

Akca, Ozden

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2008 Global Crisis: Is Foreign Currency Denominated Debt an Important Indicator?

Ozden Akca¹

University of California Santa Cruz

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Abstract: Foreign currency denominated debt as an influence of exchange rate pressure during the 2008 global crisis is explored across 58 countries. Countries with higher ratios of foreign currency denominated debt to total international debt experienced significant currency depreciation during the global crisis. Predicted values of foreign currency denominated indebtedness are obtained based on country characteristics by employing a double censored tobit model estimation technique. Comparison of actual to predicted values just prior to the crisis demonstrates whether or not countries are over-indebted. According to our analysis, “over-indebted” countries experienced higher rates of exchange rate depreciation in the global crisis of 2008. Additionally, oil exporters, countries with strong financial linkages with the US and net importers experienced significant depreciation. International reserve accumulation before the crisis is associated with currency appreciation during the crisis. However, this result is insignificantly estimated.

Keywords: 2008 Global Crisis, Exchange Rate Pressure, Foreign Currency Denominated Debt, Over-indebtedness, Double Censored Tobit Model.

JEL Classification: F31, F34, F41, G10, G15

¹ Address for Correspondence: Graduate Student, Department of Economics, University of California, Santa Cruz, CA 95064. E-mail: oakca@ucsc.edu.

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The subprime crisis hit the US economy in August 2007. The liquidity problems and the credit crunch in the subprime mortgage market were spread to all of the financial markets. Subsequently, tightening credit conditions put the developed economies into recession in the mid quarters of 2008. The crisis intensified with the bankruptcy of the large US investment bank, Lehman Brothers, and the funding needs of core financial institutions in the US and Europe. Banks had large write downs. There was huge demand for liquidity. The decoupling hypothesis of the emerging markets did not materialize, but the crisis was spread to the emerging world through trade and financial channels. Trade plummeted due to lower global demand, and capital flows have been diminished. Exchange markets experienced heavy pressure.

The purpose of this paper is to evaluate factors surrounding the global crisis, and specifically, the factors accounting for the exchange rate dynamics during the crisis. A key motivational aspect of this paper lies in the extraordinary evolution of foreign currency denominated debts in the last fourteen years prior to the crisis. Additionally, this paper examines the causal impact of foreign currency denominated debt on the exchange rate dynamics that occurred during the global crisis in 2008.

Due to unhedged foreign currency denominated liabilities, the Asian crisis of the 1990s drew attention to balance sheet problems. The Asian countries had strong economic conditions, such as high growth rates, low unemployment rates, successful fiscal policies and high foreign exchange reserves before the crisis of 1997. Financial sector problems were the main reason Asian countries experienced crisis episodes (Mishkin 1999). Before the events of 1997, the crisis countries experienced lending booms and deterioration of bank balance sheets. Several private firms and commercial banks had weak balance sheets caused by currency denomination mismatches of assets and liabilities.

Foreign currency denominated debt brings financial weakness to developing economies. A high ratio of foreign currency denominated debt to total debt creates doubt of exchange rate sustainability. This leads to capital flight, which drives a cycle of exchange rate devaluations and deeper balance sheet problems (Dornbush (2001)). In this way, the foreign currency denominated debt is a source of financial instability that increases the likelihood of currency and debt crises (Bordo, Meissner and Stuckler (2010)). Calvo et al. (2008) inferred in their paper that currency mismatches of assets and liabilities in balance sheets increase the likelihood of systematic sudden stops at

the 1 percent significance level. Balance sheet imperfections are therefore an important area to focus on because of their detrimental effects on the economies.

Eichengreen, Hausmann and Panizza (2005a, b) demonstrated that international lending and borrowing takes places in terms of five major currencies (the dollar, the euro, yen, pound sterling and the Swiss franc) and the remaining countries are unable to borrow abroad in their own currencies. They called this phenomenon *original sin*. After the crisis of the 1990s, policy prescriptions focused on the reduction of foreign currency denominated debt. Some observers claim that original sin is no longer valid. Some emerging market economies are able to borrow abroad in their own currency. However, Hausmann and Panizza (2010) have demonstrated that foreign currency indebtedness in some countries has decreased by small increments. Especially in emerging market economies, there is less reliance on foreign debt and increased participation in the domestic bond markets. However, the original sin phenomenon persists. Therefore, hard currency denominated debt and their potential risks have not been eliminated entirely.

This study explores the degree of foreign currency indebtedness during the last 14 years prior to the 2008 crisis, and its influence on the crisis. This investigation, which considers 58 countries, suggests that countries with higher ratios of foreign currency denominated debt to total international debt experienced significant currency depreciations during the global crisis of 2008. Moreover, countries experienced significant currency depreciations when they displayed strong financial ties (high stock market correlation) with the US, current account deficits and higher levels of oil exports. In other words, countries that were exposed to trade and financial market shocks before the crisis experienced stronger currency pressure in the 2008 crisis.

A novel contribution of this study to the current literature is to address each country in the data set as over or under indebted based on a calculated threshold value of foreign currency denominated debt. The threshold value is the predicted value of foreign currency denominated debt obtained from the regression of the determinants of the foreign currency denominated indebtedness. According to our model, 29 countries out of 50 were over indebted immediately before the global crisis of 2008. Moreover, the regression analysis shows that countries that were over indebted before the global crisis had higher rates of currency depreciation.

The design of the paper is as follows. We provide the literature review in the first section. The second section relates the pre-crisis country characteristics to the global crisis of 2008, with a special emphasis on the foreign currency denominated debt. The third section discusses the determinants of foreign currency denominated debt, the data and the censored tobit model specification. The fourth section focuses on the over indebtedness and its consequences for the 2008 crisis. The fifth section concludes the paper.

1. Literature Review:

The Mundell-Fleming open market economy model has shown that real depreciation shifts domestic spending from foreign to domestic nontradables. Therefore, depreciation is expansionary. However, the balance sheet effects literature has challenged this view. It concludes that depreciation creates problems in countries with too many foreign currency denominated liabilities when such currency is not backed up by foreign currency denominated assets. As a country's net worth decreases, cost of credit increases, investment collapses and demand falls.

Since developing countries are unable to borrow in their own currencies, they suffer the effects of the so called "original sin" (Eichengreen et. al. (2005a, b)). Because of currency mismatches of assets and liabilities, they accumulate foreign currency denominated debt, which leads to balance sheet problems in both the private and financial sectors. Depreciation of the currency leads to an increase in the foreign currency denominated liabilities relative to domestic currency denominated assets, which in turn will lead to prospects of insolvency and capital outflows. Corporations and entrepreneurs go bankrupt because of huge liabilities that they are unable to meet. All of this leads to a collapse of output and investment.

Aghion, Bacchetta and Banerjee (2000) construct a third generation model of currency crises that suggests an economy can move to an undesired equilibrium through expectations or real shocks. In such situations, real depreciation will increase foreign currency liabilities of firms which in turn decreases net worth and leads to lower output.

Céspedes, Chang and Velasco (2000) demonstrate in their model that expansionary monetary policy may be contractionary in the case of a devaluation due to wealth effects in the countries with too much foreign currency borrowing. In their model entrepreneurs' net worth determines the risk premium in external financing. After a devaluation, the domestic value of foreign debt increases, which decreases entrepreneurial net worth. This leads to a fall in investment and in aggregate demand. Therefore, balance sheet vulnerabilities are detrimental because devaluations contract the economy.

The accumulation of foreign currency denominated debt creates problems for the developing countries. As the developing countries increase their liabilities, they will engage in short term borrowing to rollover their debts. There will be a time when such debt rollover will not be possible, which leads to real exchange rate volatilities and financial instability. The prospect of crisis is inevitable. Eichengreen et. al. (2005a) demonstrate that higher foreign currency debt leads to an unstable macro-economic environment, with output and exchange rate volatility.

Bordo and Meissner (2005) demonstrate the relation between a higher foreign currency denominated debt and the probability of crises episodes. They found that countries with higher foreign currency denominated debt have a higher probability of crises episodes.

Calvo et al. (2008) analyze the characteristics of systematic sudden stops caused by exogenous financial factors (contagion effect). Using data for 110 developed and developing countries for the years 1990-2004, they found that balance sheet effects increase the likelihood of systematic sudden stops.

Exchange rate stability is of concern to all countries that may experience a liquidity run during financial turbulence. For this reason there is a "fear of floating" the exchange rate (Calvo and Reinhart (2000)), and the fear is present even in developed economies. Because of that, countries practice exchange rate regimes that are different from their official declarations. Calvo et. al. (2000) conclude that emerging economies have a great deal of short term interest rate fluctuation, and use pro-cyclical interest rate policies in order to smooth exchange rate fluctuations.

Since accumulating foreign currency denominated liabilities is detrimental to developing countries, some studies try to explain why developed banking systems would seek this business and/or why developing countries

would enter into this disadvantageous relationship. They offer a variety of explanations. Some of the studies linked this phenomenon with moral hazard due to government insurance of debt contracts. A fall in international interest rates in 1990s made developing country governments profitable through capital gains on external debt. Following that, developing country governments insured poorly regulated financial markets (Dooley (2000)), or provided implicit government guaranties to failing banking systems (Burnside, Eichenbaum and Rebelo (2002) and Schneider and Tornell (2000)). Investors couldn't internalize the risks they had taken, which led them to take excessive risks and to incur too much foreign currency borrowing.

Incompleteness of financial markets is another type of explanation for the current pattern of international borrowing (Eichengreen and Hausmann (1999)). Because of sovereign risk there is no market in the international financial system that will give credit to developing countries in domestic currency. Developing countries have the power to devalue their currency at the time of repayment of domestic currency denominated debt, so that the real value of debt decreases (Eichengreen and Hausmann (1999)). In anticipation of this, creditors are reluctant to give credit in domestic currency to the developing world. As a result, since their earnings are in domestic currency, developing countries can't hedge their foreign currency denominated debt exposure with foreign currency denominated assets.

There are some models that demonstrate the constraints faced by developing economies in international capital markets. Chamon (2003) has developed a model that proposes an interaction of credit and currency risk, whereby a domestic currency creditor's claim on the firm is expropriated because the borrower increases its debt by borrowing in foreign currency. Domestic currency creditors aren't compensated for that risk, which makes domestic currency lending nonexistent in the equilibrium.

In the Aghion et. al. (2001) model, devaluation and default risk are correlated, which restrains creditors from giving loans in domestic currency. Due to the fact that firms increase their borrowing in foreign currency, creditors share the residual value of the firm in case of bankruptcy. The creditor's domestic currency denominated share is expropriated. Depreciation also affects the domestic currency creditor's share. These facts are known and there is no borrowing in domestic currency in the equilibrium.

2. The Global Crisis of 2008 and Pre-Crisis Country Characteristics:

The 2008 global crisis started in the developed world and expanded to emerging markets and the rest of the world. Thirty five countries out of 47 experienced depreciations with respect to the dollar between 2007 and 2008 as demonstrated in Figure 1.² Depreciation is the percentage increase in the value of the national currency price of one dollar, from 2007 to 2008 (end of period price).

This wide spread phenomenon begs the question: what kind of pre-crisis country characteristics played a role in the exchange rate dynamics during the 2008 global crisis? More importantly, were exchange rate movements during the 2008 crisis influenced by foreign currency denominated debt prior to the crisis?

