The Two-Sided Effect of Financial Globalization on Output Volatility*

Barbara Meller†

February 15, 2009

Abstract

This paper shows that the integration of international financial markets significantly affects output volatility. In the framework of a threshold model, it is empirically shown that the relation between financial openness and output volatility depends on the financial risk of a country. Financial risk is defined as the ability of a country to pay its official, commercial and trade debts. In countries with low financial risk, financial openness decreases output volatility while financial openness increases output volatility in countries with high financial risk. Extensive robustness checks confirm these results.

Keywords: Output Volatility; Financial Openness; Financial Risk

JEL classification: E32; F36; F41

1 Introduction

Output volatility is a source of welfare loss to both developing and developed countries but its determinants are not yet fully understood. In the era of financial globalization, countries experience different evolutions in output volatility. While the US experiences declining output volatility since the 1980s (Great Moderation), some developing countries had deep economical crises in the 1990s. Could financial openness be responsible for a decline in output volatility in some countries while it aggravates economic crises in other countries? This paper reviews the controversial findings of previous research, links them together and finds a significant relation between financial openness and output volatility. Using a panel threshold model, it is empirically shown that countries with low financial risk profit from financial openness while countries with high financial risk suffer from it.

High output volatility brings about welfare losses due to the deviation from a smooth path of consumption that is preferred by risk-averse people. High output

*I thank Dieter Nautz, Marcel Fratzscher, Jaap Bos and Thorben Krieger for many helpful comments. I am especially grateful to Nicola Spatafora for sharing his data set with me. Financial support by the Frankfurt Graduate Program in Monetary Economics and Finance and the DFG is gratefully acknowledged.

†Goethe University Frankfurt,Grueneburgplatz 1, 60323 Frankfurt am Main, Germany. E-mail: meller@finance.uni-frankfurt.de.

volatility has a negative effect on output growth, it increases the risk premiums and thereby the cost of capital. The worst case of high output volatility is called an economic crises. Financial openness, defined as the sum of capital inflows and outflows as percentage of GDP, might be the missing variable in explaining different evolutions in output volatility worldwide. Financial openness has more than doubled worldwide in the period 1980-2007. In the US in the period 2000-2004, financial openness was even more than three times as high as in 1980-1984 and gross capital flows amounted to 170% of GDP. The mere magnitude of gross capital flows makes it necessary to examine the effect of financial openness on output volatility.

In the 1990s some developing countries that had opened up their financial markets experienced great economic crises. Those events lead researchers such as Stiglitz (2000) to investigate the effect of financial openness on output volatility. He comes to the conclusion that financial openness but especially short term investments can deepen or even trigger economic crises.

On the contrary, many researchers argue that financial openness may absorb exogenous or domestic shocks. Financial openness gives firms and consumers the flexibility to adjust to shocks through reallocating resources across geographic areas (Loayza et al., 2007). This idea fits into the literature of the Great Moderation (e.g. Cecchetti et al., 2006) which discusses the decrease in output volatility in the US. The results of this paper show that the increasing financial openness is one determinant of the decrease in output volatility from 1980-999. In the period 2000-2007 however, financial openness is a source of the increasing output volatility.

Two strands of literature analyze the determinants of output volatility. The first one emerges from growth literature. To explain output volatility, variables that are known to influence economic growth, such as inflation or trade openness are used (Bekaert et al., 2002, 2006; Kose et al., 2003, 2005b, 2006). The second strand is an almost independent discussion on the well documented decrease in output volatility in the USA since the 1980s, called the Great Moderation. Good luck and good policies are the most prominent explanations in the Great Moderation literature. At an early stage, the literature focused solely on US output volatility (McConnell and Perez-Quiros, 2000; Stock and Watson, 2002; Blanchard and Simon, 2001), but subsequently, the Great Moderation was also analyzed at a panel dimension (e.g. on OECD countries by Buch et al., 2005). Both strands of literature investigate among other factors the impact of financial openness on output volatility (Bekaert et al., 2002, 2006; Buch et al., 2005; Kose et al., 2003, 2005b, 2006; Stiglitz, 2000). However, empirical studies are contradicting or find a statistically insignificant relation between output volatility and financial openness.

Due to the inconclusiveness of previous research, Rogoff et al. (2006) hypothesize without testing that this relation depends on a threshold level of (a) certain variable(s). This paper empirically tests this hypothesis using financial riskiness as threshold variable. The financial risk indicator measures the ability of a country to pay its official, commercial and trade debts. It is an element of the International Country Risk Guide and is put together by the Political Risk Services (PRS) group. The index combines the information of five financial risk measures: Foreign debt as percentage of GDP, foreign debt service as percentage of exports, current account as percentage of exports, net international liquidity as months of import cover and exchange rate stability.

In this study, two thresholds are found endogenously. Countries that are below the lower threshold level of the financial risk index can be named financially risky countries. The paper shows that those countries suffer from financial openness as it increases output volatility. It is reasoned that moral hazard, present in countries that are financially risky, leads investors to have a short investment horizon. This in turn increases the risk of liquidity crises and macro-economic volatility (Kharroubi, 2007). Investors pull out capital when the country experiences a recession and thereby deepen the recession. In this case, output volatility increases as financial openness increases. On the contrary, countries exceeding the higher threshold, such as the US in 1980-1999, can be referred to as financially sound. Those countries not only attract investors with long investment horizons that sit out a recession. Even more, those countries attract new capital in times of recessions due to higher profit prospects. For financially sound countries, financial openness is one determinant of the Great Moderation. Countries that are neither financially risky nor financially sound can be thought of as having an intermediate level of risk. The paper shows that financial openness increases output volatility but less than for financially risky countries.

The effect of a change in financial openness is substantial. The model predicts that the effective increase in financial openness alone is responsible for a change in output volatility of 6% on average. As a comparison, output volatility effectively changed by 21% on average. In the 1980s, one third of the countries was respectively financially risky, financially sound or had an intermediate level of risk. Fortunately, today roughly half of the countries in the sample are considered as having an intermediate level of risk while the other half is financially sound. Therefore, financial openness has increasingly become a source of output stability rather than a source of crisis. An extreme bounds analysis and other assessments confirm the robustness of the empirical relationship between financial openness and output volatility.

The paper is organized as follows. The next section reviews the literature on theoretical and empirical links between output volatility and financial openness and ends with the motivation of a threshold model. Section three describes the threshold model, the choice of variables and the data. Section four reports the estimation results. Section five shows that the results are stable using an extreme bounds analysis and other robustness checks. Finally, Section six concludes.

2 Financial Openness and Output Volatility in the Literature

2.1 Theoretical Work

Theoretical predictions on the relationship between financial openness and output volatility are contradictory as the following discussion will show.[1]

[1]For a more comprehensive overview on early theoretical work on the relationship between financial openness and output volatility the reader is referred to Kose et al. (2003).

Financial Openness Decreases Output Volatility

Fischer (1998) stresses the benefits of financial openness that stem from the efficient allocation of investments and savings. Developing this thought further this means that investors of a booming country, i.e. a country with a lot of capital but only few investment opportunities, profit from investing their money in a recessive country because the latter generally has lower investment prices. This investment mechanism stimulates the troubled economy and results in both less exaggerated recessions and less pronounced booms. Putting it differently, the volatility of output is reduced due to counter-cyclical capital flows. Kose et al. (2003) argue that developing countries benefit most from financial openness as they are capital-poor and therefore gain from capital inflows from capital-rich developed countries. A second but indirect effect of financial openness on output volatility concerns improved risk sharing. Financial openness gives investors the possibility to diversify their risk by investing into countries whose equity and debt markets have low correlations with their home country. This reduces consumption volatility and may indirectly reduce output volatility.

Financial Openness Increases Output Volatility

In the 1990s, severe economic crises took place in developing countries that had opened up their financial markets. Those events gave rise to the hypothesis that financial openness actually leads to output instability. In the view of Stiglitz (2000), the main cause of high output volatility is a pro-cyclical nature of capital flows. When a country experiences a recession, or when foreign investors or bankers anticipate economic weaknesses, they withdraw their money from the country. Thereby, the recession is deepened or even triggered. Furthermore, Stiglitz (2000, page 1080) argues that "capital market liberalization exposes countries to vicissitudes associated with changes in economic circumstances outside the country; a sudden change in lenders perceptions concerning 'emerging market risk' can lead to huge capital outflows, undermining the viability of the entire financial system". The danger of capital market liberalization according to Stiglitz (2000) thus lies in short term capital flows which are highly volatile. This implies that there are no benefits from the global allocation of capital because capital flows are not counter-cyclical but pro-cyclical.

