incentive for capital

⁶³ Lower levels of significance reflect the fact that there were only a limited number (35) changes in the Bundesbank's rate over the period.

to flow from the U.S. to Germany, where that flow is accentuated by a larger difference between U.S. and German interest rates. (The lagged interest differential is stationary as well.) Again, the signs of all coefficient remain the same. While the effect of interest rates on exchange market pressure and the amount of intervention is no longer significant, the coefficients on our variable of interest, namely the lagged change in the exchange rate, remain significantly different from zero at high levels of confidence.

Table 10. Impact of change in dollar/DM exchange rate and interest differential

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Lagged change in exchange rate	-5.71*** (1.67)	-1.82*** (0.32)	11028.37*** (3386.54)
Lagged interest differential (Germany-US)	0.004 (0.04)	0.009* (0.005)	-61.67 (50.10)
Day, month and year controls	yes	yes	yes
N	2339	2571	2571
R squared	0.59	0.22	0.08

Standard errors reported in parentheses are robust to heteroscedasticity and autocorrelation. They are estimated using heteroscedasticity and autocorrelation-consistent (HAC) estimators with a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above 15\$ billion.

If the interest rate variables in Tables 8 and 9 are picking up capital flows between Germany and other ERM countries, while those in Table 10 pick up the incentive for capital movements between Germany and the U.S., then there is a logic for including both. We do so in Table 11. Again nothing changes. The lagged level of German interest rates increases exchange market pressure, intervention, and the number of intervening central banks. The Germany-US interest differential significantly increases only the number of countries intervening, just as before.⁶⁴

Most importantly, the coefficients for the variable of interest, the lagged change in the exchange rate, retain their previous sign and significance. Across all these tables (8 through 11), their magnitudes are little changed, confirming the robustness of the findings.

⁶⁴ Its coefficient in the EMP equation switches sign relative to Table 11, but was insignificant there and is insignificant here.

Table 11. Impact of change in dollar/DM exchange rate, German rate and interest differential

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Lagged change in exchange rate	-4.71*** (1.60)	-1.64*** (0.30)	10636.13*** (3421.92)
Lagged German interest rate	0.23*** (0.03)	0.04*** (0.006)	-88.14** (44.30)
Lagged interest rate differential (Germany-US)	-0.002 (0.04)	0.009* (0.005)	-61.23 (50.12)
Day, month and year controls	Yes	yes	yes
N	2339	2571	2571
R squared	0.63	0.26	0.09

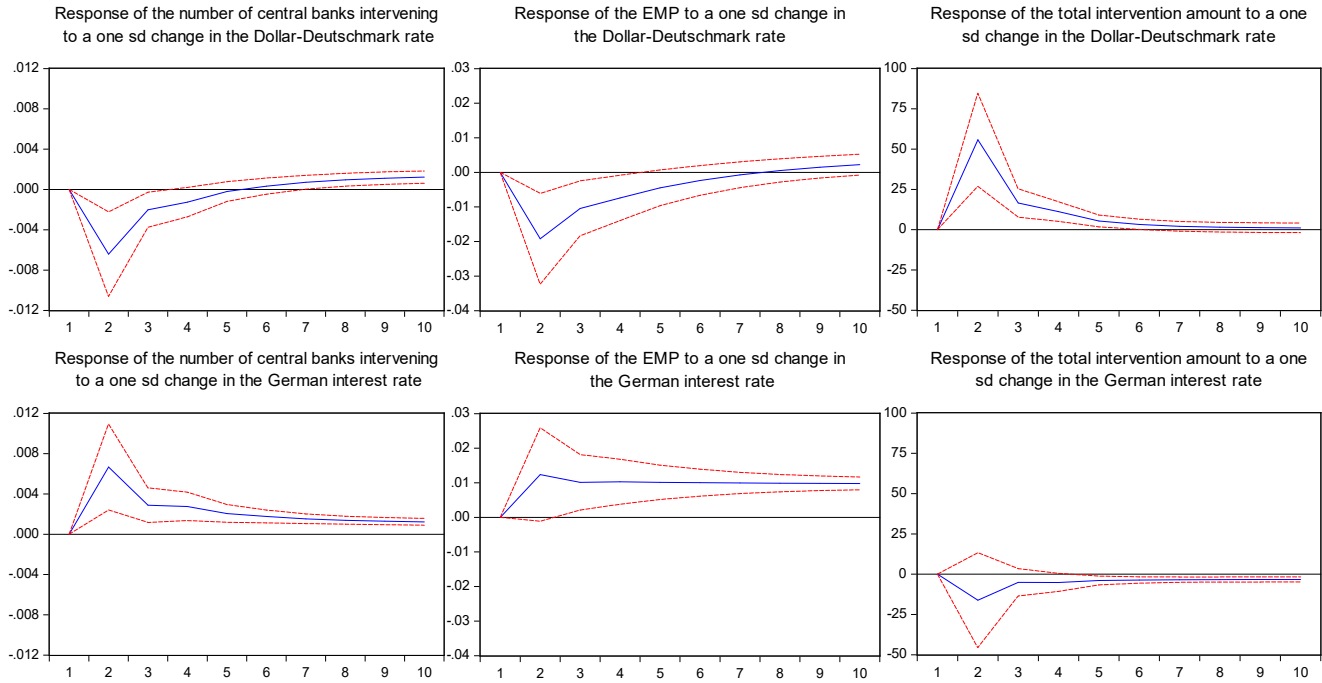
Standard errors reported in parentheses are robust to heteroscedasticity and autocorrelation. They are estimated using heteroscedasticity and autocorrelation-consistent (HAC) estimators with a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above 15\$ billion.

