COMENIUS UNIVERSITY IN BRATISLAVA
FACULTY OF MATHEMATICS, PHYSICS AND INFORMATICS

CONSUMPTION SMOOTHING DURING THE FINANCIAL CRISIS

MASTER'S THESIS

2014   **Bc. Tomáš Rizman**

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vedúci práce

Declaration on Word of Honor

I declare on my honor that this work is written on my own knowledge, references and consultation with my supervisor.

Tomáš Rizman

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Abstract

In our work, We investigate the influence of global financial crisis of 2008 on international consumption smoothing among different country groups of mostly OECD countries and emerging markets. We are estimating risk-sharing levels based on basic and also long-term perspective. In addition, we are trying to partly explain the obtained results by financial integration measured by holdings of foreign assets. Apart from global financial crisis, we are also trying to decide if there is any influence of government on consumption smoothing. In particular, we are trying to experimentally find some thresholds in gross government debt to GDP ratio, which if exceeded or not are allowing for easier international consumption risk sharing.

Keywords: Global financial crisis, consumption smoothing, international risk-sharing, financial integration, gross government debt

Abstrakt

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V našej práci sa zaoberáme finančnou krízou, ktorá vypukla v roku 2008 a jej vplyvom na medzinárodné vyrovnávanie konzumu. Analýzu zakladáme na rôznych skupinách krajín, najmä členských krajín OECD a krajín rozvíjajúcich sa trhov. Koeficient vyrovnávania konzumu odhadujeme z bežného aj z dlhodobého pohľadu. Získané výsledky sa snažíme vysvetliť pomocou finančnej integrácie (pozícií medzinárodných aktív). Okrem dopadu finančnej krízy na vyrovnávanie konzumu sa snažíme nájsť aj vzťah medzi vyrovnávaním konzumu a vládou. Konkrétne experimentálne hľadáme prahovú hodnotu v pomere hrubého vládneho dlhu ku HDP, ktorá, ak je prekročená, znamená pre krajinu vyššiu alebo nižšiu hodnotu podielu vyrovnania konzumu.

Kľúčové slová: Finančná kríza, medzinárodné vyrovnávanie konzumu, finančná integrácia, hrubý národný dlh

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4 List of acronyms

GDP- Gross Domestic product

OECD- Organization of Economic Co-operation and development

PWT- Penn World Table

WEO- World Economic Outlook

IMF- International Monetary Fund

adj. - adjusted

No. of. obs. - number of observations

FDI- financial direct investment

EQ- equity portfolio investment

CAPM- Capital Asset Pricing Model

OLS- Ordinary least squares

GLS- Generalized ordinary least squares

DOLS- Panel Dynamic Ordinary Least Squares

FMOLS- Fully Modified Ordinary Least Squares

5 Introduction

Global financial crisis that erupted in 2008 has been a source of significant impact on economies around the world and is predominantly being marked as the most severe depression since 1930s. Even today various connections with the financial crisis are being discussed in simple conversation of people, in journals, newspapers, TV programs as well as in scientific articles. Some people even doubt, what would the economists write their papers about without the eruption of financial crisis...

It all started in United States of America, with a credit boom in 2007, followed by mortgage crisis that quickly turned into a big banking panic. These events resulted in bankrupt of Lehman Brothers and Washington Mutual as well as several government takeovers. The "toxic" American assets played their role all over the world and influenced financial markets and institutions around the globe resulting e.g. in bankrupts or government supports of financial institutions in Europe. Following this chain of events, prices of assets and commodities felt drastically, the cost of borrowing has shown a substantial increase and the volatility of financial markets rose to levels that have been rarely seen in the past([1]).

The impact of financial crisis to various set of economical and financial indexes, indicators, financial markets and several more economical and financial topics was quite direct or observable. In our thesis, one of our main goals is to examine the connection of global financial crisis and international consumption smoothing (that is to international consumption risk sharing). The influence of crisis on consumption risk sharing could be either expectable- that is a negative impact on international consumption smoothing as to most of economical indicators (Since the toxic assets have badly influenced the financial markets, which are allowing agents to trade the consumption risk internationally, the impact on risk sharing is expected to be also negative) or will the result be rather surprising (due to e.g. stronger motivation of countries to eradicate the idiosyncratic risk internationally in times of crises, when closer collaboration is needed the most). This is the main hypothesis of our thesis. In addition, we examine the role of financial integration, regarding international risk sharing (similarly to previous literature on consumption smoothing) and we would also like to distinguish whether the decrease in foreign asset holdings related to the global financial crisis could at least partly be an explanatory factor for possible lower levels of international risk sharing in the data.

Lastly, regardless the role of financial crisis on consumption smoothing, we will also try to investigate whether there is any significant position of government regarding consumption smoothing. In particular, our hypothesis is motivated by thresholds in debt to GDP ratio, that could theoretically (if exceeded or not) allow for better or worse consumption risk sharing.

6 Literature review

6.1 Consumption smoothing

Firstly, we are going to start the discussion with a little introduction to consumption smoothing itself. The idea behind is about the tendency of insuring consumption streams against individual income fluctuations. That is, in open economies, borrowing and lending internationally in order to face only world aggregate risk. If financial markets are complete or if there are another institutions implementing optimal allocations, the state of full consumption insurance is possible. Accordingly to the paper of *Canova, Mort* and *Rawn* ([3]), some of these institutions do exist in a real world. On an individual level, to picture the idea of consumption smoothing or these institutions, we can think about e.g. unemployment or medical insurance schemes, welfare and social government programs or even as simple as family support within intergenerational transfers. At a country level, charities, disaster relief programs, international borrowing or lending and direct foreign aid are some of the tools that can help to insure consumption streams against fluctuations or in other words that can help to smooth the per capita consumption of a given country.

Even though there are obvious "tools" allowing for consumption smoothing, the previous literature and the empirical evidence show that the amount of risk sharing found in the data was rather limited. Considering that many factors can limit the level of risk sharing, this is not extremely surprising. Several authors have contributed to the risk-sharing literature (e.g. *Sorensen, Yosha, Wu, Zhu* ([22])) by explaining the lacking consumption risk sharing by "home bias" which is understood as a deviation from the perfect risk sharing international allocations or in different words the tendency to insure rather intranationally than internationally (the tendency of agents to prefer domestic markets against international).

In particular, *Sorensen, Yosha, Wu, Zhu* ([22])) developed a way of measuring the level of home bias of a given country (they introduced an equity home bias variable that is equal to 1 for a given country, if this country is 100 percent invested domestically and 0 if the country shows no domestic investment preference.) and subsequently used this methodology to show that lower levels of home bias are associated with higher international consumption risk sharing.

The bigger surprise, looking at the international consumption risk sharing literature is the indecisiveness of its results. E.g. one analyse the contrary results of *Canova and Ravn* ([7]) and *Artis and Hoffman* ([8]). In their papers, they devised contrary conclusions. *Canova and Ravn* showed that risk sharing is almost complete in short cycles but not in the medium and long cycles, which contradicts the conclusions of *Artis and Hoffman* who showed that there is more risk sharing in long-run than in the short run.

6.2 Consumption smoothing and financial globalization

Another example of consumption smoothing literature and their result could be *Kose, Prasad and Terones*. In their paper ([5]), they examine the role of financial globalization and consumption risk sharing. Their hypothesis was that within the benefits of financial globalization, risk sharing should be easier and more efficient. However, the empirical methods used were approving their hypothesis just to certain extend and just within some groups of countries. In particular, they showed that financial globalization has a positive effect on consumption smoothing in developed countries and even though theoretically this effect should be even higher in developing countries (especially emerging markets, which have become far more integrated to the global markets during the financial globalization period), the econometric methods fail to detect a significant increase of consumption risk being smoothed. In their paper, they also made a list of theoretical explanations for the lacking or the low levels of consumption smoothing found in the data. There are some of these categories in the next subsection of our thesis.

6.2.1 Explaining the lack of risk sharing

- *Non-tradeable and durable goods-* Even in the theoretical state of perfect risk sharing, non-tradable and durable goods are still a significant fraction of consumption and can therefore produce consumption fluctuations. However, empirical evidence of large preference shocks seems to be quite weak, which may mean that this is not the best explanation for lacking or low levels consumption smoothing.

- *Market incompleteness-* International financial markets are incomplete and therefore it is not even possible to insure your income/consumption against every possible risky event or fluctuation.
- *Transaction costs-* Transaction cost (associated with international trade of assets, goods etc.), if those transaction costs are high enough, they might also be a good explanation for the low attractivity of international diversification and might be a reason for domestic residents to diversify rather intranationally or not to diversify at all (this is kind of an explanation for the presence of "home bias" mentioned above).

One of the different views of understanding the lack of international consumption smoothing could be by understanding the way in which countries achieve their degree of risk sharing that we see in the data. *Asdrubali, Sørensen and Yosha* ([9]), in their paper, which is one of the first papers using similar methodology like ours and which is also very often cited in consumption smoothing literature, have suggested a simple decomposition of output risk. This approach allows us to identify two important channels of risk-sharing. That is firstly, the *ex-ante* way, which can be achieved e.g. by exchanging claims to their output, which is done before the uncertainty is resolved (that is why we call this *ex ante* channel of risk sharing). This channel is a way of smoothing consumption streams indirectly- by smoothing future income streams. Therefore- *ex ante* channel of risk sharing is also well known in the literature as income smoothing. Second, the *ex-post* way, that occurs after the uncertainty (current income is already observed) and is a way of smoothing fluctuations by e.g. borrowing and lending. This channel of consumption smoothing is relevant only in multi-period models, therefore it is also well-known as the *inter-temporal* consumption smoothing whereas the *ex-ante* channel is well known as *cross-sectional* channel of consumption risk sharing.

Having identified these two channels of risk sharing, *Asdrubali, Sørensen and Yosha* come up with a conclusion and a potential explanation of the lacking risk sharing. In particular their explanation is about almost not existing *ex-ante* channel of risk-sharing.

In our paper, we are convinced with to certain extend similar hypothesis like *Kose, Prasad and Terones* ([5]). That is consumption smoothing showing little growth during the period of financial globalization and than a significant decrease as a result of financial crisis. One of the simple reasons, supporting this idea, is the impact of crisis on all various financial

factors, markets or systems as well as on the process of financial integration and the toxicity of international assets. Particularly, we can e.g. think about the prices of borrowing and lending (see e.g. [1]) that are one of the basic tools of intertemporal consumption smoothing as well as the impact on labor markets, unemployment, income streams etc.