Financial Openness Ambiguously Affects Output Volatility

Next to these opposing theoretical views, there exists a literature that explores channels through which financial openness could lead to either an increase or a decrease of output volatility.

Among others, Kalemli-Ozcan et al. (2003) and Rogoff et al. (2006) point to the effect of financial openness on production decisions. They argue that financial openness could lower output volatility in capital-poor countries by making capital available that helps to diversify the production base. The diversified production base is less prone to industry specific shocks and thereby reduces output volatility. On the other hand, the available capital could also be used to increase specialization of the production base in line with comparative advantage considerations. This would make a country more vulnerable to industry specific shocks and increase output volatility.

Dynan et al. (2006) raise an argument on financial innovation which easily translates to financial openness. As is the case with financial innovation, financial openness leads to easier and cheaper access to credits as investors or households (e.g. mortgages) are not bound to the liquidity in their own country but can borrow abroad. Thus, liquidity constraints are loosened. Dynan et al. (2006) argue that thereby, economic volatility is reduced as investors and households are less sensitive to downturns in their cash flow or income. By this means, the traditional multiplier response to negative shocks is reduced. On the other hand, Dynan et al. (2006) argue that the enhanced ability to borrow could also increase volatility as it facilitates the purchase of capital goods whenever target stocks increase. Putting it differently, the "accelerator" response to positive shocks would be amplified. This view is also shared by Dalsgaard et al. (2002).

2.2 Empirical Work

On the relation between financial openness and output volatility, empirical evidence is as diverse as theoretical predictions. Some studies find a positive link, others a negative link, but most studies find no significant or stable relationship at all.

Financial Openness Decreases Output Volatility

Bekaert et al. (2006) investigate the volatility of GDP growth after financial liberalization. They study up to 95 developed and developing countries in the period 1980-2000. After financial liberalization, they almost always find a significant reduction in output volatility. However, they indicate that their results are average results and hypothesize that for a country which is "economically fragile, has low quality institutions, and a poorly developed financial sector" (p.397) financial liberalization might even increase output volatility.

Financial Openness Increases Output Volatility

Support for the hypothesis that financial openness increases output volatility is rare. There exist, however, studies on the effect of financial openness on the probability of banking crisis or economic recession, e.g. Demirgüç-Kunt and Detragiache (1998). In their analysis, they use a panel with 53 developed and developing economies during the period 1980-95. They find that financial openness has a positive effect on the likelihood of a banking crisis.

No Stable Empirical Relation

Most papers come to the conclusion that there is no significant or no stable relation between financial openness and output volatility. Rogoff et al. (2006, p.17) summarize that "the existing evidence based on papers using a variety of regression models, different country samples and time periods leads to the conclusion that there is no systematic empirical relationship between financial openness and output volatility [...]."

Buch et al. (2005) test, in the framework of a stochastic dynamic general equilibrium model, the hypothesis whether financial openness alters the effect of policies on output volatility. Analyzing a sample of 24 OECD countries in

the period 1960-2000, they conclude that more financial openness leads to more output volatility in the 1970s. However this relation is not significant in the other periods and therefore not stable over time.

Easterly et al. (2000) examine the standard paradigm concerning output volatility but add financial sector variables. They conduct their analysis on 74 countries in the time period 1960-1997. They do not find any relationship between financial openness and output volatility. Coming to the same conclusion, Razin and Rose (1992) examine 138 countries in the period from 1950-1988.

2.3 Thresholds - Unifying Theories and Empirical Work?

The conclusion of the literature review so far seems to be that there is no relation between financial openness and output volatility. Alternatively, one could also conclude that the relation exists but depends on some latent or omitted variable.

Calderón et al. (2005) find that the effect of financial openness on output volatility depends on the level of income. They show that financial openness reduces output volatility most in very poor and very rich countries and less in medium income countries. Bekaert et al. (2006) and Jayasuriya (2005) find evidence in favor of the quality of institutions as another mediating factor of the relationship.[2] Better institutions are associated with a reduction of output volatility after financial liberalization. In line with that, Rogoff et al. (2006) hypothesize without testing that financial openness leads to less output volatility when a country has a certain threshold level of financial market development, institutional quality, governance, macroeconomic policies and trade integration. On the contrary, financial openness leads to more output volatility if the country is below this threshold.

The analysis of this paper empirically tests the hypothesis of a threshold variable. However, this paper does not dwell on institutional differences but takes the perspective of an investor. The leading question is: For which criterion is investment pro-cyclical and when is it counter-cyclical. The nature of investment then determines whether financial openness increases or decreases output volatility.

Empirical work by Bordo and Meissner (2007) pinpoints such a threshold criterion. They find that countries with high financial openness are likely to have economic crises *if* credibility and financial development are weak. On the contrary, countries that were credible and financially sound were able to borrow heavily and had relatively few financial crises. The criteria that made a country a winner or a looser of financial openness are credibility and financial development. The work by Bordo and Meissner (2007) is conducted on the first era of globalization (1880 to 1913) and it will be shown in this paper that history can teach some lessons for today.

In line with Bordo and Meissner (2007)'s work, the variable that is used in this paper as a criterion to classify countries is their level of financial risk. The financial risk indicator measures the ability of a country to pay its official, trade and commercial debts. If a country is able to pay its way, then there is no reason for investors to pull their money out of the economy during a recession as they are sure that their investments are refunded. On the contrary, investors will even

[2]Both studies use an index to proxy quality of institutions relying on components of the International Country Risk Guide. The index consists of the risk of repudiation of contracts by the government, the risk of expropriation, corruption, rule of law, and bureaucratic quality.

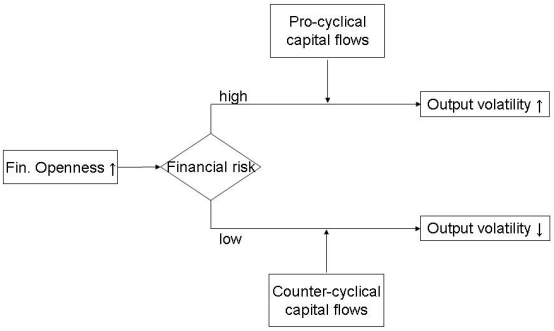


Figure 1. Exemplary effect of financial openness on output volatility

invest into the country in times of a recession as they expect high profits. Under this scenario, the international capital flow is counter-cyclical if financial risk is low. Therefore, the country is able to profit from international capital allocation and reduced output volatility. In contrast, countries that are not able to pay their debt easily are observed very carefully by investors. If there is a recession in such a country, investors fear to loose their money (e.g. due to government default) and withdraw it as soon as possible. In that case, international capital flows are pro-cyclical. Therefore, countries with high financial risk suffer from financial openness because their output volatility increases.

In summary, whether financial openness increases or decreases output volatility depends on the level of financial risk. Figure 1 illustrates a possible relation between output volatility and financial openness in a threshold model with financial risk as threshold decision variable. In case that financial risk is low, it is hypothesized that capital flows are counter-cyclical and that therefore the relation between financial openness and output volatility is negative. In case that financial risk is high, it is hypothesized that capital flows are pro-cyclical and that therefore the relation between financial openness and output volatility is positive.

3 Econometric Model and Data

In this section, the model and the data for the empirical analysis are introduced. First, the threshold model is presented and the choice of variables is discussed. Then, the data are described followed by their coverage and source.

3.1 Threshold Model

The estimation method chosen in this paper is the panel threshold model developed by Hansen (1999) that endogenously finds and tests thresholds. For the threshold model to work properly, the covariance matrix has to be homoscedas-

tic and serially uncorrelated.[3] Furthermore, the explanatory variables have to be exogenous.

The threshold model equation that is estimated has K thresholds and is defined as follows:

$$\sigma_{Yit} = \alpha_i + \delta \mathbf{Q_{it}} + \sum_{k=0}^{K-1} \beta_{k+1} FO_{it} I(\gamma_k < FR_{it} \leq \gamma_{k+1}) + \beta_{K+1} FO_{it} I(\gamma_K < FR_{it}) + \varepsilon_{it}, \quad (1)$$

where $I(\cdot)$ is the indicator function and γ_0=0. σ_{Yit} is output volatility, $\mathbf{Q_{it}}$ is the vector of control variables, FO_{it} is financial openness and FR_{it} is financial risk for country i in time period t. All variables are described in the following subsection.

3.2 Variable Selection and Data description

In this subsection, it is discussed in detail how output volatility, financial openness and financial risk are measured. Different proxies for those concepts are described and the most appropriate one is chosen for the analysis. Furthermore, the control variables are introduced. Lastly, the data is described.