2.1 Data and Explanatory Variables:

Table 1 displays the 58 countries-- 28 developed and 30 developing -- used in this study as data permits. We explore the impact of country characteristics on the exchange rate dynamics at the time of the interest. The 2008 crisis was a global shock that affected economies through reduction in trade, deleveraging or both. Countries with a significant portion of earnings from financial markets or trade were impacted more by the detrimental effects of the 2008 crisis. The first group of country characteristics we consider is the financial related factors. The primary variable in this group is foreign currency denominated indebtedness which is measured by the original sin (OSIN) index. We include the OSIN index measured in 2006 (*osin06*) in our analysis. The OSIN index is explained in detail in the next section, Section 3.1. We expect countries with higher pre-crisis levels of foreign currency denominated debt to experience higher depreciation rates in 2008. Additionally, some economists argue that the negative effects of the crisis could have been avoided if countries had capital controls. We test for this argument by using the Chinn-Ito index of financial openness (*finopen*) in 2006. Moreover, we include country's pre-crisis financial linkages to the US (*smrkcpr*) as another financial related factor. It is measured by the country's average stock market correlation with the US in 2005 and 2006 (*Data source: Datastream*). International reserve accumulation is also included in the model. International reserves serve as a war chest to buffer the adverse effects of terms of trade shocks, currency depreciations and sudden stops (Aizenman, Lee (2007)). Therefore, we expect that countries with higher pre-crisis

² European Monetary Union countries share a single currency. Therefore, they are represented here as euroland.

level of international reserves (*intreserv*), measured in 2005, wouldn't depreciate significantly in 2008 crisis. Balance sheet exposure (*blnsheet*) is also included in the model as measured by short term debt (1 year) minus reserves over the GDP in 2006 (*Data source: World Bank JEDH*).³ We also include total debt (*tdebtgdp*) as well as short term debt (*stdebtgdp*) (1 year) as right hand side variables in the model (*Data source: World Bank JEDH*).⁴ These are measured by the gross external debt over the GDP in 2006 and short term international debt securities over the GDP in 2006, respectively. External borrowing is performed in the context of consumption smoothing and alleviating the effects of terms of trade shocks as well as other factors. However, too much borrowing leads to accumulated debt stocks, and creates debt overhang effects, macroeconomic uncertainties and lower growth rates (Pattillo, Poirson and Ricci (2002)). We expect countries with higher levels of total debt and also higher levels of short term debt to experience higher depreciation rates in the 2008 crisis. Additionally, we expect countries with strong financial linkages with the US, and significant balance sheet exposure, to experience higher depreciation rates in the 2008 crisis.

The second group of country characteristics includes trade related factors. In order to account for trade related factors, we include trade openness (*topen*) right before the crisis as an explanatory variable. It is measured by the average value of exports and imports over the GDP from 2003 to 2006. Another trade related explanatory variable we consider is a country trade links to the US (*pexpimp*) prior to the crisis. Since the global crisis originated in the US, we expect the countries with stronger trade links with the US to be impacted more by the global recession. We measure trade links to the US by the average of the percentage of exports that go to the US, plus the percentage of imports that come from the US in 2005 and 2006 (*Data source: IMF DOTS*). We also include pre-crisis oil export share (*oilexp*) as another trade related factor in our model. It is measured by a country's volume of oil exports (1000 barrels per day) over the GDP in 2006 (*Data source: EIA*). We expect countries with higher trade openness, higher trade linkages with the US and a higher oil export share to experience higher levels of depreciation in the 2008 crisis.

Moreover, we consider pre-crisis flow and stock measures of the current account as explanatory variables in our model. The flow measure of the current account (*cagdp*) is measured as the net exports per GDP in 2006

³ Drawn from creditor and market sources.

⁴ Drawn from creditor and market sources.

(Data source: IFS). The stock measure of the current account is measured by the net foreign asset position over the GDP (*nfa*) in 2006 (Data source: Lane, Milesi-Ferretti (2007)). We expect countries with higher net foreign asset positions to experience less depreciation. Additionally, we include dummy variable for the OECD membership (*oecdmem*) in our model. *Oecdmem* differentiates the exchange rate pressure of the OECD members from the non members during the global crisis of 2008.

We also consider country prior crisis de facto exchange rate regimes (*exchreg*) in 2006 as an explanatory variable in our model.⁵ We expect countries with floating regimes to depreciate more than countries with pegged regimes. It is interesting to investigate whether some of the countries had to give up their prior crisis exchange rate regime during the 2008 crisis.

We associate de facto exchange rate regimes with the depreciations in Figure 2. Countries that have pegged exchange rate regimes prior to the crisis of 2008 experienced less depreciation. Hong Kong had a currency board arrangement with the US dollar in 2006, and the Hong Kong dollar has appreciated by 0.6 percent. Similarly, Lithuania, Estonia and Bulgaria had currency board arrangements to the euro and their currencies have appreciated by 1.9, 1.4 and 1.3 percent respectively against the euro (they have depreciated against the dollar at the rates of 3.8, 4.4 and 4.5 percents respectively). Conventional fixed peg arrangements allow the currency to fluctuate less than +1, -1 percent around a fixed peg. Latvian lats have a conventional fixed peg arrangement against the euro and Latvian lats appreciated by 1.6 percent against the euro (Latvian lats depreciated against the dollar by 4.16 percent). Surprisingly, Ukraine had to give up the fixed peg arrangement against the dollar and the Ukrainian hryvnia has depreciated by 52 percent against the dollar. Morocco has a fixed peg arrangement with a basket of currencies and the Moroccan dirham depreciated by 5.06 percent against the dollar. Pegged exchange rates with horizontal pegs allow the currency to fluctuate more than ± 1 percent around a fixed peg. Hungary has a horizontal peg regime against the euro, and the Hungarian forint has depreciated against the euro by 2.8 percent (8.9 percent against the dollar). Figure 2 demonstrates that all of the depreciation rates greater than 9 percent are associated with pre-crisis floating exchange rate regimes.⁶

⁵ IMF de facto exchange rate regime classification - 2006.

⁶ Managed floating with no predetermined path for the exchange rate and independently floating.

2.2 Estimation Results:

The regression results of our analysis, pre-crisis country characteristics accounted for the exchange rate movements in 2008 crisis, are demonstrated in Table 3. The left hand side variable (*exchrtmov*) is the percentage change in the value of the national currency price of 1 dollar from 2007 to 2008 (end of period price). The positive percentage change is depreciation. As part of the first group of financial related factors, foreign currency denominated debt is significant on the model at 1 percent level. Countries with higher pre-crisis volumes of foreign debt (*osin06*) experienced higher depreciation rates. This result is robust when we apply the same analysis to the sample of countries with floating exchange rate regimes (column 10). Countries with stronger financial links to the US (*smrkcor*) experienced depreciations at the 1 percent significance level (column 5 and 6). International reserve accumulation before the crisis (*intreserv*) is associated with currency appreciation during the global crisis. However, this result is insignificantly estimated (column 5). Higher pre-crisis short term debts (*stdebtgdp*) lead to higher depreciation rates. However, this result is also insignificant (column 6). Total debt to gdp ratio (*tdebtgdp*) is highly correlated with the *stdebtgdp*.⁷ Due to multicollinearity, we don't include *stdebtgdp* and *tdebtgdp* simultaneously as right hand side variables in our model. Balance sheet exposure (*blnsheet*) is a combination of the short term debt and the international reserves. Therefore, including *blnsheet* as an explanatory variable doesn't increase the explanatory power of the model (column 7). Financial openness (*finopen*) and dummy variable for the OECD membership (*oecdmem*) is insignificant in the model (column 8).⁸

As part of the trade related factors, the oil export share (*oilexp*) is significantly associated with the exchange rate movement right before the crisis. Inclusion of *oilexp* as an explanatory variable increases the explanatory power of the model (column 4). Countries with higher oil export shares before the crisis materialized experienced exchange rate depreciation. Additionally, the coefficient estimate of *cagdp* is negative and significant which concludes that net exporters have experienced appreciation of their currency during the 2008 crisis. Trade openness (*topen*) and country trade links to the US (*pexpimp*) turned out to be insignificant and are not reported in Table 3.

⁷ The correlation coefficient is 0.93.

⁸ Net foreign asset position and de facto exchange rate regime classification aren't significantly estimated, so we didn't report them in the model.

The results based on our model are robust and don't change when we exclude the outliers, Iceland and Japan (column 9). We investigated the significance of the explanatory variables for the two different groups of countries: OECD and non-OECD member countries (columns 11 and 12). A significant volume of foreign currency denominated debt relative to total debt induces depreciation for the OECD members during the 2008 crisis. However, the coefficient estimate of the foreign debt isn't significant for the non-OECD member countries. The model of the non-OECD member countries has very high explanatory power with only one significant variable. The reason is the depreciation rates for the non-OECD members don't have adequate variation to be captured by the model. On the other hand, prior crisis international reserve accumulation helped the non-OECD countries to achieve currency appreciation during the 2008 global crisis.

3. The Determinants of Foreign Currency Denominated Debt: the Data and the Censored Tobit Model Specification:

3.1. Measuring Foreign Currency Denominated Debt:

In order to quantify the foreign currency denominated indebtedness, we employ the Eichengreen, Hausmann and Panizza (2005a, b) measure of foreign debt. It is an index that measures the level of foreign currency exposure in the international debt securities issued by the residents of a country. The data under consideration are compiled from the Bank of International Settlements (BIS). This database provides data on issuing activity in the international security markets. It provides disaggregated data according to type, sector (governments, corporations and financial institutions) and currency.

The foreign currency denominated debt ($OSIN_i$) for country i is calculated by the maximum of 1 minus international debt securities issued in currency i (independent of the issuer) over total debt securities issued by country i or 0. That is,

$$OSIN_i = \max\left(1 - \frac{\text{Securities Issued in Currency } i}{\text{Securities Issued by Country } i}, 0\right).$$

The OSIN index is calculated to account for the currency swaps. Countries can alleviate their burden of foreign currency indebtedness through currency swaps. Country A can exchange its foreign currency denominated international debt with country B's international debt denominated in country A's currency. Countries can perform currency swaps no greater than the amount of their total international debt at maximum; therefore, the OSIN index cannot be negative. Thus, we restrict it to be zero at a minimum.

In summary, the OSIN index lies between 0 and 1. If a country's entire international debt is denominated in domestic currency, then the index is zero. Likewise, if a country's entire international debt is denominated in foreign currency, then the index is 1.

3.2 Model Specification:

In this section, we study the determinants of foreign currency denominated debt. We model foreign currency denominated debt with general country characteristics. The foreign debt is measured by the OSIN index, between 0 and 1. Since the dependent variable is observable only in a range, the OLS regression will not produce consistent estimates. The censored regression models are consistently estimated with the tobit models. The general formulation of the double censored tobit model is (Maddala (1983)):

$$y_i^* = \beta'x_i + u_i, \quad (1)$$

where y_i^* is the latent variable, β is a $k \times 1$ vector of unknown parameters; x_i is a $k \times 1$ vector of known constants; u_i are independently and normally distributed residuals with zero mean and constant variance. The observed dependent variable y_i is such that;

$$y_i = L_{1i} \quad \text{if} \quad y_i^* \leq L_{1i}, \quad (2)$$

$$y_i = y_i^* \quad \text{if} \quad L_{1i} < y_i^* < L_{2i}, \text{ and}$$

$$y_i = L_{2i} \quad \text{if} \quad y_i^* \geq L_{2i}.$$

Our objective is to estimate the β and the variance.

Let's denote $\Phi\left(\frac{L_{1i}-\beta'x_i}{\sigma}\right)$, $\Phi\left(\frac{L_{2i}-\beta'x_i}{\sigma}\right)$, $\phi\left(\frac{L_{1i}-\beta'x_i}{\sigma}\right)$, $\phi\left(\frac{L_{2i}-\beta'x_i}{\sigma}\right)$ by Φ_{1i} , Φ_{2i} , ϕ_{1i} and ϕ_{2i} respectively, where Φ is the cumulative distribution and ϕ is the density function of the standard normal. Then the mean of the dependent variable is:⁹

$$E[y_i] = \Phi_{1i} L_{1i} + (\Phi_{2i} - \Phi_{1i}) \left(\beta'x_i + \sigma \frac{\phi_{1i} - \phi_{2i}}{\Phi_{2i} - \Phi_{1i}} \right) + (1 - \Phi_{2i}) L_{2i}. \quad (3)$$

The likelihood function of the model is:¹⁰

$$L(\beta, \sigma | y_i, x_i, L_{1i}, L_{2i}) = \prod_{y_i=L_{1i}} \Phi_{1i} \prod_{y_i=y_i^*} \frac{1}{\sigma} \cdot \phi\left(\frac{y_i - \beta'x_i}{\sigma}\right) \prod_{y_i=L_{2i}} [1 - \Phi_{2i}]. \quad (4)$$

Then the log-likelihood function follows as:

$$\log L = \sum_0 \log \Phi_{1i} + \sum_1 \log\left(\frac{1}{(2\pi\sigma^2)^{1/2}}\right) - \sum_1 \frac{1}{2\sigma^2} (y_i - \beta'x_i)^2 + \sum_2 \log(1 - \Phi_{2i}), \quad (5)$$

where the first summation is over the N_0 observations for which $y_i = L_{1i}$, and the second summation is over the N_1 observations for which $L_{1i} \leq y_i \leq L_{2i}$ and the third summation is over the N_2 observations for which $y_i = L_{2i}$.