6.3   Consumption smoothing and financial crisis

There was no literature that examined the influence of global financial crisis on consumption risk-sharing. The only paper, we have found, dealing with crisis and consumption risk sharing was published just recently in January 2014. *Jesper Rangvidz* ([28]) used variables with numbers of banking, currency or inflation crisis in a particular year to decide whether there is more or less risk-sharing in a time of crisis. They have found higher values of risk-sharing associated with the crisis periods and their motivation or explanation of this finding was that financial markets cooperate more closely in times of crisis. However this results are based on different and rather small financial crisis for selected dates in selected countries, so it is obvious that when one or a few countries have troubles they try to share more consumption risk and therefore, we might really find higher risk-sharing in the data. Another reason might be that they do not account for the delay. Because when a crisis erupted in a certain country amd in a particular year it has impact on its economy not only in the year of eruption but also at least shortly after. But more importantly, from a global perspective of the 2008 crisis and what is also our hypothesis, the opposite should be true and that is lower levels of consumption risk-sharing for period of global financial crisis.

6.4   Consumption smoothing and financial integration

What was also frequently implemented in consumption smoothing literature is the role of financial integration ([4], [5], [8], [15], [21], [28]…). By financial integration we mean the access to international financial markets that we can measure usually as the levels or holdings of foreign asset positions, which showed a considerable growth during the period of financial globalization. The economic theory predicts that financial market integration should facilitate international consumption smoothing opportunities by allowing households to have better access to financial markets and to be able to hold more diversified equity portfolios and therefore diversify their consumption streams against country specific shocks. Another theoretical advantage of financial integration should be increased efficiency of financial agents, intermediaries and markets in countries where the financial system is more

backward or less integrated. That can happen by e.g. the entry of foreign banks and consequent improvement of the access to credit for households.

As an direct result of financial crisis, financial integration has decreased within the less healthy state of finance in crises. In our paper, we will try to distinguish weather this decrease in the levels of financial integration as an obvious impact of financial crisis, is also associated with lower levels of international risk sharing. In other words, we will examine wheter the strong correlations between foreign assets holdings and higher levels of international consumption risk sharing is still present in the data even after the financial crisis (previous literature have found that financial integration has a positive effect on consumption smoothing and we will try to examine wheatear did or did not this statement change over time).

However, in some papers ([8],[28]), the concern was raised that it might not actually be the high levels of financial integration as a foreign asset holdings that are associated with higher levels of consumption risk sharing but rather higher levels of trade integration. *Rangvid et al.* ([28]) show that trade integration has gone up in the recent period together with risk sharing and it could also possibly dominate the findings about financial integration, especially for emerging markets. However the empirical evidence is still stronger for financial integration, so we will not implement the concept of trade openness in our thesis.

6.5 Consumption smoothing and gross government debt

Another paper that showed up as an interesting one in the context of our research is the one of *Leibrecht* and *Scharler* (19) which examines the role of government in the context of international consumption risk sharing. The main point of their work was that even though financial markets allow diversifying consumption risk internationally, agents might have problems to participate in this process directly due to transaction costs and borrowing constraints. In the presence of these obstacles in direct diversification, their hypothesis was that since government has typically better access to international financial markets, government can smooth fluctuations in country-specific output by shifting risk from private sector to government and then continue the diversification process internationally. They assumed that since this is true, the size of a government should play a significant role as well. However, they found no significant role of the size of government in the data.

In our paper, again, we believe that the idea of *Leibrecht* and *Scharler* (19) was not completely wrong and indeed government has a role within international consumption risk sharing. We assume that government size is probably really not significant but within the motivation of the article of *Reinhart* and *Rogoff* about growth in a time of debt ([17]), we decided to examine wheatear gross government debt, which might also influence the access and conditions on financial markets (by e.g. influencing the prices of borrowing and lending), has significant effect on international consumption risk sharing. We are experimentaly trying to find a certain threshold in government debt, which if exceeded, is having a significant role on consumption risk sharing. It could be either a debt that is too high and countries with so high level of debt should have theoretically problems with borrowing or borrowing should be expensive for them. Another threshold could be theoretically found as an association to low amount of debt, which is actually an advantage for countries to borrow. But this idea with the low amount of debt usually works just for developed nations because developing countries very often show low amount of debt and their ability to diversify or to access international markets is not too strong.

7 Econometric setup

Most of the literature about international consumption risk sharing has derived its methodology from benchmark models with complete financial markets and frictionless trade in goods, where marginal utility growth in a country or region equals the shadow price of consumption. If so, than the marginal utility growth should be perfectly correlated. One way of the literature starting with *Beckus* ([29]), have therefore focused on consumption correlations (now famous as the consumption correlation puzzle about lower international correlations in consumption than in output).

This approach was criticized by e.g. Stockman and Tesar ([30]), who argued that preference shocks can easily drive consumption and therefore the correlations could be lower even if the state of perfect consumption risk sharing is present.

Therefore, the literature developed another approach of measuring the state of consumption risk-sharing and that is the classical risk sharing equation described in next section.

7.1 Classical risk-sharing equation

The second approach for estimating levels of consumption smoothing, mentioned above and implemented in our work, is using panel regressions like in several other works ([4], [5]…). The basic equation goes as follows:

$$\Delta c_{it} - \Delta C_t = \alpha_i + \beta\,(\Delta y_{it} - \Delta Y_t) + \varepsilon_{it} \tag{1}$$

Where c_{it} denotes natural logarithm of per capita consumption in country i and time t and C_t denotes natural logarithm of per capita consumption in a group of countries (that is „rest of the world" consumption), which is calculated as a population weighted average $(Ct = \sum_{j \neq i} w_j\, c_{jt},$ where w_j denotes the ratio between population of country i and total population of the whole group of countries). Similarly, y_{it} and Y_t are standing for natural logarithms of gross domestic product (GDP) per capita in country i and time t and for the "rest of the world" per capita GDP calculated in the same manner as the "rest of the world" consumption (for detailed derivation of this equation, please refer to e.g.([25])).

In simple terms, the idea behind the equation could be pictured like this: if risk sharing is perfect, then consumption growth rates should be equalized across countries, meaning that $\Delta C_{it} = \Delta C_{jt}$ for countries i, j and time t. In addition, if this is true, then $\Delta C_{it} = \Delta C_t$, meaning that consumption growth rate in country i and time t should be equal to the growth in rest of the world in time t. If consumption smoothing is not perfect, then consumption growth rates are decoupled from the world aggregate and may also reflect country specific factors such as country specific output (the difference between per capita GDP of a chosen country and the world aggregate). *Asdrubali, Sørensen and Yosha* in their paper ([9]) showed that the coefficient β in equation (1) can be interpreted as a fraction of risk that is <u>not</u> shared internationally, meaning that $\beta=0$ if the consumption risk sharing is perfect (within perfect consumption risk sharing and complete markets, the left hand side of equation (1) should be zero which implies that β should also be zero) and $\beta=1$ if there is no consumption risk being shared internationally.

As we can see the estimated coefficient β is restricted to be the same across all the countries as well as the whole estimation time period and the estimated coefficient α_i is allowed to vary across different countries (We are using fixed cross section effect estimation specification, because fixed- effects model is unbiased and therefore is appropriate for our macro-economic purpose. Another point of view is that there are differences between countries in consumption and GDP as well as in many other economic indices, which can mean that any assumption of a similar constant would not be proper. Some authors have been also including fixed period effects. We have been experimenting with those as well but there was no meaningfull difference between the estimates of β, so we decided to follow Fidrmuc ([5]) and use fixed cross-section dummies only). The error term ε_{it} is allowed to vary among different countries as well as among different time.

7.2 Time-varying classical risk-sharing equation

The main goal of our thesis is to examine the role of financial crisis on risk sharing, which in other words means to examine time-varying effects of consumption smoothing. For this purpose, we will implement different versions of equation (1). Firstly, we estimate the coefficient β as a time varying coefficient β_t. Since those results are unstable and are considerably fluctuating, we can smooth the results by computing their average over e.g. 5-10

years rolling window (moving average), similarly to the methodology used by *Kose, Prasad and Terones* in their paper about consumption smoothing and financial globalization ([5]).

$$\Delta c_{it} - \Delta C_t = \alpha_i + \beta_t (\Delta y_{it} - \Delta Y_t) + \varepsilon_{it} \tag{2}$$

We estimate equation (2) as a panel equation with time-specific coefficient β_t. The main reason using panel model for this equation is to estimate one equation instead of many equations (we will obtain similar results by estimating equation (2) as a simple linear regression for each year separately-as e.g. *Kose, Prasad* and *Terones* did in their work([5])).

7.3 Linear trend plus crisis dummy variables model

Another methodology, for estimating time-varying effects, is to estimate equation (1) enriched by time trend variable as well as dummy variables for years of crisis:

$$\Delta c_{it} - \Delta C_t = \alpha_i + \beta (\Delta y_{it} - \Delta Y_t) + \gamma\, trend(\Delta y_{it} - \Delta Y_t) + \delta D^{2008}(\Delta y_{it} - \Delta Y_t) + \lambda D^{2009}(\Delta y_{it} - \Delta Y_t) + \varsigma D^{2010}(\Delta y_{it} - \Delta Y_t) + \chi D^{2011}(\Delta y_{it} - \Delta Y_t) + \varepsilon_{it} \tag{3}$$

As we can see, now β is as in equation (1) time-invariant, and the time specific effects are now observable by the coefficients γ, δ, λ, ς, χ. The variable *trend* stands for linear time trend and the variables D^{2008}, D^{2009}, D^{2010} and D^{2011} stand for classical time dummy variables that is for example D^{2008} is equal to 1 for year 2008 and is zero for all the other years. We can calculate the amount of risk that is not shared internationally for a chosen period like $\beta + \gamma\, trend + \delta D^{2008} + \lambda D^{2009} + \varsigma D^{2010} + \chi D^{2011}$ .We can therefore interpret β as an amount of consumption risk that is not shared internationally in the first year of our estimation period. Basically due to our hypothesis, we expect γ to be negative, meaning the presence of positive trend in risk sharing during financial globalization period and we expect the coefficient corresponding to the crisis dummy variables- δ, λ, ς, χ to be rather positive meaning that the conditions for consumption smoothing were worse during the recent period of global financial crisis (there was a significant decrease in the level of consumption risk that is smoothed). If one time trend variable is not significant and does not explain enough of the data volatility, we might also implement different time trends for different time periods

(a good tool for decision about whether a linear time trend model like this is appropriate, could possibly be obtained after the estimation of equation (2)).

7.4 Risk sharing and financial integration

Another extension of the estimated equation ([1]) that was also implemented in several previous articles ([5], [4] …) is by adding another explanatory variable- that is financial integration interaction term:

$$\Delta c_{it} - \Delta C_t = \alpha_i + \beta (\Delta y_{it} - \Delta Y_t) + \gamma FI_{it} (\Delta y_{it} - \Delta Y_t) + \varepsilon_{it} \tag{4}$$

In equation (3), the degree of consumption risk sharing in country i and time t is estimated as $(1 - \beta - \gamma FI_i)$. The coefficient γ is also restricted as the same among time and countries and could be interpreted as follows: if $\gamma < 0$ that is if γ is negative, it implies that the greater financial integration is related with greater ability to share consumption risk and the opposite is true if $\gamma > 0$. More information about the measurement of financial integration as well as data description will be provided in next section.

