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# The 2008 Crisis: An International Finance (Over)view

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# The 2008 Crisis: An International Finance (Over)view

Joao Costa-Filho[1]

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**Abstract**

*The aim of this paper is to present an international finance view of the 2008 crisis. By relying on four traditional international finance classes of models (the intertemporal current account approach, two exchange rate risk premium models and open-economy economic policy models), we addresed, theoretically, the importance of macro-finance aspects of the episode such as portfolio reallocation and its aggregate effects, using data for supporting the claims. Moreover, by telling the story of the crisis, divided in three periods (Great Moderation, Great Recession and Euro Crisis) we provided an overview of the deployments as well as an understanding of the development from a slightly point of view.*

***Keywords:*** financial crisis, risk premium, monetary policy, fiscal policy

***JEL Classification Codes:*** E21, E43, E44, F3, F41, G11, G12

## 1. An Once-in-a-Century Crisis

*One knows a financial crisis when it happens.*
Charles Kindleberger (1989)

Dealing with financial crises is not a new feature of capitalist economies. Since the end of Bretton Woods the frequency of crises has increased (Eichengreen, 2002). And this is a problem for eight centuries or more (Reinhart & Rogoff , 2009). Nevertheless, since the Great Depression, no other episode was as strong as the 2008 financial crisis (Claessens, Kose, & Terrones (2009). An unlikely crisis hit the world economy (Costa Filho, 2015) emerging from problems in the US housing market, spreading to the rest of the world throughout a complex derivatives network and the economic policy responding to the fall Brunnermeier (2009).

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It is precisely the transmission and international impact of the crisis that is addressed in this paper and can be summarized in the following research question: from the international finance lens, how can one explain the financial crisis and its aftermath? In order to answer this question, I used four international finance models (the intertemporal current account approach, two exchange rate risk premium models and open-economy economic policy models) and this paper presents the overview of the macro-financial events before, during and after the Great Financial Crisis.

For understanding the financial crisis, here I divided it into three acts: in the first, calamity and apparent control over business cycles led us to bake the worst crisis since the Great Depression. Act two addresses the issue of problems arising from the US housing market impacting economies around the world, with a special focus on developed economies, rather than emerging markets, which managed to recover faster from the episode. The climax is exposed in act three with the so-called Euro crisis. Within the Eurozone, asymmetric behaviors before and after the bankruptcy of Lehman Brother in September of 2008 exposed the fragile economic arrangement upon which the single currency was built on. Wrong-timing austerity policies and the harms of the internal devaluation hurt countries differently throughout the crisis.

To address the entire "play", this paper is organized as follows. The next section addresses the economic environment before the financial crisis, in which financial deregulation, combined with dynamic inefficiency in China resulting in a global savings glut that influenced interest rates on the other side of the world. Section three deals with the crisis itself, focusing not only on how it emerged within the US financial system, but also (and specially) on how it has spread abroad, using portfolio a macro-financial model to understand the exchange rate risk premium channel of the crisis and a textbook open-economy model for analyzing how policymakers responded to the shock. Section four analyzes the Euro crisis and the importance of the exchange rate regime, internal devaluation and portfolio allocations based on consumption patterns. Finally, section five presents the final remarks.

## 2. Baking a Financial Crisis

The 1970s and the 1980s were complicated periods for economic policymakers. The distortions that war periods brought and the stagflation from the fiscal expansion called for tough monetary policies. The contraction of the monetary base growth imposed by the US Central Bank when Paul Volcker took over led not only to a recession in the US,

but also foreign debt problems (and defaults) in Latin America and capital outflow in developed countries. The burst of a bubble in Japan put the economy into a stagnant path and since then the economy has been struggling to get back on track. After the mid-1980s though, the world experienced a new reality: low macroeconomic volatility with sustained growth.

The so-called "Great Moderation" was a period of prosperity. Not only output, but also inflation had low volatility, especially in the 2000s, as can be seen in Figure 1:

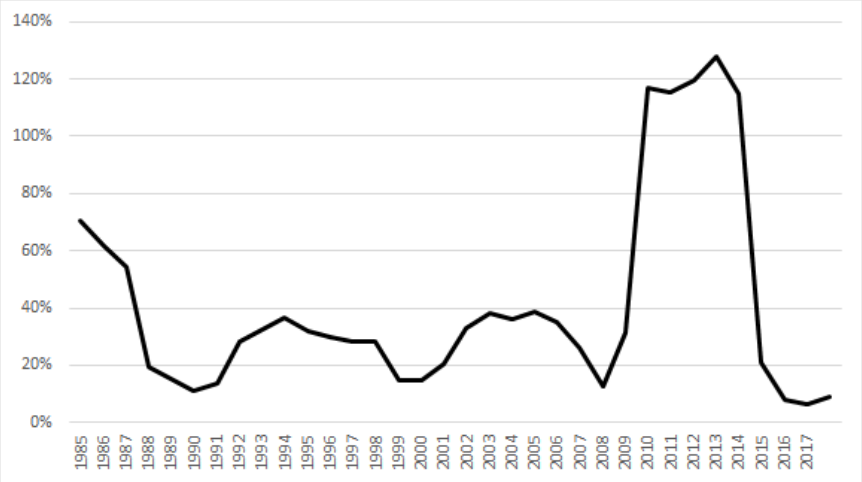


**Figure 1: Five-years Coefficient of Variation of World's GDP annual growth rates (%)**

(Data from the World Economic Outlook, October 2018)

The lower volatility was welcomed and embraced. But why did volatility diminished? Bernanke (2004) brought three possible explanations: structural, policy and luck. The first is related to the effects of institutional changes, technology gains, and business practices that served as a "buffer" for shocks that once hit the economy resulting in severe recessions.

The second reason would be the result of greater efficiency and efficacy of macroeconomic policy making. Monetary policy had been seen not only as the main responsible for disciplining inflation, but also for managing business cycles.

The "luck hypothesis" relied not on changes in the economic mechanisms (structure and/or policy), but rather on changes in the shocks themselves. They might had been softer and less frequent, bringing down macroeconomic volatility.

Bernanke (2004) advocates that, regardless the fact that the new reality may be a combination of the three hypotheses, there was improvement in monetary policymaking. The output variance/inflation variance trade-off, despite of any possibility of a “divine coincidence", was operating in a lower lever (withe the “trade-off curve" shifting to the left[2].

The thrill of an era “without" business cycles (at least in the way they had manifest themselves in the past) generated the incentives for academic research to change its focus. Macroeconomics arouse as a response to the intellectual challenges imposed by the Great Depression, but in the 2000s, the feeling was that this was overcome. A redirection to field was prosed, to a more supply-side orientation (Lucas Jr, 2003).