7.2 VAR Analysis

We next replicated the analysis in a vector autoregression (VAR) setting, using the same model but without control variables.⁶⁵ The results are quantitatively the same as in Table 8-11. Figure 7 shows the impulse response to an increase in the dollar-Deutschmark rate and German interest rate. An appreciation of the dollar against the Deutschmark leads to less pressure, fewer countries intervening, and central banks accumulating reserves (recall that a positive intervention indicates reserve accumulation). Conversely, an increase in the German interest rate (bottom panel of Figure 7) leads to more pressure on European currencies, more countries intervening, and more total intervention in defense of European currencies (though this last effect is significant only after the first five days).

⁶⁵ Note that keeping the controls yields qualitatively similar results but is more likely to bias the VAR.

Figure 7. Impulse response to changes in exchange rate and German interest rate



Response to cholesky one standard innovations. The dashed lines represent ± 2 standard errors.

7.3 Counterfactual Analysis

We next conducted a counterfactual analysis to further establish the robustness of our findings. Although the immediately preceding analysis suggests that the dollar-Deutschmark exchange rate was an important factor contributing to the pressure on European currencies, it may be that some of the variation we measure is simply due to movements in the dollar, independently of the Deutschmark. For example, the dollar-Deutschmark rate and the dollar-French franc rate tend to be positively correlated. If dollar depreciation against the franc, and not only dollar depreciation against the Deutschmark, intensifies the pressure on other EMS currencies but we include in our model only the dollar-Deutschmark rate, then we run the risk of attributing to the dollar-Deutschmark rate the effects of other bilateral dollar rates.

To explore this possibility, we replace the German exchange and interest rate with the French exchange rate and interest rate and by their other counterparts for other European countries, one country at a time. Table 12 reports the R squared for each model. The currency with the highest R squared is likely to have the most influence.

The counterfactual shows that the pressure in ERM currencies is best explained by German exchange rates and interest rates, consistent with the literature on dollar-Deutschmark polarization and the hypothesis that the Deutschmark is a closer substitute for the dollar than are other European countries. The explanatory power of the Dutch guilder is closest to the power of the Deutschmark, not surprisingly since the two currencies moved closely together and the guilder was widely regarded by market participants as a proxy for the German currency. Peripheral European currencies do a poorer job of explaining the pressure on European countries, as might be expected,

while the especially weak explanatory power of the British pound is attributable to the UK leaving the ERM in 1992.

