Key Knowledge Generation

Central Bank Intervention and Stock Market Response

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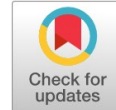
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CENTRAL BANK INTERVENTION AND STOCK MARKET RESPONSE

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Abstract. We examined the reaction of stock markets around central bank interventions using an event study framework. In the absence of intervention data, we used proxies for central bank intervention. The dataset encompasses monthly observations for 32 countries during the period 1994 to 2015. We estimated abnormal returns by using the traditional market model. Our empirical analysis indicates that all negative abnormal returns following central bank intervention are significant during the currency crises. This might be because the market forces were too strong, and central banks could not handle those. We also examined the central bank intervention in each country, and we documented some stock markets that give significant reactions to intervention events, especially when central banks have a high number of International reserves they can use. The output of this research will fill a gap in knowledge and understanding of how the stock market reacts to such central bank intervention events over the period 1994 through 2015. Eventually, it will add considerations for central banks before doing an intervention and for investors to respond to central bank intervention.

INTRODUCTION

Asian Crisis in 1998 gave underlying shocks to the economy of Asian countries and significant spillover effects outside the region. The crisis triggered exchange rate volatility. More and more short speculative traders sold the respective currencies as they no longer trusted in the value.

The economic condition and financial stability got worse when investors felt unsafe and they were likely to shift their portfolios to other countries.

In another region, Asian crisis made the U.S. products more expensive and there was a decline in individual and corporation's consumption in Asia which triggered the stock values of companies managing an international business in that region to descent.

In order to decrease the exchange rate volatility, the central bank did monetary authority's crisis management. Some central banks in Asia did an indirect intervention by increasing the interest rate. At that time, the interest rates of Indonesia, Malaysia, and Thailand increased substantially from their pre-crisis levels. Those countries whose local currencies experienced more depreciation had higher upward adjustments.

The central bank did interventions to smoothen the exchange rate movement in the foreign exchange market. Then, another question arises.

How about the stock market?

What is the stock market reaction to central bank intervention?

What are the lessons that the businesses can take from the stock market and intervention?

Should government concern the negative effect of an intervention to the stock market, before they do an intervention? This is an interesting issue to study that should be shown up. Central bank intervention might affect stock market through two ways.

Firstly, intervention can affect stock market through the exchange rate. Some previous studies argue intervention operations can influence the level of the exchange rate and stop the speculative attacks against a currency, thereby decreasing volatility (Aguilar & Nydahl, 2000; Pattanaik & Sahoo, 2003; Behera, Narasimhan, & Murty, 2008; Adler, Lisack, & Mano, 2015).

In this way, after intervention affects the exchange rate, it will influence the stock market. The relationship between exchange rate and stock prices is strengthened by previous research including: Papadamou, Sidiropoulos, and Spyromitros (2014) finds a positive correlation between exchange rate volatility and stock market variability, Reboredo, Rivera-Castro and Ugolini (2015) detect a positive relationship between stock prices and currency values in emerging countries.

Secondly, central bank intervention gives impact to the stock market through interest rates. Changes in the interest rate, as one type of indirect intervention, do not only affect the behavior of consumers and businesses, but also the stock price.

For example, when a central bank increases its country's interest rate, logically, consumers will make less consumption because they are affected by the increase bills - credit card and mortgage

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interest rate -, or they may prefer to save their money to gain interest.

For businesses, it might become more expensive for companies to borrow money from the bank, which then will make the price of the companys stock lower.

If enough companies experience declines in their stock prices, the market will go down (Egert & Kocenda, 2014).

This research is the first study in analyzing the effect of central bank intervention to stock market response. However, the papers that come closest to our research are the studies by Hartman and Perdzioch (2007) which examine the link between stock returns and exchange rate movements. They documented the nonlinear link between exchange rate movements and stock returns, and it becomes strengthened in periods of central bank interventions.

The output of this research will fill a gap in knowledge and understanding of how stock market reacts to such central bank intervention events over the period 1994 through 2015. Eventually, it will add considerations for central banks before doing an intervention, and for investors on how to respond to central bank intervention (Layyinaturrobaniyah., Masyita, & Sekartadjie, 2016).

DATA

Ideally, the central bank intervention data are provided by the central banks. However, the data are rarely available. Only most advanced economies publish actual intervention data (MacKinlay, 1997).