The estimates of β and σ are obtained by maximizing the log likelihood function. The t test for single exclusion restrictions can be performed with obtained estimates of $\hat{\beta}_j$ and its asymptotic standard error. The Wald test or the likelihood ratio test is performed in order to test for multiple exclusion restrictions.

3.3 Data and Explanatory Variables on Foreign Currency Denominated Debt and the Country Characteristics:

The model we have employed relates the average OSIN index with the following explanatory variables for each of the countries:

- logarithm of the GDP per capita (*gdppc*)
- logarithm of the inflation (*linf*)

⁹ The derivation of the mean of the dependent variable can be found in the Appendix.

¹⁰ The derivation of the likelihood function can be found in the Appendix.

- exports plus imports over the GDP (*tradelink*)
- current account per GDP (*netexpgdp*)
- international reserves over the money (*resm2*)
- international reserves over the GDP (*resgdp*)
- government debt over the GDP (*gdebtgdp*)
- money over the GDP (*m2gdp*)
- rule of law index (*ruleoflaw*)
- sovereign risk rating (*logrisk*).¹¹

The theory behind each of the right hand side explanatory variable is as follows:

The quality of policies and institutions is one of the determinants of the OSIN. Healthy functioning institutions will set market enhancing policies. We are going to test whether the countries with better policies and institutions are able to borrow in terms of their domestic currency from the international markets. It is hard to measure the policies and institutions. However, the policies and institutions are highly correlated with the level of development. Therefore, we are going to use the level of development (logarithm of the GDP per capita) as a measure of the quality of policies and institutions. We expect a negative coefficient estimate between the *gdppc* and the OSIN.

The credibility of monetary institutions is another determinant of the OSIN. Such credibility implies the ability to achieve stable prices. Foreign lenders will hesitate to lend money in the domestic currency if the country is suffering from high inflation. Lending in a stable currency (foreign currency in this case) that will not lose its purchasing power in the international markets is the preference of the foreign lenders. High inflation implies low monetary credibility and leads to a high OSIN index. The credibility of monetary institutions is proxied by the logarithm of the inflation (*linf*). We expect a positive relation between the *linf* and the OSIN.

The government's insolvency is related to the OSIN. A government with too much debt obligations that can't be covered by revenues collected has a tendency toward devaluation. If lenders anticipate the government's

¹¹ The right hand side variables except *ruleoflaw* and *logrisk* are obtained from the IFS. *Ruleoflaw* is obtained from the Kaufmann et al. (1999) and *logrisk* is obtained from the Datastream.

willingness to devalue the domestic currency, they will not give loans denominated in the domestic currency. We use the government debt per GDP ratio (*gdebtgdp*) to measure this effect.

Rose and Spiegel (2002) emphasize the importance of trade links when countries service their external debt. Countries are more likely to service debt if they have a close trade linkage with their lenders. The theory suggests that countries that trade more have lower foreign currency denominated debt. The role of trade is measured by the sum of exports and imports over the GDP (*tradelink*). We expect negative coefficient estimate for *tradelink*.

The credit market imperfections and contract enforcement are other determinants of the OSIN. Aghion et. al. (2001) constructed a third generation model of currency crises with nominal price rigidities and the credit constraints. In the model there is a credit and a devaluation risk which in equilibrium leads to firms to borrow in terms of the foreign currency.

Financial transactions are done in an intertemporal fashion. Creditors provide funds with full trust that they are going to receive repayment at a later time. Borrowers may or may not repay the loan at the appointed time. If not, a commitment problem arises. To protect the interests of both parties, the legal and judicial infrastructure must provide a variety of protections. There should be contracts for each financial transaction in order to avoid a repudiation of repayments and set agreements in legal terms.

Investors hesitate to invest in a country with credit constraints and a poor legal and judicial infrastructure. Even if they invest, creditors usually provide funds denominated in the foreign currency. This, in turn, increases the country's foreign currency exposure.

To test for the relationship between credit market imperfection, contract enforcement and OSIN, we have employed the rule of law index compiled by Kaufmann et. al. (1999). This index is an indicator of a country's quality of governance, ranging from -2.5 to 2.5, where higher values correspond to better governance outcomes. The theory predicts a negative relationship between the rule of law (*ruleoflaw*) and the OSIN index.

We also relate OSIN with the sovereign risk rating (*logrisk*). We use EIU sovereign risk rating data for this analysis. (Data source: Datastream). Countries are reluctant to lend money, especially in the domestic country's national currency, if the domestic country's risk rating is high.

The exchange rate regime classification is another determinant of OSIN. Borrowers from a country that maintains a fixed exchange rate will tend to engage in higher levels of foreign currency denominated borrowing. This is because they assume that the maintenance of fixed exchange rate is forever.

Another way to look at this issue is that countries with fixed exchange rate regimes experience higher interest rate volatility in their domestic currency. Risk-averse individuals will borrow from abroad, where they can anticipate more stable interest rates. Conversely, countries that implement a floating exchange rate regime experience exchange rate fluctuations but less interest rate volatility. For this reason, risk-averse investors from floating exchange rate countries prefer to borrow in the domestic currency (Chamon and Hausmann (2002)). The implication for the current discussion is that following a fixed exchange rate regime tends to lead to a higher OSIN index.

We used the Hausmann, Panizza and Stein (2001) index of exchange rate regime classification: the international reserves over money (*resm2*). The M2 definition of money is used here. The connection between international reserves and the exchange rate regime is the following: A country's choice of fixed or a floating exchange rate regime tends to be driven by their level of foreign currency reserves. To stabilize the exchange rates, countries that implement fixed exchange rate regimes need large amount of international reserves to intervene in the foreign exchange market. Therefore, we expect a positive relation between the OSIN index and the *resm2*.

Another aspect to consider is the relationship between foreign currency denominated debt and the current account balance (*netexpdp*). Net exporters obtain funds (export credits) from the banks in order to cover the costs of delivery and shipment before they receive payment from the importers. Therefore, we expect net exporters to have a higher OSIN index due to the export credits obtained from the banks and the export credit agencies.

3.4 Estimation Results:

In our analysis, we use panel regression of the double censored tobit model from 1993 to 2006. The regression results are given in Table 4. Dummy variables for three different groups of countries (*fincent*, *euroland*, and *othdevel*) are used in columns 2, 4, 5, 6 and 7. *Fincent* represents financial centers (the countries whose currencies are widely used in international markets for lending and borrowing purposes: the US, Japan, the UK and

Switzerland), *euroland* represents the euro adopted countries and *othdevel* represents developed countries outside the financial centers and euroland. The coefficients of *fincent* and *euroland* are significant and the explanatory power of the model increases with the inclusion of the dummy variables (columns 2 and 4).¹²

Shortly after the introduction of the euro in 1999, the euro became widely used for borrowing and lending purposes in international markets, and quickly became one of the world's major currencies. Therefore, the OSIN index decreased for the euro adopted countries (*euroland*) when they adopted the euro (Figure 3). We use time dummies to capture the effect of the euro's entrance in euroland. A time dummy equal to 1 is employed if a country had adopted the euro at a specified time, and zero otherwise. We use time dummies in all of our Table 4 regressions (column 1-7). Additionally, the variables *tradelink* and *resgdp* are highly correlated, and also the governance indicator (*gov*) and the level of development (*gdppc*) are highly correlated.¹³ We include the correlated variables separately in our model (columns 2, 3 and 4, 5).¹⁴

Strong trade linkages lead to a lower level of foreign currency denominated debt at the 1 percent significance level (column 2). Moreover, monetary credibility (lower level of *linf*) and a higher level of development (*gdppc*) lead to a significantly lower level of foreign currency denominated debt (column 4).¹⁵

International reserves and foreign currency denominated debt are negatively related (column 4). The panel regression analysis indicates the relationship between reserves and foreign debt in a time series dimension. As a country accumulates international reserves over time, it reduces its foreign currency denominated debt. In addition to the panel data analysis, we make cross sectional analyses of this relationship. Average foreign currency denominated indebtedness between 1993 and 2006 is positively related to the ratio of average international reserves to GDP, at the 7 percent significance level. That is, a country with a higher level of international reserves has a higher level of foreign currency denominated debt.

Column 7 introduces the variables *m2gdp* and *resm2* in the model. Since the money measure (M2) isn't available for each of the euroland countries after the introduction of the euro, the time dummies are dropped in this

¹² Explanatory power of the model is higher in column 2 than column 1 and column 4 than column 3.

¹³ The correlation coefficient between the variables *tradelink* and *resgdp* is 0.88 and the correlation coefficient between the variables *gov* and *gdppc* is 0.83.

¹⁴ The coefficient estimate of *logrisk* is insignificant. We didn't report it in our estimation results.

¹⁵ *Gdebtgdp* data isn't available for most of the observations in our data set; therefore, *gdebtgdp* data isn't reported in our analysis.

estimation. According to the results, having a higher level of money circulating in the economy significantly reduces the foreign currency denominated indebtedness.

In section 4, we predict the OSIN measure for each country immediately before the crisis of 2008 and compare the predicted with actual OSIN measures for all countries in our data set. Finally, we investigate whether countries with actual OSIN measures that are higher than the model predicted, experienced greater depreciation in 2008.

4. Over-Indebtedness and the Global Crisis of 2008:

Following the analysis of causal factors that result in foreign currency denominated indebtedness, another question presents itself: were the countries over or under-indebted (denominated in foreign currency) immediately before the 2008 global crisis? Further, is there a relationship between 2008 depreciations and over-indebtedness? That is, did the over-indebted countries experience significant currency pressure in 2008?

First of all, the predicted values of the foreign currency denominated debt for each of the countries in the sample are calculated based on the tobit model, that relating foreign currency denominated debt to country characteristics. We refer to this as *predosin*. Secondly, we compare the actual value of the indebtedness (*actosin*) to *predosin* just before the crisis. In order to accomplish this, we take the ratio *actosin* over *predosin* in 2006, and call this ratio *actpredosin*. A country is over-indebted if this ratio is greater than one, and under-indebted if less than one. According to our model, 29 countries out of 50 were over indebted before the global crisis of 2008 (Figure 5). Seven of the over-indebted countries are developed countries outside the financial centers.¹⁶

Next we seek to determine if the over-indebted countries experienced significant currency pressure in 2008. The left hand side variable (*exchrtmov*) in our analysis, is the percentage change in the value of the national currency price of 1 dollar from 2007 to 2008 (end of period price). A positive percentage change implies depreciation. We regress the left hand side variable on *actpredosin*. The control variables are similar to the control variables in our analysis of the foreign currency denominated indebtedness and the global crisis of 2008 (Section 2). The control variables are as follows:

¹⁶ Additionally, over-indebted UK is in the financial center group and over-indebted Slovenia is in the euroland group.

- pre-crisis financial linkage to the US (*smrkcpr*) which is measured by the country's average stock market correlation with the US in 2005 and 2006 (*Data source: Datastream*)
- pre-crisis oil export share (*oilexp*) which is measured by the country's volume of oil exports (1000 barrels per day) over the GDP in 2006 (*Data source: EIA*)
- international reserves over the GDP (*intreserv*) in 2005
- current account measure (*cagdp*) as the net exports per GDP in 2006 (*Data source: IFS*)
- short term international debt securities over the GDP (*stdebtgdp*) in 2006 (*Data source: World Bank JEDH*,
- Chinn-Ito index of financial openness (*finopen*) in 2006
- dummy variable (*oecdmem*): OECD member countries are indicated as 1 and non-OECD member countries are indicated as 0.