Dependent Variable: Output Volatility

Output volatility is measured differently throughout the literature. A first choice has to be made on how to detrend output. On the one hand, the studies emerging from the growth literature usually construct output volatility as the standard deviation of GDP growth over a k-year window (Bekaert et al., 2002; Ramey and Ramey, 1995; Spatafora and Sommer, 2007). On the other hand, the literature dealing with the Great Moderation applies usually a filter to detrend real GDP before taking the standard deviation.[4] For instance, Buch et al. (2005) use the band-pass (BP) filter advocated by Baxter and King while Cecchetti et al. (2006) use the Hodrick-Prescott (HP) filter. A less popular alternative is the computation of output volatility by using the filtered GDP growth (Spatafora and Sommer, 2007; Summers, 2005). Sometimes different measures of output volatility are used within a single paper depending on data availability (Spatafora and Sommer, 2007; Buch et al., 2005).

The diversity in the literature suggests that there is no strong case to use either first difference or filters to detrend GDP. As was pointed out by Blanchard and Simon (2001), the standard deviation of the differenced and the filtered series should yield similar results. However, Ferreira da Silva (2002) makes a convincing case for using the BP filter to detrend output. She argues that first differencing alters the timing relationship between the variables and puts more weight on very short run volatility. Furthermore, she states that the HP filter is an improvement on the first differencing method but also puts too much weight on high-frequency fluctuations. The BP filter on the other hand

[3] According to Hansen (1999), heteroscedasticity is not a severe problem. In the presence of heteroscedasticity the threshold estimates are still consistent but the bootstrapped p-values are not reliable. To correct for a potential bias in the slope coefficients of threshold regression (1), white standard errors are used.

[4] In this paper, reference is only made to that branch of the Great Moderation literature that deals with the multivariate analysis of the decline in output volatility. Another branch of the Great Moderation literature deals with the analysis of break-points in output volatility. In that context, output volatility is defined as the variance of the error-term of an AR(1) model of GDP growth.

improves on this deficiency and has several merits: "First, it removes unit roots, rendering the time-series stationary; second, it does not alter the timing relation of the variables; third, it isolates the business cycle frequencies without re-weighting components; [...]; finally, it generates business cycle components that are independent of the length of the sample period" (Ferreira da Silva, 2002, p.241). In line with those arguments, detrending is conducted using the BP filter here. A robustness check (see Section 5.1) uses first differencing instead of BP filtering and yields similar results.

A second, rather arbitrary choice for the computation of output volatility is the number of years over which to take the standard deviation of detrended GDP. In most studies, a five year window is chosen (Bekaert et al., 2002; Barrell and Gottschalk, 2004; Buch et al., 2005). Buch et al. (2005) motivate this choice by arguing that business cycles are about five years long. In contrast to that, Spatafora and Sommer (2007) claim that the length of a business cycle in advanced economies has increased to ten years in the 1980s and 1990s and therefore use a 10-year window. In order to maximize the time-series dimension of the panel as well as to enhance comparison to other literature, the five year window is chosen here.

Variable of Interest: Financial Openness

Financial openness variables can be distinguished between 'de facto' and 'de jure' measures. Most prominently used 'de jure' measures are indicator variables for equity market liberalization (Bekaert et al., 2002; Bekaert and Harvey, 2000; Bekaert et al., 2006; Jayasuriya, 2005) or the number of restrictions on the capital account (Buch et al., 2005; Kose et al., 2003, 2005a). Rogoff et al. (2006) describe those measures in detail and emphasize that 'de jure' measures cannot capture the actual effect of capital controls or liberalization. A country which has very liberal capital account laws does not necessarily have to be heavily involved in international financial investments. Furthermore, liberalizations do not necessarily happen at one point in time but materialize gradually. In contrast, 'de facto' variables are continuous variables and do not suffer from those drawbacks. The most commonly used de facto measure for financial openness is gross capital flows in percent of GDP (Buch et al., 2005; Kose et al., 2003, 2005a). An alternative measure of financial openness is banks' foreign assets in percent of banks' total assets (Buch et al., 2005). Furthermore, Beck et al. (1999) construct two measures for foreign bank penetration: firstly, the ratio of the number of foreign banks to the number of domestic banks and secondly, the ratio of the assets of foreign bank to the assets of domestic banks. While those measures have a good cross-country coverage, they are available only since 1990. For reasons of comparability as well as data coverage, here, financial openness is measured as gross capital flows as percentage of GDP. Gross capital flows are the sum of total liabilities and total assets.[5]

[5]Total liabilities= Portfolio equity liabilities + FDI liabilities +debt liabilities + financial derivatives (liabilities). Total assets= portfolio equity assets + FDI assets + debt assets + financial derivatives (assets) + total reserves minus gold.

Threshold Decision Variable: Financial Risk Rating

The financial risk index measures a country's capacity to pay for its official, commercial, and trade debt obligations. They have become a major concern in the international financial community as well as for international investors (e.g. Hoti and McAleer (2004), Hassan et al. (2003), IMF staff (2008), Girard and Omran (2007), Bekaert et al. (2006) and Jayasuriya (2005)). According to Hoti and McAleer (2004), this is especially the case because of the increase of international debt in developing countries since the 1970s and the incidences of debt rescheduling in the early 1980s. Most importantly in the context of this study, risk ratings have a direct influence on investment decisions because large changes in financial risk ratings alter the expected risk-return features for investments (Hoti and McAleer, 2004).

The financial risk index is an element of the International Country Risk Guide and is put together by the PRS group.[6] The index runs from 0 to 50 risk points and consists of five financial risk components[7]: Foreign debt as a percentage of GDP (0-10 risk points), foreign debt service as a percentage of exports of goods and services (0-10 risk points), current account as a percentage of exports of goods and services (0-15 risk points), net international liquidity as months of import cover (0-5 risk points) and exchange rate stability (0-10 risk points). According to the PRS group, countries are somewhat ad hoc classified as having very high risk if their financial risk rating is between 0 and 24.9 risk points. A rating of 25.0-29.9 indicates high risk, 30.0-34.9 indicates moderate risk, 35.0-39.9 indicates low risk and 40 or more indicates very low risk. Those exogenous and ad hoc classifications are not the ones that are endogenously found in the threshold model and that are referred to in the rest of the paper.

In this paper, the index is used to proxy the nature of capital flows. Low financial risk is associated with the counter-cyclical nature of international capital flows. If investors believe that the country is able to pay back its debts, then investors are likely to invest in that country even or especially during a recession as profits are the highest then. In contrast to that, high financial risk is associated with the pro-cyclical nature of international capital flows. The claim is that investors do not have trust in countries with high financial risk and they fear to loose their money due to default or exchange rate instability. Any sign of a possible crisis or contagion risk leads investors to pull out their money.

Control Variables

In the Great Moderation literature as well as in the growth literature, there is a consensus about variables that influence output volatility. Most commonly used are proxies for monetary policy quality, fiscal policy quality, supply shocks and trade openness. However, the definition of these variables differs among studies. For the empirical analysis in the following section, those definitions are selected which are most commonly used and have the best data coverage.

[6] According to Hoti and McAleer (2004) the International Country Risk Guide is the only risk rating agency to provide detailed and consistent monthly data over an extended period for a large number of countries.

[7] The value of each component is mapped to a fixed scale of risk points. The risk points are aggregated to give the total financial risk index.

Monetary policy is measured as the (natural logarithm of the) absolute value of inflation. Inflation has a good data coverage and is for example used by Bekaert et al. (2006), Barrell and Gottschalk (2004), Kose et al. (2003), Ferreira da Silva (2002), Spatafora and Sommer (2007) and Yang (2008). Good monetary policy (i.e. low inflation) is thought to be one of the sources of the Great Moderation and one expects a positive relation between inflation and output volatility.

The standard deviation of the rate of change of government expenditure is used to proxy fiscal policy quality. This measure is used e.g. by Kose et al. (2003). Buch et al. (2005) use a similar measure taking government consumption instead of expenditure. The less volatile government expenditure or consumption the better fiscal policy and the less volatile is output.

The standard deviation of the change in terms of trade is used to measure supply side volatility (Buch et al., 2005; Kose et al., 2003; Spatafora and Sommer, 2007).[8] Less volatile terms of trade are straight forwardly associated with less output volatility.

Most commonly, trade openness is measured as the sum of exports and imports as a percentage of GDP (Ferreira da Silva, 2002; Bekaert et al., 2006; Calderón et al., 2005; Cecchetti et al., 2006; Kose et al., 2003, 2005a). A higher ratio implies more trade openness which according to Giovanni and Levchenko (2006) leads to more output volatility. They argue that traded sectors are more volatile and that trade leads to specialization. They acknowledge that traded sectors have a smaller correlation with the domestic economy but this implicit negative relation with output volatility is offset by the former positive effects.