Tsen (2014) indicates that the changes of international reserves can be a valuable proxy for intervention in the absence of official intervention data. The proxy of central bank intervention such as the changes of international reserves is tested. For example, Adler et al. (2015) and Erler, Bauer and Herz (2015) investigated foreign exchange intervention by using reserves as the proxy for foreign exchange intervention.

In this study, we used intervention index as the proxy of central bank intervention. We accessed International reserves data and short-term interest rates from IMF's International Financial Statistics (IFS) and Datastream, respectively.

We followed an alternative approach aiming at adjusting reserves and interest rate. This approach is based on Erler et al. (2015), intervention is significant if the intervention index exceeds the average value of the previous 12 months intervention index plus three times of standard deviations.

The intervention index is a standard deviations weighted sum of the changes in interest rates and the percentage changes in reserves, as this calculation below:

$$INTX = \frac{\triangle i_t}{\sigma \triangle i_t} - \frac{\triangle r_t}{\sigma \triangle r_t}$$

We then found there were 606 interventions in those 32 countries (16 developed and 16 emerging economies) over the period January 1994-September 2015. Notice some countries have multiple interventions within a single year, we only included interventions that be at least one year apart.

If there is more than one intervention within a one year period, only the first one is included in the sample. This application reduced the sample to its final total of 247 interventions. In order to analyze stock market returns, we calculated the stock market returns from stock price index by using this formula:

$$StockReturn = \frac{EndingPrice - InitialPrice}{InitialPrice} \text{x} 100$$

The data of stock price index come from Morgan Stanley Capital International (MSCI) database.

METHODOLOGY

Event studies provide a direct test of market efficiency (Brown & Warner, 1980). Existing literature concerning the estimation of abnormal returns typically employs the event study methodology originated by Fama, Fisher, Jensen and Roll (1969), who employ it to test the market's efficiency in responding to stock split announcements.

The idea of event study is to see the movement of stock price triggered by an intervention that can create an abnormal return for the investors. This is in accordance with the opinion of Kritzman (1994) who states that some events, such as a regulatory change or an economic shock, affect many securities contemporaneously.

We chose event study to examine whether the central bank intervention event provides information to the marketplace. If it provides information, there should be a correlation between the observed change of the market value and the intervention event. Event period means how long the intervention period will affect the company's share price before and after the occurrence of this event.

As can be seen in Figure 1, the event period is t-12 through t+12. Whereas, the estimation period, which means how many months we need to get the parameter estimates by applying the return generating model, is t-24 through t-13. (We skipped a long time period after the intervention because there may be a leakage of information).

The choice of the observation period refers to the method used by Patro, Wald and Wu (2014) in investigating the effect of devaluation on the stock market response.

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FIGURE 1
Event Study Time Line
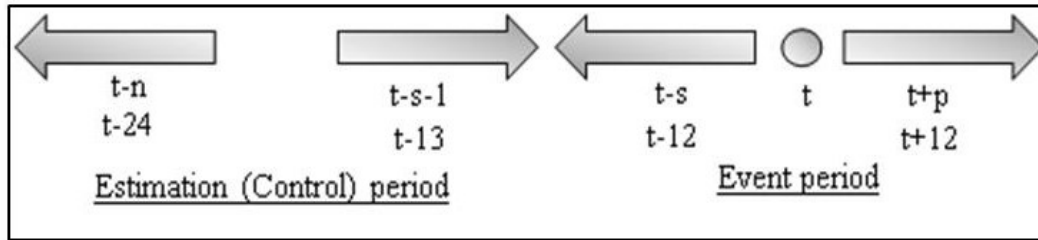
In order to estimate risk-adjusted abnormal returns, returns of each country are regressed on the returns of world market index by estimating market model as below:

$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t}$

where, $R_{i,t}$ is the monthly return of a country i in time t, $_i$ is the alpha of stock i estimated from pre-event measurement period, β_i is the beta of stock i estimated from pre-event measurement period, and $R_{m,t}$ is the return of the world market index.