The regression results are given in Table 5. The variable of interest, *actpredosin*, is a combination of the actual and the predicted values of the foreign currency denominated indebtedness. The predicted foreign currency indebtedness is obtained from the previous model foreign currency denominated debt in relation with the country characteristics (demonstrated in section 3.3 and the results are in Table 4). The predicted values of the foreign currency denominated debt are constructed by using the regressions with high explanatory power from the Table 4 (the regressions in column 2, 4, and 5). Therefore, we have three different values for the variable of interest *actpredosin*, as a right hand side variable in Table 5 as a robustness check (column 1 to 3).¹⁷

According to the results, over-indebted countries experienced significant currency depreciations in 2008 crisis. This result remains robust when we exclude the outliers, Iceland and Japan, from the model (column 4 and 5) and when we apply the same analysis to the countries with floating exchange rate regimes (columns 6 and 7). Countries with stronger financial ties with the US (*smrkcpr*) and higher oil export shares (*oilexp*) experienced significant depreciations. On the other hand, net exporters (*cagdp*) experienced currency appreciations. The coefficient estimates of *intreserv*, *stdebtgdp*, *finopen* and *oecdmem* aren't significant.

¹⁷ Each of the regressions in column 1 to column 3 in Table 5 uses different values of *actpredosin* as a right hand side variable. *Actpredosin* value in Table 5, column 1 is obtained from the regression model in Table 4, column 2. *Actpredosin* value in Table 5, column 2 is obtained from the regression model in Table 4, column 4. *Actpredosin* in Table 5, column 3 is obtained from the regression model in Table 4, column 5.

We divide the sample into two, the OECD member and non-OECD member countries, and investigate if the results of our analysis change for the two groups (columns 8 to 11). The over indebtedness is a significant determinant of the depreciation rates for the OECD members. Additionally, OECD members with stronger financial ties to the US, current account deficits and lower levels of financial openness experienced significant depreciation of their currencies. On the other hand, prior crisis international reserve accumulation helped the non-OECD countries achieve currency appreciation during the 2008 global crisis. It is important to note the fact that the non-OECD member country regression results have very high explanatory power with only one significant right hand side variable. The reason for that is the depreciation rates for the non-OECD members don't have adequate variation to be captured by the model.

5. Concluding Remarks:

Hard currency denominated debt is one of the sources of financial stress for the economies. Even though especially emerging markets have decreased their reliance on the foreign debt, hard currency denominated debt and their potential risks still persists (Hausmann and Panizza (2010)). We have investigated the evolution of the foreign debt over the period, 1993 to 2008, and the potential costs of the foreign debt especially during the 2008 global crisis. During the 2008 crisis, 35 of 47 countries experienced exchange rate depreciations between 2007 and 2008. An analysis of the 58 countries demonstrate that countries with higher ratios of foreign currency denominated debt to total international debt experienced significant currency depreciation during the global crisis. Currencies of over indebted countries – over indebted relative to the model's predicted debt level based on country characteristics - depreciated in the crisis.

Moreover, the US originated 2008 crisis was dispersed to the rest of the world through trade and financial channels. Having a strong financial link with the US was a strong determinant of the negative exchange rate pressure during the crisis. Additionally, net importing and oil exporting are important trade related linkages that led to negative exchange rate pressure during the crisis as well.

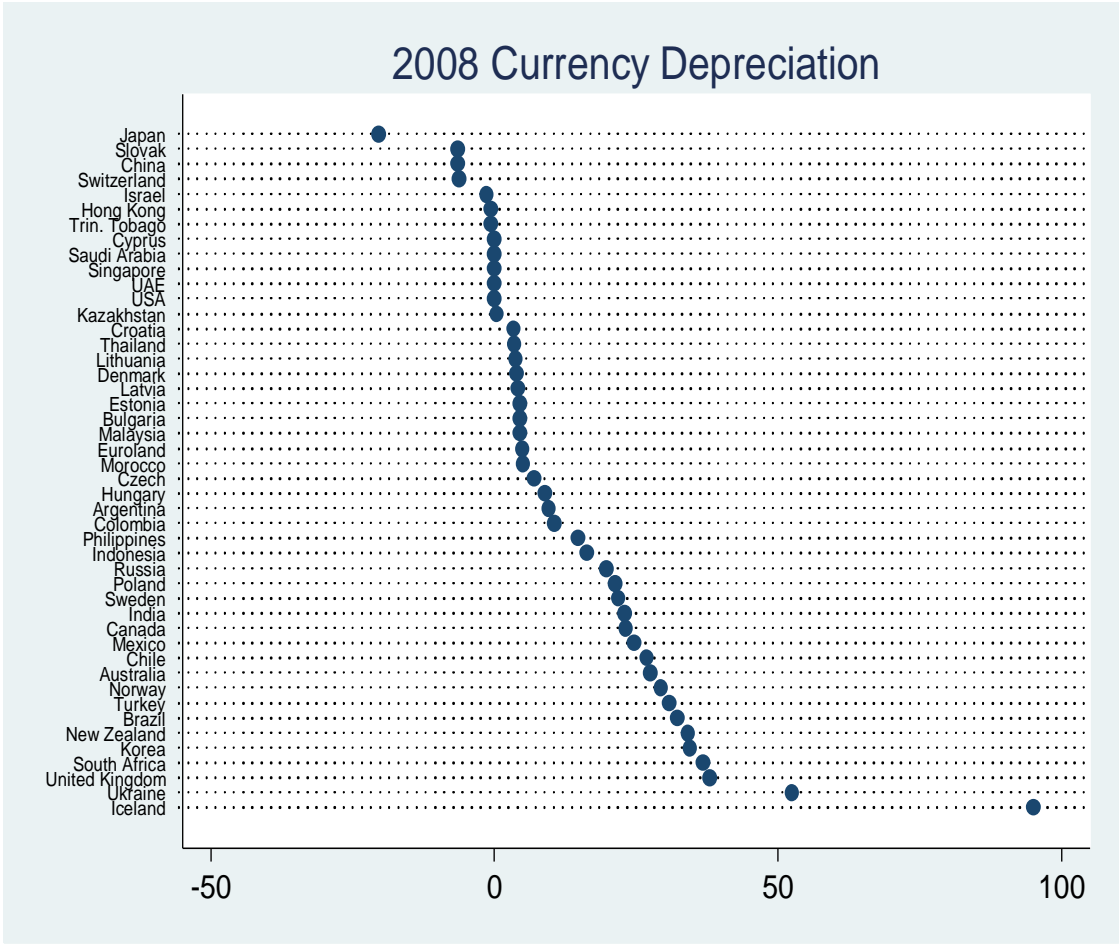
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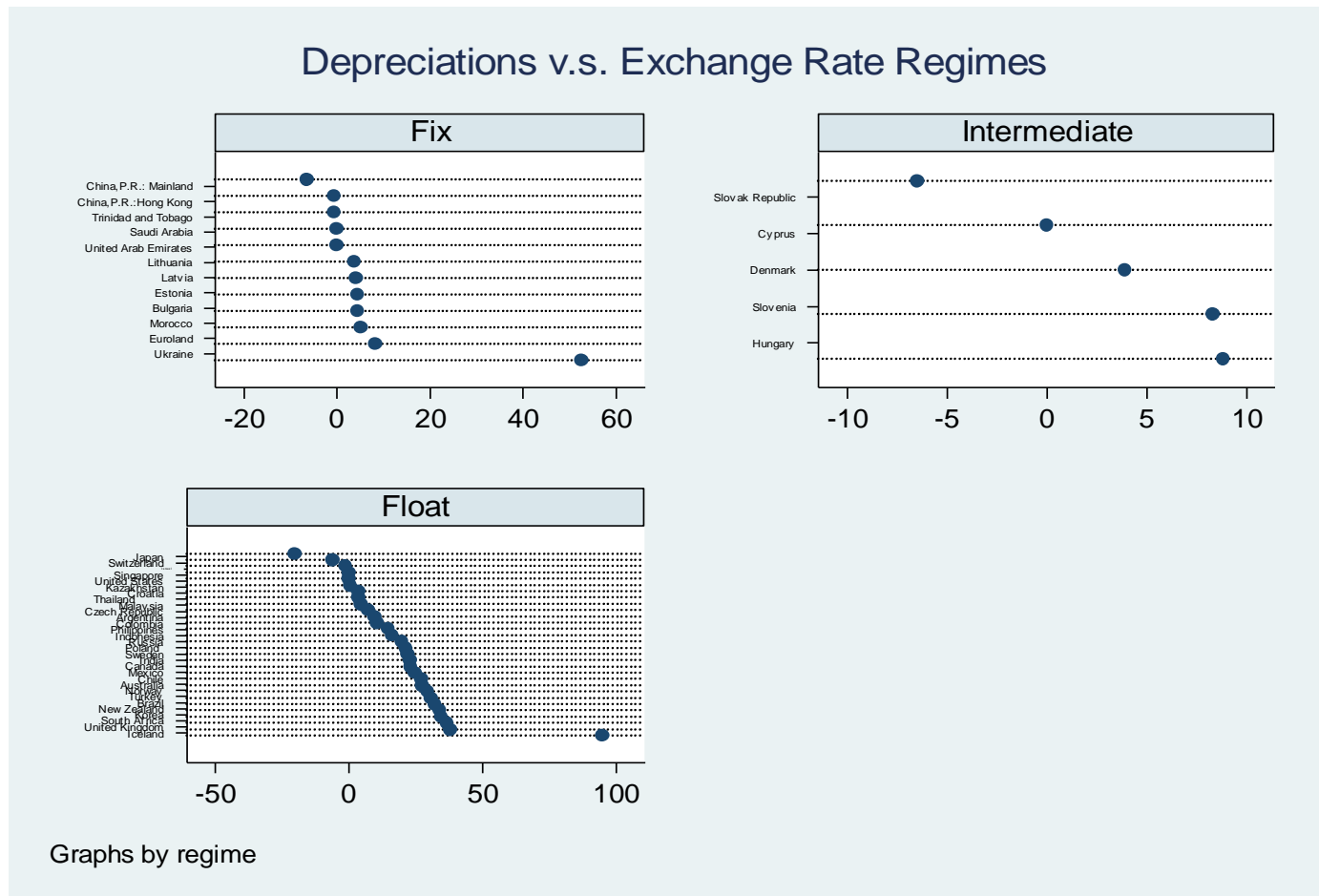
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Figure 1: Currency Depreciation Experienced in 2008 crisis.



Note: Depreciation is the percentage increase in the value of the national currency price of 1 dollar, from 2007 to 2008 (end of period price).

Figure 2: Currency Depreciation associated with Pre-Crisis Exchange Rate Regimes.



Fix regime= Exchange arrangements with no separate legal tender, Currency board arrangements, Other conventional fixed peg arrangements.

Intermediate regime= Pegged exchange rates within horizontal bands, Crawling pegs.

Floating regime= Managed floating with no predetermined path for the exchange rate, Independently floating.

Figure 3: The Evolution of Foreign Currency Denominated Debt (OSIN) for Each Country in the Sample Over the Period 1993-2008.