Without business cycles (apparently, at least), some important aspects of international monetary conditions might had facilitated the emergence of an economic environment prone to the problems revealed within the 2008 crisis. The emergence of an important agent might had changed monetary conditions on the other side of the globe.

### 2.1.The Global Savings Glut Hypothesis

In the 2000s, Bernanke (2005) raised the following hypothesis: the current account deficit in US was a consequence of the high savings in China. Indeed, if we look at 2007 data, presented in Figure 2, we can see very different patterns. The US grew less and experienced a deficit in the current account, whereas China had a higher growth combined with a current account surplus (sphere sizes in the graph represent PPP-adjusted per capita GDP).

[2] The “divine coincidence" is a term that Blanchard and Galí (2007) in reference to Goodfriend and King (1997), in which by stabilizing inflation, output is also stabilized. However, the divine coincidence breaks in forward-looking models (Clarida et. al., 2000).

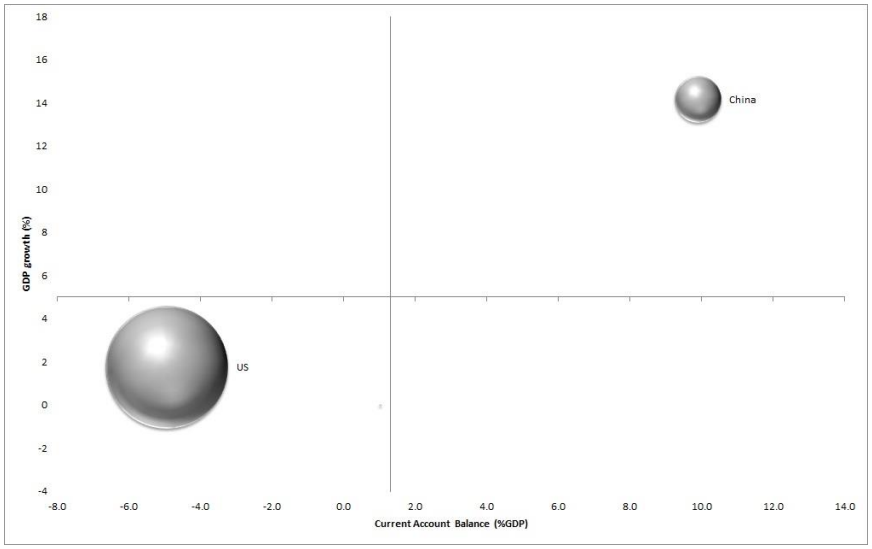


**Figure 2: China and US: Savings and Growth**
(Data from the World Economic Outlook, October 2018)

Bernanke (2005) defend that the intertemporal decision in China impacted the US, with an intertemporal-current-account-model underneath the argument. Their reasoning can be shown via a combination of a simple two-period model and an account identity as follows.

## 2.2. Current Account: an intertemporal model

The reference for this approach is Obstfeld and Rogoff (1995). Let us work with a simpler model, though the main idea still holds. In the model, individuals live for two periods and at a given time $t$, generations may overlap. The economy is composed by two (representative) agente: families and firms.

### 2.2.1. Families

Agents maximize an utility function that depends on consumption ($C$) in both periods of life

$$\max_{C_t, C_{t+1}} U = \frac{C_t^{1-\gamma}}{1-\gamma} + (1+\theta)^{-1} \frac{C_{t+1}^{1-\gamma}}{1-\gamma}$$

subject to the fact that they only work in the first period of life, yielding the following budget constraints:

$$C_t + S_t = W_t$$
$$C_{t+1} = (1 + r_{t+1}) S_t$$

where $\gamma$ is the relative risk aversion coefficient, $S$ stands for savings, $W$ is labor income, $r$ is the interest rate and $\theta$ is the discount rate. We can rewrite the problem in the following way:

$$\max_{S_t} U = \frac{(W_t - S_t)^{1-\gamma}}{1-\gamma} + (1+\theta)^{-1} \frac{((1+r_{t+1})S_t)^{1-\gamma}}{1-\gamma}$$

From the first order condition we have

$$S_t = W_t[(1+\theta)^{\frac{1}{\gamma}}(1+r_{t+1})^{1-\frac{1}{\gamma}} + 1]^{-1} \quad (1)$$

Note that in the equation above, the maximum is obtained when the utility loss by an infinitesimal increase in savings is equal to the present value of the utility gained by the increase in consumption in the second period of life. Optimal savings is thus a function of labor income ($\frac{\partial S_t}{\partial W_t} > 0$), the discount rate ($\frac{\partial S_t}{\partial \theta} < 0$) and the interest rate:

- $\gamma < 1 \Rightarrow \frac{\partial S_t}{\partial r_{t+1}} > 0$ (substitution effect is greater than income effect);
- $\gamma > 1 \frac{\partial S_t}{\partial r_{t+1}} < 0$ (income effect is greater than substitution effect);
- $\gamma = 1 \frac{\partial S_t}{\partial r} = 0$ (effects cancel out each other).

### 2.2.2. Firms

In a perfectly competitive environment, firms maximize profits ($\Pi_t$) by choosing the stock of per capita capital ($k_t = K_t/N_t$, where $K$ is the stock of capital and $N$ the population size) subject to its depreciation rate ($\delta$) and the available technology:

$$\max_{K_t} \Pi_t = Ak_t^{\alpha} - \delta k_t - r_t k_t - W_t,$$

where $\alpha$ is the capital share in the production. The first order condition implies that the (net) marginal product of capital is equal to the interest rate:

$$r_t = \alpha A k_t^{\alpha-1} - \delta. \quad (2)$$

The zero profits condition also implies that

$$W_t = (1-\alpha)Ak_t^{\alpha}. \quad (3)$$

Using equations (1), (2) and (3) and the population dynamics we have

$$k_{t+1} = (1+n)^{-1}(1-\alpha)Ak_t^{\alpha}[(1+\theta)^{\frac{1}{\gamma}}(1+\alpha Ak_t^{\alpha-1} - \delta)^{1-\frac{1}{\gamma}} + 1]^{-1}.$$

Stability requires $\frac{\partial k_{t+1}}{\partial k_t} < 0$. Under dynamic inneficency (i.e. income effect higher than substitution effect in the partial derivative of equation (1)), China's savings lowered interest rates inducing more

savings, what would create an unstable path if the economy was not open.

### 2.3. Savings and the Current Account

We may use a national accounts identity to link the previous simple model to the open-economy savings determination:

$$S - I = X - M \tag{4}$$

Equation (4) presents the equality between the capital and financial account (left hand side) and the current account (right hand side). Thus, let us make a simplification and cautiously use the identity to infer causality. If there is an increase in the decision of savings (via the aforesaid dynamic inneficiency, for instance), holding everything else constant, the country will incur in a commercial surplus. Therefore, it will export savings. But to where?

