Financial Integration and Global Imbalances

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Financial Integration and Global Imbalances

Financiële integratie en mondiale onevenwichtigheden

Thesis

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by

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Contents

1 Introduction

The purpose of the financial market is to bring buyers of financial assets together, put a price on time, liquidity and global trade, transfer risks and raise capital. The extent to which this is possible is very much affected by the degree of financial market integration. Financial integration facilitates more efficient capital allocation and risk sharing, and can lead to improved governance and higher growth (Terrones et al. (2003)). It can also have an impact on the relationship between consumption and wealth by relaxing the liquidity constraints of consumers. There are however also adverse effects of financial integration, such as increased risks of financial contagion and sudden stops of capital flows. Financial integration also enables the build-up of larger imbalances, which might increase economic and financial market volatility.

This thesis looks at how financial integration and imbalances, either global or domestic, affect macroeconomic and macrofinancial outcomes such as exchange rate sensitivity, consumption, international consumption risk sharing or financial sector development. In addition, it also uses a more appropriate approach to estimate the degree of risk sharing and to establish the long run linkages between consumption and wealth. The thesis includes an introductory chapter and four empirical articles, where the first study in Chapter 2 looks at how the composition of net foreign assets affects the exchange rate sensitivity to global financial market uncertainty, Chapter 3 uses an unobserved component approach to show how financial integration has impacted the long run relationship between consumption and asset and housing wealth, Chapter 4 studies how financial integration and inclusion affects international consumption risk sharing, and Chapter 5 looks at how deposit dollarization affects financial development.

The contribution of Chapter 3 is more methodological and shows that financial integration has increased the consumption-to-wealth ratio. Chapters 2, 4 and 5 instead highlight some of the shortcomings of the financial markets and conclude that both external and domestic imbalances can have negative effects on both the real economy and the financial sector: External imbalances in the form of large net external debt financing in relation to equity may give rise to exchange rate vulnerabilities (Chapter 2); a domestic imbalance in the form of a large share of hand-to-mouth households or high income inequality (which might prevent a large share of the population from entering the international financial markets) and a lack of financial reforms have negative effects in terms of reducing international consumption risk sharing (Chapter 4); and a domestic imbalance between deposit and credit dollarization reduces financial development (Chapter 5). Thus, both domestic and external imbalances and the lack of financial liberalization and integration can lead to increased vulnerabilities and lower welfare.

More specifically, in the first study in Chapter 2 I look at how the composition of net foreign assets affect the exchange rate sensitivity to changes in financial market risk tolerance. Using a panel of 28 currencies over the period 1/1997-6/2016 I show that debt financing increases the exchange rate sensitivity to financial turbulence, whereas equity financing reduces it. Thus, debt financed imbalances give rise to much larger swings in the exchange rate during financial market turbulence, whereas currencies of countries with more FDI or equity financing are much less vulnerable to international financial uncertainty. I also look at whether this vulnerability differs between different owners, and find that private net foreign debt heightens the exchange rate sensitivity much more than public.

Chapter 3, which is co-authored with Lorenzo Pozzi, shows that financial integration has affected the long run relationship between consumption and wealth using a more appropriate methodology than the previous literature. The most common approach to determine the long-run impact of household wealth on household consumer expenditures is to estimate a log-linear version of the household intertemporal budget constraint as a cointegrating relationship. The evidence in favor of a stable cointegrating relationship between consumption, assets and earnings is however weak. Hence, elasticity estimates based on such regressions are unreliable. This chapter follows an alternative empirical approach using an unobserved component model applied to US data over the period 1951Q4-2016Q4, where the regression of consumption on assets and earnings is augmented with a non-stationary unobserved component. By explicitly estimating - hence controlling for – such a component in the regression, valid long-run elasticity estimates of consumption to wealth can be obtained irrespective of whether consumption, assets and earnings are cointegrated. Our results suggest that there is a non-stationary latent component present in the consumption equation, and we interpret this component as stemming from financial liberalization. By relaxing liquidity constraints of consumers, we find that financial integration has permanently increased the consumption-to-wealth ratio over the sample period.

Chapter 4 empirically looks at how much consumption risk developed, emerging and developing countries share internationally, and whether international consumption risk sharing is affected by financial liberalization, integration and the share of hand-to-mouth consumers in the countries. International consumption risk sharing should allow countries to internationally diversify away consumption risks, which should lead to smoother consumption growth rates and thereby higher welfare. In a panel of 120 countries from 1970 to 2014, I find that risk sharing is significantly higher in advanced countries than in emerging or developing economies. I show that financial liberalization and financial integration has a significantly positive impact on international consumption risk sharing in poorer developing countries, whereas emerging market countries seem to have gained less from it. I also find evidence that a high share of low income individuals or high income inequality reduces consumption smoothing in less developed countries. Lack of financial reforms, a lower degree of financial integration and higher household poverty rates thus partly explain why the degree of risk sharing is lower in developing countries than in advanced economies. Like in Chapter 3, I also find that the international consumption risk sharing relationship is subject to an unobserved component, which has a differential impact on the countries in the sample. A second contribution of this paper is thus using a more appropriate estimation method when analyzing international consumption risk sharing.

Chapter 5, which is co-authored with Geoffrey Bannister and Jarkko Turunen, looks at whether dollarization has a positive or negative impact on financial development. In this chapter we study the impact of financial dollarization, differentiating between the impact of foreign currency deposits and credit dollarization, on financial depth, access and efficiency for a sample of 77 emerging market and developing countries over the past two decades. Panel regressions estimated using system GMM show that deposit dollarization, and also the mismatch between aggregate deposit and credit dollarization, has a negative impact on financial deepening and financial efficiency. Credit dollarization does not however have a similarly negative impact on financial development. This finding that deposit dollarization and the dollarization mismatch reduces financial depth and efficiency could be explained by the observation that banks tend to export the foreign currency rather than extend foreign currency loans to the economy in case the demand for foreign currency loans is low, which in turn would lead to lower credit growth and higher net interest margins. The results suggest that beyond standard concerns related to heightened financial stability risks, policy efforts to reduce dollarization can spur faster, safer and more inclusive financial development.

2 Linking net foreign portfolio debt and equity to exchange rate movements

2.1 Introduction

There have been large swings in both the financial sector's risk appetite and in exchange rates during the past 10 years, and many countries with large negative net foreign asset positions have seen their currencies depreciate sharply during times of global financial market turbulence. Several central banks, especially in emerging markets, responded to this by conducting substantial currency interventions to dampen the exchange rate movements and volatility. Different types of external capital are however heterogeneously influenced by global risk, and the country's underlying foreign debt and asset structure might affect the way the exchange rate reacts to financial market turmoil. This paper therefore empirically disentangles how the composition of net foreign assets impacts the sensitivity of exchange rates to global financial market uncertainty. As many central banks are concerned about the impact of global financial market shocks on their countries' exchange rates, a full understanding of these mechanisms are important for both policy design and evaluation, and for predicting future exchange rate movements.

Gabaix and Maggiori (2015) recently proposed a theory of exchange rate determination based on global imbalances and resulting capital flows in imperfect financial markets. Financiers absorb the global currency demand imbalances and currency risk stemming from international trade and financial flows. As the financiers' risk-bearing capacity is limited, currencies of countries with large external debts must offer high expected returns to compensate for the resulting currency risk. Balance sheet changes of the financial institutions will impact the pricing (or level) of foreign

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currency lending, which in turn affects the exchange rate.[1] Della Corte et al. (2016) indirectly prove the theory of Gabaix and Maggiori (2015) by showing that countries' external imbalances can explain cross-sectional variation in currency excess returns. They hypothesize that net debtor countries must offer a currency risk premium in order to compensate investors for taking on the risk and financing the negative external imbalances, as their currencies tend to depreciate when risk taking is limited. The vulnerabilities are moreover larger for countries with large foreign currency liabilities, as currencies of countries with difficulties issuing local currency debt tend to be riskier. Habib and Stracca (2012) also empirically confirm that currencies with large external imbalances are more vulnerable to swings in the global risk sentiment. This can also be related to the sudden stop literature that looks at the factors giving rise to sudden capital flow reversals. That literature has established that external "push" factors are the main drivers of capital flows, whereas the magnitude of such flows are determined by domestic "pull" factors (see e.g. Calvo et al., 1993; Fernández-Arias, 1996; Ghosh et al., 2014).

The empirical literature has argued that international capital flows to both advanced and emerging market economies are procyclical and tend to amplify business cycle fluctuations.[2] However, not all types of capital flows are equally procyclical. Brunnermeier et al. (2012) note that aggregate FDI and net portfolio equity flows are generally fairly stable over the financial business cycle. This is partly due to a different investor base, but mainly because in a financial crisis the foreign equity investors absorb the valuation losses, which combined with a local currency depreciation discourages portfolio equity outflows. Foreign subsidiaries moreover often maintain access to credit through their parent companies during crises, which ameliorates the capital outflow and exchange rate effect (Blalock and Gertler, 2008). Debt flows, on the other hand, portray strong procyclicalities. A large share of the debt inflow is intermediated by banks, and bank lending responds not only to the credit worthiness of the project, but also to the bank's balance-sheet capacity. Moreover, debt is subject to maturity mismatch risk as investors may choose to not roll over maturing debt under uncertain market conditions. Consequently, currencies of countries with large outstanding net debt liabilities tend to be more vulnerable to changes in the banking sector risk bearing capacity or the global risk sentiment than countries with the equivalent net portfolio equity and FDI liabilities. The crash risk for the currency

[1] Gabaix and Maggiori (2015) note that active exchange rate risk taking is greatly concentrated among a small number of large financial firms. About 80 % of the exchange rate flows in 2014 was concentrated among the 10 largest banks, and currency risks also account for a large share of these institutions' overall respective risk taking. According to Deutsche Bank's and Citigroup's regulatory findings, currency risk accounted for 17-35 % of total stressed value at risk in 2003. Hence, changes in the risk-bearing capacity of these large financial institutions can have potentially large impacts on the foreign exchange markets. Moreover, there is some evidence in the previous literature that financial institutions absorb a part of the currency risk, see e.g Tai (2005) or Martin and Mauer (2003).

[2] See Kaminsky et al. (2004), Brunnermeier et al. (2012) Bluedorn et al. (2013), Araujo et al. (2015)

with large negative net portfolio debt positions should therefore be higher, which would translate into a higher currency risk premia. Within the sudden stop literature Levchenko and Mauro (2007) find that especially FDI but also portfolio equity flows are fairly stable during sudden capital flow stops, whereas portfolio debt and other flows (such as bank loans and trade credits) experience substantial reversals.

This paper extends the empirical exchange rate and excess currency return literature that focusses on the impact of global imbalances and the financial sector risk-bearing capacity in several ways. Studies such as Brunnermeier et al. (2012), Lustig et al. (2011), Menkhoff et al. (2012) have documented a significant relationship between global risk and excess currency returns or currency movements. Many previous studies have looked at the exchange rate impact of international capital flows[3], but fewer studies have looked at the exchange rate impact of a change in the global risk tolerance, conditional on this country's net foreign asset position. To the best of my knowledge, no study has yet properly looked at how the composition of net foreign assets affects the impact of financial market uncertainty on the exchange rate.

In a panel study of 25 exchange rates against the USD over the period 1/1997-6/2016, I identify which types of net foreign assets that increase the exchange rate sensitivity to global risk intolerance. I disentangle how the relationship between the financial sector risk bearing capacity and different types of foreign capital, such as portfolio debt, equity, FDI and other investments, affects currency excess returns and the exchange rate. I differentiate between private and public net foreign assets and investments, as both public and private investors, but also investors in private and public debt, generally have different investment horizons and risk bearing capacities. I moreover show how the relationship between risk intolerance, net foreign assets and exchange rates differ between G10 and emerging market currencies, and finally I determine how this relationship has changed over the sample period.

My main findings are that the composition of the net foreign asset position matter for both the excess currency return and exchange rate sensitivity to changes in global financial market risk tolerance. Currencies of countries with large net external debt liabilities, and especially portfolio debt liabilities, are most sensitive to changes in the financial market risk appetite and banking sector risk. These currencies tend to depreciate far more in response to a surge in financial market risk intolerance than countries with smaller net external debt liabilities. Moreover, I find that currencies of countries with the equivalent negative net foreign equity position are much less affected by changes in the global risk sentiment. Due to these offsetting exchange

[3]E.g. Gourinchas and Rey (2007), Alquist and Chinn (2008), Della Corte et al. (2012), Aizenman and Binici (2015) all suggest that net foreign assets have an impact on nominal exchange rates. Ricci et al. (2013) and many others have investigated the same impact on real exchange rates.

rate effects of the external debt and equity positions, the negative impact of financial market imbalances is underestimated if we look only at the total net foreign assets. Secondly, I find that the ownership of the net foreign assets affects the exchange rate sensitivity. Private net foreign liabilities, and especially private net foreign debt, increase the exchange rate vulnerability much more than public net foreign debt. Thirdly, although the emerging market currencies are in general more sensitive to changes in the global financial market volatility index VIX, the net foreign asset position has a smaller impact on the total effect of a change in risk intolerance on the exchange rate. Thus, emerging market currencies seem to react more to a change in risk intolerance, regardless of their underlying net foreign asset position. Finally, I find that the relationship between banking sector risk intolerance, net external assets and exchange rates has become stronger over time, and especially after the great financial crisis.

These results are important for risk calculations and hedging decisions, but they also have important policy implications. In the past, many central banks[4] have engaged in currency interventions in order to smooth exchange rate volatility during times of financial turmoil. These results suggest that policy makers concerned about a high exchange rate sensitivity to global financial uncertainty could reduce this vulnerability by facilitating a shift from debt to equity liabilities. As there are substantial differences in how debt and equity investments are taxed in most countries, there is ample scope for intervention.

These results are also important for the evaluation of financial market reforms. Many emerging market economies have substantial restrictions on foreign ownership of debt, but especially equity products. When evaluating the costs and benefits of opening up the local financial markets to foreign investors, like for example Saudi Arabia is currently doing, these findings provide important information on the heterogeneous impacts of foreign debt and equity ownership on the exchange rate. From a financial stability perspective it is crucial for policy makers to know which types of liabilities that increase the exchange rate vulnerability to the global financial markets, and which types of assets have a palliative impact. Finally, my findings are also interesting from a corporate finance perspective. Modigliani and Miller (1958) state that if financial markets are complete, the liability structure should not affect the value of a firm. If this logic is transferred to the aggregate level, the value of a country's assets should not depend on its debt/equity ratio. However, as the price that investors are willing to pay for a country's currency depends on the underlying capital structure in the economy, this implies that the Modigliani-Miller theorem does not hold on the aggregate level.