Alternative measures to capture the control variables are discussed in the robustness section. Using an extreme bounds analysis this section reveals that the results of this paper do not hinge on the definition of the control variables.

Data Description

In the empirical analysis, annual data for 26 developed countries and 36 developing countries are used. The list of countries can be found in Table 6 in the Appendix. Output volatility and the control variables are available for the time period 1980-2007.[9] The financial risk indicator covers the period 1984-2006. Financial openness is available for the period 1980-2004.[10] The variables are calculated over a five year period (seven years for the last time period) using either averages or standard deviations according to their definition. For the analysis, non-overlapping windows instead of rolling windows are used in order to avoid problems stemming from serial correlation. The periods run from 1980-1984, 1985-1989, ..., 2000-2007, if data availability permits. Consequently, the time series dimension contains 5 time observations. In the Appendix, definitions of the variables as well as the sources of the data are provided in Table 8. Moreover, descriptive statistics can be found in Table 7 and Figure 2 depicts the

[8]The variation in terms of trade is used as control variable in the growth literature but also in the Great Moderation literature where it is a proxy for 'good luck' in terms of reduced shocks to the economy.

[9]Data for 2007 is based on projections from the IMFs World Economic Outlook database. Fiscal policy quality only covers the period 1981-2007 for The Netherlands, Portugal, Spain, New Zealand, South Africa, Bolivia, Brazil, Dominican Republic, Israel, Cameroon, Kenya, Malawi, Senegal, Tanzania and Togo.

[10]Except for Malawi and Haiti where financial openness covers 1980-2003.

Table 1. Benchmark: The Linear Model

$$\sigma_{Yit} = \alpha_i + \delta \mathbf{Q_{it}} + \beta FinOpen_{it} + \varepsilon_{it}$$

π	0.0008	(0.40)
σ_G	0.0019 ***	(4.05)
σ_{ToT}	0.0003	(1.61)
$TraOpen$	0.0003 *	(1.90)
$FinOpen$	0.0006	(0.71)
$R^2[\bar{R}^2]$	0.42 [0.40]	

Notes: The dependent variable is output volatility. **Q** =control variables as well as time-fixed effects. π = monetary policy. σ_G = fiscal policy. σ_{TOT} = supply shock volatility. $TraOpen$ = trade openness. $FinOpen$ = financial openness. Definitions of the variables can be found in Table 8. 62 countries and five time periods are used (i.e. 310 observations). 5-year non-overlapping windows are used. *** (**, *) denote significance at the 1 (5, 10) percent level. Robust t-statistics are given in parenthesis.

development of the mean of output volatility, financial openness and financial risk rating over time.

4 Empirical Analysis

A linear regression is estimated to serve as a benchmark and its statistics are shown in Table 1. As was expected from the literature review, there is no significant linear relation between financial openness and output volatility. Moreover, the signs of the control variables are in line with expectations. Bad fiscal policy manifested in a high government expenditure volatility (σ_G) leads to more output volatility. More trade openness ($TraOpen$) leads to more output volatility. More shocks, measured in terms of trade volatility (σ_{ToT}), lead to more output volatility but not significantly (p-value: 0.109). However, monetary policy quality (π) is highly insignificant (p-value: 0.687).

In the next step, Hansen (1999)'s threshold model is applied. It is determined whether the effect of financial openness on output volatility depends on the financial risk that a country bears. As a first step in specifying the threshold model, the 'best' threshold from a set of 300 equally spaced values of the financial risk index is chosen. For that matter, the sum of squared errors for all 300 threshold models using each potential threshold is calculated. The 'best' threshold then is the one that corresponds to the threshold model with the smallest sum of squared errors. In a second step it is verified whether the threshold effect is significant. Significance is established at the 10% significance level. Given the first threshold, the second threshold is determined analogical. The statistics of Table 2 indicate that the single threshold is significant as well as the double threshold. The triple threshold, however, is not significant. Therefore, the double threshold model is the appropriate model to work with.

As the upper part of Table 3 indicates, the two thresholds are estimated to be at a financial risk index level of 22 and 37. Therefore, countries are divided into three classes according to their level of financial risk. Countries with a level of financial risk below 22 are classified as having 'very high (financial) risk',

Table 2. Test Statistics Determining the Number of Thresholds

$\sigma_{Yit} = \alpha_i + \delta \mathbf{Q_{it}} + \sum_{k=0}^{K-1} \beta_{k+1} FO_{it} I(\gamma_k < FR_{it} \leq \gamma_{k+1}) + \beta_{K+1} FO_{it} I(\gamma_K < FR_{it}) + \varepsilon_{it}$	
Test for single threshold: (H_0: K=0 vs. H_1: K=1)	
F_1	22.6
p-value	0.057
critical values (1%, 5%, 10%):	(17.9, 24.8, 49.9)
Test for double threshold: (H_0: K=1 vs. H_1: K=2)	
F_2	13.8
p-value	0.088
critical values (1%, 5%, 10%):	(13.2, 18.2, 30.0)
Test for triple threshold: (H_0: K=2 vs. H_1: K=3)	
F_3	4.0
p-value	0.528
critical values (1%, 5%, 10%):	(11.0, 13.8, 19.5)

Notes: The dependent variable is output volatility. $\mathbf{Q}$ =control variables as well as time-fixed effects. FO = the threshold variable financial openness. FR = the threshold decision variable financial risk indicator. The definition of all variables can be found in table 8. $\gamma_k = k^{th}$ threshold level (where $\gamma_0 = 0$) and K = number of thresholds. The test statistic of a likelihood ratio testing whether there are $k-1$ versus k threshold(s) is denoted by F_k and indicate that the number of thresholds is 2. 1000 bootstrap replications were used to obtain the critical values and p-values. Each regime is required to contain at least 10% of all observations.

countries with a level of financial risk between 22 and 37 have an 'intermediate (level of financial) risk' and countries with a level of financial risk above 37 are classified as having 'low (financial) risk'.

Having determined the number of thresholds as well as their point estimates, the appropriate threshold regression (2) is estimated:

$$\begin{aligned}\sigma_{Yit} = \quad & \alpha_i + \delta \mathbf{Q_{it}} + \beta_1 FinOpen_{it} I(FinRisk_{it} \leq 22) + \beta_2 FinOpen_{it} \\ & I(22 < FinRisk_{it} \leq 37) + \beta_3 FinOpen_{it} I(FinRisk_{it} > 37) + \varepsilon_{it} \quad (2)\end{aligned}$$

As shown in the middle part of Table 3, the threshold estimation leads to similar results for the control variables as the fixed effects regression. Most importantly, however, financial openness is significant in all three financial risk classes and has the expected signs. In countries with very high financial risk, financial openness increased output volatility. If a country with very high risk increases its capital flows by the amount of its GDP[11] then output volatility would increase by 1.4 percentage points. Analogically, in countries with an intermediate level of financial risk, financial openness also increases output volatility but by less than in very risky countries. If the country's capital flows were increased by the amount of its GDP, then output volatility would increase by 0.3 percentage points. On the other hand, if a country has low financial risk, then more financial openness decreases output volatility. The positive effect of financial openness in low risk countries is however smaller than the negative effect in higher risk countries in absolute value. If the capital flows of a 'low risk' country increases by the amount of its GDP, then output volatility decreases by 0.2 percentage points.

As an illustration, the predicted effect of a change in financial openness on output volatility is computed for each of the three risk classes. Table 4 reports the average output volatility (σ_{Y_t}) and financial openness (FO_t) over all countries in the given risk class. All else being equal, the expected output volatility in period t given the change in financial openness ($\hat{\sigma}_{Y_t|\Delta FO_t}$) is computed.[12] The model predicts that output volatility changes by 1-18% and on average by 6%. As a comparison, output volatility effectively changed by 4-44% and on average by 21%. The illustration shall not demonstrate the significance of the coefficients as this is already established. It shall be demonstrated that despite of the small size of the coefficients, the effect of a change in financial openness is substantial.

Looking at the results in view of the Great Moderation, the question is how much of the change in output volatility can be explained by an increase in financial openness. The US had low financial risk in the years 1980-1999 but had an intermediate level of financial risk in 2000-2007. As the threshold model predicts, the continuous increase in financial openness during the whole sample period was associated with decreasing output volatility from 1980-1994 but with an increase in output volatility in 1999-2007. In the time period 1990-1994 the threshold model predicted a reduction in output volatility while in fact it increased slightly. In the time period 1985-1989, financial openness increased by 24 units indicating a decrease in US output by 0.04 percentage

[11] An increase of capital flows in the order of magnitude of the country's GDP leads to a 100 units increase in financial openness (see Table 8).