In this study, we calculated the abnormal return and cumulative abnormal return by using the parameters estimated from market model. As pioneered by Fama and MacBeth (1973), the abnormal returns are calculated as follows:

$AR_{i,t} = R_{i,t} - [\hat{\alpha}_i + \hat{\beta}_i R_{m,t}].$

After computing the abnormal return, then we computed the cumulative abnormal returns for each event. We also computed the Average Abnormal Return (AAR) and the Cumulative Average Abnormal Return (CAAR) for each country and all the countries. To get a sense of the accumulative effect of the abnormal returns, computing the CAARs is a good statistical analysis that can be used (Markus, 2003).

EMPIRICAL ANALYSIS

As mentioned earlier, we estimated abnormal returns around interventions by using market model. The average abnormal returns are summed and tested whether they are significantly different from zero. The empirical analysis result of 247 central bank intervention events from all the country samples shows that there are no significant abnormal returns around central bank intervention of these 32 countries (See Appendix A for the list of the countries and the intervention months of all country samples). It indicates that on average the stock market of all the country samples does not react to intervention events. There are three reasons that could make this happen. First, intervention events might not have significant information to make the investors overreact to the intervention events. In this way, the investors might think that intervention event will not give a big effect on the exchange rate and stock price index in the market, so they do wait and see in the market. What makes

the average abnormal returns is not significant (Dianita, 2015). The second reason is because intervention has to give effect to the exchange rate before intervention gives effect to the stock market. As discussed in the previous section, the central banks do an intervention in the foreign exchange market to reduce the exchange rate volatility. Exchange rates and stocks markets are naturally linked given that changes in currency values have an impact on trade flows and that stock price movements have an impact on capital movements. Meanwhile, the effectiveness of central bank intervention in influencing exchange rate is still debated and the previous researches which investigate the effects of central bank intervention on the exchange rate are rather mixed. Some argue that central bank intervention is not effective to give effect to exchange rate and even intervention will increase the exchange rate volatility in the short run (Dominguez, 1998; Beine, Benassy-Quere, & Lecourt, 2002; Inoue, 2015). However, in the absence of intervention, currency movements would be even more volatile (Madura, 2002).

Our third reason is because stock market reactions to central bank interventions immensely vary across countries. The determinant factors are the timing and the amount of International reserves the countries can use. We examined that the interventions during crises periods have many more significant abnormal returns.

In this study, we estimated abnormal returns during crises period. We studied the abnormal returns during the Asian crisis period (July 1997-1998) and during currency crises in each country. The currency crises period data in each country are taken from Reinhart and Kenneth (2010). (For currency crises periods for each country, it is available online at https://goo.gl/xYgdkR. See also Appendix C for the details). There were 27 central bank interventions during Asian crisis in 24 countries, whereas there were 41 central bank interventions during currency crises in each of 21 countries.

As we can see in Table 1 and Table 2, both of the tables show that during crises, there are significant negative abnormal returns after the central bank interventions. Figure 2 and 3 also exhibit that this study does not find the positive returns follow-

ing central bank interventions during currency crises. In similar, Glen (2002) and Patro et al. (2015) also found the negative returns following devaluations. The bottom line here is that the market forces might be too strong in currency crises period and could not be offset by the central bank.

FIGURE 2
AAR and CAAR around CBI events during Asian Crises
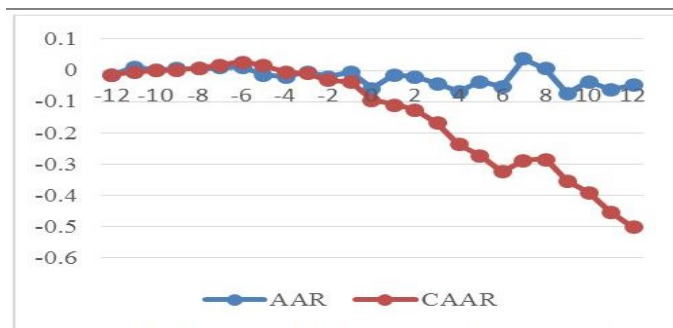
TABLE 1
Cumulative Average Abnormal Return (CAAR)
around Intervention Events during Asian Crises.