[4]This includes among others the central banks of Mexico, Brazil, India, Malaysia, Indonesia, Russia, Poland, Japan and Switzerland.

The rest of the paper is structured as follows: Section 2.2 describes the theoretical framework underlying the model and how different types of capital might affect the relationship between global risk tolerance and exchange rates. Section 2.3 describes the method and models, Section 2.4 describes the data, Section 2.5 presents and discusses the results and Section 2.6 concludes.

2.2 Theoretical framework

2.2.1 Gabaix and Maggiori's (2015) exchange rate model

The empirical model for this study is inspired by Gabaix and Maggiori's (2015) two country model with imperfect markets, where exchange rates are financially determined by capital flows and the financial sector's risk bearing capacity. In their model, households produce tradeable and nontradeable goods, trade in the frictionless international goods market and invest with financiers in nominally risk-free bonds. The international capital flows resulting from households' investment decisions are intermediated by financiers, who bear the resulting currency risk. The exchange rate s_t is determined by the demand and supply of capital denominated in the different currencies, where s_t is defined as the quantity of U.S. dollars bought by 1 unit of foreign currency. Thus, s_t determines the strength of the foreign currency and $\Delta s > 0$ implies an appreciation of the foreign currency. The financiers are subject to financial constraints, which limit their risk-bearing capacity and induce them to demand a premium for taking on the currency risk. Financiers' ability to bear risk is denoted by Γ, where a higher Γ (i.e. lower $\frac{1}{\Gamma}$) implies lower financier risk-bearing capacity.

This imperfect risk-bearing capacity creates a demand function for foreign assets. By solving the financiers' constrained optimization problem for a two period model, they arrive at the financiers' aggregate demand for assets:

$$Q_0 = \frac{1}{\Gamma} E\left[s_0 - s_1 \frac{R^*}{R}\right] \tag{2.1}$$

The financiers aggregate demand for dollar assets Q_0 is decreasing in the strength of the dollar (s_0, where a higher s implies a weaker USD) and the foreign risk-free interest rate R^*, and is increasing in the U.S. interest rate R and the expected future value of the dollar (s_1).

U.S. exports to the foreign country in time t are denoted as ξ_t, ι_t are the time t U.S. imports from the foreign country, and the dollar value of the exports is $\xi_t s_t$. Total U.S. net foreign assets or net exports in the two period model are thereby defined as $NFA_t = \xi_t s_t - \iota_t$, where a surplus in the first period has to be offset by a deficit in the second. The market clearing conditions (and the equilibrium USD "flow" demand) in period 0 and 1 for the USD against the foreign currency, which states that the net demand for dollar must be zero, are:

$$\xi_0 s_0 - \imath_0 + Q_0 = 0 \qquad \text{and} \qquad \xi_1 s_1 - \imath_1 + RQ_0 = 0 \tag{2.2}$$

By combining equations (2.1) and (2.2) and making the simplifying assumptions $R^* = R = 1$ and $\xi_t = 1$ for $t = 0, 1$ to focus on the key results, Gabaix and Maggiori (2015) reach the following expression for the period 0 exchange rate:

$$s_0 = \frac{(1+\Gamma)\imath_0 + E[\imath_1]}{2+\Gamma} \tag{2.3}$$

The exchange rate is thus affected by the foreign asset position ($\imath_0$ and $\imath_1$) and the financial sector risk intolerance Γ. The net foreign asset position at the end of the period 0 can be rewritten as $NFA_0 = \xi_0 s_0 - \imath_0 = \frac{E[\imath_1]-\imath_0}{2+\Gamma}$. This implies that if the U.S. has a positive NFA_0, and is thereby financing the deficit in the foreign country, the financiers are long the foreign (debtor) currency and short the creditor currency, i.e. the US dollar. The financiers need compensation for taking on this resulting risk, and for them to be willing to absorb the currency risk they must expect the foreign currency to appreciate.[5] This "required" appreciation can occur if the foreign currency depreciates in time 0.

According to their Proposition 2, the impact of a change in the financial sector risk bearing capacity Γ on the exchange rate s_0 is thus the following:

$$\frac{\partial s_0}{\partial \Gamma} = \frac{-NFA_0}{2+\Gamma} \tag{2.4}$$

This result implies that if there is a sudden worsening of the financier's risk-bearing capacity or a financial disruption, i.e. $\Gamma \uparrow$, countries with a negative net foreign asset position ($NFA_0 < 0$) see a currency depreciation against the foreign currency ($s \uparrow$), whereas countries with positive net foreign assets appreciate. If we consider NFA fixed and treat (2.3) as a function of only Γ, $f(\Gamma)$, by using approximation by differentials we can use $ds_0 \approx \Delta s_0$, where

$$\Delta s_0 = f'(\Gamma)\Delta\Gamma = \frac{-NFA_0}{2+\Gamma}\Delta\Gamma \tag{2.5}$$

The same results are reached if $R^* \neq R \neq 1$ is assumed and when the time frame is extended to three periods. A positive interest rate difference between the debtor and creditor countries would provide incentives for the international investors to finance the imbalance. During times of worsening funding conditions, the resulting exchange rate depreciation would thus be dampened by a higher debtor interest rate.

[5]This can be related to the carry trade, where investors borrow in a low interest rate currency and invest it abroad under the expectation of obtaining both an interest rate and currency return.

2.2.2 Different types of foreign capital

There are many different types of foreign assets that differ both in their investor base and sensitivity to global risk tolerance. Gabaix's and Maggiori's (2015) conclusion that the net foreign asset position affects the way currencies react to changes in the financial sector risk bearing capacity holds also when different types of net foreign assets are considered. When foreign debt is added to the model, the impact of a change in Γ on s is:

$$\frac{\partial s_0}{\partial \Gamma} = \frac{-NFA_0^L}{2+\Gamma} + \frac{-NFA_0^D}{2+\Gamma}$$

where NFA_0^L denotes the net foreign loans and NFA_0^D the net foreign debt position needed to finance the imbalance at the end of period 0.

Foreign assets are often separated into debt and equity instruments, or into more granular classifications such as direct investment, portfolio equity, portfolio debt and so called "other" investments which includes bank loans etc. Although equity can be thought of as a debt instrument with infinite maturity, there are however some substantial differences between these two external sources of financing. Debt creates leverage, whereas equity does not. Equity financing involves more risk and profit sharing than debt financing, and debt provides external financing at a fixed cost whereas for equity the cost of capital varies.

Not all types of foreign assets are equally influenced by the global risk sentiment or the financial sector risk bearing capacity. Brunnermeier et al. (2012) explain that foreign debt flows tend to be much more influenced by the global financial cycle than FDI and foreign equity flows. One reason for this is the different investor base. A large share of the debt inflow is intermediated by banks, and bank lending responds not only to the credit worthiness of the project, but also to the bank's balance-sheet capacity. During times of higher global risk intolerance, less external debt is therefore issued. Moreover, during times of high global risk intolerance some of the existing foreign debt is not rolled over when maturing, but instead repatriated to the foreign financial institution causing capital outflows. Portfolio debt issued by banks might also be more affected by business cycle fluctuations than trade credits, which might make currencies of countries with large foreign debt liabilities more sensitive to global financial market turbulence. Consequently, debt intermediated by the banking sector is highly procyclical and more volatile than non-bank debt flows. Additionally, as equity investments allows for greater risk sharing between creditor and borrower than debt investments, this increases the riskiness of (portfolio) debt investments compared to equity and makes debt investments more susceptible to outflows during times of low financial market risk tolerance.

Foreign equity flows are much less affected by the global risk sentiment. In a crisis, the foreign equity investors suffer both valuation losses, often in combination with a weaker local currency, which discourages portfolio equity outflows. FDI investments are often sunk in more illiquid assets, and equity related to FDI is likely to be done by investors with longer term investment horizons and is therefore less influenced by the business cycle than portfolio investments. Moreover, FDI and equity investors, often corporations, pension funds or mutual funds, are typically less or not at all leveraged, which reduces the risk of sudden stops or reversals. As international debt liabilities are more affected by global risk intolerance than international equity liabilities, an increase in global risk aversion will lead to much larger capital outflows from countries with large debt liabilities than from countries with large equity liabilities.[6] This explains why, consequently, currencies of countries with large outstanding net portfolio debt are more vulnerable to changes in the banking sector risk bearing capacity or the global risk sentiment than countries with the same amount of net portfolio equity and FDI. When considering the impact of financial market risk intolerance on the exchange rate, it is therefore necessary to take into account the type of assets and liabilities making up a countries' net foreign asset position.

Net foreign assets generally consist of both private and public foreign assets and liabilities. The foreign creditors financing public and private debt are also likely to differ, as private foreign debt is generally perceived as being riskier than government debt. The higher risk excludes many pension funds and other low risk investors that generally are less leveraged from investing in the private debt market. Moreover, many insurance or pension funds are required to invest a substantial share of their holdings in low risk government bonds. If the investor base for government bonds and liabilities is less leveraged or has a longer investment horizon than the investor base for private debt, this might lead to smaller international capital flows in response to higher risk intolerance. This would in turn mean that the exchange rate is also less affected by sudden financial market turbulence, which is indeed what I find.

2.3 Method

This section outlines the empirical strategy for studying the dynamics between changes risk intolerance, different types of global imbalances and the exchange rate or excess currency returns. As demonstrated in equation (2.4), the impact of a change in risk intolerance on the exchange rate depends on the net foreign asset position (NFA) of the country. This study tests this hypothesis empirically with help of an interaction model that disentangles the exchange rate effect of a change in risk intolerance, RI, given the net foreign asset position, where RI can be thought of as a proxy for Γ. After having done this, the NFA position is split into Net Total Debt and Net Total Equity investments, and finally into different net portfolio, net FDI and net other

[6] Investments in safe haven currencies such as the JPY, USD and CHF tend however to be exceptions.

assets, in order to see whether the underlying asset structure has an effect on the exchange rate impact.

The variable s_t stands for the log spot exchange rate in the period t in units of USD (home currency) per foreign currency. Thus, $\Delta s > 0$ implies an appreciation of the foreign currency against the USD. f_t denotes the log forward rate in month t, $\Delta s_{t+1} = s_{t+1} - s_t$ and $fd_t = f_t - s_t$ represents the forward discount. If the covered interest rate parity (CIP) holds, the forward discount is approximately equal to the interest differential between the two countries, i.e. $f_t - s_t \approx i_{US} - i$. Monthly unconditional currency excess returns rx^u_{t+1} in period $t+1$ are defined as the return from buying a foreign currency in the forward market and then selling it in the spot market in the next period t:

$$rx^u_{t+1} = s_{t+1} - f_t = s_{t+1} - s_t + s_t - f_t = \Delta s_{t+1} - fd_t$$

The conditional excess currency returns, rx_{t+1}, are defined as the returns from assuming a long position in the foreign currency, $rx_{t+1} = s_{t+1} - f_t$ if $fd_t = f_t - s_t < 0$, (or $i > i_{US}$ if CIP holds), and a assuming a short position if $fd_t > 0$. Thus

$$rx_{t+1} = \begin{cases} s_{t+1} - f_t & \text{if } fd_t = f_t - s_t < 0 \\ f_t - s_{t+1} & \text{if } fd_t > 0 \end{cases} \tag{2.6}$$

If CIP holds, then this trade is equivalent to the carry trade of going long the foreign currency and short the USD if $i > i_{US}$ and vice versa.

2.3.1 Net foreign assets

The basic panel regression equations that look at the interaction of net foreign assets and financial sector risk intolerance[7] on exchange rate changes $\Delta s_{i,t}$ and excess returns $rx_{i,t}$ of currency i against USD in period t are based on equation (2.5), where the equation has been augmented with the constitutive terms of the interaction between net foreign assets to GDP ($nfa_{i,t}$) and the change in the global financial sector risk intolerance (ΔRI_t) and additional control variables. The baseline exchange rate and excess return models are thus:

$$\Delta s_{i,t} = \beta_0 + \beta_1 \Delta RI_t + \beta_2 (nfa_{i,t} \Delta RI_t) + \beta_3 nfa_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t} \tag{2.7}$$

$$rx_{i,t} = \beta_0 + \beta_1 \Delta RI_t + \beta_2 (nfa_{i,t} \Delta RI_t) + \beta_3 nfa_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t} \tag{2.8}$$

[7] As the indices for risk tolerance used in this study are decreasing in the level of risk bearing capacity, it is more intuitive for the interpretation of the results to talk about a risk intolerance index rather than risk tolerance.

where x_{it} is a vector containing the control variables, the β's and δ contain the estimated coefficients, γ_i is the currency fixed effect and $\varepsilon_{i,t}$ is the error term. It is however possible that it is not only the net foreign asset position that affects the exchange rate, but that the exchange rate also has an impact on the external debts and liabilities. In order to avoid this simultaneity problem, the beginning of period values of the net foreign asset positions are used[8].

As we have an interaction model the estimated coefficient β_1 tells us the exchange rate impact of ΔRI_t when $nfa_{i,t}$ is zero. During times of low financial risk tolerance, most currencies, with the exception of a few of so called "safe haven currencies", tend to depreciate and excess returns are lower. Therefore, I expect $\beta_1 < 0$.

The estimated coefficient on the interaction term β_2 is expected to be positive according to Proposition 2 (equation (2.4)) of Gabaix and Maggiori (2015); countries with negative nfa react stronger to increases in risk intolerance and depreciate more (remember that $\Delta s < 0$ implies foreign currency depreciation against the USD). When the risk bearing capacity of the financial sector is good (RI is low), then the excess returns of the net debtor currencies (i.e. countries with $nfa < 0$) are positive. However, during times of financial distress when risk intolerance increase, currencies with negative net external debt positions depreciate due to foreign capital outflows. Typically, this reduces excess returns as well. Thus, $\beta_2 > 0$ would indicate that negative net debt positions increases the exchange rate sensitivity to increases in risk intolerance. The total impact of ΔRI on exchange rate changes or excess returns is $\beta_1 + \beta_2 \overline{nfa}$, where $\overline{nfa}$ is the average nfa.[9]

The estimated coefficient β_3 on the constituent term $nfa_{i,t}$ tells us the exchange rate impact of $nfa_{i,t}$ when $\Delta RI_t = 0$. If negative net foreign asset positions lead to currency depreciation or lower excess currency returns when $\Delta RI_t = 0$, then $\beta_3 > 0$. However, if large negative net foreign asset positions leads to investors demanding consistently higher currency risk premias when $\Delta RI_t = 0$, $\beta_3 < 0$.