[12] $\hat{\sigma}_{Y_t|\Delta FO_t} = \sigma_{Y_{t-1}} + \beta_{k+1} * \Delta FO_t$, where β_{k+1} is the risk class depending coefficient of financial openness.

Table 3. Estimation Results of Double Threshold Regression

$$\sigma_{Yit} = \alpha_i + \delta \mathbf{Q_{it}} + \beta_1 FO_{it} I(FR \leq \gamma_1) + \beta_2 FO_{it} I(\gamma_1 < FR_{it} \leq \gamma_2) + \beta_3 FO_{it} I(FR > \gamma_2) + \varepsilon_{it}$$

Threshold estimates		
$\widehat{\gamma_1}$	22.04	[20.08, 22.58]
$\widehat{\gamma_2}$	37.19	[27.45, 40.24]
Regression estimates		
π	-0.001400	(-0.81)
σ_G	0.001686 ***	(3.62)
σ_{ToT}	0.000318	(1.57)
$TraOpen$	0.000300 **	(2.31)
$FinOpenI(FinRisk \leq \gamma_1)$	0.000139 **	(2.17)
$FinOpenI(\gamma_1 < FinRisk \leq \gamma_2)$	0.000034 **	(2.07)
$FinOpenI(FinRisk > \gamma_2)$	-0.000016 **	(-2.06)
$R^2[\bar{R}^2]$: 0.48 [0.46]		
Test for Heteroscedasticity		
p-value		0.0000
Test for Serial Correlation		
t-statistic		1.689708
Test for Exogeneity: Variable		p-value of residuals
π		0.247
σ_G		0.932
σ_{ToT}		0.466
$TraOpen$		0.936
$FinOpen$		0.242

Notes: The dependent variable is output volatility. $\mathbf{Q}$ =control variables as well as time-fixed effects. π = monetary policy. σ_G = fiscal policy. σ_{TOT} = supply shocks. $TraOpen$ = trade openness. $FinOpen$ = financial openness. Definitions of the variables can be found in Table 8. 62 countries and five 5-year non-overlapping time periods are used (i.e. 310 observations). *** (**, *) denote significance at the 1 (5, 10) percent level. Robust t-statistics are given in parenthesis and confidence intervals are given in brackets. Heteroscedasticity: The unrestricted (heteroscedastic) and the restricted (homoscedastic) models are fitted using maximum likelihood estimation. Then it is compared whether the error terms of the two models are equivalent in which case the null hypothesis of homoscedasticity is not rejected. Serial Correlation: The residuals of the fixed effects regression are regressed on the lagged residuals. Then, the null hypothesis that there is serial correlation is tested by testing whether the correlation between the residuals and the lagged residuals is equal to -1/(T-1). Exogeneity: In a first regression, all exogenous variables, including the instrument for the variable in question are regressed on the variable in question. In a second regression, the residuals of the first regression along with all exogenous variables, excluding the instrument for the variable in question, and the variable in question are regressed on the dependent variable of the model in question. If in the second regression, the coefficient of the residuals of the first regression is not significantly different from zero, then the variable in question is exogenous.

Table 4. Quantifying the Effect of Financial Openness

t	σ_{Y_t}	FO_t	ΔFO_t	$\hat{\sigma}_{Y_t\|\Delta FO_t}$	$\Delta_{\%}(\sigma_{Y_{t-1}}, \hat{\sigma}_{Y_t\|\Delta FO_t})$
risky countries					
1980	0.0484	108			
1985	0.0464	149	41	0.0541	12%
1990	0.0669	208	59	0.0547	18%
1995	0.0507	194	-14	0.0649	-3%
medium risk countries					
1980	0.0259	145			
1985	0.0287	166	21	0.0266	3%
1990	0.0358	156	-10	0.0284	-1%
1995	0.0244	143	-13	0.0354	-1%
2000	0.0163	170	27	0.0253	4%
low risk countries					
1980	0.0159	124			
1985	0.0147	187	62	0.0149	-6%
1990	0.0135	198	11	0.0145	-1%
1995	0.0159	237	39	0.0129	-5%
2000	0.0115	354	117	0.0140	-12%

Note: σ_{Yt} = average output volatility at time period t over all countries in the given risk class. FO_t = average financial openness at time period t over all countries in the given risk class. ΔFO_t = difference of financial openness in period t and $t-1$. $\hat{\sigma}_{Y_t|\Delta FO_t}$ = expected output volatility in period t given the change in financial openness, ceteris paribus. $\Delta_{\%}(\sigma_{Y_{t-1}}, \hat{\sigma}_{Y_t|\Delta FO_t})$ = percentage change of output volatility at $t-1$ and expected output volatility at t. The model predicts that output volatility changes by 1-18% and on average by 6%

Table 5. Percentage of Countries in Each Class by Year

	1980	1985	1990	1995	2000
very high risk	27%	26%	6%	2%	0%
intermediate risk	39%	37%	50%	40%	47%
low risk	34%	37%	44%	58%	53%

Note: During the sample period, 0% to 27% of the countries were associated with very high financial risk. 37% to 50% of the countries had an intermediate level of financial risk and 34% to 58% of the countries had low financial risk.

points. In fact, the US output volatility decreased by 0.79 percentage points. Analogical, financial openness predicted an increase of US output of -0.03 (-0.08; 0.10) percentage points while in fact it increased by -0.28 (0.05; 0.40) percentage points in the time period 1990-1994 (1995-1999; 2000-2007). Thus, in three out of four time periods, the model prediction had the correct sign and in those periods it explained 5-25% of the in/decrease in output volatility. Therefore, financial openness qualifies as an important variable in the Great Moderation discussion.

It is interesting to note how many countries are classified as low, intermediate or high risk countries in each period. Table 5 reports the percentage of countries that belong to either one of the three risk classes in a given year. In general, over time there is a shift from higher risk classes to lower risk classes. Table 12 in the Appendix lists all countries categorized by their risk class. Hoti and McAleer (2004) give a detailed description of the financial risk indicator and put them into an historical context.[13]

5 Robustness Analysis

In order to check the robustness of the results of this paper, three variations are analyzed. First, the standard deviation of GDP growth instead of filtered GDP is used as alternative measure of output volatility. Secondly, an extreme bounds analysis is conducted using alternative measures of the control variables in the threshold model. Thirdly, the sample is extended. None of the variations alter the results of this paper.

5.1 Alternative Measure of Output Volatility

In order to compute output volatility, GDP has to be detrended before taking the standard deviation of the series. In the analysis so far, the BP filter was used in order to detrend GDP. Another popular way to detrend GDP is by taking first differences of GDP. When repeating the analysis of Section 4 using first differencing, the main results do not change.

First, the number of thresholds is determined (upper panel of Table 9 in the Appendix). The p-value (0.106) of the test whether there is no threshold

[13]They describe the events leading to changes in the financial risk indicator for Albania, Romania, Argentina, Chile, Cuba, Mexico, Indonesia, Malaysia, Iraq, Saudi Arabia, South Africa and Zimbabwe.

against the alternative of one threshold suggests that there is no threshold. However, the bootstrapped p-values are less reliable because the model exhibits serial correlation. As the rejection of the existence of one threshold is only marginal, the test whether there is one threshold against the alternative of two thresholds is considered as well. The statistics in the upper panel of Table 9 suggest that there are two thresholds. The two thresholds are estimated to be 23 and 29 and lie strictly within their confidence interval (middle panel of Table 9). In the lower panel of Table 9, the estimation results of the double threshold regression are shown. The coefficients of financial openness in all three risk classes have the same sign and are of similar magnitude as the estimates of the original regression. However, financial openness is not significantly negative for the class of 'low financial risk' countries.

5.2 Extreme Bounds Analysis

In this section, alternative measures of the control variables are used to estimate threshold model (2). In that way, the robustness of the results concerning financial openness with respect to the choice of control variables is determined. This robustness check is a variant of Leamer (1983) and Levine and Renelt (1992) extreme bounds analysis. The extreme bounds analysis yields upper and lower bounds for the three coefficients of financial openness from all possible combinations of control variables. The alternative variables are described briefly.

Next to the absolute value of inflation, there are the following ways to measure monetary policy. Firstly, transformations of the level of inflation are used to measure monetary policy quality: the plain level of inflation (e.g. used by Barrell and Gottschalk (2004), Ferreira da Silva (2002), Kose et al. (2003) and Yang (2008)), a semi-log transformation[14], and a non-linear transformation[15] that deteriorates rapidly when inflation is higher than 10 percent advocated by Spatafora and Sommer (2007). Secondly, the logarithm of the standard deviation of inflation also employed by Cecchetti et al. (2006); Kose et al. (2003); Bekaert et al. (2006); Barrell and Gottschalk (2004) is used.