Month	CAAR	t-values
-12	-0.0141	-0.22
-11	-0.0040	-0.06
-10	-0.0019	-0.03
-9	0.0023	0.03
-8	0.0075	0.11
-7	0.0168	0.26
-6	0.0282	0.43
-5	0.0150	0.23
-4	-0.0055	-0.08
-3	-0.0103	-0.16
-2	-0.0318	-0.49
-1	-0.0360	-0.55
0	-0.0938	-1.44
1	-0.1081	-1.66*
2	-0.1273	-1.95*
3	-0.1701	-2.60***
4	-0.2367	-3.63***
5	-0.2725	-4.17***
6	-0.3235	-4.95***
7	-0.2878	-4.41***
8	-0.2822	-4.32***
9	-0.3544	-5.43***
10	-0.3912	-5.99***
11	-0.4517	-6.92***
12	-0.4995	-7.65***

The test follows the standard normal distribution using two tail test.
Significance levels are ***$p<0.01$, **$p<0.05$, and *$p<0.10$.

FIGURE 3
AAR and CAAR around CBI events during Currency Crises in each Country
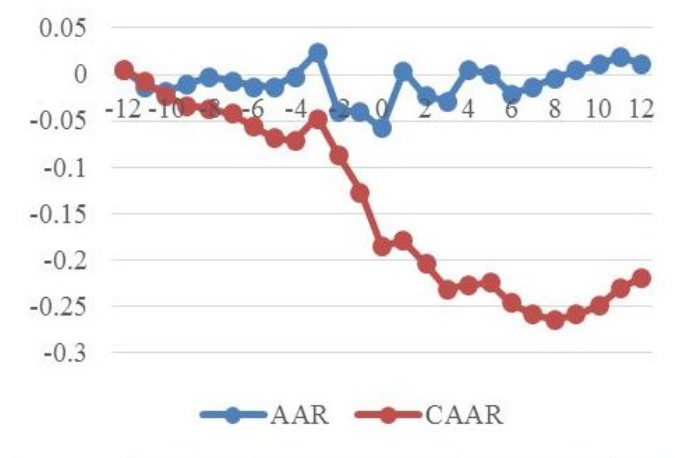
TABLE 2
CAAR around Intervention Events during
Currency Crises in each Country

Month	CAAR	t-values
-12	0.0057	0.09
-11	-0.0064	-0.10
-10	-0.0245	-0.37
-9	-0.0340	-0.51
-8	-0.0359	-0.54
-7	-0.0432	-0.65
-6	-0.0551	-0.82
-5	-0.0690	-1.03
-4	-0.0705	-1.05
-3	-0.0465	-0.70
-2	-0.0866	-1.30
-1	-0.1258	-1.88*
0	-0.1835	-2.75***
1	-0.1801	-2.69***
2	-0.2024	-3.03***
3	-0.2310	-3.46***
4	-0.2258	-3.38***
5	-0.2250	-3.37***
6	-0.2461	-3.68***
7	-0.2590	-3.88***
8	-0.2631	-3.94***
9	-0.2588	-3.87***
10	-0.2492	-3.73***
11	-0.2302	-3.45***
12	-0.2192	-3.28***

The test follows the standard normal distribution using two tail test.
Significance levels are ***$p<0.01$, **$p<0.05$, and *$p<0.10$.

This study also documents that the amount of reserves the countries can use is one of determinant factors why the stock market reactions around central bank intervention are diverse. We can take Hong Kong as an example. As can be seen in Table 3, the stock markets on average react positively to the central bank interventions from 1994 to 2015. The month t=0 CAAR, 11.63 percent, is significantly positive at the 1 percent level. Similarly, the CAAR of month t=4 is significantly different from zero at 1 percent level.

TABLE 3
Cumulative Average Abnormal Return
(CAAR) around Intervention Events in Hong Kong

Month	CAAR	CAAR t-values
-12	0.0223	0.51
-11	0.0699	1.60
-10	0.1031	2.36**
-9	0.1378	3.16***
-8	0.1011	2.32**
-7	0.1255	2.87***
-6	0.1421	3.26***
-5	0.1369	3.14***
-4	0.1550	3.55***
-3	0.1500	3.44***
-2	0.1624	3.72***
-1	0.1391	3.19***
0	0.1163	2.66***
1	0.1059	2.42**
2	0.1210	2.77***
3	0.1372	3.14***
4	0.1740	3.99***
5	0.1611	3.69***
6	0.1805	4.13***
7	0.1829	4.19***
8	0.2011	4.61***
9	0.2373	5.43***
10	0.2873	6.58***
11	0.2876	6.59***
12	0.3062	7.01***

The test follows the standard normal distribution using two tail test.
Significance levels are ***$p<0.01$, **$p<0.05$, and *$p<0.10$.