To explore the relation of financial integration and consumption risk sharing for the financial crisis period and for the period before the financial crisis erupted, we also estimate equation (4) in another lightly modified version as follows:

$$\Delta c_{it} - \Delta C_t = \alpha_i + \beta(\Delta y_{it} - \Delta Y_t) + \gamma D^{Crisis} FI_{it}(\Delta y_{it} - \Delta Y_t) + \delta D^{Pre-crisis} FI_{it} (\Delta y_{it} - \Delta Y_t) + \varepsilon_{it} \tag{4a}$$

The variables D^{Crisis} and $D^{Pre-crisis}$ represent classical period dummy variables. In particular $D^{Pre-crisis}$ is equal to one for the period before crisis (until 2007) and is equal to zero for the financial crisis period (2008-2011). D^{Crisis} is defined in similar manner- particularly D^{Crisis} is equal to one for the crisis period end zero otherwise. The estimated coefficients γ and δ could be interpreted both as the γ from previous equation (equation (4)) but γ now stands only for the period before financial crisis and δ for the period affected by global financial crisis. What would be interesting to analyse is whether γ and δ are different. If so, we can not explicitly say that the possible and expected decline in risk-sharing is caused by financial integration. But more importantly, if they are not different, we can say that the expected decline in risk

sharing recorded for the financial crisis period is at least partly connected to the decline in financial integration. To be able to say so, we are performing a simple Wald coefficient restriction test with the null hypothesis of $\gamma = \delta$.

7.5 Risk sharing and gross government debt

Another topic, we will examine, is the role of gross government debt. Our inspiration comes from an article by Reinhart and Rogoff ([17]). In their paper they examine the role of ratio of government debt to GDP and they found the value of 90% as a significant threshold for GDP growth as well as inflation time series. However, they findings were criticized and there was also a suspicion about these findings that they were actually based on a mistake in their code. Anyway, as a source of inspiration, their article is very interesting.

In our work, our idea is that high government debts make it harder for individuals to access international markets and therefore harder to diversify consumption streams *ex-post*. Our idea uses the idea of thresholds and we are constructing dummy variables for different levels of gross government debt.

$$\Delta\,c_{it} - \Delta\,C_t = \alpha_i + \beta\,(\Delta\,y_{it} - \Delta\,Y_t) + \gamma\,D_{it}^{TRESHOLD}\,(\Delta\,y_{it} - \Delta Y_t) + \varepsilon_{it} \qquad (5)$$

$D_{it}^{TRESHOLD}$ stands for dummy variable, which is 1 for a country *i* and time *t* when this country-*i* in that particular time-*t* has the gross government debt to GDP ratio on the level that does not exceed our selected threshold condition (e.g. debt lower than 30% of GDP or debt higher than 90% of GDP) and is 0 otherwise. If the estimated coefficient γ is positive, it means that countries that are satisfying the certain debt to GDP threshold condition are associated with lower risk-sharing. We might also implement more coefficients like these corresponding to different threshold (e.g. a coefficient for debt lower then 30% of GDP, a coefficient for debt between 30-60% of GDP and a coefficient corresponding to debt on 60-90% of GDP or even more groups) and see wheatear there is a significant change in consumption risk-sharing associated with certain level of debt o GDP ratio. In this model, 1-β can be interpreted as a level of consumption smoothing enjoyed by countries in the time when their gross government debt does not satisfy any of the threshold conditions.

7.6 Long-term risk sharing equation

Some authors ([4],[8],[25],([27])), have contributed to the literature by emphasizing the way in which transitory and permanent shock are pooled across countries. They usually find that long-run risk sharing among countries is quite low and the permanent shocks are pooled across countries quite badly. The methodology regarding this phenomenon is to estimate the equation (1) but instead of estimating it with differenced variables, they estimate the equation directly in levels (for full derivation of this equation, please refer to e.g. ([8]),([25])...).

$$c_{it} - C_t = \alpha_i + \beta \, (\, y_{it} - Y_t \,) + \varepsilon_{it} \qquad\qquad (6)$$

However, using not-differenced data means that the regressors $c_{it} - C_t$ and the dependent variables $y_{it} - Y_t$ might be and in practice also very often are non-stationary and there is also a possibility that they are cointegrated. However *Artis* and *Hoffman* show that the equation (6) can be consequently estimated by OLS and the coefficient β can be interpreted as the fraction of risk that is not shared internationally in the long run. Therefore some authors([6],[27]) just estimate the level regression (6) by OLS.

But since the data are or could be cointegrated and non-stationary, similarly to *Artis and Hoffman* or *Zhaozang Qiao*([8],[25]), we also estimate equation (6) by Panel dynamic OLS (DOLS) or Fully modified ordinary least squares (FMOLS).

The FMOLS estimator was first developed for time-series and later in 2000, Pedroni extended the method for panel analysis. The group means FMOLS estimator allows for both heterogeneous dynamics and heterogeneous cointegration vector which could be the case of equation (6).

As Zhaozang Qiao in his paper [25] shows, the estimator in risk sharing context allows for taste shocks, intertemporal smoothing and some other biasing factors to be wiped out and therefore we are allowed to interpret the estimated slope coefficient as a long run risk sharing fraction, similarly to the one in equation (1) for classical risk-sharing. For the DOLS

method, deriving of the formulas and econometric background, please refer to the paper mentioned above([25]).

These methods were also used by *Artis and Hoffman* ([8]). They conducted that the DOLS estimator is slightly preferable, because FMOLS is semi-parametric and might be imperfectly suited to smaller data samples (in our paper context sometimes it could be just around 20 countries and 20 periods). The DOLS estimator accounts for serial correlation and simultaneity by including leads and lags of the right hand side variables. *Artis and Hoffman* performed and experimenting method for choosing the proper amount of leads and lags and came up with 1 lead and 1 lag as a sufficient number to capture the serial dependence in their annual dataset, similar to ours. Another important thing to mention, is that in practice it does not matter if the output and consumption variables are indeed cointegrated, because *Mark and Sul* ([26]) show that even though there is no cointegration, the regression coefficient is still meaningful. It is also possible to pick either group means or panel version of these estimators and since the panel version accounts for similar constant (the constant is not allowed to vary across different countries), it is more convincible for us to use the group means method as e.g. Zhaozang Quio did in his work ([25]).

Since it is not possible to estimate time-varying risk sharing equation with FMOLS or DOLS (because of e.g. the lead and lag requirements that does not allow us to make different estimates for each time period) we employ another methodology to examine the time varying effects of risk sharing and to examine the risk sharing between. We can not use methods like equation (2) or equation (3), because there would be not enough valid observations after removing cross-sections with estimation errors. Therefore we estimate equation (6) for different time periods using quarterly dataset that makes enough observations to estimate the equation for period of crisis and a few periods before crisis so that we can compare the risk-sharing levels achieved during crisis and before.

7.7 Heteroskedasticity presence

For some of our equations, the standard errors and t-statistics were biased due to violation of standard panel equation assumptions that is firstly homoscedastic errors $Var(\varepsilon_{it})$ $= \sigma^2$ i.e. the variance of errors is constant and the second important assumption is uncorrelated errors i.e. $Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0$ for $i \neq j$. If there are some violations of these assumption we can still use OLS estimation (the OLS estimates are still consistent but no

longer optimal). With particular correction (GLS, white-cross section...) we can achieve robust standard errors (for theoretical properties of these models refer to e.g. [23] or [24]). For practical use, we just note that White-cross section robust standard errors are in practice often used and are appropriate when T>>N (we have much more time observations then countries in our panel estimate) and it is robust to cross sectional heteroskedasticity- $Var(\varepsilon_{it})$ = σ_i^2 and $Cov(\varepsilon_{it},\ \varepsilon_{jt})= \sigma_{ij}$ (cross-sectional heteroskedasticity and correlation across cross sections). White period robust standard errors are often used in practice when the opposite is true- N>>T and also when the selection of cross-sections is a random sample (this correction is robust to $Var(\varepsilon_{it}) = \sigma_t^2$ and $Cov(\varepsilon_{it},\ \varepsilon_{jt})= \sigma_{ts}$). There is also a third option- White diagonal standard errors and t-statistics that are robust to any kind of heteroskedasticity but not to any kind of correlation across time and cross section.

Since our dataset does not contain random selection of countries (at least for most of the groups we will examine), the most appropriate was the White-Cross section option. However in some cases, e.g. when number of countries implemented was higher then the number of time observations, we have been also implementing the White period t-statistics and standard errors correction. In most of the cases White-Cross section was performing the best.

In addition, one might argue, that White heteroskedasticity adjusting is not sufficient since White's adjusting methods only affect the standard errors and t-statistics. It is a common practice to use either OLS or generalized least squares (GLS) when one of the statements bellow holds([23]):

1. If $Var(\varepsilon_{it}) =\sigma^2$ and all covariances between error terms are zero, there is no need for weightening or generalization and classical OLS can be applied.

2. If $Var(\varepsilon_{it}) = \sigma_i^2$ and all covariances between error terms are zero, we have cross-sectional heteroscedasticity present in our dataset and GLS can be applied (cross-section weights):

3. If $Var(\varepsilon_{it}) = \sigma_i^2$, $Cov(\varepsilon_{it}, \varepsilon_{jt}) = \sigma_{ij}$ and all other covariances are zero, i.e. we allow for contemporaneous correlation between cross-sections. GLS can be applied (SUR weights).

Again, in some cases of our analysis the cross-section weighted generalized least squares or cross-section sur weighted generalized least squares estimator might have been appropriate. We have also estimated our equations using GLS but we did not find any important difference (especially within the most important results of our thesis) in the values of estimated coefficients comparing GLS, OLS and White heteroskedasticity correction.

8 Data Description

8.1 GDP and consumption

We have been experimenting with GDP and consumption data published by OECD ([13]), but since our focus is not only on OECD countries and the data available for emerging markets in this database were rather limited (just a very few non-OECD member countries included as well as considerable amount of particular not-available fields), we decided to use Penn World Table 8.0 ([10]) which is a widely used source of data in Consumption-smoothing literature. This latest version of Penn World Table covers 167 countries and the periods from 1950 to 2011. The construction of a database, the measurement and adjusting the data so that they are internationally comparable within so many countries involved is a complicated process including exchange rates, price adjusting etc. Since this dataset is widely used we will not go further to the process of data construction (for further details, please refer to [12]). GDP and private consumption data are expressed in constant prices, in $ with a base year 2005. In order to obtain per capita data and proper computation of world population fraction (to calculate "rest of the world" consumption and GDP) we are also using data for population, also from Penn World Table 8.0.