An alternative measure of fiscal policy is a dummy variable that accounts for large current account deficits. It is defined as deficits exceeding five percent of GDP and is used e.g. by Spatafora and Sommer (2007).

The change in oil price or the standard deviation of the change in oil price (e.g. used by Buch et al. (2005)) are used as alternative measures to capture shocks to the economy.

The robustness check is conducted as follows. Threshold regression (2) is run thirty times. Each regression includes all four control variables but a different combination of their measures. Out of these thirty regressions, Table 10 in the Appendix lists the highest and lowest coefficients together with their standard error and p-value of financial openness in each of the three risk classes. In none of the thirty threshold regressions the sign of the coefficients of financial openness has changed and the coefficients are significant in all regressions. Therefore, the results of this paper are robust to the measurement of the control variables.

[14]The variable is equal to the logarithm of inflation if inflation is greater than 1. Otherwise the variable is equal to 1-inflation.

[15]The index is not prone to short-term inflation fluctuations stemming e.g. from changes in the oil price. It is defined as $\exp 0.005 * (\pi - 2\%)^2$.

5.3 Extending the Sample

The use of Hansen's panel threshold model restricts the panel to be balanced. However, one could think of one way to extend the database. The panel has to be balanced only in order to determine the number and the value of the thresholds. In this section, the thresholds of the balanced panel are treated as given in order to compute the coefficients for the unbalanced panel. Table 11 in the Appendix shows the estimation results of model (2) when using the unbalanced panel. There are 86 instead of 61 countries with four to five time observations, leading to a total of 408 observations.[16] The signs of the variables are unchanged. Financial openness becomes insignificant for the class of countries with an 'intermediate level of financial risk' while it remains significant in the two extreme classes. All three coefficients of financial openness are smaller in absolute terms than in the balanced regression.

6 Conclusion

Financial globalization brings about winners and losers in terms of reduced and increased output volatility. To capture this two-sided effect of financial openness on output volatility, the hypothesis was tested that this effect depends on the degree of financial risk of a country.

This dependency is easily understood when taking the perspective of an investor. Investors will not pull their money out of an economy that is able to pay its way even during a recession because they are sure that their investments are refunded. On the contrary, investors will even invest in that country due to higher profit prospects. Therefore, international capital flows are countercyclical if financial risk is low. The country is able to profit from international capital allocation and reduced output volatility. On the other hand, countries that are not able to pay their debt easily are observed very carefully by investors. If there is a recession in such a country, investors might fear to loose their money (e.g. due to government default) and withdraw it as soon as possible. In that case, international capital flows are pro-cyclical. Countries with high financial risk suffer from financial openness because their output volatility increases.

This hypothesis is tested using a panel threshold model with financial risk as decision variable. To quantify financial risk, an indicator is used that measures the ability of a country to pay its trade, commercial and official debts. The estimation reveals that financial openness decreases output volatility in a financially sound country. On the other hand, a country that is financially unstable or has 'very high financial risk' experiences more output volatility when financial openness increases. In case a country has an 'intermediate level of risk', financial openness also increases output volatility, but less severely. Extensive robustness checks confirm that the effect of financial openness on output volatility is significant, stable and depending on financial risk.

The implications of this result are two-fold. Firstly, the results have a direct policy implication. Financial openness can be good for any country as long as it has 'low financial risk'. Countries that do not fulfill this requirement should first

[16]The sample is extended with the following countries, covering the time period 1985-2007: Angola, Botswana, Burkina Faso, Chile, China, Colombia, Cte d'Ivoire, El Salvador, Ethiopia, Guinea, Hungary, Republic of Korea, Madagascar, Malaysia, Mali, Mozambique, Niger, Nigeria, Oman, Poland, Qatar, Switzerland, Trinidad and Tobago, Uganda, Zimbabwe.

improve on those terms before opening their financial markets. Fortunately, less and less countries in the sample were considered to have 'very high financial risk' and in the period 2000-2007, no country had 'very high financial risk'. Roughly half of the countries in that time period belong to the intermediate and the other half to the low financial risk class. In short, potential harms stemming from increasing financial openness have become less severe on average. Secondly, the results contribute to the discussion on the Great Moderation. Financial openness explains up to 25% of the change in output volatility in the US from one time period to the next. Adding to this, not only the decreasing output volatility in many, mainly developed, countries can be explained, but also the increased output volatility in many, mainly developing, countries.

This paper reconciles the contradicting literature on the impact of financial openness on output volatility. It adds to the discussion by linking theoretical work using a threshold model which was loosely proposed by Rogoff et al. (2006). Further research is necessary to support the empirical finding with a profound theoretical framework. Furthermore, incorporating elements of smooth transition between the risk classes into the threshold model or rendering the model more robust to heteroscedasticity, serial correlation and endogeneity could be an extension and is left for future research.

References

Barrell, R. and S. Gottschalk (2004). The Volatility Of The Output Gap In The G7. Royal Economic Society Annual Conference 2004 136.

Beck, T., A. Demirguc-Kunt, and R. Levine (1999). A new database on financial development and structure. Policy Research Working Paper Series 2146, The World Bank.

Bekaert, G., C. Harvey, and C. Lundblad (2006). Growth Volatility and Financial Liberalization. *Journal of International Money and Finance 58*, 370–403.

Bekaert, G. and C. R. Harvey (2000). Foreign Speculators and Emerging Equity Markets. *Journal of Finance 55*, 565–613.

Bekaert, G., C. R. Harvey, and C. Lundblad (2002). Growth Volatility and Equity Market Liberalization. Unpublished.

Blanchard, O. and J. Simon (2001). The Long and Large Decline in U.S. Output Volatility. *Brookings Papers on Economic Activity 2001*, 135–164.

Bordo, M. D. and C. M. Meissner (2007). Foreign Capital and Economic Growth in the First Era of Globalization. Working Paper 13577, National Bureau of Economic Research.

Buch, C. M., J. Doepke, and C. Pierdzioch (2005). Financial openness and business cycle volatility. *Journal of International Money and Finance 24*, 744–765.

Calderón, C., N. Loayza, and K. Schmidt-Hebbel (2005). Openness, Vulnerability, and Growth. Unpublished.

Cecchetti, S. G., A. Flores-Lagunes, and S. Krause (2006). Assessing the Sources of Changes in the Volatility of Real Growth. Working Paper 11946, National Bureau of Economic Research.

Dalsgaard, T., J. Elmeskov, and C.-Y. Park (2002). Ongoing changes in the business cycle - evidence and causes. Working Paper 315.

Demirgüç-Kunt, A. and E. Detragiache (1998). Financial Liberalization and Financial Fragility. In *Annual World Bank Conference on Development Economics*.

Dynan, K. E., D. W. Elmendorf, and D. E. Sichel (2006). Can financial innovation help to explain the reduced volatility of economic activity? *Journal of Monetary Economics 53*, 123–150.

Easterly, W., R. Islam, and J. E. Stiglitz (2000). Shaken and Stirred: Explaining Growth Volatility. In *Annual World Bank Conference on Development Economics*, pp. 191–211.

Ferreira da Silva, G. (2002). The impact of financial system development on business cycles volatility: cross-country evidence. *Journal of Macroeconomics 24*, 233–253.

Fischer, S. (1998). Capital-account liberalization and the role of the IMF. In *Should the IMF Pursue Capital-Account Convertibility?*, Number 207 in Essays in International Finance. Princeton University.

Giovanni, J. and A. A. Levchenko (2006). Openness, Volatility and the Risk Content of Exports. Technical report, International Monetary Fund.

Girard, E. and M. Omran (2007). What are the risks when investing in thin emerging equity markets: Evidence from the Arab world. *Journal of International Financial Markets Institutions and Money 17*, 102–123.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics 93*, 345–368.

Hassan, M. K., N. C. Maroney, H. M. El-Sady, and A. Telfah (2003). Country risk and stock market volatility, predictability, and diversification in the Middle East and Africa. *Economic Systems 27*, 63–82.

Hoti, S. and M. McAleer (2004). An Empirical Assessment of Country Risk Ratings and Associated Models. *Journal of Economic Surveys 18*, 539–588.

IMF staff (2008). *Global Financial Stability Report - Containing Systemic Risks and Restoring Financial Soundness*. International Monetary Fund.

Jayasuriya, S. (2005). Stock market liberalization and volatility in the presence of favorable market characteristics and institutions. *Emerging Markets Review 6*, 170–191.