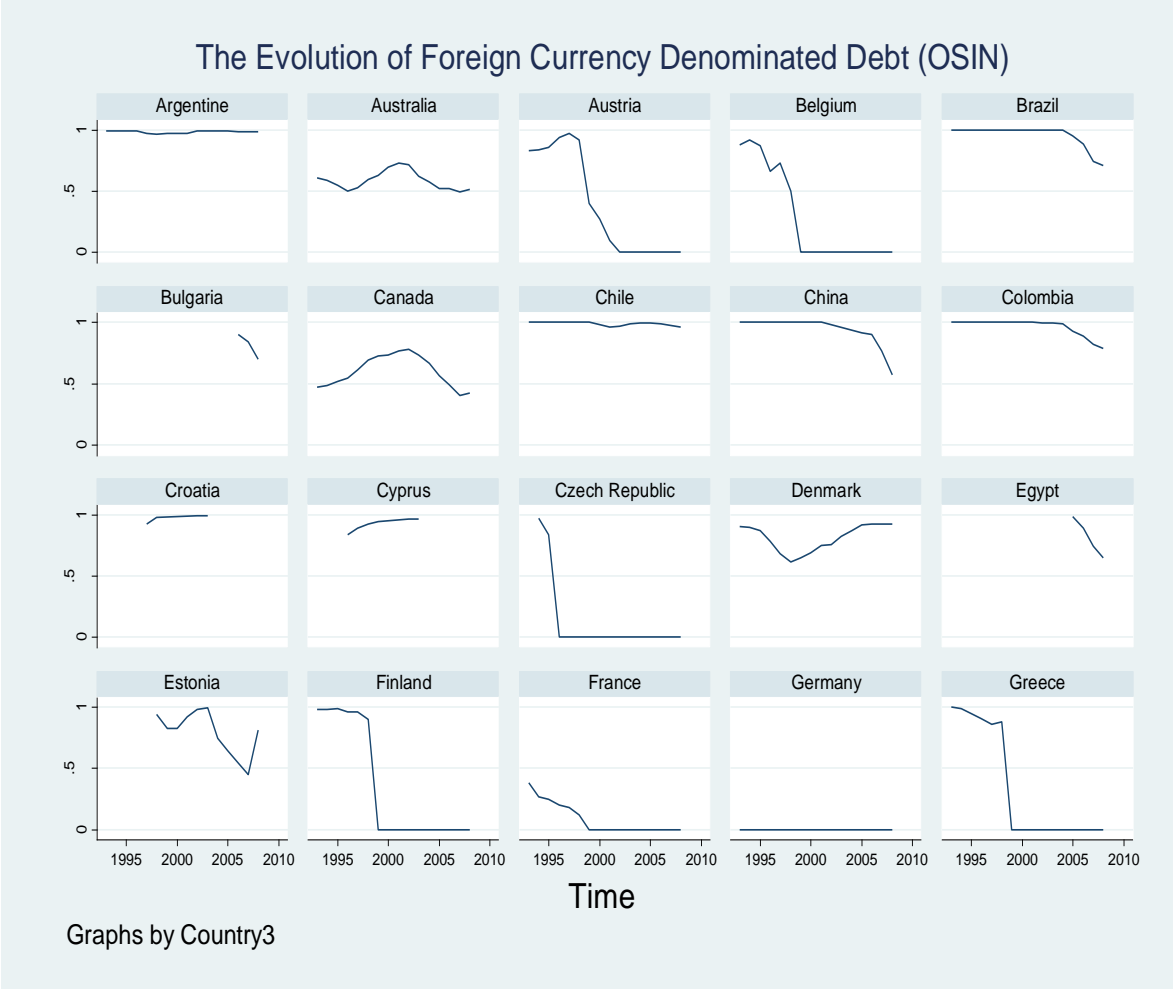


Figure 3: (Continued1) The Evolution of Foreign Currency Denominated Debt (OSIN) for Each Country in the Sample Over the Period 1993-2008.

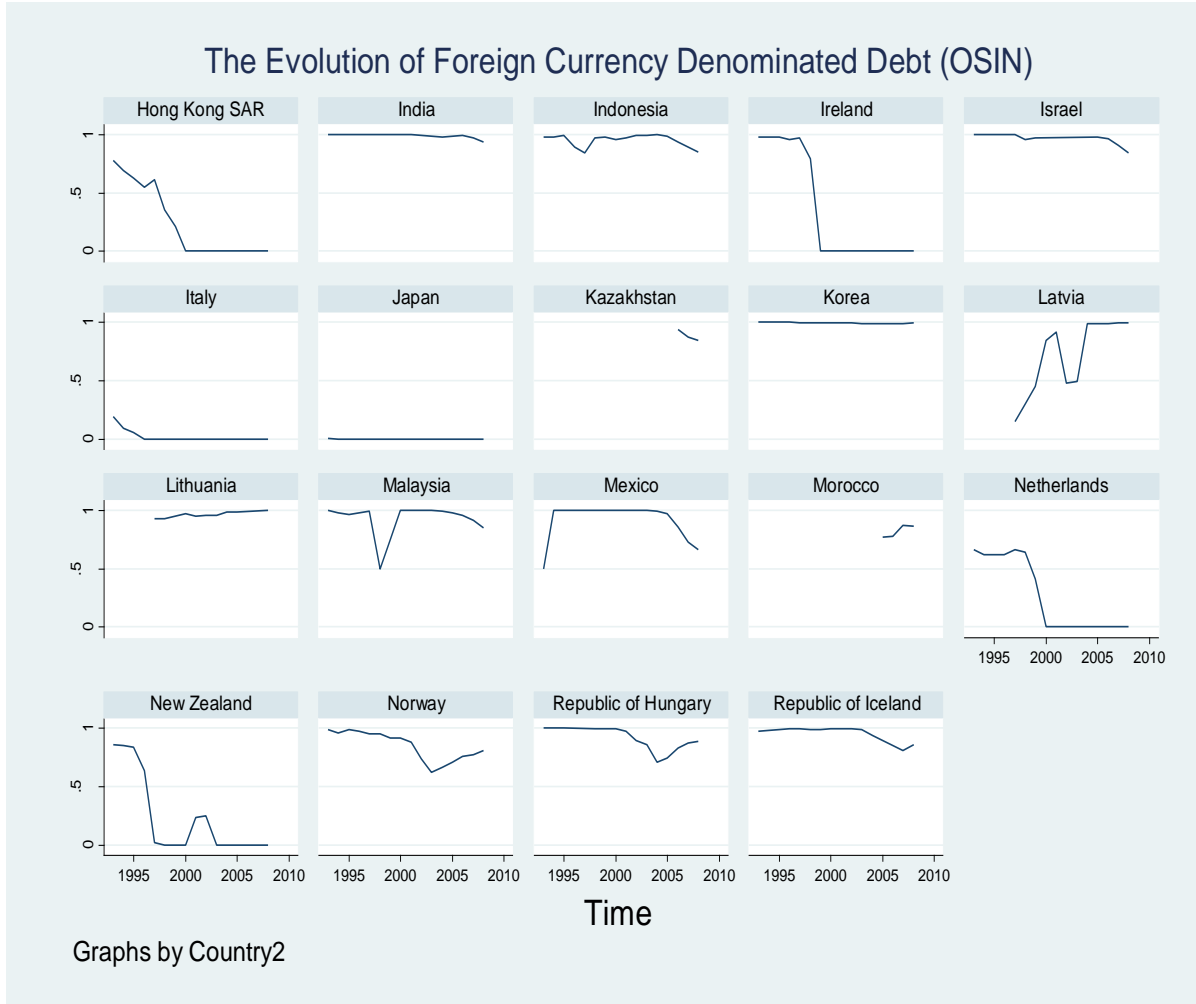


Figure 3: (Continued 2). The Evolution of Foreign Currency Denominated Debt (OSIN) for Each Country in the Sample Over the Period 1993-2008.

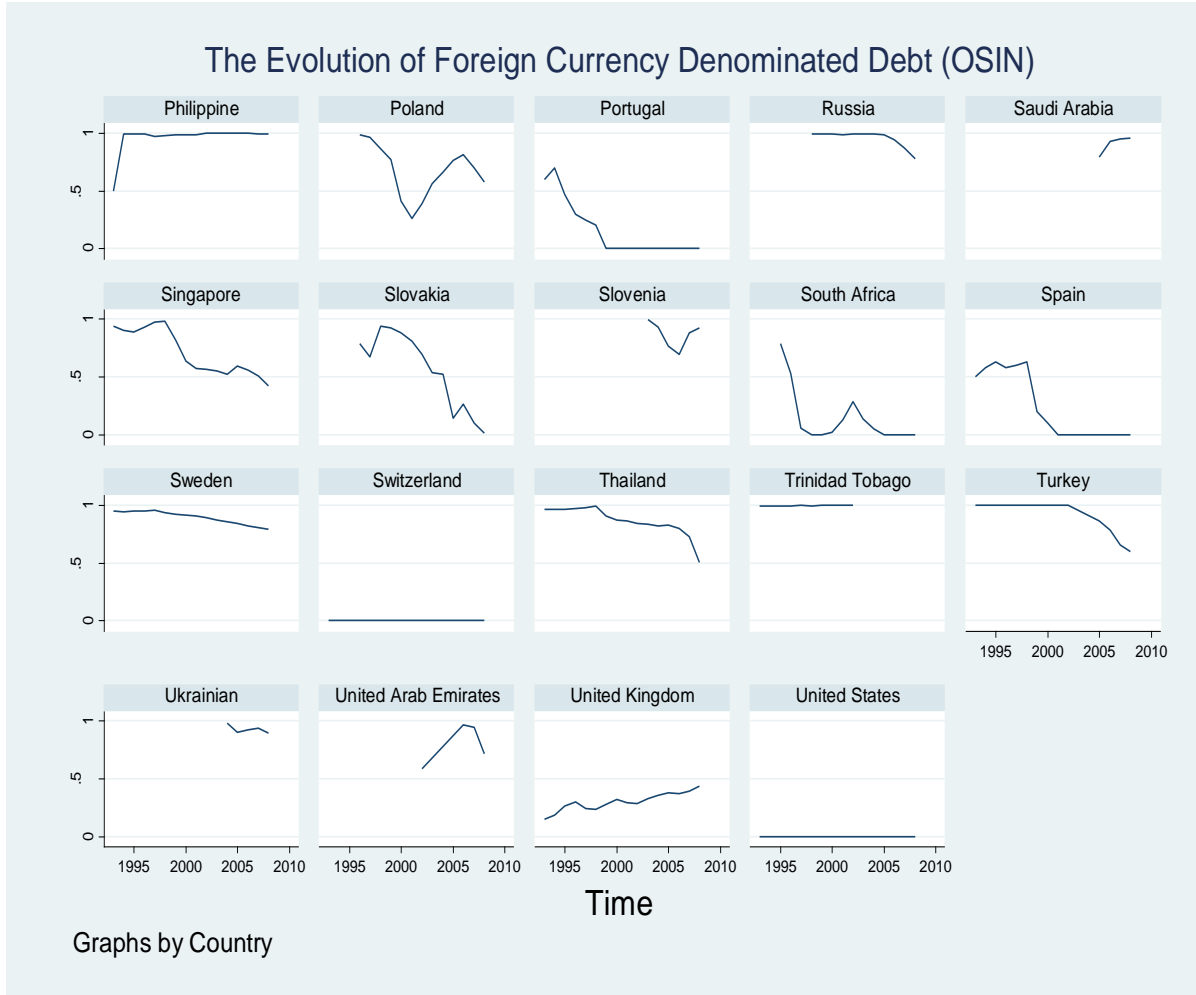


Figure 4: 2008 Depreciation Rates vs. Pre-Crisis Explanatory Variables (measured in 2006).