8.2 Financial integration

For financial integration, we are using the database of *Lane and Milesi-Ferretti* ([11]), which is also widely used in consumption smoothing literature. The database was published in 2007 and we are using the updated and extended version of this dataset, which is enlarging the database from the previous range of 1970-2004 to 1970-2011 that is the period we are focusing on. The range of countries is also very wide; especially the countries we are focusing on with our research are all covered within this database. In particular, we are using 3 kinds of financial integration measurement, that is: portfolio equity investment, debt investment and FDI (Financial Direct Investment). This dataset is also constructed within a lot of obstacles involved in the process so we will just briefly describe the meaning of individual variables (details available at the original paper of *Lane and Milesi-Ferretti* ([14])).

Portfolio equity assets and liabilities- measure the ownership of shares of companies. As a statistical method to distinguish between portfolio investment and direct investment, 10 % is taken as a threshold.

FDI- Financial direct investment- controlling stakes in acquired foreign firms and enterprises (distinction between portfolio and direct investment within 10% threshold as described above), holding of foreign property is also an important value for some countries.

Debt assets and liabilities- this category includes foreign debt securities as well as bank loans and   deposits and some other debt investment instruments.

For our purpose, we are computing the financial integration variable that we implement into our models based on similar methodology as e.g. *Sorensen* or *Fidrmuc* ([4],[15]). That is computing the financial integration term (FI_{it}) as follows:

$$FI_{it} = \frac{F_{it}^{I} + F_{it}^{O}}{Y_{it}}$$

Where F_{it}^{I} and F_{it}^{O} denotes particular kind of financial assets and liabilities for country *i* in time *t*.

On next figure, we are presenting the dynamics of financial integration term for some countries. Firstly Iceland as a country that experienced a huge bank crisis and therefore the impact of financial crisis on financial integration should be obvious and as we can see on the figure it also really is. Next we picked as Luxembourg as a country that is an obvious outlier, enjoying the highest values of financial integration measure implemented in our paper, which is sometimes even 100 times higher than levels enjoyed by other countries and the opposite South Korea that is enjoying the lowest levels of our financial integration measure. For all selected countries, there is an obvious positive trend corresponding to financial globalization period and even for outliers (except the FDI measure of financial integration), we can observe an impact of financial as a decrease of financial integration.
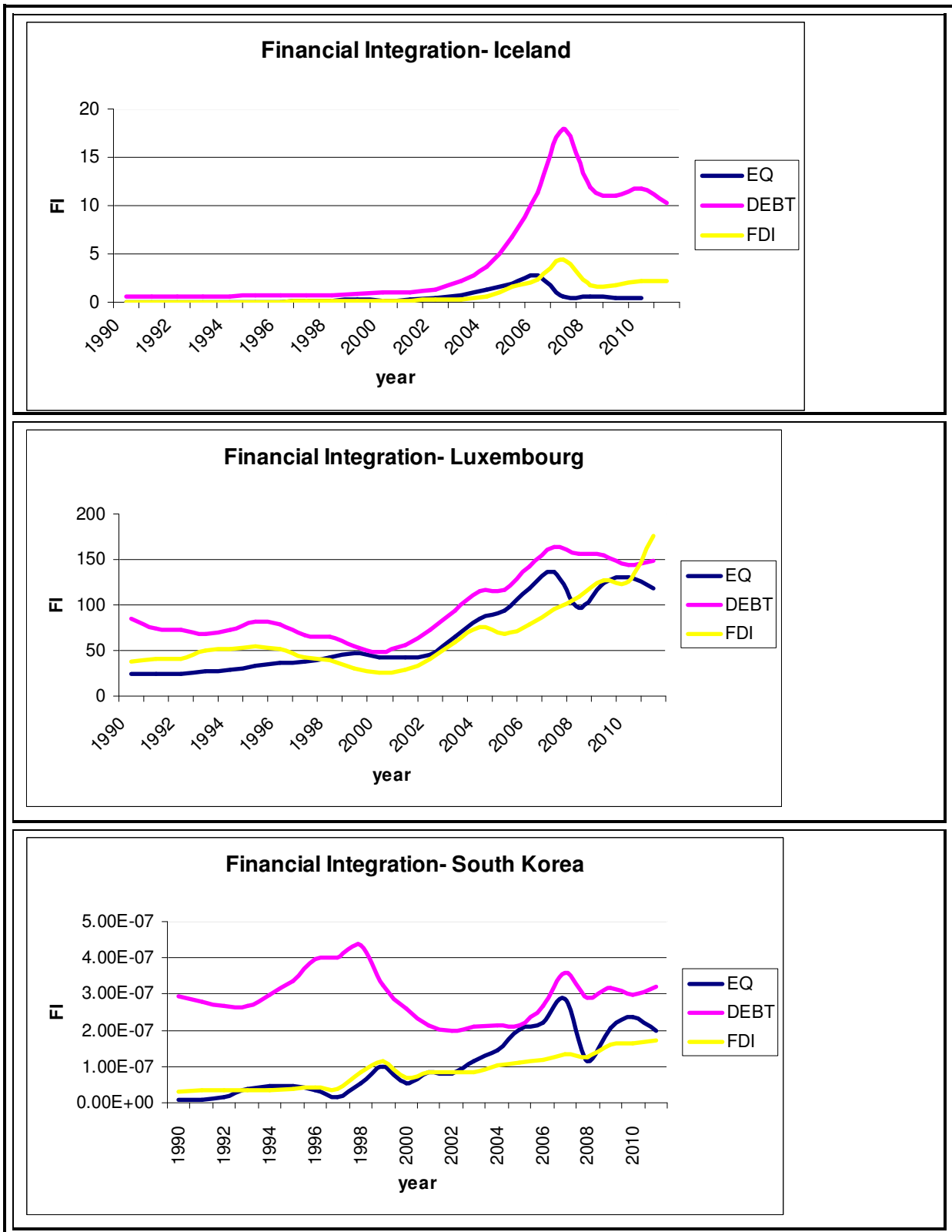
Figure 1- Financial Integration for selected countries

8.3 Gross government debt

For gross government debt, we are using World Economic Outlook database published by International Monetary Fund- IMF ([18]). For some countries, the data is available for the period 1980-2011, which is quite well corresponding to our previous data but we have to be careful because data for some countries is not available until year 2000 or similar. However, the biggest focus within this section of our research is for OECD countries or even smaller subgroup of OECD countries, for which the data should be good enough.

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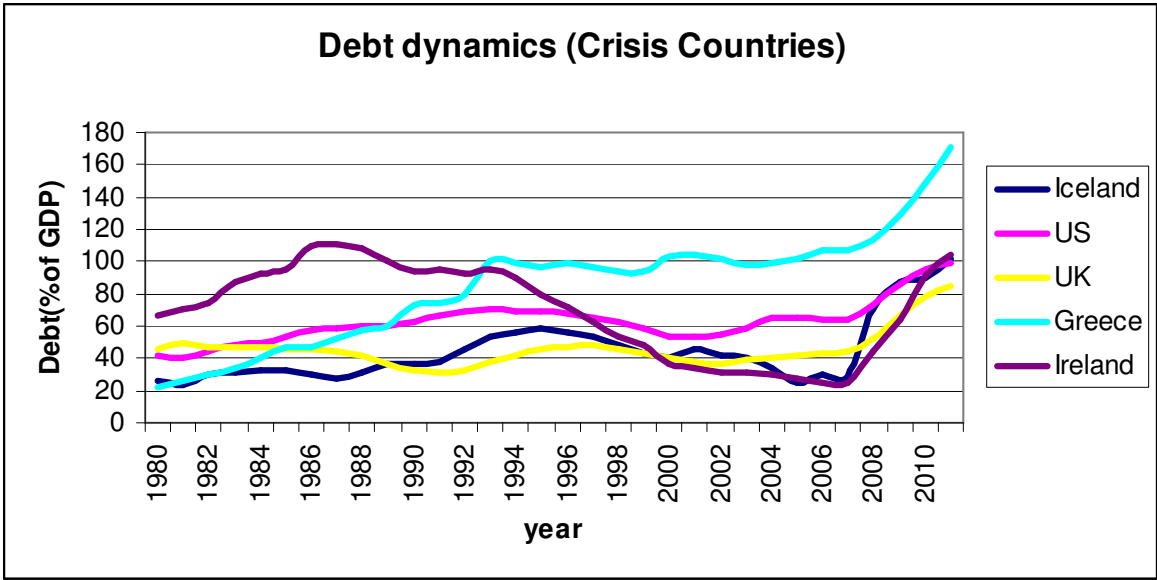
Figure 2- Gross Government Debt (Crisis countries)

Having these data-sets available, we are now able to identify several country groups, for which, we will implement the econometric models, described in previous chapter.

8.4 Country groups

In literature, a considerable amount of papers focused just on OECD countries, some of the papers were comparing OECD countries with emerging economies and some papers also compared traditional or core member states of OECD with its new members. We will work with those country groups:

- *OECD members*- a group of 34 OECD member states, namely: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France,

Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States

- *OECD members adjusted*- some countries in previous group only exist since 1990 or similar, which makes the estimations only possible from 1990-2011. To extend the available time horizon for estimating our regressions, we are implementing group of OECD states, without Slovakia, Slovenia, Czech Republic, Estonia and Israel.

- *Traditional OECD countries*: countries that are OECD members for long-time period (they joined OECD before 1980). Namely 24 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, Spain, Turkey, United Kingdom, United States.

- *Emerging markets*- according to MSCI index ([16]) we made a selection of countries that could be classified as emerging economies. In particular: Brazil, Chile, Colombia, Mexico, Peru, Czech Republic, Egypt, Greece, Hungary, Poland, Russia, South Africa, Turkey, China, India, Indonesia, South Korea, Malaysia, Philippines, Taiwan and Thailand.

- *Emerging markets adjusted*- similarly to OECD countries, due to data availability reasons, we implement another emerging market group without Czech Republic and Russia.

- *All countries*- a combination of OECD and emerging markets, a total of 47 countries.

- *All countries adjusted*- a combination of OECD and emerging markets as in previous group, excluding Russia, Estonia, Israel, Slovakia, Slovenia and Czech republic (due to data availability).

We were also trying to implement a group of *New OECD member countries*- as a opposite to traditional OECD countries (countries that joined OECD after 1990), namely: Chile, Czech Republic, Estonia, Hungary, Israel, Mexico, Poland, Slovakia, Slovenia, South Korea but we decided to omit this group according to data problems.