Control variables

Several control variables are included to ensure that the impact of changes in risk sentiment is correctly identified. As deviations from relative/absolute/trend PPP give rise to excess currency returns according to among others Coakley and Fuertes (2001), Habib and Stracca (2012), Jorda and Taylor (2012) and Hossfeld and MacDonald (2015), relative PPP ($PPP_{i,t}$) is also included. As mentioned in Rossi (2013), interest rate and inflation differentials have an impact on the exchange rate. Moreover, differences in economic outlooks might also affect the potential return differences in the stock market, which could also have an impact on the exchange rate. The dif-

[8]The results are also robust to the use of further lags of the net foreign assets.

[9]The standard error of this term is se($\beta_1 + \beta_2\overline{nfa}$) = $\sqrt{var(\beta_1) + \overline{nfa}^2 var(\beta_2) + 2\overline{nfa}\, cov(\beta_1, \beta_2)}$

ference in local stock market performance versus the US ($\Delta stock_{i,t} - \Delta S\&P$), inflation differentials ($\pi_{i,t} - \pi_{US,t}$) and 3 month interbank rate differentials ($i_{i,t} - i_{US,t}$) (or $fd_{i,t}$) are therefore included to control for yield differentials. To account for carry trade reversals, an interaction term between the interest differential and risk intolerance (here proxied by VIX), $(i_{i,t} - i_{US,t}) * VIX_t$, is also included like in Habib and Stracca (2012). Finally, log changes in central bank currency reserves ($\Delta Res_{i,t}$) are included to capture central bank currency interventions. As the exchange rate might have an effect on inflation, interest rates and stock markets, lags of all the control variables are used instead of the contemporaneous values to avoid possible simultaneity issues.[10]

2.3.2 Different types of foreign capital

Net total foreign debt and net total foreign equity

As explained above, not all types of foreign capital flows are procyclical and equally influenced by the global risk sentiment. To distinguish between the impact of different types of net foreign assets on the exchange rate change and excess returns, the variable nfa is split into 3 components; net total debt[11] ($nTotDebt$), net total equity[12] ($nTotEquity$) and foreign reserve assets (res). Net total debt and net total equity are the variables of interest and the change in central bank currency reserves, ΔRes, is included as a control variable in x. The empirical model for the exchange rate impact is presented below. The same model is also used to study the impact of different types of net foreign assets and risk intolerance on excess returns (rx).

$$\begin{aligned} \Delta s_{i,t} = \beta_1 \Delta RI_t + \beta_2 (nTotDebt_{i,t} \Delta RI_t) + \beta_3 (nTotEquity_{i,t} \Delta RI_t) \\ + \beta_4 nTotDebt_{i,t} + \beta_5 nTotEquity_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t} \end{aligned} \tag{2.9}$$

Currencies with negative net foreign debt assets are expected to be most affected by the global financial business cycle, as foreign banks often repatriate their capital during times of low risk tolerance, whereas equity investors are discouraged to sell their assets due to the depressed equity prices. The estimated coefficient on the interaction term including net total foreign debt is therefore expected to be positive, i.e. $\beta_2 > 0$. Moreover, I also expect β_2 to be larger in magnitude than β_3, as I expect net foreign equity liabilities to have a much smaller destabilizing exchange rate impact. The β_1 is again expected to be negative. The total effect of a change in global risk intolerance RI, as proxied either by VIX or TED, is thus $\beta_1 + \beta_2 \overline{nTotDebt} +$

[10] As inflation and the stock market returns are forward looking variables, it might be that current values of these are correlated with future nfa. To ensure that the results are not driven by inflation, stock market or interest rate expectations, for robustness further lags of these are also included in the model.

[11] Total debt assets include portfolio debt, FDI debt and other debt such as bank loans and deposits, other loans, trade credits and other accounts payable and receivable.

[12] Total equity assets include Portfolio equity, FDI equity and other equity.

$\beta_3 \overline{nTotEquity}$, where the bar denotes the averages of the series. β_4 and β_5 tell us the impact of $nTotDebt_{i,t}$ and $nTotEquity_{i,t}$ on $\Delta s_{i,t}$ when RI is unchanged.

Portfolio debt and equity

There are also substantial differences between different types of debts and equity. Equity related to FDI is likely to be done by investors with longer term investment horizons and could therefore be less influenced by the business cycle than portfolio equity. Also, portfolio debt issued by banks might also be more sensitive to business cycle fluctuations than trade credits. The net total debt and net total equity are therefore split into 4 components; net portfolio equity ($nPEquity$), net portfolio debt ($nPDebt$), net FDI ($nFDI$) and net "other" investment ($nOther$). The variables $nPDebt$, $nPEquity$, $nOther$ and $nFDI$ and their interaction with ΔRI are our variables of interest. The model allowing for a differential impact on exchange rate changes Δs (or excess returns rx) of the different assets is:

$$\begin{aligned} \Delta s_{i,t} &= \beta_1 \Delta RI_t + \beta_2 (nPDebt_{i,t} \Delta RI_t) + \beta_3 (nPEquity_{i,t} \Delta RI_t) \\ &+ \beta_4 (nFDI_{i,t} \Delta RI_t) + \beta_5 (nOther_{i,t} \Delta RI_t) + \beta_6 nPDebt_{i,t} \\ &+ \beta_7 nPEquity_{i,t} + \beta_8 nFDI_{i,t} + \beta_9 nOther_{i,t} + \delta x_{i,t-1} + \gamma_i + \varepsilon_{i,t} \end{aligned} \tag{2.10}$$

The total impact of a change in RI_t on $\Delta s_{i,t}$ is $\beta_1 + \beta_2 \overline{nPDebt} + \beta_3 \overline{nPEquity} + \beta_4 \overline{nFDI} + \beta_5 \overline{nOther}$, where the bars again signify averages. If portfolio debt is more highly affected by the risk bearing capacity of the financial market than portfolio equity and FDI, then the exchange rate of a country with larger net debt would react more strongly to a change in financial market risk intolerance. Therefore, the estimated β_2 on the interaction term including $nPDebt$ should be much larger than β_3 with $nPEquity$ and β_4 with $nFDI$. The category "other investment" includes a large share of bank loans. As new bank loans are highly influenced by banking sector risk tolerance, the estimated coefficient on the interaction term including $nOther$, β_5, is also expected to be positive and larger than β_3 and β_4.

Public and private net foreign debt

The net foreign assets consist of both private and public foreign assets and liabilities. The foreign creditors financing public and private debt are also likely to differ, both in their risk tolerance and investment horizon. If the investor base for government bonds and liabilities is less leveraged or has a longer investment horizon than the investor base for private debt, this might lead to smaller international capital flows in response to higher global risk intolerance. This, would in turn mean that the exchange rate would also be less affected by sudden financial market turbulence. Alfaro et al. (2014) also note that net public debt flows (sovereign-to-sovereign flows) are negatively correlated with growth in developing countries, whereas the correlation between net private capital inflows and growth is instead positive. As the different sources and recipients of external financing are heterogeneously related to the real economy, it could be that the exchange rate response is also affected by the ownership structure of the net foreign asset position. The exchange rate impact of the size of private ($PRIV$) and general government ($GOVT$) net foreign assets, net total debt, net portfolio debt and net other investments on the exchange rate is therefore considered separately as well. Finally as financial institutions might have different investment objectives than households and other corporations, the private net foreign assets are also separated into net foreign assets held by deposit taking financial institutions, $BANK$, and non-bank sectors (including households), $OSECT$.

Emerging markets versus G10 currencies

Bluedorn et al. (2013) note that net capital flows have been roughly equally volatile for emerging market and advanced economies since 1980. Emerging Market investments, both debt, equity and other investments, are however generally perceived as being riskier than investments in most of the advanced economies. The higher risk of emerging market investments compared to similar investments in the G10 currency countries[13] might attract a different foreign investor base and at the same time excludes some low risk investors that generally are less leveraged. Moreover, Bluedorn et al. (2013) note that net capital flows to emerging markets are driven primarily by foreign investors, whereas in advanced economies the net flows are driven by both foreign and domestic financiers. If the international investor base in the emerging markets is very different from the one in advanced economies, more leveraged or affected by the global financial business cycle, this might lead to larger international capital flows in response to higher risk intolerance. This, would in turn mean that the exchange rates of the emerging markets would be more affected by sudden financial market turbulence. The sample is therefore split into a G10 currency and an Emerging Market currency sample as well.

An evolving relationship

It is possible that the relationship between imbalances, risk-bearing capacity and exchange rates has changed over time for several reasons. First, financial innovation has led to a wider range of financial products, which allows for different investment (and hedging) opportunities, which could have an effect on the above mentioned relationship. Second, changes in financial openness, financial reforms and financial integration has also altered the characteristics of the capital flows between countries.

[13]The G10 currency countries are Australia (AUD), Canada (CAD), Eurozone (EUR), Japan (JPY), New Zealand (NZD), Norway (NOK), Sweden (SEK), Switzerland (CHF), UK (GBP) and USA (USD).

Third, changes in banking regulations (both global and domestic) after the recent financial crisis has also changed the amount and type of risk taking allowed by financial institutions. Finally, the global role of the emerging market economies has evolved over time, which could have had impacted the international capital flow dynamics. Also, it might be that the impact of financial market uncertainty was stronger during the financial crisis than in normal times due to additional negative spill over effects. I therefore investigate whether these dynamics have changed over time, and in particular during and after the financial crisis. The sample is therefore split into a pre financial crisis sample (1/1997-3/2007), a financial crisis sample (4/2007-12/2009) and a post-crisis sample (1/2010-6/2016).

2.4 Data

The analysis is done using monthly data for an unbalanced panel of 26 advanced (G10) and Emerging Market (EM) currencies over the period 1/1997 to 6/2016. The included countries and currencies are listed in Appendix A. Bilateral (end of period) exchange rates and 1 month forward rates against the USD are downloaded from Bloomberg. The included currencies are freely floating or at least subject to a managed float for most of the sample period. The observations for currencies which were temporarily subject to exchange rate pegs or strict capital controls, such as the 1.20 floor on EUR/CHF during 2011-2014, are excluded. The INR is excluded from 1/2014 onward due to the strict capital controls implemented by the Indian government since then. EUR is included from 1/1999 onwards. The excess returns rx are computed as outlined in 2.3 and the cross-sectional averages for both Δs and rx are presented in Figure 2.1. The correlation between Δs and rx in the sample is 0.66.

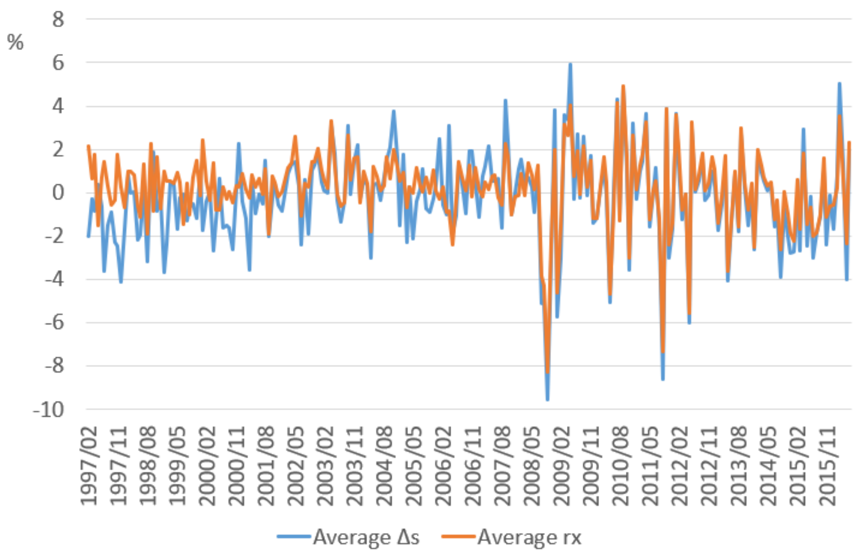


Figure 2.1: Average Δs and rx

External assets and liabilities

Data on total external assets and liabilities, FDI, external portfolio debt assets and liabilities and the subcomponents are collected from IMF's Balance of Payments and International Investment Position Statistics (BoP-IIP, 2016). As these data are only available at a quarterly frequency, the last known value is used until the data is updated next quarter. External assets is the USD value of the assets a country owns abroad, and external or foreign liabilities refers to the USD value of domestic assets owned by foreigners. Net foreign assets (nfa) is the difference between external assets and liabilities relative to GDP. Net total debt ($nTotDebt$), net total equity ($nTotEquity$), net portfolio debt ($nPDebt$), net portfolio equity ($nPEquity$), net FDI assets ($nFDI$) and net other investments ($nOther$) are defined in a similar manner and depicted in Figures 2.2 and 2.3. Net Total Debt consists of Portfolio investment: Debt securities, Direct investment: Debt instruments and Other investment: Currency and deposits, loans, Other accounts receivable, Trade credits and advances. Net Total Equity is in turn made up of portfolio investment: Equity and investment fund shares, Direct investment: Equity and investment fund shares, and Other investment: Other equity. Data for the holders of foreign liabilities and assets are also available for many of the countries in the sample. The underlying net foreign asset positions can therefore be split into net foreign assets or investments held either by the private sector (nfa^{PRIV}) or the general government (nfa^{GOVT}). The privately held net assets are in turn made up of assets and liabilities held by deposit taking corporations, labeled $BANK$, and other sectors, $OSECT$, which includes nonfinancial corporations, households, other financial corporations and other sectors. The private net foreign position is created by subtracting the private foreign liabilities from the private foreign assets, and the same applies to the other ownership positions.