Kim and Wu (2008) may shed some light on it. Agency ratings may direct flows with credit ratings. Therefore, investment instruments such as pension funds, for instance, when looking for a destination of its investments, may be attracted (due to their statutes) by triple-A bonds. Developed financial markets may absorb the inflow and the US has the most developed one. The consequence of the foreign capital inflow is a persistent interest rate fall as can be seen in Figure 3.

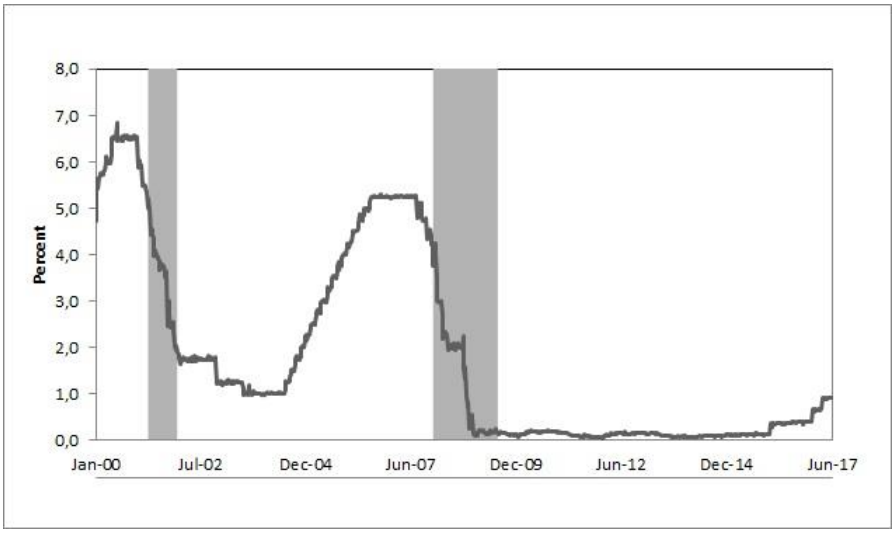


**Figure 3: Effective Federal Funds Rate**
(Data from the Board of Governors of the Federal Reserve System (US)/FRED)

How the global savings glut hypothesis is linked to the "Great Recession"? To answer that question we may have to revisit the literature relating finance and growth. Driffill (2003) presents a survey on the matter. The author questions which financial architecture is the best, opposing two models: the US-UK "hands-off banks" (low participation in management and strong short term finance) with a Japanese-German style, in which banks focus on long term projects and have a more active role in management.

King and Levine (1993) use cross-country regression and find evidence that corroborates with the Schumpeterian hypothesis that a well developed financial market is essential for economic development. The financial markets could

- Reduce risks (trough diversification and monitoring);
- Help to allocate resources;
- Discipline/monitor managers;
- Mobilize capital;
- Facilitate goods and services trade.

The benefits of the development of financial markets do not come without costs. Deidda and Fattouh (2002) found a non-linear relation between finance and growth. Arcand, Berkes, and Panizza (2015) also found evidence of a non-linear dynamics. The authors built a model that may help us to link the global savings glut hypothesis with the 2008 financial crisis. Financial development may provide several opportunities. Since agents are risk averse, they may incur in more financial transactions than the social optimal. This would divert resources from other productive usages to (too much) finance. The decision of China (and other surplus countries) regarding savings (and the interest rate fall as a consequence), combined with a deregulation period, led to reckless subprime lending in the US housing market. It turns out that (fast) financial development made the world riskier (Rajan, 2006).

## 3. The International Aspect of Crisis

The low interest rates and abundant capital created the incentives for the investor to look for new opportunities. Deregulation made it possible. The advent of a (new) global player – China – contained goods and services inflation (Calomiris, 2009) and there were less incentives for increasing the policy rate. Actually, before the crisis, interest rate deviations from the prescription of a Taylor rule are associated with the

causes of the crisis (Rose and Spiegel, 2012) and China's savings glut may have pushed it away from the usual behavior.

With the excess of resources and the recent financial innovations, the housing market was stimulated. Housing prices started to rise and the low interest rate environment made it easy to take a loan and renegotiate it. Risky loans for agents such as the "NINJAs" (a person with no income, no job or assets) and the sensation of risk diversification was in the core of the housing market dynamics in mid 2000s (Brunnermeier, 2009). The result was the sharp rise (above the sample average – gray line) in housing prices shown in Figure 4.

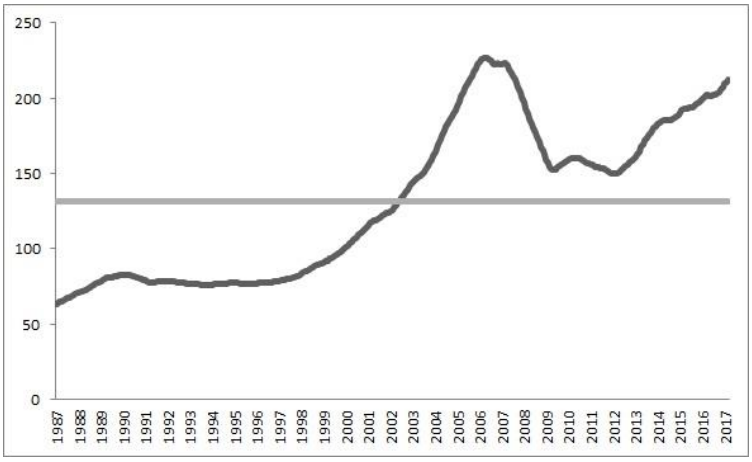


**Figure 4: S&P/Case-Shiller Home Price Index**
(Data from the Board of Governors of the Federal Reserve System (US)/FRED)

Eventually, the interest rates would rise. Moreover, there is nothing guaranteeing that prices might not fall (specially after a bubbly increase). Renegotiation became harder and mortgage defaults triggered the crisis, albeit there is a view that mortgage default arouse actually from real estate investors, rather than subprime credit (Albanesi, De Giorgi, & Nosal 2017) and the "crisis" aspect of the episode may have been established due to the change of expectations (Gennaioli & Shleifer, 2018). The problem is that the loans were "packed" and distributed to free space for more loans, while complex derivatives that were created to reduce risk amplifying it, making possible to transmit the crisis internationally (Brunnermeier, 2009). The financial crisis emerged

from problems in the US housing market and spread throughout the world[3].

Investors had to relocate portfolio amid a rise in uncertainty and risk aversion. The international financial markets thus moved capital from risky countries to the US, in a flight to quality dynamics. The counterintuitive feature of this movement is that, usually, capital moves away from countries where the crisis was born. This time was different, however. The safety guaranteed by US bonds was more important than the economic problems and the troubles within its financial system.

The portfolio reallocation can be analyzed with the international Capital Asset Pricing Model (CAPM), following Dornbusch (1980) and Frankel (1982).