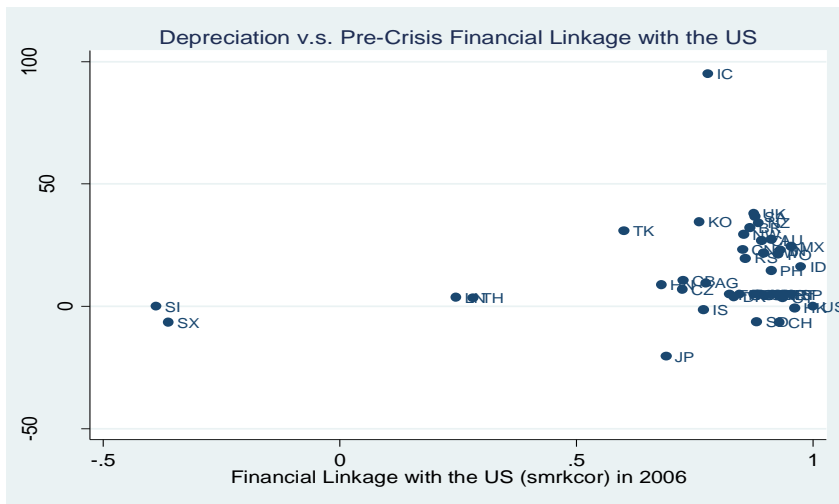
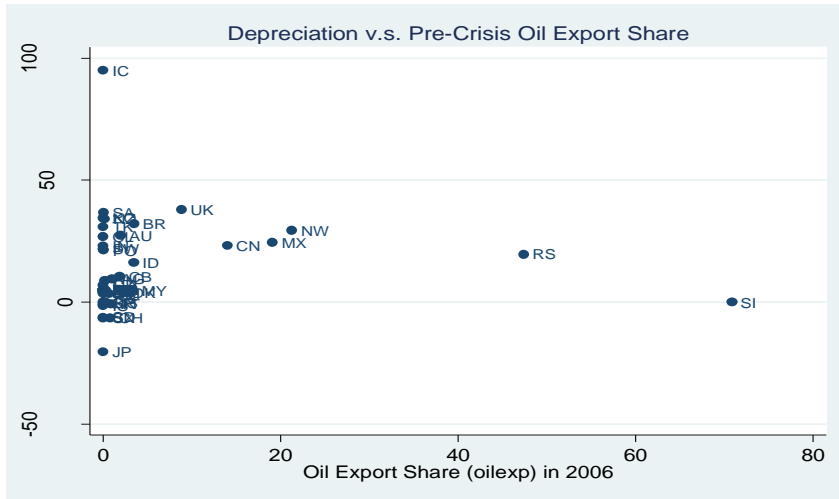
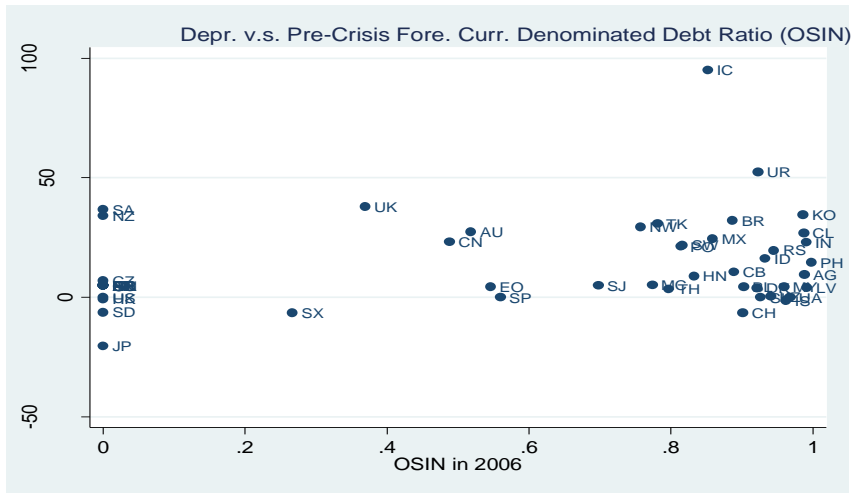


Figure 4: (Continued 1) 2008 Depreciation Rates vs. Pre-Crisis Explanatory Variables (measured in 2006).

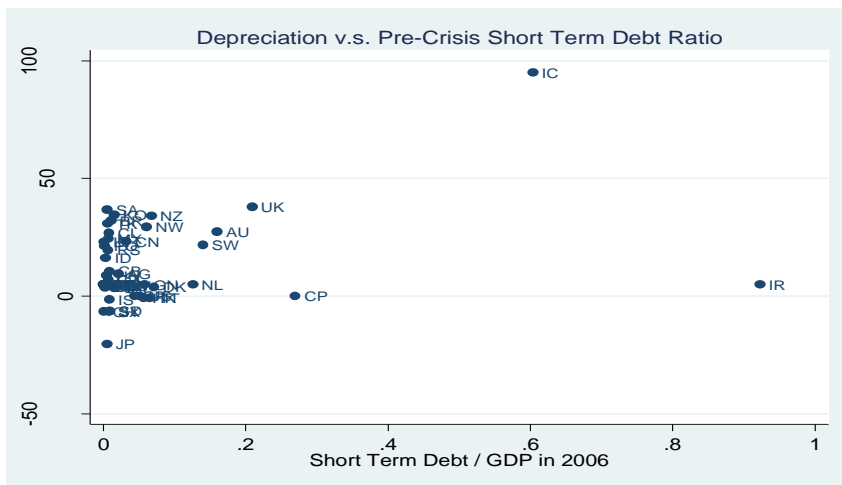
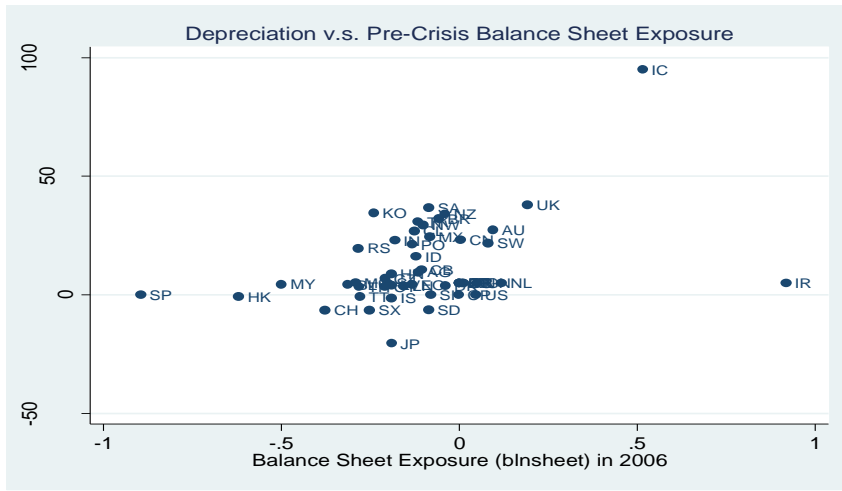
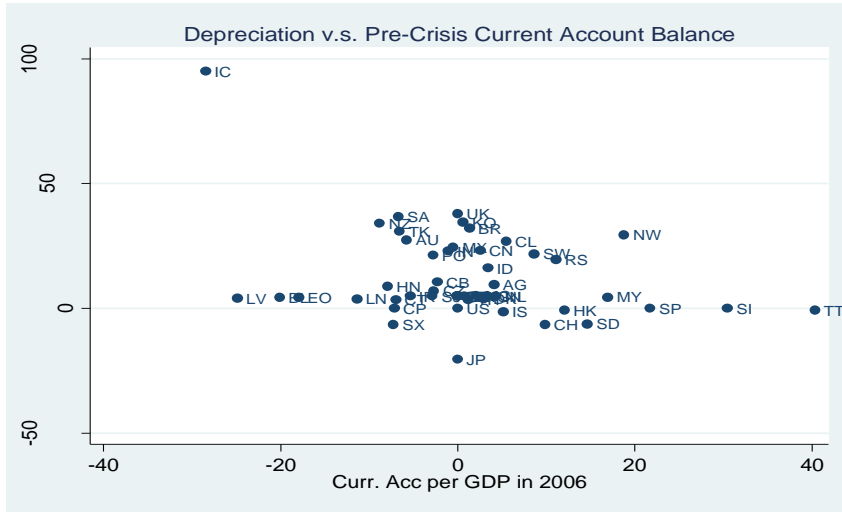
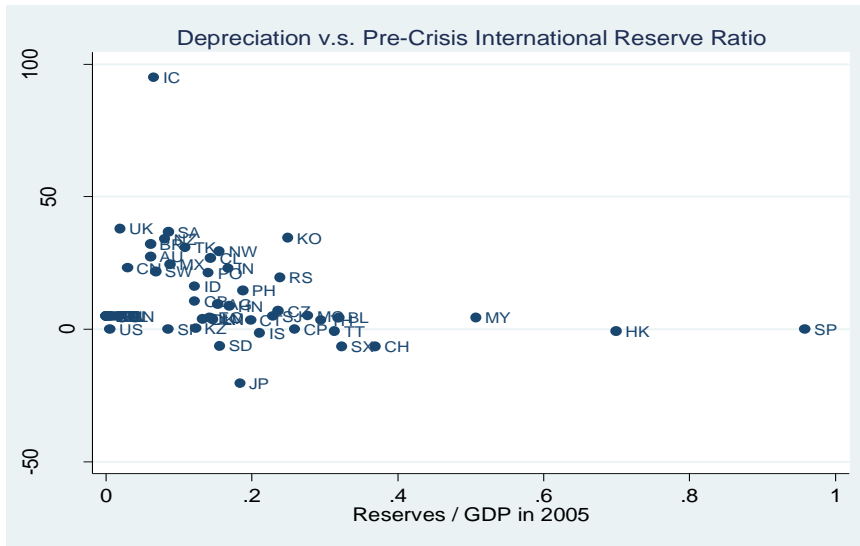


Figure 4: (Continued 2) 2008 Depreciation Rates vs. Pre-Crisis Explanatory Variables (measured in 2006).



Country Abbreviations:

AG: Argentina, AT: Austria, AU: Australia, BG: Belgium, BL: Bulgaria, BR: Brazil, CB: Colombia, CH: China, CL: Chile, CN: Canada, CP: Cyprus, CT: Croatia, CZ: Czech Republic, DK: Denmark, EO: Estonia, EY: Egypt, FN: Finland, FR: France, GN: Germany, GR: Greece, HK: Hong Kong, HN: Hungary, IC: Iceland, ID: Indonesia, IN: India, IR: Ireland, IS: Israel, IT: Italy, JP: Japan, KO: Korea, KZ: Kazakhstan, LN: Lithuania, LV: Latvia, MC: Morocco, MY: Malaysia, MX: Mexico, NL: Netherlands, NW: Norway, NZ: New Zealand, PH: Philippines, PO: Poland, PT: Portugal, RS: Russia, SA: South Africa, SD: Switzerland, SI: Saudi Arabia, SJ: Slovenia, SN: Spain, SP: Singapore, SW: Sweden, SX: Slovak Republic, TH: Thailand, TK: Turkey, TT: Trinidad and Tobago, UA: United Arab Emirates, UK: United Kingdom, UR: Ukraine, US: United States.

Figure 5: Actual versus Predicted Values of (Foreign Currency Denominated Debt) OSIN in 2006.