Table 12. Counterfactual analysis based on model of Table 8, R-squared only

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Dollar-Deutschmark rate (from Table 8)	0.63	0.25	0.09
Dollar-Dutch guilder rate	0.61	0.24	0.08
Dollar-French franc rate	0.60	0.23	0.08
Dollar-Belgian franc	0.60	0.21	0.08
Dollar-Norwegian krone	0.60	0.21	0.07
Dollar-Italian lira rate	0.59	0.20	0.07
Dollar-Spanish pesetas	0.58	0.21	0.08
Dollar-British pound	0.58	0.20	0.07

Overall, this is evidence that the dollar played an important role in the development of exchange market pressure in Europe in this period.

8 Conclusion

Using archival evidence on foreign exchange market intervention, we have provided a new perspective on the 1992-3 EMS crisis. We use those intervention data, together with exchange rates and interest rates, to construct a daily measure of exchange market pressure. That series allows us to pinpoint when and where the 1992-3 crisis was most intense. It shows that pressure on EMS currencies started building well before the Danish referendum. It points to a fateful interview by Bundesbank President Schlesinger prior to the September 1992 French referendum on the Maastricht Treaty as the event triggering the most acute phase of the crisis.

The new data also enable us to revisit the role of the dollar. Relating the time-series for exchange market pressure to changes in the dollar/DM exchange rate and in U.S. German interest differentials, we confirm that dollar depreciation in 1991-2 was a major factor in the crisis.

Contemporaries drew several lessons from the 1992-3 episode. They concluded that divergences and imbalances between EMS member states could generate intense pressure on ERM parities. They saw that large cross-border financial flows in an environment free of capital controls could produce self-fulfilling prophecies, in which doubts about the stability of a currency could lead to the very instability anticipated by market participants. Both conclusions – that convergence should proceed more rapidly and that the ERM was intrinsically fragile – provided motivation for completing the three stages of the Maastricht process culminating in monetary unification.

But so too did a third lesson, that the system could be upended by disturbances from outside, specifically exchange rate shocks coming from the United States. Only completing the transition to the euro could insulate intra-European exchange rates from this threat. Although subsequent historical accounts and economic analyses generally neglected this problem, contemporaries were aware and concerned about it. The analysis here indicates that they were right to be concerned.

9 References

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Appendix A: Data Sources

Daily intervention data

Archives of the Bank of England, Dealers' daily reports, reference C8 (for most of the data).

Archives of the Deutsche Bundesbank, Daily market reports, Hauptabteilung Ausland, reference B330_3184, 41585, 32834 for (7/29/1993 to 4/8/1993 only).

Exchange rates

Most exchange rates are from Global Financial Data. Rates for the Greek Drachma are cross rates obtained using the DEM/USD rate. We are grateful to Rebecca Stuart for pointing us to the Irish punt exchange rates (<https://www.centralbank.ie/docs/default-source/statistics/interest-rates-exchange-rates/exchange-rates/ieprates-1979-1988.xls?sfvrsn=6>).

Interest rate data

Belgium: We are grateful to Pierre Wunsch, Hugues Fameree and Raf Wouters for sharing the data with us.

Denmark: BIS (2019) 'Central Bank Policy Rates' Available online: <https://www.bis.org/statistics/cbpol.htm?m=6%7C382%7C679> Accessed: 5 May 2019.

Finland: We are grateful to Juha Tarkka for sharing data with us.

France: We are grateful to Vincent Bignon for sharing data with us.

Germany: Center for Financial Stability (2019) 'Historical financial statistics' Available online: <http://www.centerforfinancialstability.org/hfs.php> Accessed: 5 May 2019.

Ireland: We thank Rebecca Stuart at the Bank of Ireland for sharing rates with us.

Italy: Center for Financial Stability (2019) 'Historical financial statistics' Available online: <http://www.centerforfinancialstability.org/hfs.php> Accessed: 5 May 2019.

Norway: We are grateful to Oyvind Ethrheim for pointing us to Norwegian rates (<https://www.norges-bank.no/en/topics/Monetary-policy/Policy-rate/Key-policy-rate-Monetary-policy-meetings-and-changes-in-the-policy-rate/>) Accessed: 28 June 2019.

Portugal: We thank Jorge Braga de Macedo and Luis Catela Nunes with help finding the data from various sources. Partial data are at [https://www.bportugal.pt/EstatisticasWeb/\(S\(j34c2e23dz2x4045jdu2q045\)\)/DEFAULT.ASPX?Lang=en-GB](https://www.bportugal.pt/EstatisticasWeb/(S(j34c2e23dz2x4045jdu2q045))/DEFAULT.ASPX?Lang=en-GB) Accessed: 19 August 2019.