### 3.1. International CAPM

International investors allocate resources based on risk-return evaluation from a Von Neumannâ€“Morgenstern utility function, $U_i(\overline{W}_i; \sigma_W^2)$, with

$$\frac{\partial U_i}{\partial \overline{W}_i} > 0; \quad \frac{\partial U_i}{\partial \sigma_W^2} < 0, \tag{5}$$

where $\overline{W}_i$ é is expected return of a portfolio ($E[\widetilde{W}] = \overline{W}$) and $\sigma_W^2$ is the variance of the return. There are two types of assets in the portfolio: domestic assets, with share $a$, yielding returns equal to $\tilde{r}$ and foreign assets, with share $(1-a)$, yielding returns equal to $\tilde{r}^*$. Given a initial wealth ($W_{0,i}$), the expected portfolio return is thus:

$$\widetilde{W}_i = [a \cdot (1+\tilde{r}) + (1-a) \cdot (1+\tilde{r}^*)] \cdot W_{0,i}. \tag{6}$$

Working with the definition of the variance of the return we have

$$\sigma_W^2 = [a^2\sigma_r^2 + (1-a)^2\sigma_{r^*}^2 + 2a(1-a)\sigma_{r,r^*}] \cdot W_{0,i}, \tag{7}$$

where $\sigma_r^2$ is the variance of domestic assets' return, $\sigma_{r^*}^2$ is the variance of foreign assets' return and $\sigma_{r,r^*}$ is the covariance between domestic and foreign interest rates. It is useful to define a portfolio of minimum variance.

#### 3.1.1. Minimum Variance Portfolio

[3] (Kamin & DeMarco, 2012). See (Wolf, 2015) for the developments of the crisis, the transmissions, the troubles within Europe and the learning that arouse from the episode.

What is the allocation that minimizes portfolio variance? This can be found by choosing the share of domestic assets that minimizes equation (7).

$$\min_a \sigma_W^2 = [a^2\sigma_r^2 + (1-a)^2\sigma_{r^*}^2 + 2a(1-a)\sigma_{r,r^*}] \cdot W_{0,i}.$$

The first order condition for an initial wealth different from zero yields a domestics assets share of:

$$\hat{a}_{min} = \frac{\sigma_{r^*}^2 - \sigma_{r,r^*}}{\Delta}, \quad (5')$$

where $\Delta = VAR[(1+r)-(1+r^*)] = \sigma_r^2 + \sigma_{r^*}^2 - 2\sigma_{r,r^*}$. Now we may go back to the investor's problem.

### 3.1.2. Investor's Problem

Each investor $i$ maximizes its expected utility subject the aforesaid constraints as follows:

$$\max_a U_i(\bar{W}_i; \sigma_W^2)$$

s.t.

$$E[\widetilde{W}_i] = \bar{W}_i = [a \cdot (1+\bar{r}) + (1-a) \cdot (1+\bar{r}^*)] \cdot W_{0,i}, \quad (3')$$

$$\sigma_W^2 = [a^2\sigma_r^2 + (1-a)^2\sigma_{r^*}^2 + 2a(1-a)\sigma_{r,r^*}] \cdot W_{0,i}. \quad (4')$$

The first order condition is thus

$$\frac{\partial U_i}{\partial \bar{W}_i} \cdot \frac{\partial \bar{W}_i}{\partial a} + \frac{\partial U_i}{\partial \sigma_W^2} \cdot \frac{\partial \sigma_W^2}{\partial a} = 0$$

In the equation above the maringal cost with respect to volatility is equal to marginal expected return. Define $\frac{\partial U_i}{\partial \bar{W}_i} = U'_1$ and $\frac{\partial U_i}{\partial \sigma_W^2} = U'_2$. Then we have

$$a^* = \hat{a}_{min} + \frac{1}{\theta_i} \cdot \frac{[\bar{r} - \bar{r}^*]}{\Delta} \Leftarrow [\bar{r} - \bar{r}^*] = \theta_i \Delta (a^* - \hat{a}_{min}),$$

where $\frac{1}{\theta_i} = (\frac{U'_1}{2U'_2} W_{0,i})$.

### 3.1.3. International Equilibrium

Define $V^S$ as the supply of domestic assets, $V^{*S}$ as the supply of foreign assets and global wealth as $W = V^S + V^{*S}$. Assets market equilibrium requires

$$V^S = V^D,$$

where $V^D = \sum_{i=1}^{n} a_i^* W_i$. From the previous equations we have

$$V^S = \hat{a}_{min} W + \frac{[\bar{r} - \bar{r}^*]}{\Delta} \sum_{i=1}^{n} \frac{W_i}{\theta_i}.$$

Define $1/\theta = \sum_{i=1}^{n} \frac{W_i}{W\theta_i}$ as the market degree of risk aversion. Then,

$$[\bar{r} - \bar{r}^*] = (\frac{V^S}{V^S + V^{S*}} - \hat{a}_{min})\Delta\theta.$$

### 3.1.4. Risk premium

International real interest rates (foreign and domestic) with consumption inflation ($\pi^C$) can be defined as:

$$r = i - \pi^C,$$
$$r^* = i^* - \pi^{*C}.$$

Consumption inflation is a convex combination of domestic inflation (with share $0 < \lambda < 1$) and foreign inflation (for the foreign country, the same reasoning applis, but with an asterisk. Therefore

$$\pi^C = \lambda\pi + (1 - \lambda)(\pi^* + d)$$
$$\pi^{*C} = \lambda^*(\pi + d) + (1 - \lambda^*)(\pi^*)$$

where $d$ expected exchange rate change. If $\lambda = \lambda^*$ we have that

$$\hat{a}_{min} = \lambda.$$

whenever $\lambda \neq \lambda^*$, we have that:

$$\hat{a}_{min} = \frac{\lambda^{*2} + (1-\lambda)\lambda^*}{(1-\lambda+\lambda^*)^2}.$$

Finally:

$$[\bar{r} - \bar{r}^*] = \sigma_d^2 \theta (\frac{V^S}{V^S + V^{S*}} - \hat{a}_{min}). \quad (8)$$

The equation above can be interpreted as follows. The risk premium required for deviating from the minimum variance portfolio share is a function of the supply of domestic assets relative to total assets, exchange rate volatility and risk aversion.

We may use equation (8) to understand some features of the crisis. For instance, interest rate differentials augmented during the crisis. One could infer, from the model, that this was a response to a) risk aversion ($\theta$) and b) increased volatility ($\sigma_d^2$). The portfolio reallocation due to the spread of the crisis may had being driven by an "International CAPM reasoning". Moreover, the liquidity crisis with peak in December 2008 may also be understood using the previous equation. Banks were facing the "Queen of Spades problem" (Taylor, 2009). The interbank interest rate rose due to an increase in risk aversion (as equation (8) prescribes.