Kalemli-Ozcan, S., B. E. Sorensen, and O. Yosha (2003). Risk Sharing and Industrial Specialization: Regional and International Evidence. *American Economic Review 93*, 903–918.

Kharroubi, E. (2007). Crises, Volatility, and Growth. *World Bank Economic Review 21*, 439–460.

Kose, M. A., E. Prasad, and M. Terrones (2003). Financial Integration and Macroeconomic Volatility. Working paper 03/50, International Monetary Fund.

Kose, M. A., E. Prasad, and M. Terrones (2005a). How Do Trade and Financial Integration Affect the Relationship Between Growth and Volatility? IMF Working Papers 05/19, International Monetary Fund.

Kose, M. A., E. S. Prasad, K. Rogoff, and S.-J. Wei (2003). Effects of Financial Globalization on Developing Countries: some Empirical Evidence. Occasional paper 220, International Monetary Fund.

Kose, M. A., E. S. Prasad, and M. E. Terrones (2005b). Growth and Volatility in an Era of Globalization. *IMF Staff Papers 52*, 4.

Kose, M. A., E. S. Prasad, and M. E. Terrones (2006). How do trade and financial integration affect the relationship between growth and volatility? *Journal of International Economics 69*, 176–202.

Leamer, E. E. (1983). Let's Take the Con Out of Econometrics. *American Economic Review 73*, 31–43.

Levine, R. and D. Renelt (1992). A Sensitivity Analysis of Cross-Country Growth Regressions. *American Economic Review 82*, 942–63.

Loayza, N. V., R. Ranciere, L. Serven, and J. Ventura (2007). Macroeconomic Volatility and Welfare in Developing Countries: An Introduction. *World Bank Economic Review 21*, 343–357.

McConnell, M. M. and G. Perez-Quiros (2000). Output Fluctuations in the United States: What Has Changed Since the Early 1980's? *The American Economic Review 90*, 1464–1476.

Ramey, G. and V. A. Ramey (1995). Cross-Country Evidence on the Link between Volatility and Growth. *American Economic Review 85*, 1138–51.

Razin, A. and A. Rose (1992). Business Cycle Volatility and Openness: An Exploratory Cross-Section Analysis. Working Paper 4208, National Bureau of Economic Research.

Rogoff, K., M. A. Kose, E. Prasad, and S.-J. Wei (2006). Financial Globalization: A Reappraisal. IMF Working Papers 189, International Monetary Fund.

Spatafora, N. and M. Sommer (2007). The Changing Dynamics of the Global Business Cycle. In *World Economic Outlook: Globalization and Inequality*, Chapter 5, pp. 67–94. IMF.

Stiglitz, J. E. (2000). Capital Market Liberalization, Economic Growth, and Instability. *World Development 28*, 1075–1086.

Stock, J. H. and M. W. Watson (2002). Has the Business Cycle Changed and Why? Working Paper 9127, National Bureau of Economic Research.

Summers, P. M. (2005). What caused the Great Moderation? Some Cross-country Evidence. *Economic Review 90*, 5–32.

Yang, B. (2008). Does democracy lower growth volatility? A dynamic panel analysis. *Journal of Macroeconomics 30*, 562–574.

Appendix

Table 6. List of Countries in the Balanced Sample

26 developed countries

Australia; Austria; Belgium; Canada; Denmark; Finland; France; Germany; Greece; Hong Kong; Iceland; Ireland; Israel; Italy; Japan; Netherlands; New Zealand; Norway; Portugal; Singapore; South Africa; Spain; Sweden; Taiwan; United Kingdom; United States

36 developing countries

Argentina; Bolivia; Brazil; Cameroon; Costa Rica; Dominican Republic; Ecuador; Egypt; Haiti; Indonesia; Iran; Jamaica; Jordan; Kenya; Kuwait; Lebanon; Libya; Malawi; Mexico; Morocco; Nicaragua; Pakistan; Panama; Paraguay; Peru; Philippines; Senegal; Sri Lanka; Sudan; Syria; Tanzania; Thailand; Togo; Tunisia; United Arab Emirates; Zambia

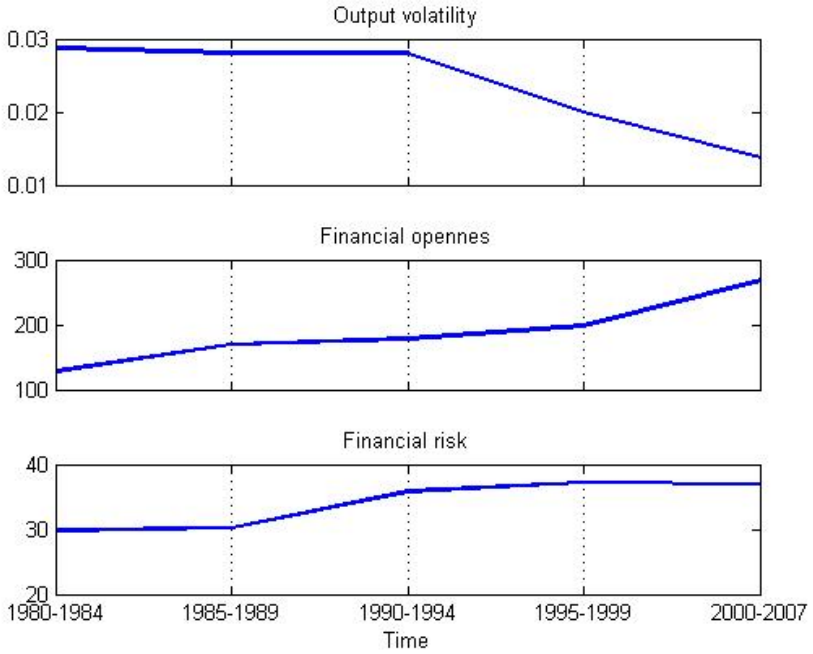
Note: Singapore; Taiwan and Hong Kong are neither termed as 'developed' nor 'developing' countries. However, they belong to the group of 'advanced' economies termed by the IMF and are therefore included in the group of 'developed' countries.

Table 7. Descriptive Statistics

Variable	Mean	Std.	Min	25%	75%	Max
Output Volatility (σ_Y)	0.024	0.029	0.002	0.010	0.028	0.253
Monetary Policy (π)	1.888	1.349	-1.280	0.935	2.652	8.000
Fiscal Policy (σ_G)	3.060	5.815	0.257	1.084	3.053	84.866
Supply Shock Volatility (σ_{ToT})	9.138	11.778	0.000	2.171	11.415	94.766
Trade Openness ($TraOpen$)	74.06	54.49	13.76	46.46	86.37	420.55
Financial Openness ($FinOpen$)	188.3	205.4	25.6	85.8	202.3	1623.1
Financial Risk ($FinRisk$)	33.99	9.49	9.71	26.95	41.61	49.83

Notes: Statistics are calculated using 310 observations. For definitions of the variables see Table 8.

Figure 2. Development of Variables over Time, Mean over all Countries



Note that a higher financial risk rating indicates less risk.

Table 8. Variables: Definition and Source

Variable	Definition	Source
Output Volatility	5-year standard deviation of detrended logarithm of real GDP using BP filter	Real GDP (2000 international dollars): PWT[N3] and WEO[N4]
Monetary Policy Quality	5-year average of $ln(\|inflation\|)$	Inflation (% change in CPI): WEO and WDI[N5]
Fiscal Policy Quality	5-year standard deviation Δgovernment expenditures/GDP	General Government Expenditure and Net Lending (% of GDP): WEO
Supply Shock	5-year standard deviation of Δterms of trades	terms of trades in goods and services: WEO
Trade openness	5-year average of exports + imports of goods and services (% of GDP)	WDI and WEO
Financial openness	5-year average of total liabilities[N1] + total assets[N2] (% of GDP)	Lane and Milesi-Ferretti, 2006
Financial Risk Indicator	Aggregate of financial risk components	Index constructed by PRS group[N6]

Most data was kindly provided to me by Nikola Spatafora who used the data in Spatafora and Sommer (2007). [N1]Total Liabilities = portfolio equity liabilities + FDI liabilities +debt liabilities + financial derivatives (liabilities); [N2]Total Assets = portfolio equity assets + FDI assets + debt assets + financial derivatives (assets) + (total reserves - gold); [N3]PWT: Heston, Summers, and Atens Penn World Tables Version 6.2 (2006); [N4]WEO: IMFs World Economic Outlook database; [N5]WDI: the World Banks World Development Indicators database (2007); [N6]PRS group: Political Risk Service group; International Country Risk Guide. More information on http://www.prsgroup.com