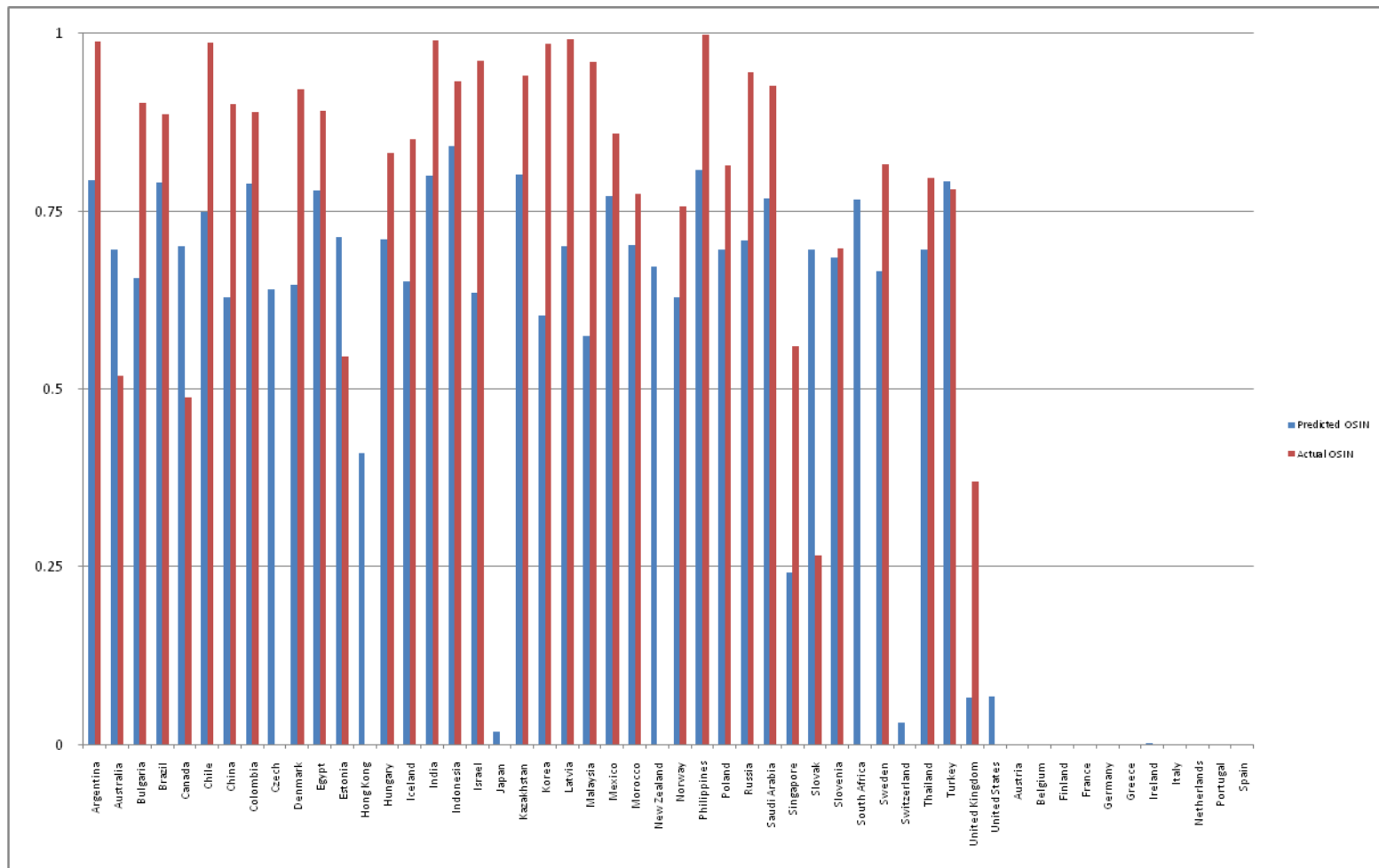


Table 1: Countries Studied in This Paper.

Developing	Developed
Argentine	Australia
Bulgaria	Austria
Brazil	Belgium
Chile	Canada
China	Cyprus
Colombia	Denmark
Croatia	Finland
Czech Republic	France
Egypt	Germany
Estonia	Greece
Hungary	Hong Kong
India	Iceland
Indonesia	Ireland
Kazakhstan	Israel
Latvia	Italy
Lithuania	Japan
Malaysia	Korea
Mexico	Netherlands
Morocco	New Zealand
Philippine	Norway
Poland	Portugal
Russia	Singapore
Saudi Arabia	Slovenia
Slovakia	Spain
South Africa	Sweden
Thailand	Switzerland
Trinidad Tobacco	UK
Turkey	US
Ukrainian	
United Arab Emirates	

Table 2: Summary of the Variables Used in This Study.

Variable	obs.	mean	std dev.	Min.	Max	Source
exchrtmov	57	12.15	17.734	-20.395	94.956	IFS
topen	56	0.658	0.637	0.0002	3.379	IFS
pexpimp	56	0.229	0.278	0.028	1.377	IMF DOTS
oilexp	54	3.759	12.013	0	70.856	Energy Information Administration (EIA)
cagdp	54	0.862	11.643	-28.486	40.336	IFS
osin06	54	0.548	0.42	0	0.998	BIS Database
finopen	58	1.42	1.302	-1.129	2.541	Chinn-Ito index
smrkcpr	46	0.784	0.291	-0.388	1	Datastream
blnsheet	54	-0.105	0.247	-0.895	0.918	World Bank JEDH
tdebtgdp	46	0.867	1.454	0.00056	9.23	World Bank JEDH
stdebtgdp	52	0.061	0.155	0.000016	0.923	World Bank JEDH
intreserv	56	0.163	0.173	0.000019	0.958	IFS
nfa	54	-1.01E-07	6.65E-07	1.33E-06	2.72E-06	Lane and Milesi-Ferretti (2007)
exchreg	57	4.018	1.959	1	6	IMF De Facto Classification

exchrtmov = Percentage change in the value of the national currency price of 1 dollar from 2007 to 2008 (end of period price). (A positive change is depreciation).

topen (trade openness) = Exports + Imports / GDP from 2003 to 2006.

pexpimp (trade links to the US) = Average of the percent of exports that go to the US + percent of imports that come from the US in 2005 and 2006.

oilexp (oil export share) = Volume of oil exports (1000 barrels per day) / GDP in 2006.

osin06 (ratio of foreign currency denominated international debt to total international debt) = OSIN index in 2006 (explained in page 11 and 12).

finopen (financial openness) = Chinn-Ito index of financial openness in 2006.

smrkcpr (financial linkages to the US) = Average stock market correlation with the US in 2005 and 2006.

blnsheet (balance sheet exposure) = Short term debt (1 year) – international reserves / GDP in 2006.

tdebtgdp (total debt) = Gross external debt / GDP in 2006.

stdebtgdp (short term debt) = Short term (1 year) international debt securities / GDP in 2006.

cagdp (current account balance) = Net exports / GDP in 2006.

nfa (net foreign asset position) = Net foreign asset position / GDP in 2006.

intreserv = International reserves / GDP in 2005.

exchreg (exchange rate regime) = IMF de facto exchange rate regime classification - 2006.

Table 2: (Continued) Summary of the Variables Used in This Study.

Panel data analysis of the determinants of foreign currency denominated debt from 1993- 2006:

Variable	obs.	mean	std dev.	Min.	Max	Source
OSIN	653	0.615	0.413	0	1	BIS
gdppc	776	4.325	0.963	2.726	7.779	IFS
linf	762	0.61	0.578	-1.971	3.675	IFS
resgdp	776	0.118	0.155	1.70E-05	1.014	IFS
m2gdp	637	0.58	0.517	4.30E-04	2.792	IFS
logrisk	370	1.414	0.315	0.637	1.854	Datastream
tradelink	759	0.497	0.552	0.0001	3.697	IFS
resm2	672	2.227	13.849	4.94E-05	137.815	IFS
ruleoflaw	464	0.737	0.88	-1.059	2.116	Kaufmann et al. (1999)
netexpgdp	759	0.0017	0.056	-0.285	0.403	IFS

OSIN (ratio of foreign currency denominated international debt to total international debt) = OSIN index

gdppc = Logarithm of GDP per capita.

linf = Logarithm of inflation.

resgdp = International reserves / GDP.

m2gdp = Money (M2) / GDP.

logrisk = Logarithm of EIU sovereign risk rating.

tradelink= Exports + Imports / GDP.

resm2 = International reserves / the money (M2).

ruleoflaw = Rule of law index compiled by Kaufmann et al. (1999).

netexpgdp = Net exports / GDP.

Table 3: 2008 Currency Depreciation in relation with Country Characteristics.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)Iceland and Japan dropped	(10)Floating re-jimes	(11)OECD members	(12)non- OECD
exchrtmov	11.553**	14.911***	18.882***	15.317***	15.775***	16.370***	16.373***	17.185**	11.497***	15.753***	24.178**	-19.059
	(5.164)	(5.745)	(5.258)	(4.586)	(5.081)	(5.024)	(5.482)	(8.175)	(4.372)	(5.255)	(9.650)	(14.743)
smrkcov		14.812***	10.421	21.987***	21.416***	23.101***	23.115**	25.737**	16.513***	16.101	17.940*	13.785
		(3.007)	(9.563)	(5.343)	(6.130)	(6.853)	(10.656)	(10.729)	(5.993)	(12.367)	(10.497)	(18.113)
cagdp			-1.108**	-1.617***	-1.583***	-1.499***	-1.500***	-1.466**	-0.858**	-1.021**	-1.441**	0.627
			(0.488)	(0.462)	(0.528)	(0.536)	(0.593)	(0.596)	(0.438)	(0.495)	(0.589)	(1.332)
oilexp				0.714***	0.691***	0.572**	0.572*	0.570*	0.477*	0.405*	0.928	0.145
				(0.246)	(0.287)	(0.280)	(0.317)	(0.325)	(0.247)	(0.243)	(0.675)	(0.201)
intreserv					-4.345	-1.850	-1.510	17.023	-11.242	-8.614	-15.382	-91.733**
					(16.528)	(16.539)	(155.345)	(162.562)	(13.740)	(22.565)	(41.537)	(40.620)
stdebtgdp						14.797	14.458	0.882	-2.154	-3.394	13.024	195.732
						(25.180)	(156.741)	(165.201)	(11.296)	(10.983)	(23.441)	(311.440)
blnsheet							0.335	13.763				
							(152.481)	(163.429)				
finopen								-1.126				
								(2.558)				
oecdmem								5.014				
								(6.913)				
cons	6.681**	-5.375	-1.907	-11.832**	-10.963*	-13.747**	-13.762	-18.789	-4.602	-4.447	-10.935	33.019
	(2.921)	(3.853)	(8.710)	(5.073)	(6.233)	(6.696)	(10.924)	(13.264)	(4.994)	(10.618)	(9.417)	(28.700)
N	53	44	43	43	43	42	42	42	40	34	28	14
R-sq	0.071	0.151	0.430	0.565	0.566	0.579	0.579	0.589	0.381	0.413	0.68	0.70

Standard errors are in the parenthesis. Robust standard errors are estimated.
***1% significance level, **5% significance level, *10% significance level.

Table 4: The Determinants of OSIN.

OSIN	(1)	(2)	(3)	(4)	(5)	(6)	(7)
linf	0.126*** (0.028)	0.099*** (0.025)	0.144*** (0.030)	0.105*** (0.023)	0.092*** (0.028)	0.086*** (0.021)	0.090*** (0.022)
netexpgdp	0.135 (0.241)	0.079 (0.225)	0.070 (0.252)	0.126 (0.204)	-0.004 (0.213)	0.124 (0.186)	0.050 (0.182)
gdppc	-0.168** (0.037)	-0.077*** (0.036)	-0.160*** (0.037)	-0.089*** (0.031)		-0.079*** (0.031)	-0.073*** (0.031)
tradelink	-0.195*** (0.043)	-0.180*** (0.042)					
resgdp			-0.292** (0.153)	-0.528*** (0.126)	-0.319*** (0.131)	-0.275** (0.144)	
gov					-0.055 (0.042)		
m2gdp						-0.128*** (0.050)	-0.186*** 0.040
resm2							0.001 (0.002)
fincent		-0.452*** (0.171)		-0.585*** (0.044)	-0.510*** (0.047)	-0.680*** (0.058)	-0.649*** (0.073)
othdevel		-0.033 (0.107)		-0.036 (0.091)	-0.015 (0.107)	-0.010 (0.086)	0.013 (0.084)
euroland		-0.333*** (0.077)		-0.614*** (0.030)	-0.604*** (0.036)		
Obs. (N)	603	603	603	603	357	476	476
Uncensored Obs. (percent)	67.1	67.1	67.1	67.1	66.7	75.2	75.2
R-sq	0.272	0.597	0.313	0.599	0.611	0.411	0.431

Standard errors are in the parenthesis. Marginal effects are estimated at the mean values. Change of the dummy variables is a discrete change from 0 to 1. ***1% significance, **5% significance, *10% significance levels. Time dummies are used in order to capture the effect of the euro's entrance in the euroland.

Table 5: 2008 Currency Depreciation in relation with Country Over-indebtedness.