### 3.2. Monetary Policy in a Liquidity Trap

The worst crisis after the Great Depression emerged after decades without a global recession (Imbs, 2010). This time, however, a debt-deflation depression was avoided[4]. With that in mind the Federal Reserve initiated a balance-sheet expansion (Figure 5). The monetary endeavor now known as "quantitative easing" had three phases, resulting in an amount of total assets held in the Federal Reserve system five times its level in the first day for 2008.

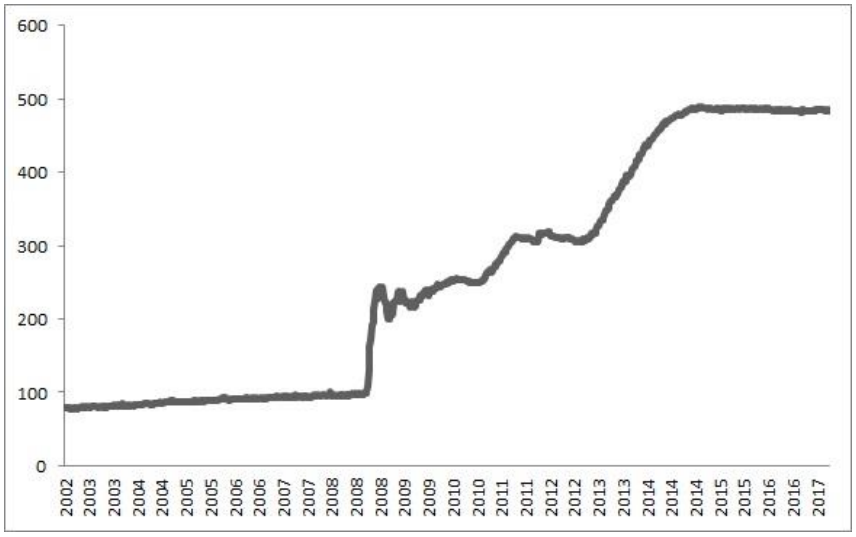


**Figure 5: Federal Reserve Banks: Total Assets (jan/08 = 100)**
(Data from the Board of Governors of the Federal Reserve System (US)/FRED)

The Federal Reserve "toolkit" was discriminated in Clouse et al. (2000) and Bernanke (2002) and can be summarized as follows:

- Expand monetary base;
- Purchase of bonds with longer maturities;
- Twist Operation: buy long-term bonds and sell short-term bonds;
- Buying foreign-denominated bonds.

The first three were implemented and no sign of inflation was seen, This was due to the fact that monetary (and fiscal) expansion in an economy within a liquidity trap does not increase inflation. Moreover, a fiscal expansion does not increase interest rates, so it also can (and should) be implemented in a liquidit trap (DeLong &Summers, 2012). A simple way to see the argument is to use a Mundell-Fleming approach

[4] See Fisher (1933) for the debt-deflation explanation of the Great Depression.

extended it with a liquidity trap (with a kinked LM curve), even though it is a small open-economy model. Figure 6 presents the impact of an expansionary fiscal policy:

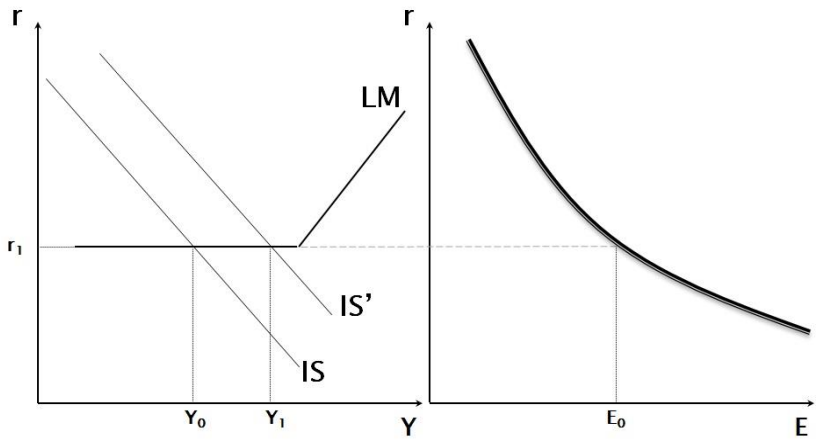


**Figure 6: Mundell-Fleming in a Liquidity Trap**

After an initial fiscal expansion (such as the Economic Stimuls Act, injecting USD 100 bi in the US economy) and the quantitative easing programs, deflation was avoided. The bankruptcy of Lehman Brothers and rescue of AIG and other institutions led to liquidity problems since identifying which institutions were in trouble was hard during the crisis (Taylor, 2009). Countries that had more room for expansionary policies (higher interest rates and a better fiscal management – the latter as a combination of both fiscal balance and grow debt) before the crisis, experienced a less severe first year (Costa Filho, 2016).

The combination of credit expansion and housing prices bubble boom-burst preceding a recession due to a financial crisis usually indicates a slow recovery (Reinhart & Rogoff (2009) ; Reinhart & Reinhart (2010). This is exactly what one should expect from the 2008 crisis. In 2011, overall economic performance seemed to have restored in a "aggregate supply" relation. The world experienced a positive cross-country relation of GPD growth and inflation (Figure 7).

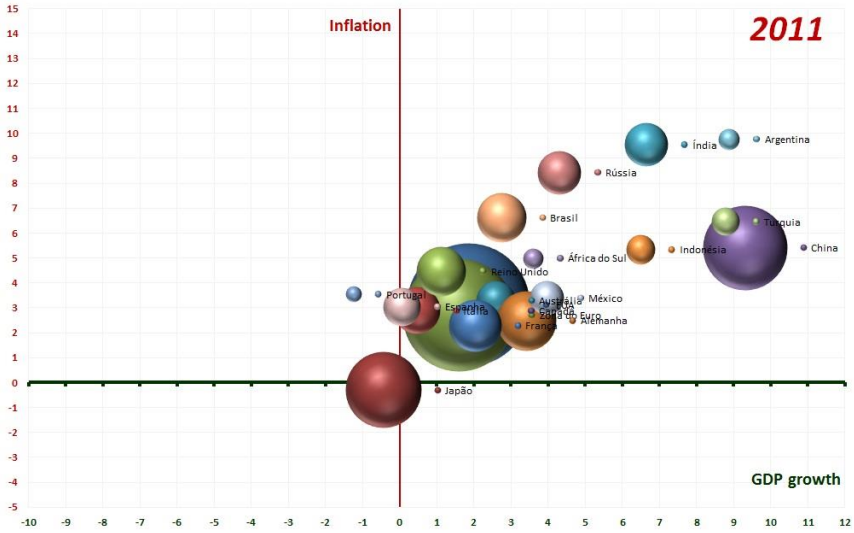


**Figure 7: World's Aggregate Supply Curve (2011)**
(Data from the World Economic Outlook, October 2018)

In 2012, however, the picture looks quite different. Also, the macroeconomics of low inflation imposes some difficulties (Akerlof, Dickens & Perry, 1996).