Risk intolerance

This paper uses two different proxies for global financial sector risk intolerance, the VIX index and the TED spread. The volatility index VIX of the Chicago Board Options Exchange (CBOE) is a commonly used measure of financial sector risk, which measures the implied volatility of S&P 500 index options. Several papers have found that the VIX is closely related to different types of financial market risk and risk intolerance (Collin-Dufresn et al., 2001). A surge in the VIX index ($\Delta VIX > 0$) implies higher financial market volatility and typically higher market uncertainty and risk intolerance. The TED spread is generally used as a measure of the banking sector risk intolerance. The TED spread is the difference between the 3 month interest rates on interbank loans (LIBOR) and short-term government debt (T-bills). The TED spread can be seen as an indicator of credit or banking sector risk, as the short-term government debt can be considered risk free, whereas the interbank rate reflects the

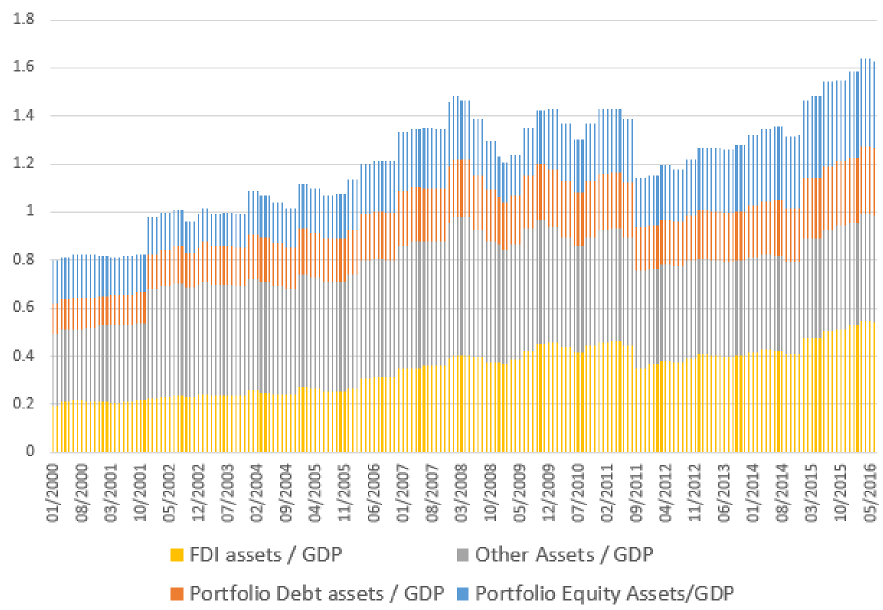


Figure 2.2: Different types of foreign assets in the sample

credit risk of borrowing to banks. An surge in the TED spread ($\Delta TED > 0$) signals increased interbank default risks, which implies that the banking sector risk bearing capacity is lower and risk intolerance is higher. This paper uses a weighted TED spread which combines the TED spreads of the US, UK, the Eurozone (Germany), Canada, Switzerland and Japan. The contribution of each country to the weighted TED spread is determined by their relative GDP. Data for the TED spreads and the VIX index are downloaded from Bloomberg. To make the VIX and TED series comparable, they are normalized to have a mean of 0 and a standard deviation of 1.

Control variables

As for the control variables, 3 month interbank interest rates and 1 year swap rates, inflation (CPI), output (GDP), PPP and stock market data are downloaded from Bloomberg. The interest rate differential is the 3 month interbank rate difference[14] between the foreign country and the US. The 1 year swap rate difference is used for robustness. The stock market differential captures the monthly differences between the main stock market index of the foreign country versus the US, and the inflation differential is the difference between foreign and US CPI.[15] The change in foreign currency reserves is defined as the change in foreign reserve assets relative to GDP.

[14] For Chile the 1 year swap rate difference is used instead of the interbank rate difference.

[15] To ensure that the results are not driven by a correlation with nfa and future inflation or stock market returns, as these might be forward looking, in the robustness check the models are also estimated with 4 month lags of the inflation and stock market return differentials.

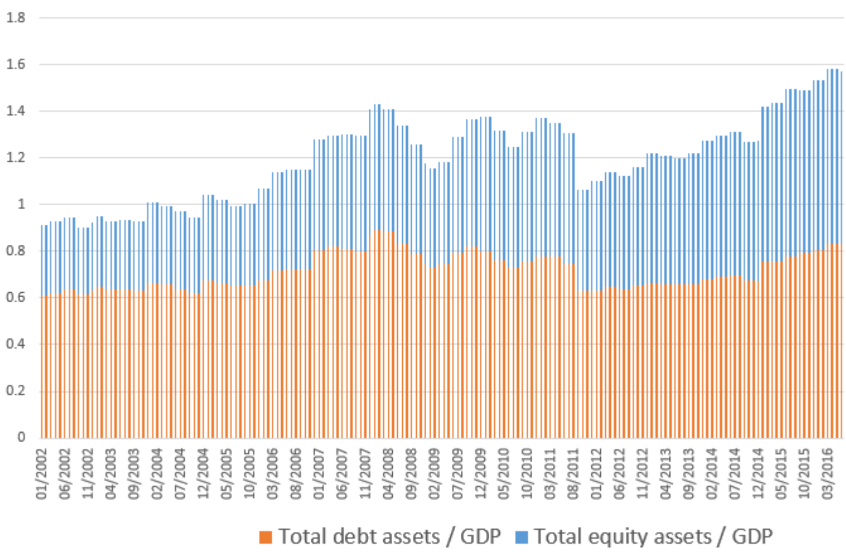


Figure 2.3: Total foreign debt vs. total foreign equity in the sample

2.5 Results

The results from models (2.7) - (2.10), which regress exchange rate changes or excess currency returns on net foreign assets, changes in risk intolerance and the interaction of these two are presented below. The models are estimated both without and with control variables[16] for the full sample, and for the subsamples of G10 and Emerging Market (EM) currencies. As it is possible that the impact of external assets and liabilities has changed over time due to either changes in financial market integration or regulation, or because the relationship might have been different during the great financial crisis, the sample is also split into three subperiods, one before the financial crisis, 1/1997-3/2007, a crisis period 4/2007-12/2009 and one after the financial crisis, 1/2010-6/2016.

2.5.1 Net foreign assets

First, the results from models (2.7) and (2.8) that look at the impact of total nfa on the exchange rate or excess returns are presented below. As can be seen from Table 2.1, the coefficients on the change in global risk intolerance ΔRI, as proxied either by an increase in financial market volatility, ΔVIX, or banking sector uncertainty, ΔTED, and on the interaction terms of nfa and a change in risk intolerance, are significant and of the expected sign. The negative estimated coefficient on ΔRI, $\hat{\beta}_1$, implies that an increase in RI leads to a significant currency depreciation against the USD (as $\Delta s < 0$ imply foreign currency depreciation) and a reduction in currency

[16]For the sake of space the control variables are not presented in the tables included in the text. The full tables with the control variables for a selection of the models can be found in the appendix.

excess returns rx in countries with zero net foreign assets.[17] When the sample is split into G10 and EM currencies, the same conclusion can be drawn and the Chow tests[18] does not reject the null hypothesis of no structural differences between the two subsamples.

The interaction effect of a change in risk intolerance, as measured either by ΔVIX or ΔTED, and nfa on both Δs and rx is significant in both the full, crisis and the post-crisis sample, and the coefficient on the interaction term is positive. The positive coefficients imply that countries with negative net foreign assets ($nfa < 0$) pay lower excess currency returns and depreciate in case of a sudden worsening of the financial market sentiment (ΔVIX or $\Delta TED > 0$). Countries with a positive net foreign asset position, on the other hand, experience a much smaller currency depreciation (if at all any) and pay relatively higher excess currency returns when risk intolerance increase.[19]

The total estimated impact on Δs or rx of a change in RI is $\hat{\beta}_1 + \hat{\beta}_2\overline{nfa}$. As an illustration, the results in column (ii) suggest that a one standard deviation increase in the VIX volatility index would depreciate currencies with no net foreign assets by 1.44 % against the USD. However, countries with negative net foreign assets will experience a much larger depreciation. For example Mexico, which has an average negative nfa among the net debtor countries, would depreciate by an additional 0.27 %-points against USD, so in total by 1.7 %. The exchange rate impact of the increase in VIX is thus almost 20 % larger for the MXN than for a country with zero net foreign assets. The effect on a net creditor currency like the Swiss franc, CHF, is the opposite. Due to its positive net foreign asset, the effect of a one standard deviation increase in the VIX index is much smaller and results in CHF depreciating by only 0.48 % against the USD. The total impact of a change in risk intolerance on the dependent variable, Avg. ΔRI impact, for the average nfa position is also reported in the tables. As the average nfa position in the sample is rather small (and globally it should be zero), the average ΔRI impact is however fairly close to the estimated impact of ΔRI for when $nfa = 0$.

The estimated interaction coefficients including ΔTED are all much smaller in magnitude compared to the ones including ΔVIX for the full sample, and the average impact of a change in VIX is in most cases twice as large compared to the

[17] A lagged dependent variable was initially included in the models, but as it was in most cases close to zero and rarely significant, and the panel Durbin Watson test indicates the absence of serial correlation, it was excluded. When lags of the interaction terms are added to the models, the sign of the estimated coefficients on lagged interaction variables are in most cases positive but insignificant.

[18] The Chow test for structural stability tests whether the true coefficients of the linear regressions on different datasets are identical.

[19] Proposition 7 in GM (2015) states that low risk bearing capacity in period 0 implies that the required expected currency returns must be higher for the financiers to be willing to undertake the investment. Lags of the change in the risk intolerance are used to test whether a drop in the risk bearing capacity in the previous period leads to higher excess currency returns. The results are however insignificant and not reported here.

same change in TED. The $\bar{R}^2$ is also substantially higher for the models using VIX to proxy risk intolerance as compared to the ones using TED. It thus seems like in the full sample between 1997-2016, the main channel through which large external debt positions affect the exchange rate or excess returns is via the change in financial market volatility and the uncertainty resulting from that, rather than via banking sector uncertainty. The same conclusion holds for the G10 and EM subsamples, presented in the lower panel of Table 2.1.

However, when the sample period is split into pre-, crisis and post-crisis periods in Table 2.2, this changes, and the Chow test points to structural instabilities in the relationship. After the financial crisis, the change in the TED spread seems to have a much larger exchange rate impact than before the crisis, and of similar magnitude as the VIX, as both the interaction coefficient in columns (x) and (xii) are much larger than in the pre-crisis and crisis models, and the $\bar{R}^2$ is also higher.[20] Thus, the impact of banking sector risk for the exchange rate vulnerability seems to have increased since the financial crisis. These results thus imply that a policy maker concerned about exchange rate volatility should be more alert when the private net foreign liabilities are large. Also, as the impact of the banking sector uncertainty has become stronger in the past years, this also warrants more attention now than 20 years ago.

The net foreign assets are finally split into private (nfa^{PRIV}) and general government holdings (nfa^{GOVT}), with the results for the full and the post-crisis sample presented in Table 2.3. The coefficients for the full and the post-crisis estimates are not significantly different from each other in the estimations involving ΔVIX, but the coefficients on the models including ΔTED are somewhat larger in the post-crisis period than in the full sample. The impact of private negative net foreign assets on the exchange rate sensitivity is much larger than that of negative public ones, as is suggested by the much larger and more significant coefficients on the interaction terms involving the private net external assets. Instead, negative government nfa holdings seem to ameliorate the exchange rate response to an increase in the TED spread, as suggested by the significantly negative interaction coefficient in column (iii) (although this is no longer the case in the post-crisis sample). When the positions are split into private net foreign assets held by the banking sector (nfa^{BANK}) and other sectors (nfa^{OSECT}), the results suggest that the effect is the largest for net foreign liabilities held by the banking sector. Thus, negative private net foreign assets seem to be the channel through which the vulnerability arises.

[20]Similar results are also obtained if the post-crisis sample starts in 2011 or 2012 after the onset and worst part of the European debt crisis.

	Full sample							
Dep. Var	Δs				rx			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	-1.520***	-1.438***			-1.602***	-1.449***		
	(0.090)	(0.086)			(0.091)	(0.087)		
ΔTED			-0.810***	-0.772***			-0.854***	-0.788***
			(0.114)	(0.116)			(0.118)	(0.119)
ΔVIX*nfa	0.882***	0.803***			0.911***	0.800***		
	(0.133)	(0.127)			(0.134)	(0.127)		
ΔTED*nfa			0.403**	0.401**			0.436**	0.421**
			(0.172)	(0.167)			(0.175)	(0.170)
nfa	0.228	-0.014	0.269	0.000	0.233	-0.017	0.274	0.006
	(0.227)	(0.235)	(0.231)	(0.242)	(0.233)	(0.240)	(0.237)	(0.247)
Avg.ΔRI impact	-1.606***	-1.516***	-0.849***	-0.810***	-1.690***	-1.527***	-0.897***	-0.829***
	(0.10)	(0.09)	(0.12)	(0.12)	(0.10)	(0.09)	(0.13)	(0.13)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
N	25	25	25	25	25	25	25	25
T	233	233	233	233	233	233	233	233
Obs	5,175	4,861	5,175	4,861	4,959	4,752	4,959	4,752
$\bar{R}^2$	0.082	0.115	0.012	0.053	0.092	0.132	0.013	0.070
DW	1.97	2.05	1.94	2.01	1.98	2.06	1.95	2.02

	G10 currencies				**EM**			
Dep. Var	Δs		rx		Δs		rx	
	(ii)	(iii)	(vi)	(vii)	(ii)	(iii)	(vi)	(vii)
ΔVIX	-1.208***		-1.209***		-1.623***		-1.647***	
	(0.134)		(0.135)		(0.106)		(0.107)	
ΔTED		-0.537***		-0.535***		-0.977***		-1.023***
		(0.167)		(0.167)		(0.158)		(0.166)
ΔVIX*nfa	1.048***		1.051***		0.517***		0.502***	
	(0.233)		(0.233)		(0.130)		(0.129)	
ΔTED*nfa		0.558*		0.557*		0.145		0.156
		(0.316)		(0.316)		(0.169)		(0.173)
nfa	-0.711*	-0.784*	-0.740*	-0.813**	0.361	0.409	0.625**	0.716**
	(0.395)	(0.406)	(0.396)	(0.406)	(0.293)	(0.300)	(0.300)	(0.308)
Avg.ΔRI impact	-1.185***	-0.525***	-1.186***	-0.523***	-1.718***	-1.003***	-1.739***	-1.052***
	(0.10)	(0.09)	(0.10)	(0.09)	(0.15)	(0.15)	(0.25)	(0.22)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9	9	9	9	16	16	16	16
T	233	233	233	233	233	233	233	233
Obs	1,930	1,930	1,930	1,930	2,931	2,931	2,822	2,822
$\bar{R}^2$	0.093	0.047	0.096	0.049	0.136	0.065	0.162	0.091
DW	2.04	2.01	2.04	2.00	2.06	2.01	2.07	2.03
Chow	1.19	1.16	1.16	1.13	1.19	1.16	1.16	1.13

Note: White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\,\overline{nfa}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation and Chow to the Chow test for poolability of the EM and G10 sample, with H_0 : no structural difference between the samples.