Spain: Banco de Espana, Boletin Estadistica (2019) 'Monthly Policy Rate' Available online: <https://www.bde.es/webbde/en/estadis/infoest/tipos/tipos.html> Accessed: 5 May 2019.

Sweden: BIS (2019) 'Central Bank Policy Rates' Available online: <https://www.bis.org/statistics/cbpol.htm?m=6%7C382%7C679> Accessed: 5 May 2019.

UK: Bank of England (2019) 'Bank Policy Rate' Available online: <https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate> Accessed: 5 May 2019.

US: FRED 'Effective Federal Funds Rate' from <https://fred.stlouisfed.org/series/FEDFUNDS> Accessed: 5 May 2019.

Appendix B: Individual Country EMP Indices

Figure B1. EMP index for Belgium

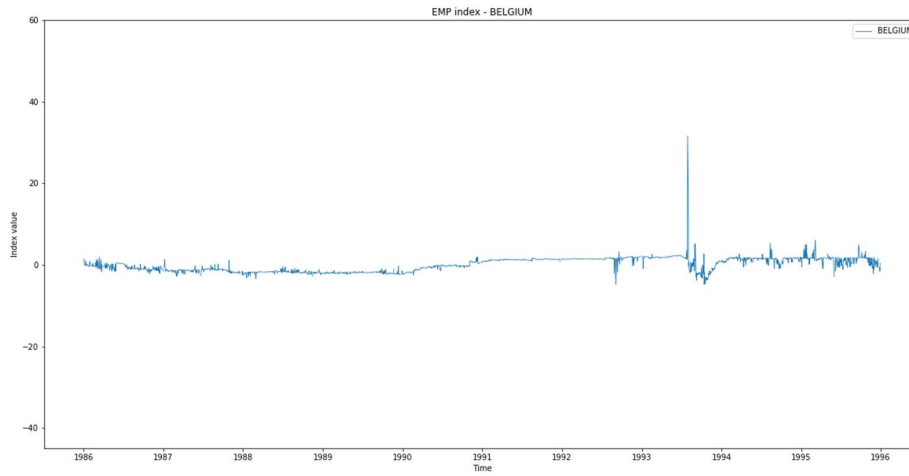