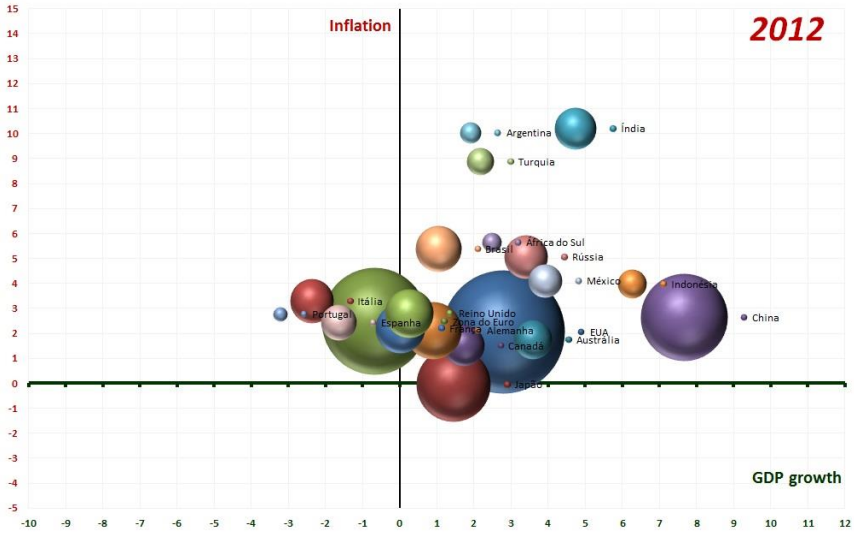


**Figure 8: World's Aggregate Supply Curve (2012)**
(Data from the World Economic Outlook April 2017)

What happened?

## 4. A Greek Tragedy: The Euro Crisis

The 2008 financial crisis hit the world economy hard, but different countries experienced asymmetric impacts. Even (and specially) within the Eurozone, the shock revealed that the far-from-optimal currency union was vulnerable[5]. And its vulnerability was not in the fiscal front. Figure 9 presents the current account balance of selected Eurozone members. It is easy to see that whereas Germany, France and Poland experienced high surpluses, the other countries like Portugal, Spain, Italy Ireland and Greece had high deficits.

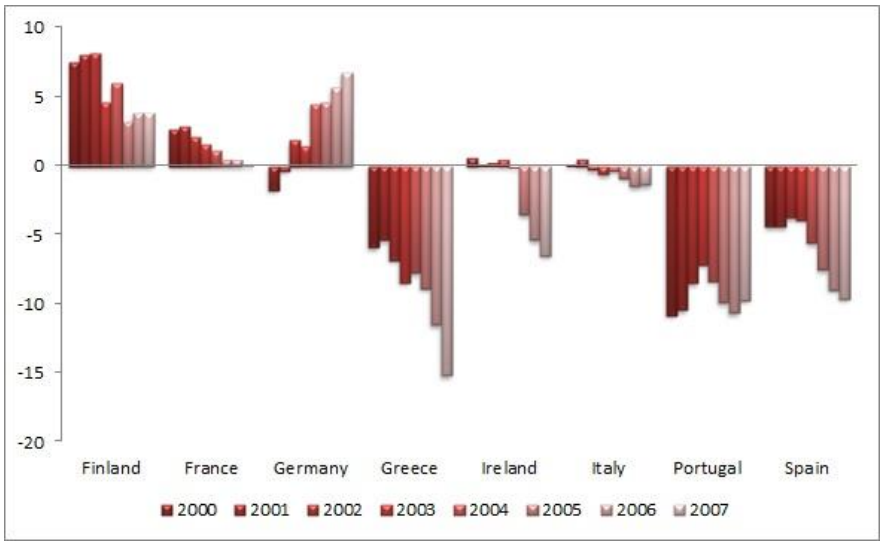


**Figure 9: Current Account Balance (%GDP)**
(Data from the World Economic Outlook, April 2017)

At the same time, with two exceptions (Greece and Italy), the countries that experienced current account deficits had "controlled" levels of gross debt as share of GDP. Ireland and Spain even had a downward trajectory, while Portugal with its long-run problems were already with a growing debt, but still far below Italian figures, for instance (Figure 10).

[5] See Mundell (1961) and McKinnon (1963) for the theory of optimum currency areas.

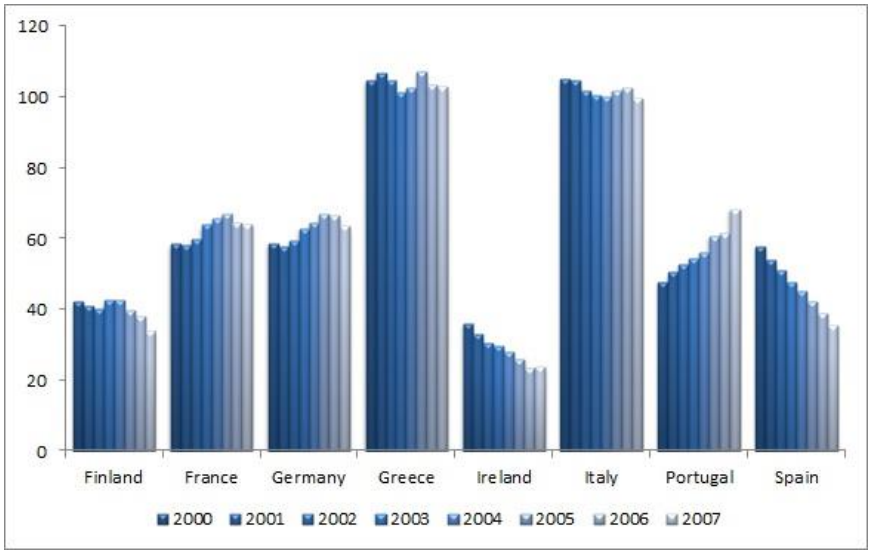


**Figure 10: Gross Debt (%GDP)**
(Data from the World Economic Outlook April 2017)

Public debt usually grows in recessions and the financial crisis was no exception. However, within a currency union, the fixed exchange rate regime imposes a hard reality: fiscal austerity cannot be accommodated by the nominal exchange rate depreciation. Furthermore, the lack of monetary policy imposed another restriction (see Figure 11). The wrong-timing austerity programs amplified the recession.