It could be said that on average, intervention is an important event and has essential information for investors in Hong Kong. The potential effectiveness of central bank's direct intervention is the amount of reserves it can use (Madura, 2002). Hong Kong has high International reserves and the government can convince investors that the exchange rate will be maintained. It may reduce fears of investors that the local currency will weaken and thus may encourage investors to maintain their investment in Hong Kong.

Comparing the central bank holdings of International reserves of all countries in the sample, we found that all the AARs and CAARs in the countries with least International reserves (e.g. Israel, Hungary, Australia, Canada, Chile, Denmark, New Zealand, Portugal, and South Africa) are not significant. It also shows that the effectiveness of central bank intervention depends on a number of International reserves it can use.

CONCLUSION

In this paper, we studied stock market reaction to central bank intervention. Our empirical analysis indicates that on average, in all the 32 country samples, there are no significant abnormal returns around central bank intervention. This might be because the central bank intervention affects stock market indirectly, through the exchange rate. The other reason is because the

stock market reactions to central bank interventions vary greatly across countries. The determinant factors are the timing and a number of International reserves the countries can use.

Our empirical analysis indicates that all negative abnormal returns following central bank intervention are significant during currency crises period (especially during Asian crises and crises in each country). It is because the market forces were too strong and central banks could not handle those. We also found that for the countries with highest International reserves holding mostly have significant abnormal returns. It proves that the success of central bank intervention depends on a number of holdings it can use. The limitation of this study is in the absence of inter-

vention data from central banks. In this study, the authors use changes of interest rates and International reserves as proxies for central bank intervention.

We discovered that the central bank's decision whether to intervene or not is quite risky. Particularly in currency crises period, central bank intervention does not always have effective impact on exchange rate and stock market return. There are some other variables impacting the condition of the market. This study would be great if the researchers add some macroeconomic variables to account the direction of stock market response to the central bank intervention, which can be used for the future research.

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APPENDIX A. COUNTRY LIST AND CBI EVENTS IN ALL COUNTRY SAMPLES

Countries	Central Bank Intervention Event Months							
Argentina	Jan-95	Jan-96	Mar-97	Sep-99	Oct-00	Oct-01	Jan-03	Jan-06
	Oct-08							
Australia	Oct-94	Mar-98	May-00	Feb-02	Aug-03	Sep-04	Aug-07	Jun-09
	May-10	Aug-12	Jan-14					
Canada	Mar-94	Apr-97	Aug-98	May-00	Jul-02	Nov-04	Dec-05	Oct-09
Chile	Mar-97	Apr-98	Apr-99	Apr-00	Apr-01	Apr-03	Jun-05	Jun-06
	Aug-07	Oct-08	Dec-09	Jan-11	Jan-12	Jan-13	Feb-15	
China	Dec-03	Nov-07	Oct-08	May-10	Jun-11	Jun-13	Sep-14	
Colombia	Nov-94	Dec-95	Oct-97	Jul-99	Jun-01	Mar-05	Jun-07	
Czech	May-97	Jun-98	Aug-00	Oct-08	Nov-10	May-12	Sep-14	
Denmark	—Feb-14	Mar-95	May-96	Apr-98	Oct-99	Feb-06	Oct-08	Oct-09
	Nov-10	May-15						
Finland	May-94	May-96	Nov-97	Oct-99	Mar-06	Oct-09		
France	Feb-94	Oct-95	Jan-99	Mar-00	Apr-02	Feb-04	Feb-05	Dec-07
	Oct-09	Apr-11	Feb-13	Jul-15				
Hong Kong	Jun-98	May-04	Jun-05	Jun-08	Dec-09	Jan-13		
Hungary	Apr-97	Sep-98	Apr-00	Mar-03	Jan-05	Jul-06	Oct-08	Dec-09
	Jul-11	Aug-13						
India	May-95	Aug-96	Sep-97	Aug-00	Dec-05	Jun-08	Dec-09	Jul-13
Indonesia	Apr-94	Jan-98	Feb-99	Sep-00	Jun-04	Jul-05	Oct-06	Jan-08
	May-10	Sep-11	Jun-13	Mar-15				
Israel	Aug-95	Aug-97	Sep-98	Apr-00	Mar-02	May-04	Jul-07	Dec-09
Japan	Jan-94	Nov-95	Dec-97	Oct-99	Apr-04	Oct-08		
Malaysia	Sep-94	Jul-97	Jul-99	Dec-05	Sep-08			
Mexico	Nov-95	Mar-97	Jun-98	Apr-00	Feb-02	Oct-06	Oct-08	
Netherlands	Jan-99	Apr-00	Feb-04	Aug-07	Oct-09			
New Zealand	Mar-94	Jun-96	Jul-97	Mar-99	Mar-02	Aug-03	Feb-05	Jan-07
	Jul-08	Jul-09	Jul-10	Aug-11	Dec-12	Dec-13	Dec-14	
Poland	Oct-94	Apr-96	Jul-97	Mar-99	Sep-08	Dec-09		
Portugal	Mar-94	Jun-96	Jan-99	Feb-03	Dec-05	May-07	Sep-08	Nov-09
	Apr-11	May-15						
Russia	Sep-97	Aug-99	Dec-00	Dec-01	Oct-08	Dec-14		
South Africa	Apr-95	Apr-86	Aug-97	Dec-99	Jan-02			
Spain	Jan-95	Dec-98	Jul-03	Mar-05				
Sweden	Apr-04	Jun-95	Nov-96	Nov-97	Mar-99	Aug-06	Nov-09	
Switzerland	Jan-94	Jan-96	Mar-98	Sep-99	Jun-04	Jul-09	Jul-10	Sep-11
	Jan-13	Feb-15						
Taiwan	Jan-94	Mar-95	Mar-96	Jun-97	Oct-00	Aug-02	Jun-07	Aug-08
	Sep-11							
Thailand	May-08	Dec-09	May-11					
Turkey	Jan-94	May-95	Dec-96	Aug-98	Nov-00	Feb-03	Jun-06	Oct-08
	Dec-11							
United Kingdom	Aug-94	Sep-96	Aug-99	Feb-01	Jan-03	Apr-04	Jun-06	Mar-08
	Jun-09	Sep-11						
United States	May-94	Oct-99	Feb-02	Sep-08				