Table 9. Alternative Measure of Output Volatility

$$\sigma_{\Delta Y it} = \alpha_i + \delta \mathbf{Q_{it}} + \beta_1 FO_{it} I(FR \leq \gamma_1) + \beta_2 FO_{it} I(\gamma_1 < FR_{it} \leq \gamma_2) + \beta_3 FO_{it} I(FR > \gamma_2) + \varepsilon_{it}$$

Number of Thresholds		
F_1 [*p-values*]	17.86	[*0.106*]
F_2 [*p-values*]	11.61	[*0.095*]
F_3 [*p-values*]	4.28	[*0.435*]
Threshold Estimates		
$\widehat{\gamma_1}$	22.58	[20.08, 23.85]
$\widehat{\gamma_2}$	28.91	[26.46, 40.24]
Regression Estimates		
π	-0.001468	(-0.66)
σ_G	0.003382 ***	(4.47)
σ_{ToT}	0.000204	(0.69)
$TraOpen$	0.000206	(1.48)
$FinOpenI(FinRisk \leq \gamma_1)$	0.000146 ***	(2.72)
$FinOpenI(\gamma_1 < FinRisk \leq \gamma_2)$	0.000047 ***	(3.31)
$FinOpenI(FinRisk > \gamma_2)$	-0.000015	(-1.14)
$R^2[\bar{R}^2]$		0.50 [0.49]

Notes: The dependent variable is output volatility measured as $\sigma(\Delta(ln(GDP)))$. π = monetary policy. σ_G = fiscal policy. σ_{TOT} = supply shocks. $TraOpen$ = trade openness. $FinOpen$ = financial openness. A constant and time-fixed effects are included. Definitions of the variables can be found in Table 8. 62 countries and five 5-year non-overlapping windows are used. F_i is the test for H_0: there are i-1 thresholds vs H_1: there are i thresholds. 1000 bootstrap replications were used to obtain [*p-values*] and [confidence intervals]. *** (**, *) denote significance at the 1 (5, 10) percent level. Robust t-statistics are given in parenthesis.

Table 10. Robustness to Measurement of Control Variables

	β (s.e.)	p-value
Financial openness in high risk class		
high:	0.000247 (0.0062)	0.000
base:	0.000138 (0.0064)	0.031
low:	0.000128 (0.0068)	0.059
Financial openness in intermediate risk class		
high:	0.000059 (0.0025)	0.018
base:	0.000033 (0.0016)	0.039
low:	0.000032 (0.0016)	0.050
Financial openness in low risk class		
high:	-0.000013 (0.0007)	0.057
base:	-0.000016 (0.0008)	0.039
low:	-0.000021 (0.0010)	0.032

Notes: Thirty regressions of type (2) are run, each including all four control variables but a different combination of their measures were run. The estimate, standard deviation, and p-value for "base" refer to the model used in section 4. The rows labeled "high" and "low" give the highest and lowest estimate from the 30 regressions using different measures of the control variables and their permutations.

Table 11. Estimation results for the unbalanced panel

$\sigma_{Yit} = \alpha_i + \delta \mathbf{Q_{it}} + \beta_1 FO_{it} I(FR \leq \gamma_1) + \beta_2 FO_{it} I(\gamma_1 < FR_{it} \leq \gamma_2) + \beta_3 FO_{it} I(FR > \gamma_2) + \varepsilon_{it}$

π	-0.000889	(-0.57)
σ_G	0.001732 ***	(3.27)
σ_{ToT}	0.000108	(0.84)
$TraOpen$	0.000241 **	(2.30)
$FinOpenI(FinRisk \leq 22)$	0.000123 **	(2.17)
$FinOpenI(22 < FinRisk \leq 37)$	0.000010	(0.55)
$FinOpenI(FinRisk > 37)$	-0.000012 *	(-1.91)
$R^2[\bar{R}^2]$		0.39 [0.37]

Notes: The dependent variable is output volatility. π = monetary policy. σ_G = fiscal policy. σ_{TOT} = supply shocks. $TraOpen$ = trade openness. $FinOpen$ = financial openness. Definitions of the variables can be found in Table 8. 87 countries and four to five 5-year non-overlapping time periods are used leading to 410 observations. A constant and time-fixed effects are included. *** (**, *) denote significance at the 1 (5, 10) percent level. Robust t-statistics are given in parenthesis and confidence intervals are given in brackets. The thresholds are those estimated for regression (2).

Table 12. Countries in each time period by class

Countries with very high financial risk	
1980:	Argentina; Bolivia; Brazil; Costa Rica; Dominican Republic; Ecuador; Haiti; Iran; Jamaica; Lebanon; Libya; Nicaragua; Peru; Philippines; Sudan; Syria; Zambia
1985:	Argentina; Bolivia; Dominican Republic; Ecuador; Egypt; Haiti; Iran; Lebanon; Libya; Nicaragua; Peru; Philippines; Sri Lanka; Sudan; Syria; Zambia
1990:	Haiti; Lebanon; Sudan; Zambia
1995:	Sudan
Countries with an intermediate level of financial risk	
1980:	Cameroon; Egypt; Greece; Indonesia; Israel; Jordan; Kenya; Kuwait; Malawi; Mexico; Morocco; Pakistan; Panama; Paraguay; Portugal; Senegal; South Africa; Spain; Sri Lanka; Tanzania; Thailand; Togo; Tunisia; United Arab Emirates
1985:	Brazil; Cameroon; Costa Rica; Greece; Indonesia; Israel; Jamaica; Jordan; Kenya; Kuwait; Malawi; Mexico; Morocco; Pakistan; Panama; Paraguay; Senegal; South Africa; Tanzania; Thailand; Togo; Tunisia; United Arab Emirates
1990:	Argentina; Bolivia; Brazil; Cameroon; Costa Rica; Dominican Republic; Ecuador; Egypt; Greece; 1990; Israel; Jamaica; Jordan; Kenya; Kuwait; Libya; Malawi; Morocco; Nicaragua; Pakistan; Panama; Peru; Philippines; Senegal; South Africa; Sri Lanka; Syria; Tanzania; Togo; Tunisia; United Arab Emirates
1995:	Argentina; Bolivia; Brazil; Cameroon; Dominican Republic; Ecuador; Greece; Haiti; Indonesia; Kenya; Lebanon; Malawi; Mexico; Nicaragua; Pakistan; Panama; Peru; Philippines; Senegal; Sri Lanka; Syria; Tanzania; Togo; Tunisia; Zambia
2000:	Argentina; Australia; Bolivia; Brazil; Cameroon; Dominican Republic; Ecuador; Greece; Haiti; Iceland; Indonesia; Jamaica; Kenya; Lebanon; Malawi; New Zealand; Nicaragua; Pakistan; Panama; Philippines; Portugal; Senegal; Sri Lanka; Sudan; Tanzania; Togo; Tunisia; United States; Zambia
Countries with low financial risk	
1980:	Australia; Austria; Belgium; Canada; Denmark; Finland; France; Germany; Hong Kong; Iceland; Ireland; Italy; Japan; Netherlands; New Zealand; Norway; Singapore; Sweden; Taiwan; United Kingdom; United States
1985:	Australia; Austria; Belgium; Canada; Denmark; Finland; France; Germany; Hong Kong; Iceland; Ireland; Italy; Japan; Netherlands; New Zealand; Norway; Portugal; Singapore; Spain; Sweden; Taiwan; United Kingdom; United States
1990:	Australia; Austria; Belgium; Canada; Denmark; Finland; France; Germany; Hong Kong; Iceland; Indonesia; Ireland; Italy; Japan; Mexico; Netherlands; New Zealand; Norway; Paraguay; Portugal; Singapore; Spain; Sweden; Taiwan; Thailand; United Kingdom; United States
1995:	Australia; Austria; Belgium; Canada; Costa Rica; Denmark; Egypt; Finland; France; Germany; Hong Kong; Iceland; Iran; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kuwait; Libya; Morocco; Netherlands; New Zealand; Norway; Paraguay; Portugal; Singapore; South Africa; Spain; Sweden; Taiwan; Thailand; United Arab Emirates; United Kingdom; United States
2000:	Austria; Belgium; Canada; Costa Rica; Denmark; Egypt; Finland; France; Germany; Hong Kong; Iran; Ireland; Israel; Italy; Japan; Jordan; Kuwait; Libya; Mexico; Morocco; Netherlands; Norway; Paraguay; Peru; Singapore; South Africa; Spain; Sweden; Syria; Taiwan; Thailand; United Arab Emirates; United Kingdom

Notes: The table lists which country belongs to a certain financial risk class during a certain time period.