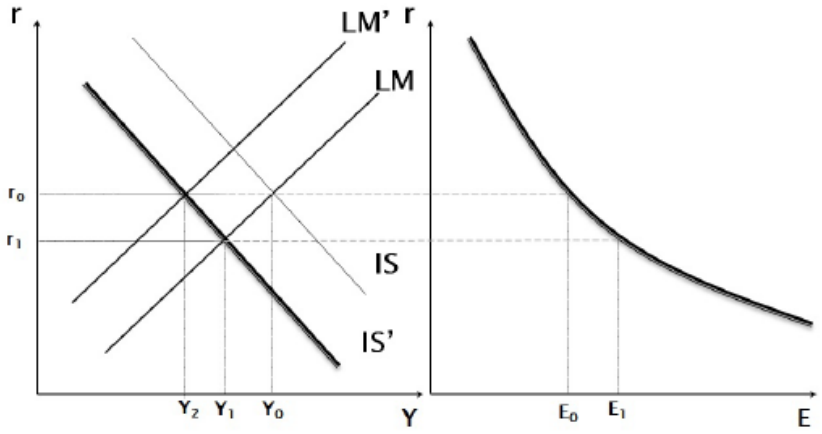


**Figure 11: Austerity with a Fixed Exchange Rate**

The imbalances in the currency union previously to the crisis should be resolved. The economy always finds a way to adjust. The

problem in the crisis was the chosen path. Without the nominal exchange rate to restore the balance-of-payments equilibrium, the commercial relations have to respond to the real exchange rate movements via relative price changes. The velocity, though, is very different. The equation below presents the bilateral definition of the real exchange rate ($Q$):

$$Q = e \cdot \frac{P^*}{P},$$

where $e$ stands for the nominal exchange rate and $P^*$ and $P$ and foreign and domestic prices, respectively. Note that for a real exchange rate devaluation, given the fixed exchange rate regime, there are two possibilities (or a convex combination of both): a rise on foreign prices or a fall in domestic prices. The first one was out of question due to inflation intolerance in Germany. The only option was to cut prices. However, due to nominal price rigidity, in order to reduce prices (or to reduce inflation relative to foreign inflation), there should be a cost reduction. But the trajectory of labor costs imposed some difficulties:

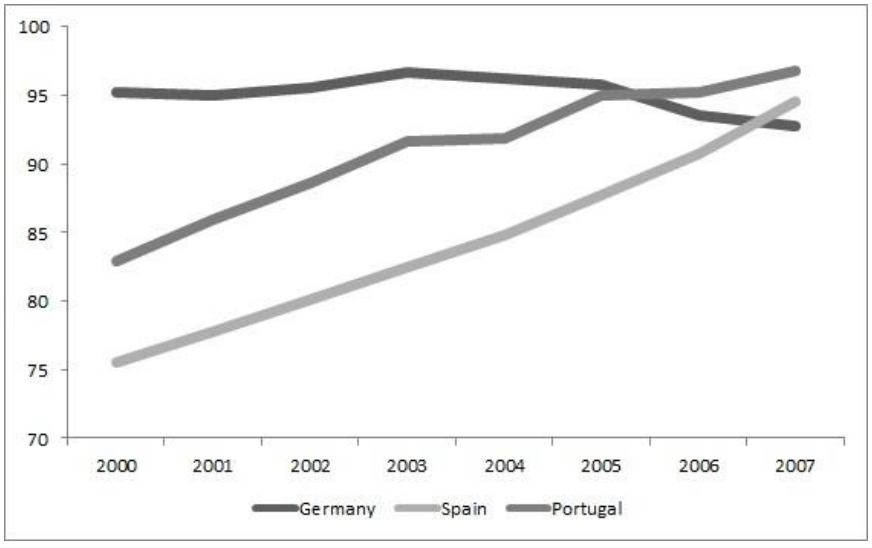


**Figure 12: Unit Labor Costs (hours worked)**
(Data from the OECD)

Figure 12 shows that while German labor costs diminished in the 2000-07 period, Spain's and Portugal's costs rose. Therefore, to obtain a cost reduction, given nominal wage rigidity, unemployment should augment. The adjust in quantities, rather than in prices takes more time and the burden of the internal devaluation

was carried by Eurozone member to balance the current account and restore exports competitiveness.

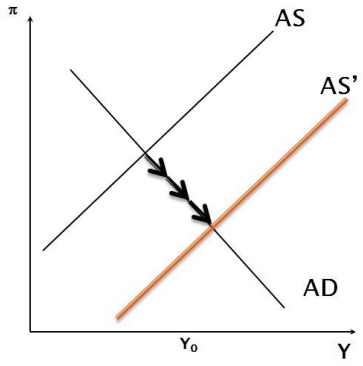


**Figure 13: Internal Devaluation**

In the meantime, Eurozone countries had to deal with its own crisis, "inside" the previous one. In 2009, Greece registered a fiscal deficit of 10% of GDP, Ireland and Spain saw their housing bubbles burst (Wolf, 2015). Investors than realized that each country's ability to honor its own commitments regarding sovereign debt is different. The shock moved from a pooling equilibrium in which "everybody was Germany" to a separator equilibrium, with high interest rates for a few countries as can be seen in Figure 14.

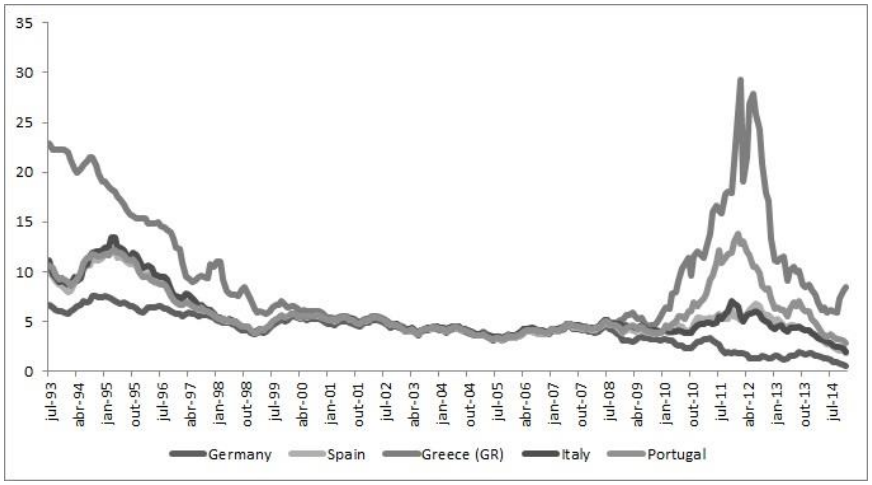


**Figure 14: Long-term Interest Rates**
(Data from the OECD)

Suddenly, investors realized that Euro countries are subject to the "original sin"[6]. Since the creation of the euro, countries have abdicated the possibility of money-printing and therefore, even though they are all part of the Eurozone, debt is denominated in a currency they cannot issue. This made the investors tolerate different levels of debt according to each countries idiosyncrasies[7]. Investor thus demanded different risk premiums for Eurozone countries. This can be seen with the Consumption CAPM model (Cumby, 1988).