Table 2.1: Panel regression of models (1) and (2)

	Before the crisis, 1/1997-3/2007				Crisis, 4/2007-12/2009				After the crisis, 1/2010-6/2016			
Dep. Var	Δs		rx		Δs		rx		Δs		rx	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
ΔVIX	-0.363**		-0.372***		-2.524***		-2.551***		-1.418***		-1.432***	
	(0.142)		(0.144)		(0.247)		(0.247)		(0.119)		(0.119)	
ΔTED		-0.341**		-0.351**		-1.088***		-1.100***		-1.383***		-1.387***
		(0.141)		(0.151)		(0.213)		(0.213)		(0.348)		(0.348)
ΔVIX*nfa	1.014***		0.966***		0.843***		0.852***		0.603***		0.606***	
	(0.218)		(0.215)		(0.299)		(0.298)		(0.165)		(0.165)	
ΔTED*nfa		0.068		0.059		0.404*		0.404*		0.853		0.848
		(0.235)		(0.241)		(0.237)		(0.237)		(0.548)		(0.547)
nfa	0.859***	0.872***	0.939***	0.950***	3.082**	3.819**	3.096**	3.845**	1.247*	1.496*	1.257*	1.510*
	(0.317)	(0.316)	(0.305)	(0.304)	(1.540)	(1.589)	(1.534)	(1.584)	(0.753)	(0.781)	(0.753)	(0.781)
Avg. ΔRI	-0.46***	-0.35**	-0.50***	-0.359**	-2.587***	-1.12***	-2.61***	-1.13***	-1.46***	-1.45***	-1.48***	-1.45***
	(0.15)	(0.15)	(0.16)	(0.16)	(0.25)	(0.00)	(0.25)	(0.22)	(0.12)	(0.35)	(0.12)	(0.35)
N	25	25	25	25	25	25	25	25	25	25	25	25
T	122	122	122	122	33	33	33	33	78	78	78	78
Obs	2,174	2,174	2,065	2,065	812	812	812	812	1,875	1,875	1,875	1,875
$\bar{R}^2$	0.043	0.034	0.068	0.060	0.245	0.142	0.242	0.135	0.194	0.114	0.194	0.112
DW	2.04	2.02	2.03	2.00	2.14	2.01	2.13	2.00	2.28	2.26	2.28	2.27
Chow	9.01***	8.68***	7.67***	7.23***	9.01***	8.68***	7.67***	7.23***	9.01***	8.68***	7.67***	7.23***

Note: White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2 \, \overline{nfa}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation. Chow refers to the Chow test for structural stability of the parameters in the different subsamples, with H_0 : structural stability.

Table 2.2: Panel regression of models (1) and (2) for the different time periods

	Full sample 1/1997-6/2016				Post-crisis sample 1/2010-6/2016			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	-1.0649***	-0.9028***			-0.9671***	-0.7918***		
	(0.117)	(0.130)			(0.157)	(0.183)		
ΔTED			-0.8619***	-0.7249***			-0.6716	-0.3205
			(0.172)	(0.172)			(0.512)	(0.556)
ΔVIX*nfa^{PRIV}	1.6200***				1.3484***			
	(0.264)				(0.402)			
ΔVIX*nfa^{GOVT}	0.1924	0.5642*			0.2552	0.5886*		
	(0.286)	(0.307)			(0.280)	(0.325)		
ΔVIX*nfa^{OSEC}		1.4388***				1.0950**		
		(0.291)				(0.473)		
ΔVIX*nfa^{BANK}		3.3893***				3.2025***		
		(0.774)				(1.052)		
ΔTED*nfa^{PRIV}			1.0561***				2.5263**	
			(0.298)				(1.273)	
ΔTED*nfa^{GOVT}			-1.6458**	-1.2587			-0.3404	0.1451
			(0.779)	(0.879)			(0.939)	(1.048)
ΔTED*nfa^{OSEC}				1.1958***				2.2536
				(0.324)				(1.404)
ΔTED*nfa^{BANK}				1.4422				5.7234*
				(0.957)				(3.085)
N	21	21	21	21	20	20	20	20
T	233	233	233	233	78	78	78	78
Obs	3,209	3,629	3,209	3,629	1,382	1,437	1,382	1,437
$\bar{R}^2$	0.12	0.12	0.06	0.05	0.18	0.19	0.11	0.12
DW	2.09	2.08	2.04	2.04	2.26	2.27	2.23	2.26

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included.

Table 2.3: Panel regression of model (1) for the full and post-crisis sample

2.5.2 Different types of foreign capital

Net total debt and net total equity

As not all types of capital are equally affected by the business cycle, the foreign assets are first split into two components, net total debt, ($nTotDebt$) and net total equity ($nTotEquity$). This allows us to see whether net external debt, consisting of portfolio debt, bank loans and "other debt", has a different impact on the exchange rate than net foreign equity (portfolio equity, direct investment equity and "other equity"). Moreover, it tells us whether currencies with negative net foreign total debt are more sensitive to risk sentiment changes than countries with similar net foreign total equity positions. As the results for using Δs and rx as dependent variables are fairly similar and rarely significantly different from each other, only the results using Δs are presented for the sake of space. The conclusions regarding the relationship between net foreign assets, ΔRI and Δs thus also apply for the excess currency returns.

As can be seen from Tables 2.4 and 2.5, in both the full sample and in the subsamples, the estimated coefficients on the ΔRI proxies are all negative and in most cases significant. The negative coefficients on the ΔRI terms again imply that countries with zero net total debt and equity experience a currency depreciation against the USD when global risk intolerance increases. The interaction terms including $nTotDebt$ and the change in either VIX or the TED spread are positive and significant in almost all models (with the exception of column (iv) in the EM sample and (vi) for the pre-crisis period in Table 2.5). The positive and significant interaction terms imply that negative net total debt positions increase the exchange rate sensitivity to surges in risk intolerance so that the currency depreciates even further, whereas countries with positive net total debt depreciate much less or not at all. Alternatively, in case the risk sentiment improves ($\Delta RI < 0$), currencies of countries with positive net debt positions appreciate more against the USD than currencies with negative debt positions. The impact of net equity positions on the exchange rate sensitivity is small and insignificant in most cases, however for the EM currencies the results indicate that currencies of countries with net equity liabilities tend to appreciate rather than depreciate when the global risk intolerance increases.

When the sample is split into G10 and EM currencies in Table 2.5, two observations can be made. First, the coefficients on both ΔVIX and ΔTED are much larger for the EM than for the G10 currencies, implying that EM countries with no net debt or equity experience much larger depreciations against the USD than the G10 currencies. The average impact of a change in risk intolerance on the exchange rate is moreover significantly larger for the EM than for the G10 currencies, even though the interaction term on total debt and risk intolerance is smaller. This suggests that

Dep. Var:		Δs		
	(i)	(ii)	(iii)	(iv)
ΔVIX	-1.201***	-1.227***		
	(0.095)	(0.091)		
ΔTED			-0.717***	-0.729***
			(0.125)	(0.115)
ΔVIX*nTotDebt	1.368***	1.338***		
	(0.205)	(0.204)		
ΔVIX*nTotEquity	0.229			
	(0.281)			
ΔTED*nTotDebt			0.599**	0.499**
			(0.244)	(0.246)
ΔTED*nTotEquity			0.565	
			(0.459)	
Avg. ΔRI impact	-1.492	-1.492	-0.885	-0.828
N	25	25	25	25
T	233	233	233	233
Obs	4,703	4,888	4,703	4,888
$\bar{R}^2$	0.116	0.117	0.052	0.053
DW	2.07	2.05	2.03	2.01

Note: White SE in parentheses.Symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\,\overline{nTotDebt} + \hat{\beta}_3\,\overline{nTotEquity}$.

Table 2.4: Panel regression of model (3) for the full sample

the EM currencies are much more vulnerable to changes in the global risk sentiment than the G10 currencies, regardless of their net foreign debt or equity positions.

When the sample is divided into a pre-crisis, crisis and a post-crisis sample to see whether the relationship between Δs, ΔRI and $nTotDebt$ has stayed constant over time, the Chow test again suggest that there are structural differences between the samples. As can be seen from columns (v) to (x) in Table 2.5, the impact of changes in VIX has been fairly constant over the full currency sample, which raises suspicions that the significant Chow statistic is driven by some large residuals during the crisis period. The impact of banking sector uncertainty, TED, is however much larger after the crisis. The interaction effect between net total debt and the TED spread is much stronger in the post-crisis sample, which suggests a tighter relationship between the banking sector and foreign exchange markets now than during the beginning of this millennium. My results thus suggest that the interaction between net total debt and banking sector risk intolerance has a much larger impact on the exchange rate since the financial crisis. The substantially higher $\bar{R}^2$ also confirm that the factors included in the models explain a larger share of the variation in Δs since the credit crisis.

The total exchange rate or excess return impact of a change in risk intolerance, RI, is $\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$. As the average net debt and net equity position in the sample are rather small (as the sample consists of both net debtor and net creditors), the average total impact of a change in risk intolerance is fairly close to the impact for $nTotDebt$ and $nTotEquity$=0. Figure 2.4 therefore illustrates how the different currencies in the sample respond to changes VIX and TED. According to the figure, reactions between the different currencies vary substantially. An increase in the VIX index or the TED spread causes the CHF to appreciate against the USD, whereas the HUF, NZD and TRY depreciate the most due to their countries' large negative net debt positions. Again can be seen that the impact of the banking sector risk intolerance, the TED spread, has a much smaller impact on the exchange rate and excess returns than a change in the VIX index.

When the net total debt positions are split into private and public holdings Table 2.6, the results suggest that private net total debt increases the exchange rate sensitivity to the VIX index more than two times more than private net total debt in both the full and the post-crisis period. The estimates including VIX are not significantly different in the full and post-crisis sample, but the TED estimates in column (x) are somewhat larger. The results in column (v) indicate that only private net debt makes the exchange rate respond stronger to a change in banking sector risk bearing capacity, although the reaction is much smaller than compared to the change in VIX. When the net private debt is split into banking sector holdings and non-bank holdings, the interaction between non-bank holdings and the VIX seem to move the exchange rate the most.

	G10 currencies		Emerging Markets		Before the crisis, 01/1997-03/2007		Crisis, 4/2007-12/2009		After the crisis, 1/2010-06/2016	
	01/1997-06/2016									
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-0.786***		-1.849***		-0.107		-2.414***		-1.152***	
	(0.159)		(0.200)		(0.150)		(0.277)		(0.131)	
ΔTED		-0.314*		-0.905***		-0.352**		-1.036***		-0.958**
		(0.185)		(0.287)		(0.151)		(0.227)		(0.405)
ΔVIX*nTotDebt	1.554***		1.083***		1.203***		1.290***		1.262***	
	(0.309)		(0.267)		(0.253)		(0.468)		(0.310)	
ΔVIX*nTotEquity	-0.114		-1.466**		0.877		-0.120		-0.050	
	(0.400)		(0.719)		(0.626)		(0.908)		(0.324)	
ΔTED*nTotDebt		0.611*		0.270		-0.048		0.700*		2.061**
		(0.336)		(0.355)		(0.291)		(0.380)		(1.001)
ΔTED*nTotEquity		-1.345		0.715		1.168*		0.065		-0.292
		(0.882)		(0.930)		(0.620)		(0.719)		(1.037)
Avg. ΔRI impact	-1.132	-0.616	-1.732	-1.119	-0.404	-0.447	-2.610	-1.155	-1.465	-1.456
N	9	9	16	16	24	24	24	24	25	25
T	233	233	231	231	122	122	33	33	78	78
Obs	1,930	1,930	2,773	2,773	2,064	2,064	779	779	1,860	1,860
$\bar{R}^2$	0.100	0.049	0.139	0.066	0.044	0.039	0.237	0.133	0.195	0.113
DW	2.05	2.01	2.09	2.04	2.09	2.06	2.15	2.02	2.27	2.27
Chow	1.38*	1.28	1.38*	1.28	8.59***	8.33***	8.59***	8.33***	8.59***	8.33***

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation. Chow refers to the Chow test for structural stability of the parameters in the different subsamples, with H_0 : structural stability.

Table 2.5: Panel regression of model (3) for the different currency samples and time periods

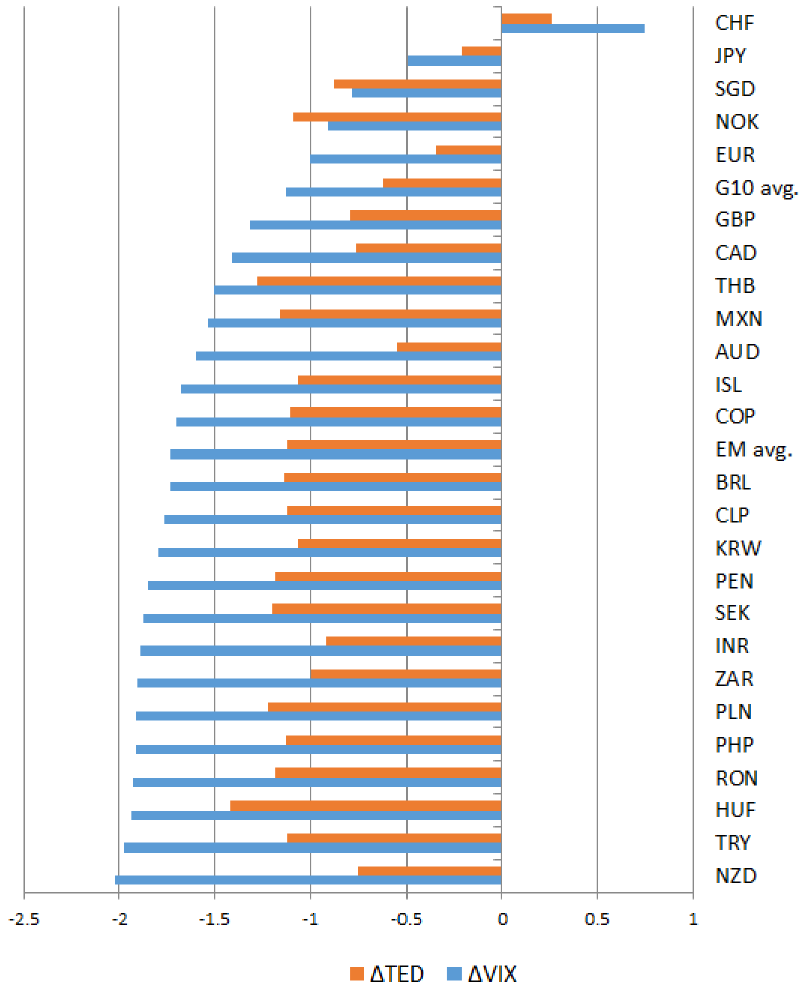


Figure 2.4: Total effect of ΔRI taking the impact of nTotDebt and nTotEquity into account

My findings that large debt liabilities increase the exchange rate sensitivity to financial market risk intolerance are in line with Gabaix's and Maggiori's (2015) exchange rate theory, which hypothesizes that currencies of net debtor countries depreciate in case of a sudden deterioration in the market sentiment. They posit that the main channel which this effect operates through is the balance sheet channel of banks. If there is a deterioration in the bank's risk bearing capacity, this leads the bank to reprice their currency lending which in turn affects both capital flows and the exchange rate. If that was the case here, one would expect especially the coefficient on the interaction between ΔTED and nfa to be positive and significant, and of much larger magnitude than the coefficients on the terms including VIX. Although the coefficient was mostly significant and positive as expected, it is only in the post-crisis period that TED has had a larger impact on the exchange rate vulnerability than VIX. Also, in all the models that use the TED spread as the measure of risk intolerance produced substantially smaller $\bar{R}^2$'s than the same models that use VIX instead. This would suggest that it is not only the banking sector risk bearing capacity that plays a role, but also the risk bearing capacity of other financial market players. My finding that the influence of ΔTED has become stronger after the financial crisis however gives support to Gabaix and Maggiori's (2015) theory that the exchange rate vulnerability originates from changes in the international financial sector risk bearing capacity.