Figure B2. EMP index for Denmark

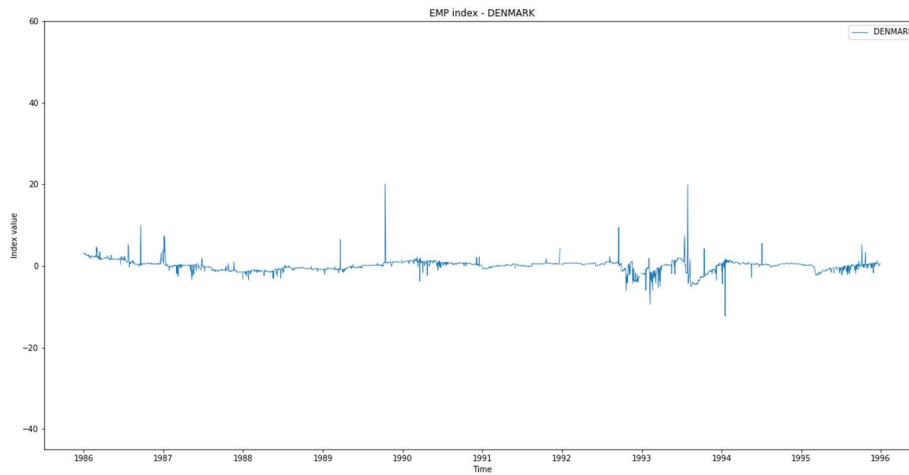


Figure B3. EMP index for Finland

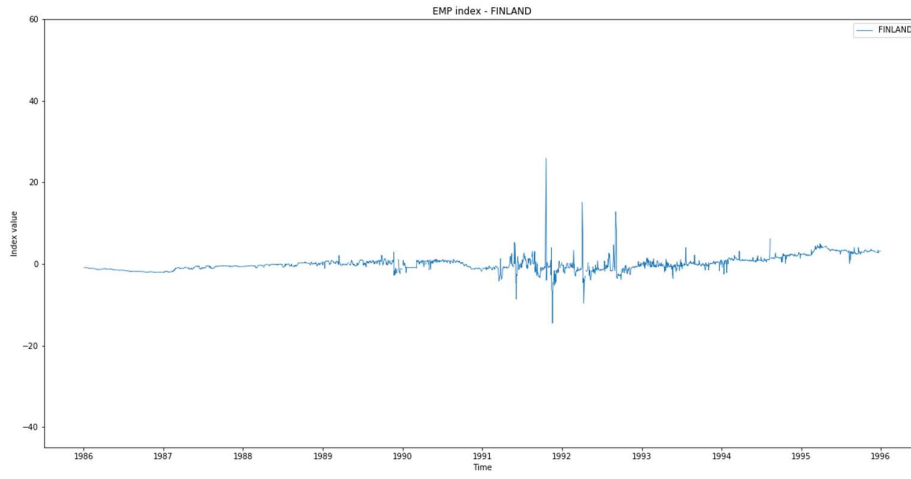


Figure B4. EMP index for France

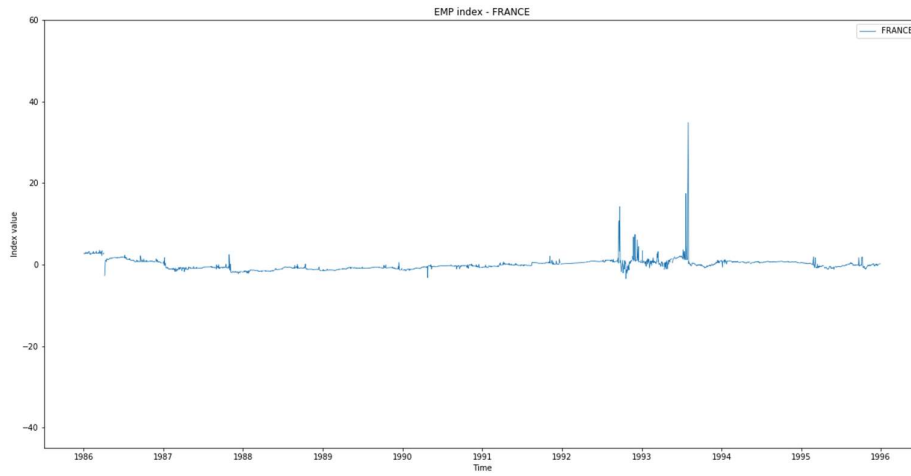


Figure B5. EMP index for Italy

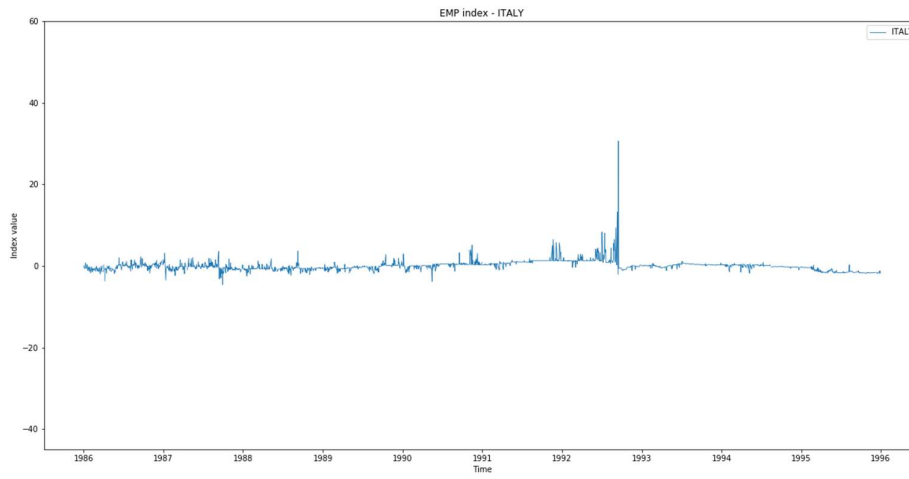


Figure B6. EMP index for Ireland

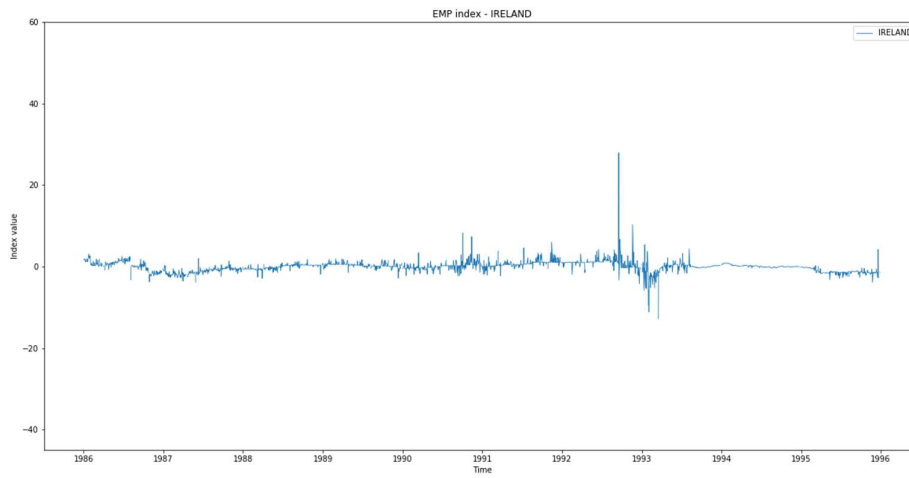


Figure B7. EMP index for the Netherlands

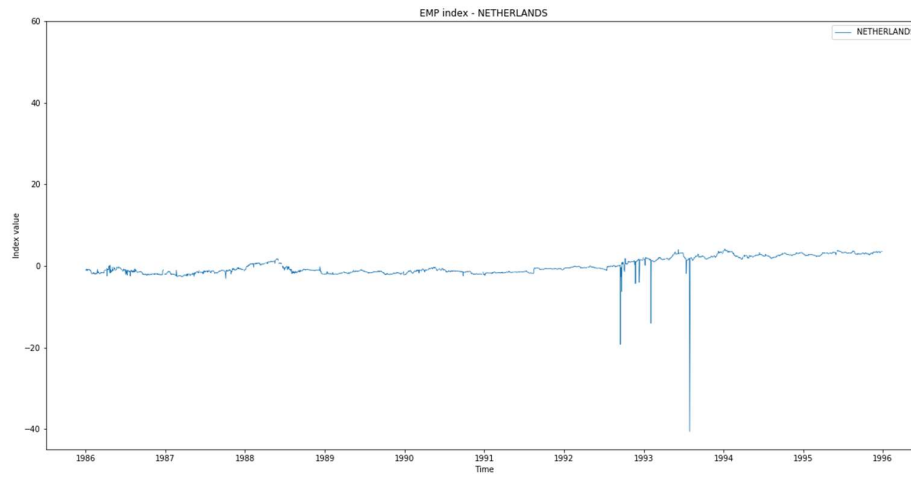


Figure B8. EMP index for Norway

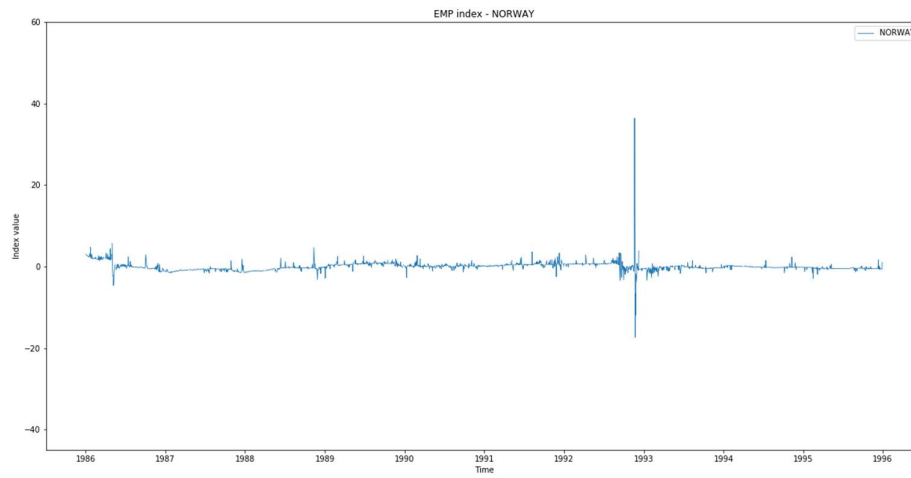


Figure B9. EMP index for Portugal

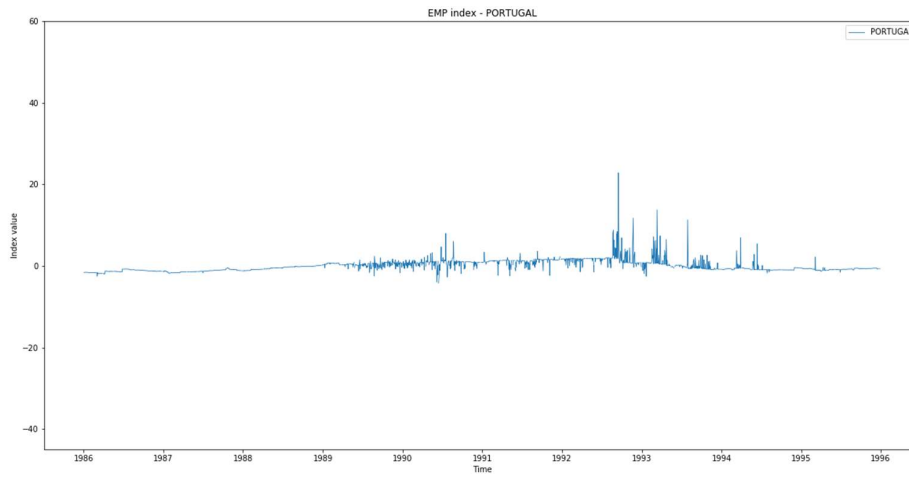


Figure B10. EMP index for Spain

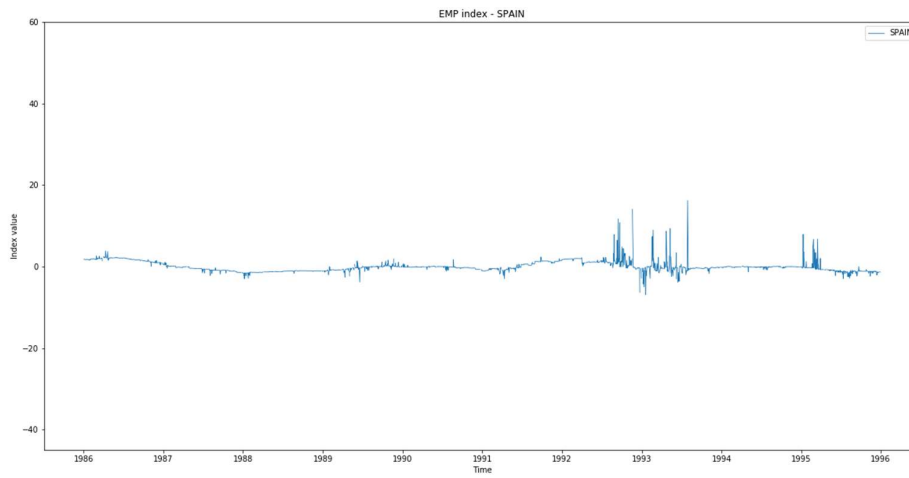