APPENDIX B. CBI EVENTS DURING ASIAN CRISES

Country	Event Months	
Australia	Mar-98	
Canada	Jul-97	Aug-98
Chile	Aug-97	Sept-98
Colombia	Oct-97	
Czech Republic	Nov-97	
Denmark	Apr-98	
Finland	Nov-97	
Hong Kong	Jul-98	
Hungary	Sep-98	
India	Sep-97	
Indonesia	Jul-97	
Israel	Aug-97	Sep-98
Japan	Dec-97	
Malaysia	Jul-97	
Mexico	Nov-97	
New Zealand	Jul-97	
Poland	Jul-97	
Russia	Sep-97	
South Africa	Aug-97	
Spain	Dec-98	
Sweden	Jul-97	
Switzerland	Mar-98	
Taiwan	Jul-97	
Turkey	Nov-97	

APPENDIX C. CBI EVENTS DURING CURRENCY CRISES IN EACH COUNTRY

Country	Event Months					
Argentina	Mar-02					
Australia	May-00					
Chile	Oct-08					
Colombia	Jun-95	Oct-97	Jul-99			
Denmark	Nov-10					
France	Feb-05					
Hungary	Apr-97	Mar-99				
India	Jun-08					
Indonesia	Mar-97	Jun-98	Sep-00	Jan-08		
Malaysia	Jul-97					
Mexico	Nov-95	Jun-98	Oct-08			
New Zealand	Jan-97	Jul-08				
Poland	Apr-96	Jul-97	Mar-99	Sep-08		
Portugal	Dec-05					
Russia	Jan-98	Aug-99	Oct-08			
South Africa	Feb-96	Jan-98				
Spain	Mar-05					
Switzerland	Sep-99					
Turkey	Jan-94	May-95	Dec-96	Aug-98	Nov-00	Oct-08
United Kingdom	Mar-08					
United States	Feb-02					

Data are based on the author's calculation of intervention months and the currency crises period from Reinhart, Carmen M. and Kenneth S. Rogoff, "From Financial Crash to Debt Crisis," NBER Working Paper 15795, March 2010. Reinhart paperwork provides currency crises data period from 1960 until 2010, and it does not provide currency crises data period for Czech Republic, Hong Kong, and Israel.