	Full sample 1/1997-6/2016						Post-crisis sample 1/2010-6/2016			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-0.897***	-1.052***	-1.285***				-0.697***	-1.149***		
	(0.164)	(0.197)	(0.123)				(0.187)	(0.164)		
ΔTED				-1.112***	-1.325***	-0.909***			-0.565	-0.829*
				(0.279)	(0.306)	(0.173)			(0.693)	(0.474)
ΔVIX*nTotDebt^{PRIV}	3.203***						3.078***			
	(0.618)						(0.756)			
ΔVIX*nTotDebt^{GOVT}	1.336*	1.206*					1.466**			
	(0.692)	(0.692)					(0.719)			
ΔVIX*nTotDebt^{OSEC}		5.295***	4.417***					4.139***		
		(1.253)	(0.978)					(1.379)		
ΔVIX*nTotDebt^{BANK}		2.228**	2.199***					2.074**		
		(0.895)	(0.762)					(1.010)		
ΔTED*nTotDebt^{PRIV}				1.747*						
				(0.948)						
ΔTED*nTotDebt^{GOVT}				-1.677	-1.331				0.392	
				(1.651)	(1.660)				(2.190)	
ΔTED*nTotDebt^{OSEC}					5.568***	1.748			6.412	8.682**
					(1.888)	(1.348)			(4.805)	(4.196)
ΔTED*nTotDebt^{BANK}					0.041	1.022			4.653	4.308
					(1.244)	(0.959)			(3.228)	(2.866)
Avg. ΔRI impact	-0.90	-1.05	-1.28	-1.11	-1.32	-0.91	-0.70	-1.15	-0.57	-0.83
N	12	12	19	12	12	19	12	19	12	19
T	233	233	233	233	233	233	78	78	78	78
Obs	1,690	1,690	3,250	1,690	1,690	3,250	867	1,405	867	1,405
$\bar{R}^2$	0.143	0.143	0.129	0.080	0.081	0.061	0.190	0.199	0.114	0.122
DW	2.11	2.11	2.07	2.07	2.07	2.03	2.23	2.27	2.23	2.26

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 2.6: Panel regression of model (3) for the full and post-crisis sample

Net portfolio debt and equity, net FDI and net Other investment

The net foreign assets are eventually split into four different components, net portfolio debt ($nPDebt$), net portfolio equity ($nPEquity$), net portfolio FDI ($nFDI$) and net other investment (*nOther*), where the "other investments" include among other items bank loans and trade credits. As can be seen from the results in Table 2.7, the positive interaction coefficients on $nPDebt$ and *nOther* suggest that negative net foreign portfolio debt and negative net foreign other investments lead to a significantly larger currency depreciation during times of financial turbulence than countries with positive net positions in the full sample. The less cyclical net external portfolio equity holdings seems to insulate the exchange rate from an increase in financial market risk aversion, as suggested by the negative coefficients on the interaction terms including $nPEquity$ and VIX in columns (i) and (ii). These results imply that currencies of countries with large negative portfolio debt holdings and negative net other investments (which consists to a large extent of bank loans) are the most vulnerable to a sudden worsening in the global financial market risk sentiment. Currencies of countries that have the same amount of outstanding external liabilities in portfolio equity are however not affected by swings in the market sentiment to the same extent. Thus, negative net external portfolio debt increases the exchange rate vulnerability to financial market volatility, whereas external portfolio equity reduces this impact somewhat. As a large share of the portfolio debt inflow is intermediated via foreign banks whose risk bearing capacity decreases during times of financial uncertainty, an increase in risk intolerance translates into larger currency depreciation for countries with large portfolio debt liabilities and bank loans. The result that changes in banking sector risk, as measured by ΔTED gives support to this hypothesis. However, as the exchange rate impact of ΔTED is again much smaller than ΔVIX, this suggests that it is not only the banking sector risk that matter for the exchange rate sensitivity to global risk aversion, but that risk intolerance of other financial market players matter as well.

The sensitivity of the currencies in the sample to changes in global financial market risk intolerance are illustrated in Figure 2.5. Again, the CHF is associated with only a tiny exchange rate depreciation (appreciation) in case of a sudden increase (decrease) in RI, whereas the reaction of the NZD, HUF and CLP to changes in VIX is over 50 % larger than for the average currency in the sample. The impact of a change in banking sector risk intolerance, as measured by ΔTED, on the exchange rate is much smaller than for ΔVIX, and moreover less significant, especially when the sample is split into subsamples or subperiods in Table 2.8.

When I look at how the relationship between different types of net foreign assets, global risk intolerance and exchange rates has changed over time (Table 2.8), I again find that the impact of banking sector risk bearing capacity, TED, has become stronger after the financial crisis, although it is only significant at the 10 % significance level. There is also some weak evidence pointing to negative net foreign portfolio equity reducing the exchange rate sensitivity to swings in global risk tolerance. The significantly higher $\bar{R}^2$ after the crisis also point to global risk intolerance and external imbalances playing a much bigger role for both exchange rate movements and excess currency returns. As the Chow test indicates structural instability in the series over time, more weight should be given to the post-crisis results.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	-1.089***	-1.188***	-1.279***	-1.456***				
	(0.127)	(0.123)	(0.117)	(0.087)				
ΔTED					-0.562***	-0.667***	-0.846***	-0.698***
					(0.165)	(0.147)	(0.116)	(0.146)
ΔVIX*nPDebt	1.139***	1.184***	1.081***	1.183***				
	(0.237)	(0.232)	(0.219)	(0.216)				
ΔVIX*nPEquity	-0.631*	-0.939***						
	(0.372)	(0.320)						
ΔVIX*nFDI	0.687							
	(0.427)							
ΔVIX*nOther	3.112***	1.995***	1.703**					
	(1.060)	(0.735)	(0.717)					
ΔTED*nPDebt					0.083	0.345	0.494*	
					(0.287)	(0.281)	(0.275)	
ΔTED*nPEquity					-0.222			
					(0.668)			
ΔTED*nFDI					1.006*			
					(0.549)			
ΔTED*nOther					2.638*	1.593*		0.906
					(1.464)	(0.875)		(0.964)
Avg. ΔRI impact	-1.58	-1.48	-1.52	-1.50	-0.99	-0.87	-0.86	-0.81
N	23	24	25	25	23	25	25	25
T	233	233	233	233	233	233	233	233
Obs	4,414	4,640	4,814	4,814	4,414	4,814	4,814	4,888
$\bar{R}^2$	0.118	0.113	0.115	0.114	0.054	0.053	0.052	0.052
DW	2.07	2.07	2.06	2.06	2.03	2.02	2.02	2.01

Note: Dependent variable Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constituent terms, controls and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\, \overline{nPDebt} + \hat{\beta}_3\, \overline{nPEquity} + \hat{\beta}_4\, \overline{nFDI} + \hat{\beta}_5\, \overline{nOther}$, where RI is proxied either by VIX or TED.

Table 2.7: Panel regression of model (4) for the full sample

	G10		EM		Before the crisis, 1/1997-3/2007		Crisis, 4/2007-12/2009		After the crisis, 1/2010-6/2016	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-0.834***		-1.720***		-0.136		-2.590***		-1.087***	
	(0.154)		(0.213)		(0.195)		(0.357)		(0.161)	
ΔTED		-0.392**		-1.081***		-0.343*		-0.939***		-0.701
		(0.195)		(0.297)		(0.186)		(0.274)		(0.494)
ΔVIX*nPDebt	1.304***		1.596***		1.533***		1.541**		0.926***	
	(0.365)		(0.572)		(0.330)		(0.599)		(0.316)	
ΔVIX*nPEquity	-0.538		-1.523*		-0.354		-1.976*		-0.792**	
	(0.417)		(0.810)		(0.809)		(1.170)		(0.379)	
ΔVIX*nOther	4.714**		-0.373		1.744*		0.664		2.318**	
	(2.086)		(1.000)		(0.946)		(2.070)		(1.123)	
ΔTED*nPDebt		-0.045		-0.172		-0.184		0.686		1.729*
		(0.480)		(0.797)		(0.382)		(0.469)		(1.046)
ΔTED*nPEquity		-1.514*		0.715		0.071		-0.907		-2.379*
		(0.915)		(1.649)		(0.924)		(0.972)		(1.239)
ΔTED*nOther		3.560		0.039		0.696		2.395		4.674
		(3.221)		(1.158)		(0.860)		(2.015)		(3.270)
Avg. ΔRI impact	-1.15	-0.53	-1.68	-1.09	-0.42	-0.43	-2.66	-1.19	-1.43	-1.43
N	9	9	15	15	24	24	24	24	24	24
T	233	233	231	231	122	122	33	33	78	78
Obs	1,930	1,930	2,710	2,710	2,064	2,064	779	779	1,797	1,797
$\bar{R}^2$	0.104	0.055	0.132	0.065	0.044	0.035	0.235	0.130	0.186	0.109
DW	2.06	2.02	2.09	2.04	2.09	2.06	2.15	2.01	2.27	2.27
Chow	1.35*	1.37*	1.35*	1.37*	7.54***	7.04***	7.54***	7.04***	7.54***	7.04***

Dep. var: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constituent terms, controls and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nPDebt} + \hat{\beta}_3\ \overline{nPEquity} + \hat{\beta}_4\ \overline{nFDI} + \hat{\beta}_5\ \overline{nOther}$, where RI is proxied either by VIX or TED.

Table 2.8: Panel regression of model (4) for the different subsamples

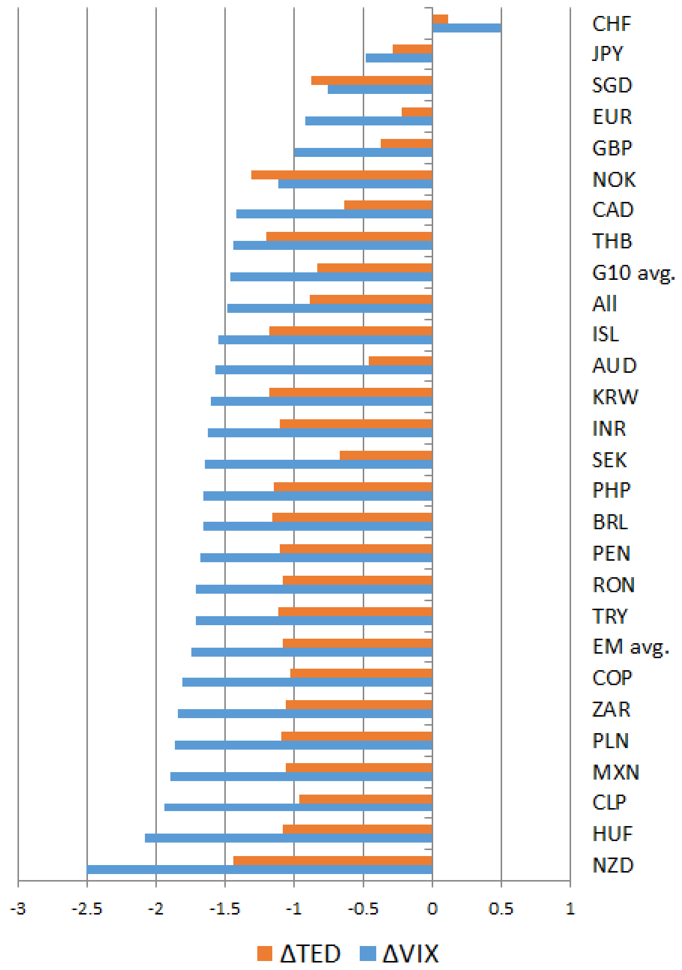


Figure 2.5: Total effect of ΔRI on Δs taking the impact of net portfolio debt, equity and other investments into account

2.5.3 Robustness

Finally, some robustness tests are conducted to confirm that the results are not driven by the choice of base currency, some underlying time trend or outliers. The results from the robustness tests are presented in Appendix 2C.

Base currency and endogeneity concerns

What matters from a policy maker's perspective is not necessarily currency movements against the USD, but the currency movements against the country's most important trading partners. The results of using the trade weighted currency basket as dependent variable can therefore be found in Table 2.12 in Appendix 2C. When the analysis is done using the change in the trade weighted currency basket as dependent variable instead of the currency pairs against the USD, the same conclusions as before can be drawn. The biggest difference to the main results are that the impact of ΔTED is much stronger and comparable to the impact of ΔVIX.

As the USD is used as the base currency and the VIX Index is a risk intolerance measure originating from stock options on U.S. stocks, there is the potential risk that a change in USD has an impact on the VIX. To exclude this possibility, the analysis is done with different G10 currencies and the bigger EM currencies like KRW as base currency, while excluding USD from the sample. Changes in GBP and EUR, but especially changes in smaller currencies like the SEK and KRW against all other currencies, are very unlikely to have a significant impact on the VIX or TED spread. The results for using EUR, GBP, SEK and KRW as base currency can be found in Tables 2.13 and 2.14. From there can be seen that when using different base currencies and excluding USD from the sample, the same conclusion as in the main analysis can be drawn. Therefore, it seems very unlikely that the results and conclusions are driven by the impact of USD on VIX. Finally, one could argue that a big change in USD could have an impact on VIX via JPY and CHF against other currencies, as USD, JPY and CHF all tend to move in the same direction in case of an increase in financial market turbulence due to their (perceived) 'safe haven' status. As the original conclusion also prevails even after excluding USD, JPY and CHF from the sample, this strongly suggests that the results are not driven by reverse causality. These results are not reported for the sake of space, but are available upon request.