8.5 Long term risk sharing

We are using quarterly data from OECD statistics ([13]). All series are expressed in US dollars, current prices and current PPPs (international prices) and are seasonally adjusted so they should be comparable on international level which makes them perfect for our purpose. According to data availability, we are running long term risk sharing analysis just on two country groups. In particular, the first group is the traditional OECD countries, similarly to the group implemented in our yearly data analysis (24 countries) as well as group of OECD adjusted countries that contains all OECD member states excluding Greece because the data for Greece were unfortunately not available for the Crisis period. This full OECD data sample ranges only from 1997Q2 to 2013Q2, but for our purpose, that is estimating the risk sharing coefficient for crisis period and period before crisis, it is enough.

9 Results

9.1 Basic risk sharing- equation (1)

In *Table 1*, we are presenting the results for our selected country groups and the longest possible time periods of equation (1). The highest risk sharing coefficient estimate was for traditional OECD countries, which goes well with the results of previous consumption- risk sharing literature.

Table 1- Classical risk sharing equation

Country Group	Estimation Period	Constant-C	Risk Sharing coefficient(1	R^2 adjusted, number of
All countries	1991-2011	0.002**	0.335***	0.545
		(1.974)	(13.482)	987
All countries adjusted	1971-2011	0.002***	0.356***	0.503
		(2.730)	(11.671)	1681
OECD countries	1991-2011	-0.001	0.292***	0.510
		(-0.119)	(9.598)	714
OECD countries	1971-2011	-0.001	0.421***	0.390
		(-0.621)	(14.669)	1189
OECD traditional	1971-2011	-0.001	0.582***	0.232
		(-0.895)	(9.219)	984
Emerging markets	1991-2011	0.003	0.386***	0.570
		(1.478)	(6.064)	441
Emerging markets adjusted	1971-2011	0.004***	0.233***	0.612
		(5.685)	(20.873)	779

Notes: *, **, *** denotes significance at 10%, 5% and 1% level. In parenthesis are t-statistics, which were computed using White heteroscedasticity standard errors and t-statistics correction.

What is surprising is the fact that for full group of Emerging markets, we obtained greater risk sharing coefficient than for full group of OECD countries in the same estimation period.

However the explanation for this can be easily found in the extremely small coefficient that we could estimate if we implement also a group of new OECD members, that we decided to omit. We will just note that for those countries the coefficient was around 10%, which is low enough to be biasing the whole OECD group estimate. With the exception of full country group (all countries), we also obtained a lower estimation of risk sharing coefficient for the full groups than for the subgroups (which are adjusted for higher data availability, namely OECD and OECD adj. , emerging markets and emerging markets adj.). It can be also caused by the fact that subgroups are composed by countries with rich history and therefore theoretically should enjoy higher levels of international consumption risk-sharing (related to e.g. good access to international financial markets).

9.2 Time-specific risk sharing- equation (2)

Second result, we are going to present is based on equation (2). We have estimated the coefficient β_t for 4 country groups with the longest time period, namely Emerging markets adjusted, OECD adjusted, All countries adjusted and OECD traditional countries. These estimates of β_t were quite unstable, so we used 5-year moving average for further smoothing of the results (β_t is computed as (β_{t-2}+ β_{t-1} + β_t + β_{t+1} + β_{t+2})/5), similarly to *Kose, Prasad* and *Terrones* ([8]) in their paper about the time effects of financial globalization. Even from such a simple methodology we can observe obvious effect of financial crisis. On the following graphs, there is an easily observable positive time trend for the period around 1990-2006, (this time horizon is slightly varying depending on the particular country group) and after that an obvious negative trend or jump caused by financial crisis. Risk sharing levels before the period around 1970 were having slightly different dynamics for different country groups; there is e.g. negative time trend for the group of traditional OECD countries, but this time period is not important for the purpose of our thesis (i.e. to examine the relation between financial crisis and consumption smoothing).

Table 2 - equation (2) results
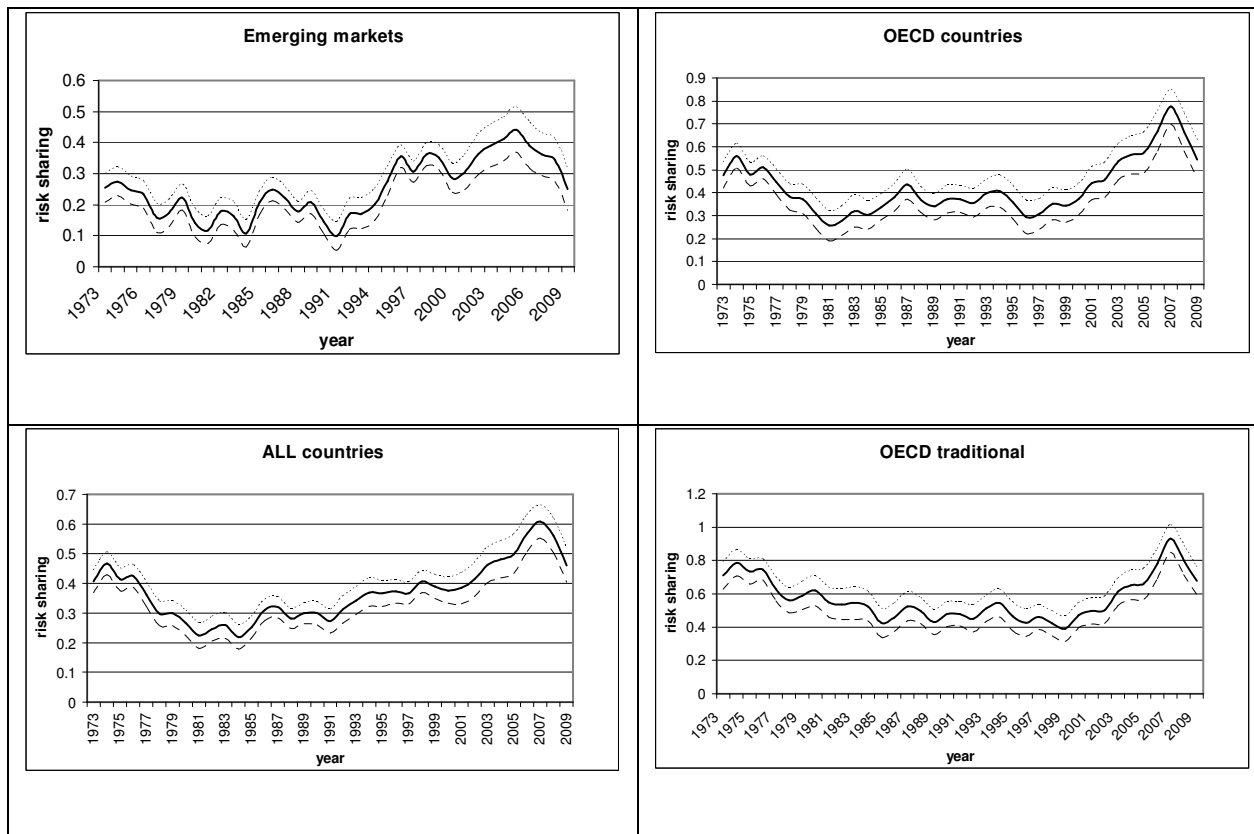
The solid lines stand for actual estimates of 1- β_t from equation (2), smoothed by 5 year average rolling window, whereas the dashed lines stand for confidence interval(plus/minus 2 times standard deviation).

The financial crisis erupted around the year 2008 and since we used the 5-year average rolling window to smooth the results our estimation time period ends in 2009. When focusing on the impact of crisis on risk sharing, regarding these figures, we have to take into account the fact that already observation for year 2006 is influenced by the period of crisis. Therefore the last 3 observations are the most important in the case of financial crisis.

To be able to compare those results, we also include all the estimated curves from Figure 1 in one single graph:
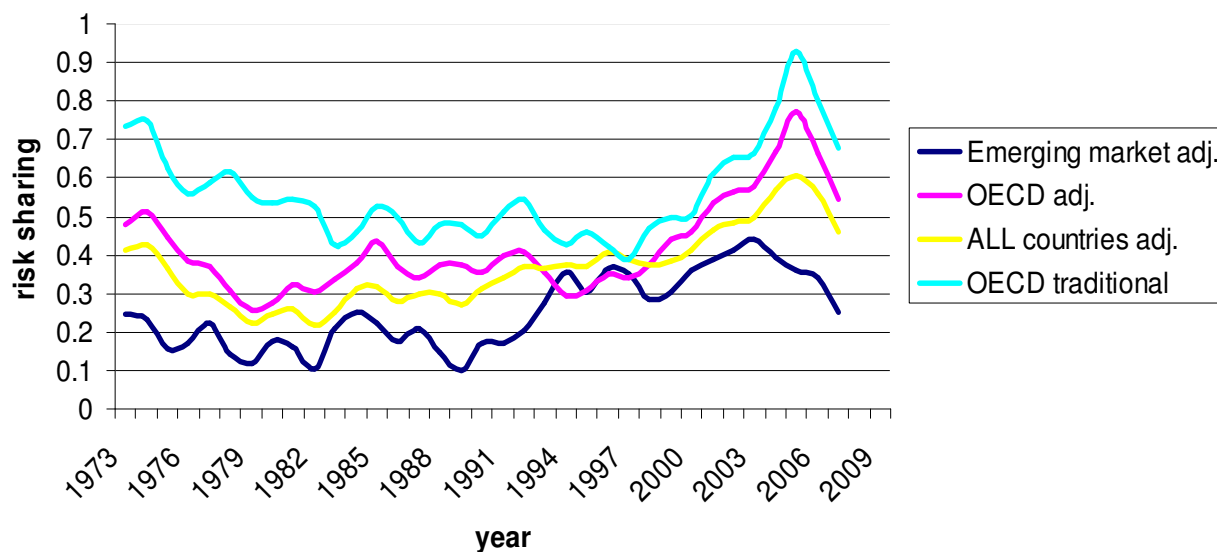
Figure 3- equation (2) compared

We can see that the position of the individual curves corresponds well with our results in Table 1. The country group with the highest risk sharing coefficient for full period 1971-2011 has also a curve which enjoys risk sharing levels above the ones enjoyed by other groups. In particular, highest risk sharing levels are enjoyed by traditional OECD countries, than all OECD countries, than all countries and the least amount of risk is shared within emerging market economies, which is in fact confirming the results of previous literature.

As well as in figure 1 also in figure 2, we can observe a positive linear time trend for the variable time period between 1990 and 2005, which is also motivation for our next step-estimating equation (3). We have experimented with the estimation period, inspired by Figure 1 and Figure 2 and we tried to adjust the time period to the obvious positive (positive for risk sharing means negative in the estimated coefficient related to trend variable in data) linear time trend on the figures. We firstly show the results in table 2.

9.3 Risk sharing and financial crisis

9.3.1 Equation (3) results

We are now going to present our results obtained by estimating equation (3). That is modeling the financial globalization consumption risk sharing growth with a linear trend and then implementing dummy variables for the crisis period. The results are presented on next page in Table 2 followed by a discussion and interpretation of the results.