### 4.1. The Consumption CAPM

A representative household maximizes the present value (discounted by $0 < \beta < 1$) of its expected utility by choosing consumption ($c$) for each time $t$:

$$\max_{c_t} E_t[\sum_{t=0}^{\infty} \beta^t U(c_t)] \tag{9}$$

subject to the following budget constraint:

$$q_t^i x_t^i + c_t = y_t + x_{t-1}^i (q_t^i + \pi_t^i), \tag{10}$$

where $q_t^i$ is the price of asset $i$, $x_t^i$ the amount of asset $i$, $y_t$ is the labor income and $x_{t-1}^i (q_t^i + \pi_t^i)$ represents previous period $(t-1)$ savings, evaluated at $t$, in which there is not only capital gains, but also dividends payment ($\pi_t^i$). The first order condition results in the following equation:

$$\delta E_t[\frac{(q_{t+1}^i + \pi_{t+1}^i)}{q_t} \frac{U\prime(c_{t+1})}{U\prime(c_t)}] = 1. \tag{11}$$

Define the gross return of asset $i$ as $R_{t+1}^i = \frac{(q_{t+1}^i + \pi_{t+1}^i)}{q_t}$ and $g_{t+1} = \frac{U\prime(c_{t+1})}{U\prime(c_t)}$ the marginal utility growth. By the definition of variance we have:

$$\bar{R}_{t+1}^i = \frac{1}{\delta \bar{g}_{t+1}} - \frac{1}{\bar{g}_{t+1}} COV(R_{t+1}^i, g_{t+1}). \tag{12}$$

With $E_t[R_{t+1}^i] = \bar{R}_{t+1}^i$ e $E_t[g_{t+1}] = \bar{g}_{t+1}$. Let us assume there exists an asset $z$ such that $COV(R_{t+1}^z, g_{t+1}) = 0$. Analogously, we have:

$$\bar{R}_{t+1}^z = \frac{1}{\delta \bar{g}_{t+1}}. \tag{13}$$

Subtracting (9) from (8) yields:

[6] See Eichengreen and Hausmann (1999) for the concept of the "Original Sin".

[7] See Rogoff, Savastano, and Reinhart, (2003) for the concept of 'debt intolerance".

$$(\bar{R}^i_{t+1} - \bar{R}^z_{t+1}) = -\frac{COV(R^i_{t+1}, g_{t+1})}{\bar{g}_{t+1}}. \quad (14)$$

The expected excess return of an asset $i$ over the risk free asset $z$ is negatively correlated with the covariance between marginal utility growth and the gross return of asset $i$. If the asset provides a 'natural hedge" for the investor relative its consumption patterns, the investor qualifies the asset as a "good" one and asks for a lower risk premium. On the other hand, if the return is low, on average, exactly at time the investor needs the most, for allocating its resources on the asset it will ask for a higher risk premium.

Let us define a "benchmark currency" $i = 1$. we have that

$$(\bar{R}^i_{t+1} - \bar{R}^z_{t+1}) = \frac{\beta^i}{\beta^1}(\bar{R}^1_{t+1} - \bar{R}^z_{t+1}),$$

where $\beta^i = -\frac{COV(R^i_{t+1}, g_{t+1})}{\bar{g}_{t+1}}$ e $\beta^1 = -\frac{COV(R^1_{t+1}, g_{t+1})}{\bar{g}_{t+1}}$. Remember that, in the original CAPM, $\beta_a = COV(a, M)/\sigma^2_M$.

### 4.1.1. Risk Premium and the Euro Crisis

The convertibility risk manifested itself as a risk premium on sovereign debt interest rates of Eurozone countries over German bonds. The troubles in Greece specifically after the discover of the lies public statistics. From one country to another, contagion spread and asset prices felt the possibility of a more intense recessions due to, i) the austerity programs and, ii) the revealed intensity of the crisis. Moreover, even an Eurozone breakup was on table (at least on the foreseeable scenarios). Following Kaminsky, Reinhart and Vegh (2003), for one economy contaminate another, there are some necessary elements (a trinity, as they call it):

- Leveraged common investor.
- Surprise.
- Sudden stop.

Who was the Leveraged common investor? The German banks (Wolf, 2015). The deficit in the aforesaid euro countries was financed via capital and financial account surplus. When the crisis hit the monetary union, banks from the core countries were exposed. Since the likelihood of the 2008 crisis was very low (Costa Filho, 2015) and the events after the crisis occurred in unknown territory, surprise was definitely present. The problems within some bank system in euro countries (Wolf, 2015) impulsed capital the outflow. The sudden halt was inevitable.

In the peak of the Euro crisis, an expression changed the path to a sustainable one. The president of the European Central Bank (ECB) said the bank would do “whatever it takes" to solve the crisis (Wolf, 2015). It has worked. The “Long-Term Refinancing Operation" served as a mechanism for the ECB to inject money into the economies by respecting its mandate and statute. The ECB cannot lend directly to a country, only to banks. So they demanded public bonds as warranties as in the representation below:


**Figure 15: Long-Term Refinancing Operation Flow**

Under these dynamics, spreads diminished since the demand for sovereign bonds increased. Moreover, the “Outright Monetary Transaction" (buying sovereign bonds in the secondary market) also helped to diminish spreads. Furthermore, the injection in the banking system could also provide a buffer to contain contagion[8].

## 5. Final Remarks

The 2008 financial crisis, like the Great Depression, attracted the attention of researchers and it is still a majorly discussed topic. Much effort has been made to understand its roots, its transmission and how to prevent another episode with the same proportions to happen. Nevertheless, it seems that the usual approach is to start from the microeocnomic dynamics of US housing market and then keep increasing the radius of analysis to macroeocnomic events. In some sense, this paper also contains that structure. However, by summoning four internation finance models, one may provide some reasoning of the outspreading of the crisis.

From the intertemporal current account approach model we may understand the role of foreign savings in the monetary conditions of the US. After the fall, the international CAPM helps us to understand the effects of portfolio reallocation, whereas its consumption versions are useful for deployments of the euro crisis. Moreover, textbook open-economy economic policy models seem still useful for clarifying the effects of the chosen policies not only

[8] See Allen and Gale (2000) for a model where contagion arises from a shock on liquidity preferences as an equilibrium result.

in the US, but also in other countries such the ones sharing the single currency in Europe. For future research, an extended version of the model could also shed some light on the relegated alternative paths (such as high inflation within the euro area, asymetrically distributed towards commercial surpluses countries) during the crisis.

As this paper tries to present, the traditional international finance models capture the essence of the 2008 financial crisis and are a good starting point for further analysis, highlighting the importance of macro-finance dynamics such portfolio choices, risk premiums and financial market development dynamics.

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