Regarding endogeneity concerns between the net foreign asset position and exchange rate changes, I reach the same conclusion even if I condition the exchange rate response on the net foreign asset position from over a year back, i.e. if I use the asset positions lagged by 12 months.

Impact of RI instead of ΔRI

In Gabaix's and Maggiori's (2015) model, an increase in the financial sector risk intolerance leads to a depreciation of the net debtor currency against the net creditor one. It is however also possible that net debtor currencies depreciate whenever the risk bearing capacity is low (i.e. risk intolerance is high), instead of only being affected by the change in risk intolerance. The analysis is therefore repeated using the levels of VIX and the TED spread instead of changes. The results in Table 2.15 reveal that a higher VIX index, i.e. higher financial market uncertainty, is also associated with weaker exchange rates in negative net foreign asset countries. However, once I include both the risk sentiment level and change in the model, only the interaction terms with the net foreign assets and ΔVIX or ΔTED are significant, and the interaction terms with VIX or TED and the net foreign assets are insignificant.[21] This suggests that the baseline specification is more appropriate than the one in Table 2.15.

Gross foreign asset and liability positions

Forbes and Warnock (2012) show that gross foreign capital inflows can behave very differently from net foreign capital inflows during sudden capital flow stops. Although looking at the relationship between gross capital flows or gross positions and exchange rates is a fundamentally different question, I show that my conclusions based on the net positions hold also for gross positions. To see how the underlying stock of assets and liabilities affect the impact of ΔRI on Δs and rx, the net total foreign debt and equity positions in equation (2.9) are split into total foreign debt assets $TotDebtAs$, total foreign debt liabilities $TotDebtLiab$, total foreign equity assets $TotEquityAs$ and total foreign equity liabilities $TotEquityLiab$. In this way, we are able to disentangle the separate effects of gross foreign asset and liability stocks on the exchange rate sensitivity to risk intolerance. Fairly similar conclusions can be drawn from the results presented in Table 2.16 in Appendix 2C as from the analysis on net foreign assets. The significantly negative coefficients for the gross total debt liabilities and most of the gross total equity liabilities imply that both foreign debt and equity liabilities are associated with weaker currencies against the USD and lower excess currency returns. Total debt liabilities significantly increase the sensitivity of the foreign currency to changes in the financial market risk intolerance, as measured either by an increase in the TED spread or VIX index. Total foreign debt assets on the other hand, decrease the exchange rate vulnerability to changes in RI, whereas foreign equity assets increase the exchange rate sensitivity to changes in VIX. These conclusions are thus generally supporting the claim that higher foreign debt liabilities makes the exchange rate more sensitive to changes in VIX or TED, and this negative effect is offset by holding foreign debt assets.

[21] These results are not reported here but are available upon request.

Time fixed effects or time trend

As both the VIX index and the weighted TED spread are global indices, the inclusion of time fixed effects is not possible as the time fixed effect and the risk intolerance measure would be linearly dependent. In order to circumvent this problem and confirm that the results are not driven by some underlying time trend, the (global) weighted TED spread, (which includes the GDP weighted average of the TED spreads for UK, EMU, Japan, Switzerland, Canada and the US) is made into country-specific foreign TED spreads. This is done by excluding the contribution of the own-country TED spread from the global average for the global weighted TED spreads for the countries that the weighted TED spread is made up of. Thereby, the weighted foreign country TED spread for the GBP, EUR, JPY, CHF, CAD and the USD are not identical to the weighted TED spreads for the rest of the currencies included in the sample. The results presented in Table 2.17 show that the previous conclusions hold and are robust to the inclusion of time fixed effects. The conclusions are also robust to the inclusion of currency specific time trends (not reported here), where the time trends are allowed to have a different impact on the different currency pairs.

Final robustness tests

Finally, some additional robustness checks are done.[22] To ensure that the results are not driven by extreme outliers the analysis is conducted using winzorized data.[23] The same conclusions can be drawn as in the main analysis. Also, if the covered interest rate parity (CIP) holds, then the forward discount $fd_t = f_t - s_t \approx i^{US} - i$. When I use fd as a control variable instead of the interest rate difference, my results do not change much. Moreover, as inflation and the stock market returns are forward looking variables, it might be that current values of these are correlated with future net foreign assets. To ensure that the results are not driven by inflation, stock market or interest rate expectations, further lags of these are also included in the model to confirm this. Additionally, as the log change in central bank reserves are related to the actual reserves to GDP (which are included in the total nfa position but not in the decompositions into debt and equity), I also confirm that the results and conclusions do not change if I exclude ΔRes from the control variables or if I exclude the reserves from the net foreign asset position. Also, to rule out that the results are driven by omitted variable bias because I use lagged control variables, I confirm that my conclusions hold also when the contemporaneous values of the control variables are used. The conclusions are also robust to the deletion of single countries from the sample as well as to the use data on total net foreign assets, net foreign debt and net foreign equity instead of the ratios of these to the countries' GDP.

[22]These final robustness tests are not reported for the sake of space, but are available upon request.

[23]A 95 % winsorization involves computing the lowest 2.5 and 97.5 quantiles of the data, and replacing the values in these quantiles by the respective 2.5 and 97.5 cutoff values.

2.6 Conclusion

In this panel study of 25 advanced economy and emerging market currency pairs against the USD over the time period 1/1997-6/2016, I show that the composition of net foreign assets affects the way exchange rates and excess currency returns react to financial market uncertainty.

Gabbaix and Maggiori's (2015) exchange rate theory predicts that the exchange rates of countries with net foreign liabilities are more sensitive to reductions in financial market risk bearing capacity. I find that this is indeed the case, but more importantly, I show that different types of net foreign assets have different effects on this exchange rate vulnerability. Net foreign debt liabilities, and in particular private and portfolio debt liabilities, increase the exchange rate sensitivity to especially changes in financial market uncertainty. Net foreign equity liabilities, on the other hand, seem to ameliorate the negative exchange rate and excess currency return impact of financial market uncertainty somewhat. Due to these offsetting exchange rate effects of the different types of net foreign assets, if one only considers the impact of the total net foreign asset position, the negative impact of different external imbalances on exchange rate stability is underestimated. Thus, the exchange rates of countries with large net foreign debt liabilities depreciate much more in response to a drop in the global risk sentiment than countries with the equivalent net foreign equity position. This phenomenon can partially be explained by the observation that net debt investments are more procyclical than net equity investments, owing to both a different investor base, different degrees of risk sharing, the fact that a large share of foreign debt is issued and intermediated by international banks and the debt rollover risk. Net FDI positions do not have any significant impact on the relationship between risk intolerance and the exchange rate, which can be explained by FDI flows being less influenced by the global financial cycle.

Another important finding of this paper is that private and public net foreign assets have different effects on the exchange rate vulnerability. The sensitivity of the exchange rate to global financial market uncertainty seems to be driven largely by private foreign investment, whereas public net foreign assets do not add to the exchange rate vulnerability to the same extent. This can be explained by the lower risk associated with government debt as compared to corporate, which makes it easier for governments to attract financing during crisis times than corporations. Moreover, private investors are often more leveraged than public ones, which suggests that the investors are more affected by both banking sector and general financial market uncertainty. I also find that emerging market currencies are overall more influenced by the global risk sentiment than the G10 currencies. The interaction effect between different types of net foreign assets and risk intolerance is nevertheless smaller for the emerging market currencies than for the G10 currencies. In this paper I only briefly look at the separate impact of gross foreign assets and liabilities, but as the foreign and domestic capital flows tend to behave differently, it would be interesting to take a closer look at the relationship between the gross asset positions and exchange rate movements in the future.

Although the currencies react to changes in global banking sector uncertainty, as measured by the TED spread, I find that the impact of global financial market risk intolerance, as proxied by the VIX index, is much larger. This suggests that not all of the impact is coming from the change in the banking sector's risk bearing capacity, but also via non-bank investors and additional channels. My results suggest that the relationship between the exchange rates, different net foreign assets and global financial market uncertainty, as measured by the VIX index, has remained fairly constant over the sample period, although the Chow test points to some structural instability in the full sample. The exchange rate impact of the TED spread, and the interaction effect with different types of net foreign assets, has nevertheless become larger and stronger after the financial crisis of 2007-2008. Currencies of countries with negative net debt respond more strongly to changes in banking sector risk now than before the credit crisis.

My findings are of importance for central banks that are worried that their exchange rates are too sensitive to the global financial business cycle, and for the evaluation of the impact of financial reforms. My results imply that a policy maker concerned about exchange rate volatility should be more alert when the net foreign private and portfolio debt liabilities are large. As the impact of the banking sector uncertainty has become stronger in the past six years, this also warrants more attention than at the beginning of the millennium. The finding that foreign debt liabilities reduce exchange rate stability whereas foreign equity liabilities even marginally supports it, weakens the justification for levying lower taxes on debt investments than on equity investments. My results suggest that policy makers could reduce the exchange rate sensitivity to fluctuations in the financial market risk sentiment by reducing their dependence on debt financing and shifting towards more equity financing. Finally, knowledge of the differential impact of net foreign debt equity on the exchange rate vulnerability is furthermore important for the countries that are currently considering reducing restrictions on foreign ownership of both equity and debt instruments.

2.7 Appendix

Appendix 2A. List of countries, currencies and nfa variables

Australia (AUD), Brazil (BRL), Canada (CAD), Chile (CLP), Colombia (COP), Euro Area (EUR), Hungary (HUF), India (INR), Israel (ISL), Japan (JPY), Korea (KRW), Mexico (MXN), New Zealand (NZD), Norway (NOK), Peru (PEN), Philippines (PHP), Poland (PLN), Romania (RON), Singapore (SGD), South Africa (ZAR), Sweden (SEK), Switzerland (CHF), Thailand (THB), Turkey (TRY), United Kingdom (GBP), and United States (USD).

Variable	Description
nfa	Net foreign assets
nfa^{PRIV}	Net foreign assets held by the private sector
nfa^{GOVT}	Net foreign assets held by the government
nfa^{OSEC}	Net foreign assets held by nonfinancial corporations, households and NPISH
nfa^{BANK}	Net foreign assets held by deposit taking corporations
nTotDebt	Net total foreign debt assets
nTotEquity	Net total foreign equity assets
nToTDebt^{PRIV}	Net total foreign debt assets held by the private sector
nToTDebt^{GOVT}	Net total foreign debt assets held by the government
nToTDebt^{OSEC}	Net total foreign debt assets held by nonfinancial corporations, households and NPISH
nToTDebt^{BANK}	Net total foreign debt assets held by deposit taking corporations
nPDebt	Net foreign portfolio debt assets
nPEquity	Net foreign portfolio equity assets
nFDI	Net foreign direct investment
nOther	Net foreign other investment

Table 2.9: A description of the net foreign asset variables

Appendix 2B. Full tables for selected models

	Full sample, 1/1997-6/2016		Before the crisis, 1/1997-3/2007		Crisis, 4/2007-12/2009		After the crisis, 1/2010-6/2016	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Constant	0.2635	0.1326	-10.07***	-10.04***	-14.94	-20.56**	18.80***	23.93***
	(0.914)	(0.940)	(2.064)	(2.090)	(9.798)	(10.48)	(4.358)	(4.350)
ΔVIX	-1.44***		-0.3631**		-2.52***		-1.4180***	
	(0.086)		(0.142)		(0.247)		(0.119)	
ΔTED		-0.7716***		-0.3414**		-1.0879***		-1.3826***
		(0.116)		(0.141)		(0.213)		(0.348)
nfa	-0.0140	0.0001	0.8589***	0.8723***	3.0822**	3.8190**	1.2473*	1.4961*
	(0.235)	(0.242)	(0.317)	(0.316)	(1.540)	(1.589)	(0.753)	(0.781)
ΔVIX*nfa	0.8032***		1.014***		0.8426***		0.6029***	
	(0.127)		(0.218)		(0.299)		(0.165)	
ΔTED*nfa		0.4006**		0.0685		0.4041*		0.8528
		(0.167)		(0.235)		(0.237)		(0.548)
ΔRes_{-1}	3.684***	3.570***	2.673***	2.124**	0.5648	2.649	7.295***	8.518***
	(0.835)	(0.901)	(1.019)	(1.020)	(1.80)	(2.17)	(2.25)	(2.25)
$(stock - stock^{US})_{-1}$	4.983***	5.716***	3.530**	3.350**	3.304	3.866	6.104***	9.994***
	(1.15)	(1.17)	(1.68)	(1.70)	(2.37)	(2.55)	(1.86)	(1.95)
$(\pi - \pi^{US})_{-1}$	0.0386*	0.0402*	0.0456	0.0468	0.0774	0.1131*	0.0999*	0.0817
	(0.023)	(0.024)	(0.030)	(0.031)	(0.065)	(0.068)	(0.054)	(0.055)
$(i - i^{US})_{-1}$	0.1771***	0.2531***	0.1675**	0.1916***	0.1267	0.3329**	0.6498***	0.8935***
	(0.045)	(0.048)	(0.068)	(0.070)	(0.132)	(0.145)	(0.122)	(0.120)
$(i - i^{US})_{-1} * VIX_{-1}$	-0.0090***	-0.0120***	-0.0037	-0.0047*	-0.0167***	-0.0227***	-0.0258***	-0.0360***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)
PPP_{-1}	-0.195	-0.135	6.15***	6.14***	8.88*	11.85**	-9.87***	-12.48***
	(0.49)	(0.505)	(1.24)	(1.26)	(5.38)	(5.77)	(2.19)	(2.19)
Avg.ΔRI impact	-1.516***	-0.810***	-0.495***	-0.350**	-2.587***	-1.118***	-1.462***	-1.445***
N	25	25	25	25	25	25	25	25
T	233	233	122	122	33	33	78	78
Obs	4,861	4,861	2,174	2,174	812	812	1,875	1,875
$\bar{R}^2$	0.115	0.053	0.043	0.034	0.245	0.142	0.194	0.114
DW	2.05	2.01	2.04	2.02	2.14	2.01	2.28	2.26

Note: Dependent variable Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2 \overline{nfa}$, where RI is proxied either by VIX or TED. DW refers to the panel Durbin-Watson test statistic for serial correlation.