Table 3 - equation (3) results

Country Group	Estimation	C (constant)	β	γ (trend)	δ (D^{2008})	λ (D^{2009})	ς (D^{2010})	χ (D^{2011})	R^2 adjusted, number of obs.
All countries	1996-2011	0.004*** (3.555)	0.785*** (20.906)	-0.025*** (-2.605)	-0.039 (-0.433)	0.086 (0.758)	0.02 (0.195)	0.383*** (3.364)	752 0.545
All countries	1990-2011	0.003*** (2.815)	0.741*** (10.526)	-0.016** (-2.187)	-0.140 (-1.530)	-0.051 (-0.534)	0.0310 (0.301)	0.452*** (4.217)	902 0.531
OECD countries	1991-2011	0.001 (0.687)	0.957*** (15.28657)	-0.035*** (-4.563)	-0.097 (-1.024)	-0.975% (-0.918)	0.249** (2.366)	0.485*** (4.556)	714 0.552
OECD countries	1995-2011	0.001 (0.825)	0.752*** (6.678)	-0.038** (-2.458)	-0.131 (-1.045)	-0.225 (-1.582)	0.401** (2.541)	0.772*** (4.641)	493 0.385
OECD traditional	1997-2011	0.000 (0.202)	0.744*** (8.251)	-0.064*** (-3.180)	0.023 (0.131)	-0.213 (-1.086)	0.615*** (3.017)	1.044*** (4.204)	360 0.297
Emerging markets	1995-2011	0.007*** (5.219)	0.818*** (12.050)	-0.0143 (-1.460)	0.219** (2.373)	0.118 (1.084)	-0.008 (-0.077)	0.319*** (2.843)	357 0.669
Emerging markets	1982-2011	0.006*** (5.639)	0.965*** (12.819)	-0.017*** (-3.984)	0.159** (2.376)	0.209*** (2.904)	0.136* (1.770)	0.434*** (5.734)	570 0.676

Notes: *, **, *** denotes significance at 10%, 5% and 1% level. Regressions also include cross-section fixed effects. In parenthesis are t-statistics, which were computed using White heteroscedasticity t-statistics and standard errors correction.

After a brief analysis of table 2, it is quite hard to interpret the results. For better understanding, we will interpret the results also graphically in next section. Before that, we can notice that the expectations for linear time trend coefficient γ to be negative were fulfilled for all the country groups, with the exception of full group of emerging market economies, where the time trend was negative but was not significant for the time horizon that we implement. What might be quite surprising is that for several country groups, the coefficients δ and λ corresponding to dummy variables D^{2008} and D^{2009}, were rather negative(excluding emerging market groups and new OECD members). The negatives of these coefficients would actually mean positive impact of financial crisis on consumption smoothing but as we can see none of these coefficients were significant. The other two coefficients ς and χ corresponding to dummy variables D^{2010} and D^{2011} were in fact corresponding to our hypothesis- they were significant and positive. So basically we see an obvious impact of financial crisis on consumption risk sharing. The decline in the levels of international consumption risk sharing that we have seen in Figure 1 and Figure 2, was not just a mistake of equation (2) but indeed a statistically significant effect. For classical country groups, the impact seems to be more obvious starting from 2010, which means that there is some delay between the dates of crisis and the obvious impact. This delay is not too surprising, because the early years of crisis were the worst for United States and in took some time until the crisis turned into a global depression. Another explanation for this delay in classical country groups might be seen in the composition of these groups that is mostly European countries- for which the biggest crises of Ireland, Iceland and Greece occurred slightly later. In particular e.g. for Greece, European Union offered financial support to Greece on 25 of March 2010, on 23 of April 2010 Greece was seeking financial support and on 2 of May 2010, the loan package for Greece was agreed. For traditional OECD member states the coefficient χ seems even extremely high- 104.4% but we have to take into account that there is also very high (the highest of our group sample) trend coefficient γ -6.352%. For full group of emerging markets, the results are quite non-significant but on 1% level, we have found significant increase of consumption smoothing for the years 2008 and 2011. For adjusted group of emerging markets, we have all of the dummy coefficients positive, e.g. we have found a significant deviation from the positive trend of previous period in the period of crisis.

Next step in our presentation of results from table 2 is re-estimating those equations after removing variables that are not significant and presenting some of these results graphically at Figure 3: As we can see, these graphs are almost perfect illustrations of our hypothesis. There is an obvious growth corresponding to the period of financial globalization, followed by decrease in risk sharing levels associated with financial crisis. However there are some limitations, like e.g. the curve for traditional OECD countries which slightly exceeds the 100% level of risk sharing, which is not possible in reality. In 3 out of 4 country groups the dynamics of risk sharing are the same, the only light exception is the group of emerging markets (adjusted), where the decrease in risk sharing associated with financial crisis was not "linear". Similarly to Figures 1 and 2, the solid line corresponds to the estimated levels of risk sharing whereas the dashed line means levels of risk sharing plus/minus two times standard deviation.
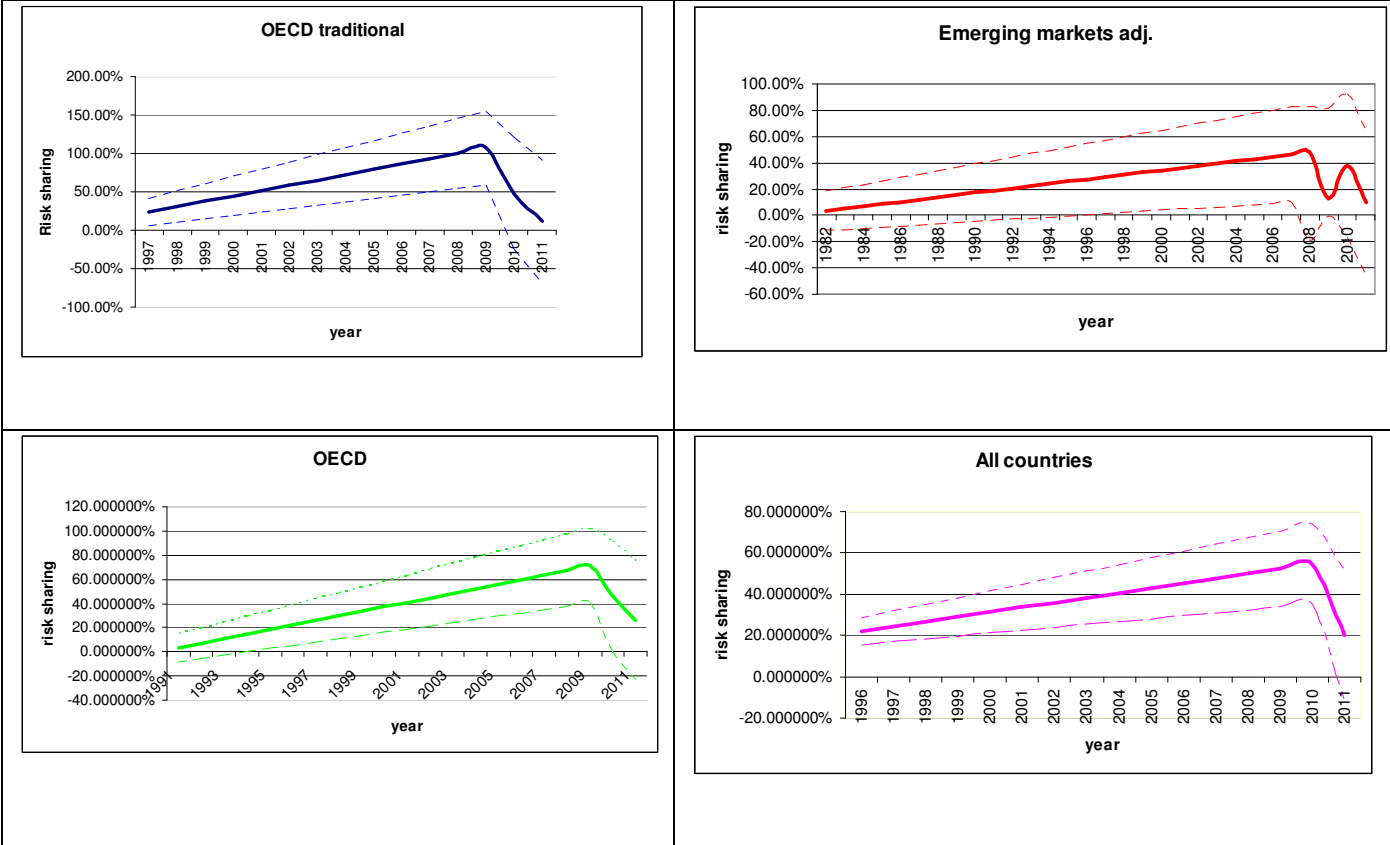
Figure 4- equation (3) results

9.4 Risk sharing and financial integration

Our results for financial integration are presented in Table 3. Since our data set contains 3 different kinds of foreign assets to measure financial integration, we are

implementing a total of 7 kinds of financial integration variables (similarly to Kose, Prasad and Terrones ([5])):

1. Equity portfolio investment

2. Financial direct investment

3. Debt investment

4. Equity portfolio investment + Financial direct investment

5. Equity portfolio investment + Debt investment

6. Debt investment + Financial direct investment

7. Debt investment + Financial direct investment + Equity portfolio investment

First 3 kinds of financial integration measures are described in previous sections of our paper (Data description) and the remaining 4 kinds are just simple combinations of those 3 basic approaches.

The β coefficient from equation (4) can be found in Table 3 in the row marked "output", whereas the γ coefficient corresponding to financial integration is allocated in the row marked "Output $_x$ Interaction". We also include constant, adjusted R squared, number of observations and estimation period. The expected value of γ is negative, meaning that higher foreign asset holdings are associated with higher consumption risk sharing. In fact the only positive results obtained for γ were for Emerging market groups and more importantly none of these positive estimations of γ coefficients was statistically significant. Particular level of γ were around 0.5-0.8 % for single financial integration measure (numbers 1,2,3 on a list above) and accordingly lower for combined approaches of financial integration measure(around 0.3-0.4% for combination of two approaches and around 0.2% for the sum of all 3 classical approaches).