Model uses from table 4	M2	M4	M5	M4	M5	M4	M5	M4	M4	M5	M5
exchrtmov	(1)	(2)	(3)	(4)Iceland and Japan dropped	(5)Iceland and Japan dropped	(6)Floating rejimes	(7)Floating rejimes	(8)OECD members	(9)non- OECD	(10)OECD members	(11)non- OECD
actpredosin	4.777*** (1.799)	6.208*** (2.258)	5.132*** (1.961)	5.303*** (1.233)	4.522*** (1.046)	6.004*** (1.636)	4.946*** (1.389)	5.149** (2.302)	-15.684 (13.310)	4.111** (1.837)	-10.506 (13.374)
smrkcpr	25.356*** (6.767)	25.149*** (6.710)	25.179*** (6.693)	17.896*** (6.062)	17.838*** (6.025)	17.512 13.023	17.414 13.225	26.884*** (9.254)	10.024 (20.760)	27.654*** (9.251)	16.105 (20.981)
cagdp	-1.497** (0.615)	-1.504** (0.601)	-1.509*** (0.607)	-0.759* (0.457)	-0.752* (0.456)	-1.077** (0.501)	-1.086** (0.499)	-1.475** (0.708)	0.945 (1.487)	-1.489** (0.712)	0.496 (1.486)
oilexp	0.616** (0.306)	0.586** (0.296)	0.607** (0.299)	0.433* (0.234)	0.444* (0.233)	0.414* (0.216)	0.432** (0.215)	1.255 (0.753)	0.084 (0.229)	1.293* (0.753)	0.114 (0.251)
intreserv	5.716 (18.151)	5.144 (18.193)	6.247 (18.055)	-8.300 (15.745)	-7.570 (15.452)	12.676 (19.569)	16.751 (19.749)	14.165 (35.445)	-86.219* (36.758)	17.151 (35.424)	-81.042* (39.527)
stdebtgdp	12.353 (25.784)	11.623 (24.891)	11.802 (25.220)	-5.746 (6.523)	-5.999 (6.302)	-10.281* (5.741)	-10.522* (5.713)	16.086 (26.510)	75.998 (537.101)	16.421 (26.844)	205.792 (545.808)
finopen	-2.682 (1.889)	-2.339 (1.922)	-2.538 (1.893)	-2.314 (1.980)	-2.474 (1.961)			-5.772** (2.591)	-0.775 (2.585)	-6.063** (2.590)	-0.861 (2.792)
oecdmem	1.420 (6.539)	1.895 (6.402)	1.676 (6.444)	2.683 (5.861)	2.551 (5.876)						
cons	-9.920 (8.812)	-11.316 (8.958)	-10.515 8.812	-3.236 (7.876)	-2.602 (7.790)	-4.919 (11.751)	-4.724 (11.978)	-6.606 (10.779)	37.831 (32.905)	-6.640 (10.794)	26.341 (33.604)
N	42	42	42	40	40	34	34	28	14	28	14
R-sq	0.574	0.586	0.582	0.463	0.465	0.454	0.447	0.690	0.708	0.686	0.679

Standard errors are in the parenthesis. Robust standard errors are estimated.
***1% significance level, **5% significance level, *10% Significance level.

Appendix:

The double censored tobit model is one type of a limited dependent variable models. The dependent variable is censored from above and below and it is continuous in the limits. The general formulation of the double censored tobit model is:

$$y_i^* = \beta'x_i + u_i, \quad (A.1)$$

where y_i^* is the latent variable, β is $k \times 1$ vector of unknown parameters; x_i is a $k \times 1$ vector of known constants; u_i are independently and normally distributed residuals with zero mean and constant variance, σ^2 . The observed dependent variable y_i is such that;

$$y_i = L_{1i} \quad \text{if} \quad y_i^* \leq L_{1i}, \quad (A.2)$$

$$y_i = y_i^* \quad \text{if} \quad L_{1i} < y_i^* < L_{2i}, \text{ and}$$

$$y_i = L_{2i} \quad \text{if} \quad y_i^* \geq L_{2i}.$$

The latent variable y_i^* has a normal, homoskedastic distribution. The observed variable y_i is equal to y_i^* between the limits. Therefore, y_i has a continuous normal distribution between the limits.

The mean of the dependent variable is:

$$E(y_i) = P(y_i = L_{1i}) \cdot L_{1i} + P(L_{1i} < y_i^* < L_{2i}) \cdot E(y_i | L_{1i} < y_i^* < L_{2i}) + P(y_i = L_{2i}) \cdot L_{2i}.$$

Let's find the corresponding probabilities and the conditional expectation and plug them into the mean of y_i . By the way let's denote $\Phi\left(\frac{L_{1i} - \beta'x_i}{\sigma}\right)$, $\Phi\left(\frac{L_{2i} - \beta'x_i}{\sigma}\right)$, $\phi\left(\frac{L_{1i} - \beta'x_i}{\sigma}\right)$, $\phi\left(\frac{L_{2i} - \beta'x_i}{\sigma}\right)$ by Φ_{1i} , Φ_{2i} , ϕ_{1i} and ϕ_{2i} respectively ($\Phi(\cdot)$ and $\phi(\cdot)$ are the standard normal cumulative distribution and density function). The mean and the conditional expectation are the following:

$$P(y_i = L_{1i}) = P(y_i^* \leq L_{1i}) = P(\beta'x_i + u_i < L_{1i}) = P\left(\frac{u_i}{\sigma} < \frac{L_{1i} - \beta'x_i}{\sigma}\right) = \Phi\left(\frac{L_{1i} - \beta'x_i}{\sigma}\right) = \Phi_{1i},$$

$$P(L_{1i} < y_i^* < L_{2i}) = P(L_{1i} < \beta'x_i + u_i < L_{2i}) = P\left(\frac{L_{1i} - \beta'x_i}{\sigma} < \frac{u_i}{\sigma} < \frac{L_{2i} - \beta'x_i}{\sigma}\right) = \Phi_{2i} - \Phi_{1i},$$

$$\begin{aligned}
E(y_i | L_{1i} < y_i^* < L_{2i}) &= \beta'x_i + E(u_i | L_{1i} < \beta'x_i + u_i < L_{2i}) = \beta'x_i + \sigma \cdot E\left(u_i \mid \frac{L_{1i} - \beta'x_i}{\sigma} < \frac{u_i}{\sigma} < \frac{L_{2i} - \beta'x_i}{\sigma}\right) \\
&= \beta'x_i + \sigma \frac{\Phi_{1i} - \Phi_{2i}}{\Phi_{2i} - \Phi_{1i}}.
\end{aligned}$$

Then the mean of the dependent variable is:

$$E[y_i] = \Phi_{1i} L_{1i} + (\Phi_{2i} - \Phi_{1i}) \left(\beta'x_i + \sigma \frac{\Phi_{1i} - \Phi_{2i}}{\Phi_{2i} - \Phi_{1i}} \right) + (1 - \Phi_{2i}) L_{2i}. \quad (\text{A.3})$$

Let's drive the density of y_i in order to find the log likelihood function:

$$P(y_i = L_{1i}) = P(y_i^* \leq L_{1i}) = \Phi\left(\frac{L_{1i} - \beta'x_i}{\sigma}\right) = \Phi_{1i},$$

$$P(y_i = L_{2i}) = P(y_i^* \geq L_{2i}) = 1 - \Phi\left(\frac{L_{2i} - \beta'x_i}{\sigma}\right) = 1 - \Phi_{2i},$$

$$f(y) = \frac{1}{\sigma} \phi\left(\frac{y_i - \beta'x_i}{\sigma}\right) \quad L_{1i} < y_i < L_{2i}.$$

The density for y_i by using the indicator function $1[\cdot]$ as

$$f(y) = \{\Phi_{1i}\}^{1[y=L_{1i}]} \left\{\frac{1}{\sigma} \phi\left(\frac{y_i - \beta'x_i}{\sigma}\right)\right\}^{1[L_{1i} < y_i < L_{2i}]} \{1 - \Phi_{2i}\}^{1[y=L_{2i}]}. \quad (\text{A.4})$$

The likelihood function is:

$$L(\beta, \sigma | y_i, x_i, L_{1i}, L_{2i}) = \prod_{y_i=L_{1i}} \Phi_{1i} \prod_{y_i=y_i^*} \frac{1}{\sigma} \phi\left(\frac{y_i - \beta'x_i}{\sigma}\right) \prod_{y_i=L_{2i}} [1 - \Phi_{2i}]. \quad (\text{A.5})$$

The logarithm of the likelihood function:

$$\log L = \sum_0 \log \Phi_{1i} + \sum_1 \log\left(\frac{1}{(2\pi\sigma^2)^{1/2}}\right) - \sum_1 \frac{1}{2\sigma^2} (y_i - \beta'x_i)^2 + \sum_2 \log(1 - \Phi_{2i}). \quad (\text{A.6})$$

where the first summation is over the N_0 observations for which $y_i = L_{1i}$ and the second summation is over the N_1 observations for which $L_{1i} \leq y_i \leq L_{2i}$ and the third summation is over the N_2 observations for which $y_i = L_{2i}$.

The estimation of the parameters β and σ are obtained by maximizing the log likelihood function. The first and second order conditions for a maximum are:

$$\frac{\partial \log L}{\partial \beta} = \sum_0 \frac{\Phi_{1i} x_i}{\Phi_{1i}} + \frac{1}{\sigma^2} \sum_1 (y_i - \beta' x_i) x_i - \sum_2 \frac{\Phi_{2i} x_i}{1 - \Phi_{2i}} = 0,$$

$$\frac{\partial \log L}{\partial \sigma^2} = -\frac{1}{2\sigma^2} \sum_0 \left(\frac{\beta' x_i \Phi_{1i}}{\Phi_{1i}} \right) - \frac{N_1}{2\sigma^2} + \frac{1}{2\sigma^4} \sum_1 (y_i - \beta' x_i)^2 + \frac{1}{2\sigma^2} \sum_2 \left(\frac{\beta' x_i \Phi_{2i}}{1 - \Phi_{2i}} \right) = 0,$$

$$\frac{\partial^2 \log L}{\partial \beta \partial \beta'} = -\sum_0 \frac{\Phi_{1i}}{\Phi_{1i}^2} \left[\frac{1}{\sigma^2} \Phi_{1i} \beta' x_i + \Phi_{1i} \right] x_i x_i' - \frac{1}{\sigma^2} \sum_1 x_i x_i' - \sum_2 \frac{\Phi_{2i}}{\Phi_{2i}^2} \left[\Phi_{2i} - \frac{1}{\sigma^2} (1 - \Phi_{2i}) \beta' x_i \right] x_i x_i',$$

$$\begin{aligned} \frac{\partial^2 \log L}{\partial \sigma^2 \partial \beta} &= \frac{1}{2\sigma^2} \sum_0 \frac{\Phi_{1i}}{\Phi_{1i}^2} \left[\frac{1}{\sigma^2} \Phi_{1i} (\beta' x_i)^2 - \Phi_{1i} - \beta' x_i \Phi_{1i} \right] x_i - \frac{1}{\sigma^4} \sum_1 (y_i - \beta' x_i) x_i \\ &\quad - \frac{1}{2\sigma^2} \sum_2 \frac{\Phi_{2i}}{(1 - \Phi_{2i})^2} \left[\frac{1}{\sigma^2} (1 - \Phi_{2i}) (\beta' x_i)^2 - (1 - \Phi_{2i}) - \beta' x_i \Phi_{2i} \right] x_i, \end{aligned}$$

$$\begin{aligned} \frac{\partial^2 \log L}{\partial (\sigma^2)^2} &= \frac{1}{4\sigma^4} \sum_0 \frac{\Phi_{1i}}{\Phi_{1i}^2} \left[-\frac{1}{\sigma^2} \Phi_{1i} (\beta' x_i)^3 + 3\Phi_{1i} \beta' x_i - (\beta' x_i)^2 \Phi_{1i} \right] + \frac{N_1}{2\sigma^4} - \frac{1}{\sigma^6} \sum_1 (y_i - \beta' x_i)^2 \\ &\quad + \frac{1}{4\sigma^4} \sum_0 \frac{\Phi_{2i}}{(1 - \Phi_{2i})^2} \left[\frac{1}{\sigma^2} (1 - \Phi_{2i}) (\beta' x_i)^3 - 3(1 - \Phi_{2i}) \beta' x_i - (\beta' x_i)^2 \Phi_{2i} \right]. \end{aligned}$$

Hessian matrix is negative semidefinite and loglikelihood function has a single maximum (Maddala, 1993). The proof of the concavity of the log likelihood functions isn't presented here. The t test of single exclusion restrictions can be performed with obtained estimates of $\hat{\beta}_j$ and its asymptotic standard error. The wald test or the likelihood ratio test is performed in order to test for multiple exclusion restrictions.