Figure B11. EMP index for Sweden

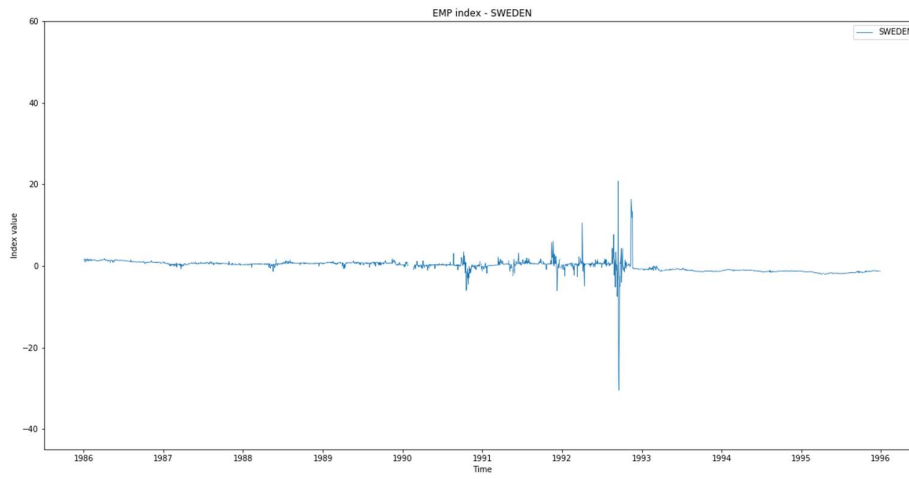
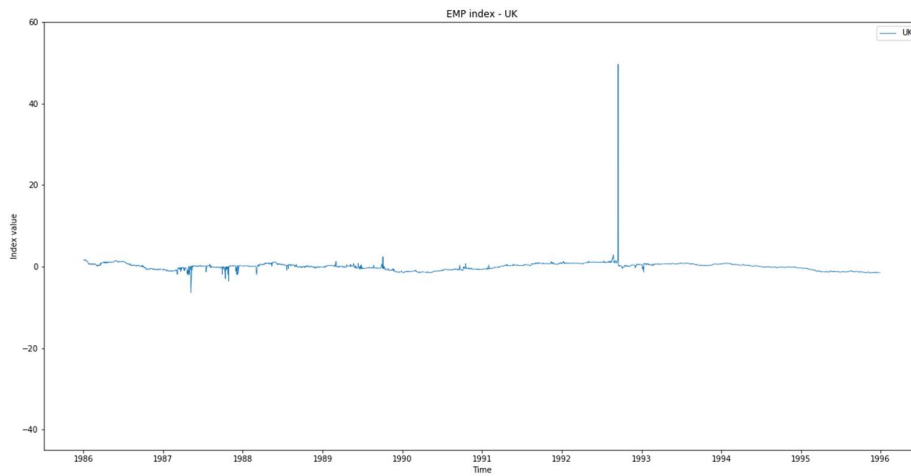


Figure B12. EMP index for the UK



Appendix C. Robustness Checks

Table C1. Simple bivariate regression

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Lagged change in exchange rate	-5.40*** (2.22)	-1.73*** (0.32)	11110*** (3500)
N	2342	2575	2575
R squared	0.004	0.01	0.007

Standard errors reported in parenthesis are robust to heteroscedasticity and autocorrelation using a heteroscedasticity and autocorrelation-consistent (HAC) estimators, using a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above 15\$ billion.

Table C2. Same day exchange rate