Table 4- Financial integration and risk sharing results

Country group	Equity	FDI	Debt	FDI + Equity	FDI + Debt	Debt + Equity	FDI + Equity + Debt
<ins>1. All countries</ins>							
Constant	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(2.816)	(2.795)	(2.763)	(2.779)	(2.776)	(2.784)	(2.771)
Output	0.666***	0.632***	0.674***	0.666***	0.671***	0.671***	0.67***
	(11.317)	(12.749)	(11.512)	(11.293)	(11.432)	(11.480)	(11.401)
Output $_x$ Interaction	-0.007***	-0.006***	-0.006***	-0.004***	-0.003***	-0.003***	-0.002
	(-8.166)	(-8.984)	(-5.474)	(-8.13)	(-6.306)	(-6.534)	(-6.961)
R^2 adjusted	0.550	0.532	0.554	0.551	0.553	0.553	0.552
Number of Observations (+period)	979 (1991-2011)	980 (1991-2011)	979 (1991-2011)	979 (1991-2011)	979 (1991-2011)	979 (1991-2011)	979 (1991-2011)
<ins>2.OECD countries</ins>							
Constant	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.473)	(0.424)	(0.443)	(0.447)	(0.433)	(0.456)	(0.445)
Output	0.66***	0.658***	0.671***	0.658***	0.666***	0.666***	0.664***
	(10.805)	(10.731)	(11.119)	(10.781)	(10.968)	(11.019)	(10.937)
Output $_x$ Interaction	-0.008***	-0.008***	-0.006***	-0.004***	-0.004***	-0.004***	-0.003***
	(-5.507)	(-4.511)	(-5.202)	(-5.208)	(-5.126)	(-5.58)	(-5.399)
R^2 adjusted	0.484	0.484	0.490	0.484	0.488	0.488	0.487
Number of Observations (+period)	708 (1991-2011)	708 (1991-2011)	708 (1991-2011)	708 (1991-2011)	708 (1991-2011)	708 (1991-2011)	708 (1991-2011)
<ins>3.Emerging markets adjusted</ins>							
Constant	0.005***	0.006***	0.006*** (5.116)	0.006***	0.006***	0.006*** (5.190)	0.006***
	(4.868)	(5.067)		(4.951)	(5.084)		(5.115)
Output	0.753***	0.752***	0.746***	0.751***	0.750***	0.744***	0.746***
	(18.498)	(19.129)	(19.161)	(17.959)	(18.572)	(17.96)	(17.554)

Country group	Equity	FDI	Debt	FDI + Equity	FDI + Debt	Debt + Equity	FDI + Equity + Debt
Output $_x$ Interaction	-0.729**	-0.063	0.018	-0.109	0.000	-0.011	-0.014
	(-2.483)	(-0.61)	(0.255)	(-1.182)	(0.008)	(-0.163)	(-0.282)
R^2 adjusted	0.591	0.609	0.607	0.593	0.607	0.592	0.592
Number of Observations (+period)	719 (1971-2011)	754 (1971-2011)	750 (1971-2011)	711 (1971-2011)	748 (1971-2011)	710 (1971-2011)	710 (1971-2011)

4.OECD traditional

Country group	Equity	FDI	Debt	FDI + Equity	FDI + Debt	Debt + Equity	FDI + Equity + Debt
Constant	- 0.001	- 0.001	- 0.001	- 0.001	- 0.001	- 0.001	- 0.001
	(-0.943)	(-0.977)	(-0.951)	(-0.959)	(-0.962)	(-0.945)	(-0.954)
Output	0.475***	0.472***	0.479***	0.475***	0.476***	0.479***	0.478***
	(10.536)	(10.635)	(10.858)	(10.568)	(10.775)	(10.716)	(10.682)
Output $_x$ Interaction	-0.005***	-0.005***	-0.004***	-0.003***	-0.002***	-0.002***	-0.002***
	(-3.663)	(-3.419)	(-3.535)	(-3.696)	(-3.579)	(-3.749)	(-3.731)
R^2 adjusted	0.259	0.278	0.261	0.259	0.260	0.260	0.260
Number of Observations (+period)	960 (1971-2011)	965 (1971-2011)	965 (1971-2011)	960 (1971-2011)	965 (1971-2011)	960 (1971-2011)	960 (1971-2011)

5.All countries adj.

Country group	Equity	FDI	Debt	FDI + Equity	FDI + Debt	Debt + Equity	FDI + Equity + Debt
Constant	0.002***	0.002**	0.002**	0.002***	0.002***	0.002***	0.002***
	(9.982)	(9.072)	(9.303)	(10.119)	(9.380)	(10.242)	(10.205)
Output	0.656***	0.668***	0.675***	0.657***	0.673***	0.661***	0.659***
	(12.690)	(12.898)	(12.979)	(12.513)	(12.937)	(12.556)	(12.543)
Output $_x$ Interaction	-0.007***	-0.007***	-0.006***	-0.004***	-0.003***	-0.003***	-0.002***
	(-9.493)	(-8.968)	(-5.388)	(-9.105)	(-6.401)	(-6.629)	(-7.144)
R^2 adjusted	0.5	0.518	0.518	0.501	0.518	0.501	0.501

Country group	Equity	FDI	Debt	FDI + Equity	FDI + Debt	Debt + Equity	FDI + Equity + Debt
Number of Observations (+period)	1602 (1971-2011)	1637 (1971-2011)	1633 (1971-2011)	1594 (1971-2011)	1631 (1971-2011)	1593 (1971-2011)	1593 (1971-2011)
6.OECD countries adj.							
Constant	-0.001 (-0.875)	-0.001 (-0.972)	-0.001 (-0.962)	-0.001 (-0.895)	-0.001 (-0.957)	-0.001 (-0.881)	-0.001 (-0.891)
Output	0.622*** (15.825)	0.618*** (16.005)	0.626*** (16.46)	0.622*** (15.889)	0.623*** (16.26)	0.627*** (16.154)	0.625*** (16.094)
Output $_x$ Interaction	-0.007*** (-5.285)	-0.007*** (-4.629)	-0.006*** (-5.416)	-0.004*** (-5.228)	-0.003*** (-5.327)	-0.003*** (-5.663)	-0.002*** (-5.532)
R^2 adjusted	0.412	0.411	0.414	0.412	0.413	0.414	0.413
Number of Observations (+period)	1143 (1971-2011)	1153 (1971-2011)	1155 (1971-2011)	1143 (1971-2011)	1153 (1971-2011)	1143 (1971-2011)	1143 (1971-2011)
7.Emerging markets							
Constant	0.003 (1.324)	0.003** (1.971)	0.004 (1.466)	0.004 (1.501)	0.004 (1.552)	0.004 (1.485)	0.004 (1.557)
Output	0.650*** (7.301)	0.570*** (4.955)	0.616*** (6.893)	0.631*** (6.858)	0.610*** (6.464)	0.620*** (6.683)	0.615*** (6.370)
Output $_x$ Interaction	-0.250 (-0.655)	0.241 (1.344)	0.076 (1.085)	0.058 (0.475)	0.068 (1.201)	0.056 (0.773)	0.053 (0.925)
R^2 adjusted	0.590	0.569	0.591	0.590	0.592	0.591	0.591
Number of Observations (+period)	437 (1991-2011)	438 (1991-2011)	437 (1991-2011)	437 (1991-2011)	437 (1991-2011)	437 (1991-2011)	437 (1991-2011)

*Notes: *, **, *** denotes significance at 10%, 5% and 1% level. Regressions also include cross-section fixed effects. In parenthesis are t-statistics, which were computed using White heteroscedasticity t-statistics and standard errors correction.*

For some reason, for emerging markets, the benefits of financial integration do not have any significant impact on risk sharing (all γ estimates were not significant except the extremely high (72.9%) for equity investment in adjusted group of Emerging markets. However the exceptional estimate is associated with p-value around 3% and standard error around 32%, which does not make it too meaningful). This is also in accordance to previous literature, since *Kose, Prasad and Terrones* in their work([5]) also did not find any significant relation between financial integration and consumption risk sharing for emerging markets.

What would be interesting for our purposes, is to examine whether there are differences among these coefficients regarding financial integration for the periods of financial crisis and the pre-crisis period. To examine this issue, we are estimating equation (4a). Since there are almost none differences among the estimated coefficients regarding the different approaches of measuring financial integration, we are presenting the results for equation (4a) based just on the combination of all 3 possible measures i.e. the sum of financial direct investment, equity portfolio investment and debt investment. We do not present the results for both of our emerging market groups, since we have shown in previous table that there is none significant relation between financial integration and consumption risk sharing among emerging markets. What we show in the table bellow is that the Wald test does not reject the null hypothesis of financial integration interaction term being equal for periods of financial crisis and pre-crisis period for most of the country groups. The only exception, were the groups of All countries, where the p-values corresponding to our Wald restriction were quite low- 2.7% and 9% . However on e.g. 1% level the null hypothesis would be still not rejected. More importantly, since the previous literature and our previous estimations regarding financial integration do not find strong relations within emerging markets and financial integration and the full country groups are including also emerging countries, these results are not that important.

More importantly, the results for OECD country groups showed very high p-values for the Wald restriction, which allows us to partly explain the declining risk sharing in crisis period by decline in financial integration.

Table 5 - financial integration, risk sharing and financial crisis

Country group	Estimation period	β (output)	γ ($D^{Pre\text{-}crisis}$ FI)	δ (D^{Crisis} FI)	Wald restriction ($\gamma = \delta$)	R^2 adjusted (no. of obs.)
All countries adj.	1971-2011	0.659[***]	-0.0019[***]	-0.0025[***]	0.027	0.501
		(12.511)	(-6.232)	(-6.918)	(-2.221)	(1593)
All countries	1991-2011	0.665[***]	-0.0024[***]	-0.0019[***]	0.092	0.544
		(11.397)	(-6.352)	(-6.421)	(-1.687)	(979)
OECD	1991-2011	0.663[***]	-0.0023[***]	-0.0027[***]	0.669	0.486
		(10.934)	(-3.739)	(-4.286)	(-0.428)	(708)
OECD adj.	1971-2011	0.625[***]	-0.0022[***]	-0.0026[***]	0.643	0.413
		(16.111)	(-3.628)	(-4.296)	(-0.464)	(1143)
OECD traditional	1971-2011	0.477[***]	-0.0014[**]	-0.0021[***]	0.381	0.260
		(10.692)	(-2.194)	(-3.665)	(0.876)	(960)

*Notes: *, **, *** denotes significance at 10%, 5% and 1% level. Regressions also include cross-section fixed effects. In parenthesis are t-statistics, which were computed using White heteroscedasticity t-statistics and standard errors correction. The numbers for Wald restriction column represent p-value and corresponding t-statistic for the null hypothesis of H0: $\gamma = \delta$.*

10.1 Risk sharing and gross government debt

Reading the article of *Reinhart* and *Rogoff* ([17]) that find significant thresholds for gross government debt at 90% for GDP growth and inflation was quite inspirational. No matter the critique against their work the idea of using thresholds for government gross debt might be useful also for our purpose. After experimenting with different values, similar to their -30,60 and 90 % of gross government debt we have find just a few interesting but also quite contrary results that are presented in Table 4.