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Change in exchange rate	-4.58*** (1.26)	-1.30*** (0.26)	5387** (2575)
Control: Lagged change in interest differential (Germany-US)	0.04 (0.03)	0.009 (0.004)	-162.38 (77.84)
Day of the week, month and year control	yes	yes	yes
N	2345	2572	2571
R squared	0.59	0.21	0.08

Standard errors reported in parenthesis are robust to heteroscedasticity and autocorrelation using a heteroscedasticity and autocorrelation-consistent (HAC) estimators, using a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above 15\$ billion.

Table C3. Squared distance from exchange rate highest point

	Average EMP for all countries	Number of countries intervening	Average DM intervention
Squared distance from exchange rate highest point	-5.71*** (1.67)	-1.79*** (0.32)	11028*** (3386)
Control: Lagged change in interest differential (Germany-US)	0.003 (0.04)	0.009 (0.004)	-61.38 (50.10)
Day of the week, month and year control	yes	yes	yes
N	2339	2572	2571
R squared	0.59	0.21	0.08

Standard errors reported in parenthesis are robust to heteroscedasticity and autocorrelation using a heteroscedasticity and autocorrelation-consistent (HAC) estimators, using a Newey-West correction. *** signifies statistically significant at the 1% level of significance; ** at the 5% level of significance; * at the 10% level of significance. We drop three outliers when intervention is above 15\$ billion.