Table 6- Risk sharing and Gross government debt

Country group	C (constant)	β (output)	γ ($D^{TRESHOLD}$)	Criteria	Estimation period	R^2 adj., no. of obs.
Traditional	0	0.439***	-0.264***	debt<30%	1991-2011	0.243
OECD	(0.159)	(5.818)	(-2.763)	GDP		484
Emerging	0.005***	0.375***	0.159**	debt<30%	1991-2011	0.645
Markets	(2.741)	(10.018)	(2.184)	GDP		339
All countries	0.005***	0.576***	0.099**	debt<30%	1991-2011	0.518
	(3.335)	(9.959)	(2.289)	GDP		860
All countries adj.	0.003***	0.570***	0.106	debt<30%	1980-2011	0.482
	(3.452)	(11.113)	(1.289)	GDP		925
Emerging Markets adj.	0.007***	0.692***	0.196**	debt<30%	1980-2011	0.652
	(5.964)	(17.563)	(2.067)	GDP		330
OECD countries	0.002	0.498***	0.134	debt<30%	1991-2011	0.400
	(1.180)	(7.212)	(1.365)	GDP		652
OECD countries adj.	0.001	0.493***	0.065	debt<30%	1980-2011	0.367
	(0.803)	(8.367)	(0.728)	GDP		731

Notes: *, **, *** denotes significance at 10%, 5% and 1% level. Regressions also include cross-section fixed effects. In parenthesis are t-statistics, which were computed using White heteroscedasticity standard errors and t-statistics correction.

Taking into account the fact that the data availability for gross government debt for such a general country sample was rather limited, we have to be careful interpreting these

results. E.g. comparing numbers of observations from table 1 and table 4 might leads us to numbers around 75% of the originals. However we obtained 4 out of 7 significant numbers for the critical value of debt under 30% of GDP. With such a criteria, we might expect the interaction coefficient γ to be negative because when a government is not experiencing problems with debt (which a country with debt smaller than 30% of its GDP likely does not), it should not have problems entering international financial markets. This hypothesis was also affirmed for the group of traditional OECD countries.

However another group of countries that usually experience low amount of debt are developing countries that are not as integrated on financial markets as developed countries and therefore the interaction coefficient γ oughts to be rather positive, meaning that developing countries with low amount of debt tend to have limited access to financial markets and therefore experience lower levels of international risk sharing than the countries with higher debt. In fact, for both group of emerging markets and also for full group of all countries this was true and the coefficient γ was positive.

The remaining country groups are rather composed of countries which were in past or still might be marked or considered as developing as well as countries which are marked as developed. This might explain the non-significance of the interaction coefficient.

10.2 Long term risk-sharing regression

We are presenting the results of equation (6) for different periods in next table:

Table 7- long-term risk sharing

Country group	Method	Period	Output (β)	R^2 adjusted (no. of obs.)
OECD traditional	DOLS	1990Q1- 1995Q4	0.795*** (15.691)	0.806 (576)

	FMOLS	1990Q1-1995Q4	0.801*** (19.237)	0.807 (576)
	DOLS	1996Q1-2001Q4	0.887*** (5.110)	0.678 (576)
	FMOLS	1996Q1-2001Q4	0.754*** (9.458)	0.771 (576)
	DOLS	2002Q1-2007Q4	0.679*** (13.559)	0.427 (576)
	FMOLS	2002Q1-2007Q4	0.681*** (16.363)	0.490 (576)
	DOLS	2008Q1-2013Q2	0.823*** (16.678)	0.643 (360)
	FMOLS	2008Q1-2013Q3	0.796*** (20.614)	0.767 (456)
OECD adj.	DOLS	1997Q3-2007Q4	0.729*** (16.871)	0.741 (1386)
	FMOLS	1997Q3-2007Q4	0.723*** (20.053)	0.752 (1386)
	DOLS	2008Q1-2013Q2	0.86*** (15.627)	0.675 (495)
	FMOLS	2008Q1-2013Q3	0.820*** (22.606)	0.771 (627)

Notes: *, **, *** denotes significance at 10%, 5% and 1% level. Numbers at parenthesis are t-statistics. The estimation methods were described in chapter 7.

As we can see in Table 5, the methods DOLS and FMOLS were contributing to our analysis with quite similar results. The only exception is for traditional OECD countries and the period 1996Q1-2001Q4, where the DOLS method recorded surprisingly high coefficient-0.887, that means just around 11% of permanent shock were smoothed during this period. This is the only result that is not corresponding to our theoretical predictions and our hypothesis about long term risk sharing showing considerable growth during the period of financial globalization and then decrease during the period of recent financial crisis. However all the other results are well corresponding with our hypothesis and that is around 20% of

transitory shocks smoothed during 1990-1996, then either the exceptional estimate of 11% or a small growth to 25% for the period of 1996-2001 and for the period of 2002-2007 another growth up to 32% of long term consumption risk shared. For the global financial crisis period 2008-2013, the estimated levels for OECD traditional countries decreased to levels around 20%, which is nicely corresponding with our theoretical expectations and hypothesis.

For the group of full OECD countries without Greece (OECD adj.), the dataset is available just from 1997-2013, so we decided to estimate the equation (6) just for two periods divided by the eruption of financial crisis. Around 27% of permanent shock were pooled across OECD countries during the pre-crisis period and then again for the post-crisis period the long term risk-sharing have fallen down to levels around 14-18% depending on the estimation method, which again corresponds well with our hypothesis.

11 Conclusions

Consumption based international risk sharing measures seem to accept our main hypothesis about lower risk-sharing levels enjoyed by various country groups and using various methods. In particular, we benefited to the literature by a few findings:

Firstly our methods approved the findings of previous literature and concluded that among full estimation period (1970-2011) traditional OECD countries are enjoying the highest levels of risk-sharing (58%) whereas the lowest levels are enjoyed by emerging markets (23%).

Secondly, using classical risk-sharing equation with time varying effects, we have found the highest decrease in risk-sharing among OECD countries for periods after 2009 that could be related to the global financial crisis of 2008. Another important finding, for the period between 2008 and 2011, the results showed that only negative change (decrease) in the risk-sharing coefficient was significant. Focusing on the lower frequencies of the data and estimating the long-run perspective of consumption risk-sharing equation using quarterly data has also approved our hypothesis about lower risk-sharing levels for the financial crisis period. In particular the estimated levels for OECD countries and traditional OECD countries were around 10-15% higher in the period before the financial crisis erupted.

Thirdly, our implementation of financial integration related variables showed similarly to previous literature that countries associated with higher foreign assets holdings are enjoying higher levels of consumption risk-sharing. In order to examine the relation between financial crisis, consumption smoothing and financial integration, we have performed a Wald test to test if the impact of financial integration on risk-sharing (the higher-risk sharing benefit regarded to higher international asset positions) has changed for the crisis and pre-crisis period. Our result showed that for most of the country groups, the coefficient remained the same. That could also partly explain the lower international risk-sharing levels related to the global financial crisis (because financial crisis brought us lower levels of foreign asset holdings).

Our last finding is regarding the position of government in consumption smoothing. As previous literature have not found any significant impact of government (In particular government size), our research concluded that for OECD traditional countries, having

country debt lower than 30% is beneficial for consumption smoothing. However, our findings were contrary for groups of all countries and emerging markets, which could be partly explained by the phenomenon that underdeveloped or less developed countries are usually enjoying low levels of debt to GDP ratio. Also, if a country is less developed it usually does not have too good access to international financial markets and therefore it can not enjoy the low-debt risk-sharing benefit even though it has low level of debt to GDP ratio. There is also a space for further research regarding these findings. For example we do not have any explanation for the threshold of 30% debt to GDP ratio we have implemented, the choice was purely experimental.

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13 Resumé

V našej práci sa zaoberáme medzinárodným intertemporálnym vyrovnávaním konzumu najmä počas globálnej finančnej krízy. Predchádzajúca literatúra skúmala vyrovnávanie konzumu pomocou panelových regresií, ktoré nám umožnia odhadnúť koeficient vyrovnania konzumu a interpretovať ho ako podiel na idiosynkratickom riziku, ktoré nie je diverzifikované medzinárodne.

Našim hlavným cieľom je odhadovať tento koeficient a interpretovať ho z hľadiska rôznych časových období, najmä pre obdobie pred finančnou krízou a pre obdobie finančnej krízy. Teoreticky by mal tento koeficient jemne rásť v období pred globálnou finančnou krízou (kvôli vplyvu finančnej globalizácie) a potom pravdepodobne poklesnúť ako dôsledok finančnej krízy. Použitím rôznych metód pre rôzne skupiny krajín sa nám podarilo ukázať, že počas finančnej krízy sa tento koeficient naozaj významne znížil.

Predchádzajúca literatúra používala vo svojích analýzach aj viacero doplnkových vysvetľujúcich veličín ako sú finančná integrácia, otvorenosť obchodovania, preferencia domácich trhov alebo napríklad aj veľkosť vlády. Najsilnejší vzťah bol typicky nájdený medzi finančnou integráciou a vyrovnávaním konzumu. Konkrétne krajiny s vyššou finančnou integráciou (meranou podielmi na medzinárodných aktívach rôzneho druhu) dosahujú vyššie odhadované úrovne koeficientu vyrovnania konzumu. Keďže počas finančnej krízy hodnoty finančnej integrácie poklesli, bolo pre nás zaujímavé zistiť, či sa tento silný vzťah medzi vyrovnávaním konzumu a finančnou integráciou nezmenil alebo nezoslabol v dôsledku finančnej krízy. Hypotézu o tom, že koeficient vplyvu finančnej integrácie zostal nezmenený aj počas finančnej krízy sme nezamietli (hlavne pre krajiny OECD), čo nám umožňuje čiastočne vysvetliť pokles vo vyrovnávaní konzumu poklesom vo finančnej integrácii.

Okrem klasického koeficientu vyrovnávania konzumu odhadujeme aj podobný koeficient vyrovnávania konzumu, avšak z dlhodobého hľadiska. Použitím štvrťročných dát sa nám podarilo ukázať, že aj tento koeficient sa výrazne znížil počas globálnej finančnej krízy, konkrétne poklesol o 10-15 %.

Okrem efektu finančnej krízy sa v našej práci snažíme nájsť aj ďalšie vysvetľujúce premenné. Konkrétne predošlá literatúra uvažovala o presúvaní rizika z domácnosti na vládu, ktorá ma lepší prístup k medzinárodným trhom a tým pádom vie teoreticky ľahšie diverzifikovať. Snažila sa preto nájsť vzťah medzi veľkosťou vlády a vyrovnaním konzumu, čo sa jej však nepodarilo. My sme sa pokúšali nahradiť koeficient veľkosti vládu pomerom dlhu na HDP. Najzaujímavejší výsledok, ktorý sme dostali, je pre tradičné OECD krajiny a hovorí o tom, že krajiny ktoré majú dlh nižší ako 30% HDP vedia lepšie medzinárodne diverzifikovať konzum konkrétne o cca 25%.