Table 2.10: Panel regression of models (1) and (2) with constitutive terms and controls presented (Tables 2.1 and 2.2)

	Full sample		Post-crisis sample		G10 currencies		EM currencies	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Constant	0.196	0.067	17.792***	22.509***	-0.117	0.009	0.666	0.439
	(0.893)	(0.920)	(4.411)	(4.415)	(1.246)	(1.270)	(1.264)	(1.308)
ΔVIX	-1.201***		-1.152***		-0.786***		-1.849***	
	(0.095)		(0.131)		(0.159)		(0.200)	
ΔTED		-0.717***		-0.958**		-0.314*		-0.905***
		(0.125)		(0.405)		(0.185)		(0.287)
nTotDebt	0.683**	0.664*	1.471	1.572	0.516	0.549	1.023**	1.039**
	(0.330)	(0.350)	(0.977)	(1.035)	(0.558)	(0.603)	(0.406)	(0.427)
nTotEquity	-0.434	-0.410	0.442	0.644	-0.949**	-0.999**	-0.523	-0.381
	(0.328)	(0.334)	(0.832)	(0.851)	(0.428)	(0.436)	(0.553)	(0.569)
ΔVIX*nTotDebt	1.368***		1.262***		1.554***		1.083***	
	(0.205)		(0.310)		(0.309)		(0.267)	
ΔVIX*nTotEquity	0.229		-0.050		-0.114		-1.466**	
	(0.281)		(0.324)		(0.400)		(0.719)	
ΔTED*nTotDebt		0.599**		2.061**		0.611*		0.270
		(0.244)		(1.001)		(0.336)		(0.355)
ΔTED*nTotEquity		0.565		-0.292		-1.345		0.715
		(0.459)		(1.037)		(0.882)		(0.930)
ΔRes_{-1}	3.459***	3.196***	6.890***	8.177***	1.976*	1.559	4.850***	5.093***
	(0.799)	(0.886)	(2.213)	(2.249)	(1.055)	(1.154)	(1.201)	(1.338)
$(stock - stock^{US})_{-1}$	4.056***	5.026***	6.060***	9.972***	7.619***	8.706***	3.162***	4.226***
	(0.974)	(1.012)	(1.868)	(1.963)	(2.296)	(2.352)	(1.061)	(1.105)
$(\pi - \pi^{US})_{-1}$	0.029	0.030	0.121**	0.105*	0.249***	0.253***	0.004	0.002
	(0.022)	(0.023)	(0.057)	(0.059)	(0.071)	(0.072)	(0.024)	(0.025)
$(i - i^{US})_{-1}$	0.185***	0.258***	0.638***	0.866***	0.518***	0.668***	0.164***	0.240***
	(0.043)	(0.046)	(0.121)	(0.120)	(0.132)	(0.140)	(0.045)	(0.049)
$(i - i^{US})_{-1} * VIX_{-1}$	-0.009***	-0.012***	-0.026***	-0.036***	-0.022***	-0.029***	-0.008***	-0.010***
	(0.002)	(0.002)	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)	(0.002)
PPP_{-1}	-0.106	-0.045	-9.201***	-11.587***	0.494	0.409	-0.339	-0.240
	(0.486)	(0.501)	(2.210)	(2.216)	(1.102)	(1.123)	(0.543)	(0.563)
Avg. ΔRI impact	-1.492	-0.885	-1.465	-1.456	-1.132	-0.616	-1.732	-1.119
N	25	25	25	25	9	9	16	16
T	233	233	78	78	233	233	231	231
Obs	4,703	4,703	1,860	1,860	1,930	1,930	2,773	2,773
$\bar{R}^2$	0.116	0.052	0.195	0.113	0.100	0.049	0.139	0.066
DW	2.07	2.03	2.27	2.27	2.05	2.01	2.09	2.04

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 2.11: Panel regression of model (3) with control variables and constitutive terms presented (Tables 2.4 and 2.5)

Appendix 2C. Additional Results

	Full sample						G10		EM	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
ΔVIX	-1.438***		-1.201***		-1.188***		0.048		-0.497***	
	(0.086)		(0.095)		(0.123)		(0.093)		(0.126)	
ΔTED		-0.296***		-0.190**		-0.266***		-0.008		-0.267
		(0.076)		(0.077)		(0.094)		(0.112)		(0.218)
ΔVIX*nfa	0.803***									
	(0.127)									
ΔTED*nfa		0.478***								
		(0.101)								
ΔVIX*nTotDebt			1.368***				0.201		0.308**	
			(0.205)				(0.142)		(0.131)	
ΔVIX*nTotEquity			0.229				-0.153		-0.671	
			(0.281)				(0.228)		(0.426)	
ΔTED*nTotDebt				0.553***				0.654***		0.165
				(0.133)				(0.187)		(0.166)
ΔTED*nTotEquity				0.865***				0.500		1.108
				(0.240)				(0.484)		(0.696)
ΔVIX*nPDebt					1.184***					
					(0.232)					
ΔVIX*nPEquity					-0.939***					
					(0.320)					
ΔVIX*nOther					1.995***					
					(0.735)					
ΔTED*nPDebt						0.614***				
						(0.152)				
ΔTED*nPEquity						-0.284				
						(0.316)				
ΔTED*nOther						0.676				
						(0.528)				
Avg. ΔRI impact	-1.52	-0.34	-1.49	-0.37	-1.48	-0.37	-0.01	-0.08	-0.41	-0.55
N	25	25	25	25	24	24	10	10	16	16
T	233	233	233	233	233	233	233	233	231	231
Obs	4,861	4,861	4,703	4,703	4,640	4,640	2,163	2,163	2,773	2,773
$\bar{R}^2$	0.115	0.053	0.116	0.051	0.113	0.049	0.037	0.043	0.063	0.063

Note: Dep. Var: Δ Trade weighted currency basket. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 2.12: Panel regression of models (1), (3) and (4) for a trade weighted currency basket

Base currency:			EUR						GBP			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
ΔVIX	-0.363***		-0.142		-0.093		-1.010***		-0.772***		-0.725***	
	(0.086)		(0.095)		(0.123)		(0.091)		(0.102)		(0.133)	
ΔTED		-0.259**		-0.192		-0.165		-0.121		-0.062		-0.032
		(0.114)		(0.119)		(0.159)		(0.119)		(0.128)		(0.155)
ΔVIX*nfa	0.813***						0.953***					
	(0.129)						(0.127)					
ΔTED*nfa		0.434***						0.435***				
		(0.137)						(0.167)				
ΔVIX*nTotDebt			1.286***						1.372***			
			(0.169)						(0.204)			
ΔVIX*nTotEquity			0.177						0.209			
			(0.227)						(0.266)			
ΔTED*nTotDebt				0.557***						0.559**		
				(0.181)						(0.237)		
ΔTED*nTotEquity				0.358						0.552		
				(0.394)						(0.463)		
ΔVIX*nPDebt					1.203***						1.173***	
					(0.200)						(0.235)	
ΔVIX*nPEquity					-0.957***						-0.507	
					(0.293)						(0.310)	
ΔVIX*nOther					2.042***						2.391***	
					(0.734)						(0.793)	
ΔTED*nPDebt						0.417*						0.346
						(0.227)						(0.276)
ΔTED*nPEquity						-0.591						-0.297
						(0.530)						(0.581)
ΔTED*nOther						1.225						1.382
						(0.982)						(0.931)
N	24	24	24	24	23	23	24	24	24	24	23	23
T	220	220	220	220	220	220	233	233	233	233	233	233
Obs	4,564	4,564	4,419	4,419	4,356	4,356	4,628	4,628	4,470	4,470	4,407	4,407
$\bar{R}^2$	0.034	0.021	0.034	0.020	0.034	0.020	0.055	0.010	0.054	0.010	0.053	0.010
DW	2.00	1.99	2.01	2.00	2.01	2.00	2.02	2.03	2.04	2.05	2.04	2.05

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 2.13: Panel regression of models (1), (3) and (4) using EUR and GBP as base currency

Base currency:			SEK						KRW			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
ΔVIX	0.058		0.245**		0.222*		0.064		0.324***		0.370**	
	(0.090)		(0.099)		(0.127)		(0.110)		(0.123)		(0.166)	
ΔTED		-0.126		-0.110		-0.079		0.838***		0.869***		0.962***
		(0.121)		(0.129)		(0.172)		(0.148)		(0.164)		(0.205)
ΔVIX*nfa	0.789***						0.888***					
	(0.143)						(0.154)					
ΔTED*nfa		0.458***						0.447**				
		(0.158)						(0.227)				
ΔVIX*nTotDebt			1.368***						1.438***			
			(0.201)						(0.234)			
ΔVIX*nTotEquity			-0.059						0.168			
			(0.254)						(0.281)			
ΔTED*nTotDebt				0.671***						0.593*		
				(0.226)						(0.314)		
ΔTED*nTotEquity				-0.015						0.302		
				(0.488)						(0.556)		
ΔVIX*nPDebt					1.415***						1.328***	
					(0.254)						(0.262)	
ΔVIX*nPEquity					-1.249***						-1.130***	
					(0.334)						(0.335)	
ΔVIX*nOther					1.341*						2.166**	
					(0.767)						(0.997)	
ΔTED*nPDebt						0.571**						0.394
						(0.286)						(0.399)
ΔTED*nPEquity						-0.566						-0.915
						(0.594)						(0.721)
ΔTED*nOther						1.068						1.805
						(1.010)						(1.200)
N	24	24	24	24	23	23	24	24	24	24	23	23
T	233	233	233	233	233	233	233	233	233	233	233	233
Obs	4,654	4,654	4,496	4,496	4,433	4,433	4,719	4,719	4,561	4,561	4,498	4,498
$\bar{R}^2$	0.014	0.008	0.017	0.008	0.019	0.008	0.006	0.008	0.009	0.008	0.009	0.008
DW	2.02	2.02	2.05	2.05	2.05	2.05	2.07	2.07	2.06	2.06	2.06	2.06

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. ΔRI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 2.14: Panel regression of models (1), (3) and (4) using SEK and KRW as base currency

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
VIX	-0.263***		-0.204***		-0.256***	
	(0.062)		(0.065)		(0.082)	
TED		-0.144**		-0.154**		-0.190**
		(0.059)		(0.065)		(0.082)
VIX*nfa	0.186**					
	(0.094)					
TED*nfa		0.063				
		(0.085)				
VIX*nTotDebt			0.303**			
			(0.139)			
VIX*nTotEquity			0.215			
			(0.232)			
TED*nTotDebt				0.142		
				(0.126)		
TED*nTotEquity				-0.185		
				(0.236)		
VIX*nPDebt					0.303*	
					(0.158)	
VIX*nPEquity					-0.241	
					(0.270)	
VIX*nOther					0.156	
					(0.467)	
TED*nPDebt						0.133
						(0.155)
TED*nPEquity						-0.018
						(0.295)
TED*nOther						-0.230
						(0.465)
Avg. RI impact	-0.28	-0.15	-0.28	-0.17	-0.29	-0.17
N	25	25	25	25	24	24
T	233	233	233	233	233	233
Obs	4,861	4,861	4,703	4,703	4,640	4,640
$\bar{R}^2$	0.047	0.043	0.045	0.041	0.045	0.041
DW	1.99	2.00	2.01	2.02	2.01	2.02

Note: Dependent variable: Δs. White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables and currency fixed effects included. Avg. RI impact=$\hat{\beta}_1 + \hat{\beta}_2\ \overline{nTotDebt} + \hat{\beta}_3\ \overline{nTotEquity}$, where RI is proxied either by VIX or TED.

Table 2.15: Panel regression of models (1), (3) and (4) for the level of RI instead of ΔRI

Dep. Var	Δs				rx			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
ΔVIX	0.069	-0.317			-0.560	-0.496		
	(0.760)	(0.717)			(0.738)	(0.719)		
ΔTED			0.335	0.255			0.429	-0.035
			(0.818)	(0.814)			(0.861)	(0.840)
ΔVIX*TotDebt As	6.498***	6.230***			6.626***	6.071***		
	(0.939)	(0.954)			(0.974)	(0.970)		
ΔVIX*TotEquity As	-2.161***	-2.411***			-2.059***	-2.092***		
	(0.531)	(0.552)			(0.545)	(0.569)		
ΔVIX*TotDebt Liab	-4.602***	-4.331***			-4.803***	-4.382***		
	(1.261)	(1.228)			(1.301)	(1.251)		
ΔVIX*TotEquity Liab	-1.085	-0.365			-0.417	-0.241		
	(1.176)	(1.080)			(1.102)	(1.080)		
ΔTED*TotDebt As			2.015*	2.364**			2.127*	2.145*
			(1.077)	(1.161)			(1.175)	(1.267)
ΔTED*TotEquity As			-0.113	-0.144			0.248	0.241
			(0.520)	(0.618)			(0.554)	(0.711)
ΔTED*TotDebt Liab			-0.764	-0.221			-0.618	-0.339
			(1.668)	(1.647)			(1.792)	(1.734)
ΔTED*TotEquity Liab			-2.416*	-3.165**			-3.127**	-2.824**
			(1.251)	(1.252)			(1.253)	(1.248)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
N	25	25	25	25	25	25	25	25
T	233	233	233	233	233	233	233	233
Obs	5,003	4,700	5,003	4,700	4,798	4,591	4,798	4,591
$\bar{R}^2$	0.088	0.118	0.015	0.054	0.102	0.140	0.022	0.077

Note: White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant and currency fixed effects included.

Table 2.16: Panel regression with gross assets and liabilities instead of net

	Full sample				
	(i)	(ii)	(iii)	(iv)	(v)
ΔTED	1.024	1.098	1.096	0.498	2.179**
	(0.932)	(0.934)	(0.936)	(0.866)	(1.043)
ΔTED*nfa	0.508***				
	(0.150)				
ΔTED*nTotDebt		0.713***	0.716***		
		(0.219)	(0.220)		
ΔTED*nTotEquity		0.309			
		(0.421)			
ΔTED*nfa^{PRIV}				1.119***	
				(0.278)	
ΔTED*nfa^{GOV}				-2.034***	
				(0.718)	
ΔTED*nTotDebt^{PRIV}					1.852**
					(0.911)
ΔTED*nTotDebt^{GOV}					-0.278
					(1.593)
N	25	25	25	21	12
T	184	184	184	184	184
Obs	4,355	4,244	4,365	2,880	1,618
$\bar{R}^2$	0.462	0.463	0.463	0.484	0.500

Note: Dep. var: Δ*s* White SE in parentheses. The symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Constant, constitutive terms, control variables, currency and time fixed effects included.

Table 2.17: Models including time fixed effects and using a 'country specific' TED spread

3 Consumption and wealth in the long run: the impact of financial liberalization

with Lorenzo Pozzi[1]

3.1 Introduction

The study of the long run aggregate relationship between consumption and total household wealth (i.e., the sum of tangible assets and unobserved human wealth) serves a twofold purpose. First, it is central to the estimation of long run elasticities of consumption to wealth and its components. These elasticities are useful, among other things, to evaluate and predict the implications of wealth changes for economic growth. Second, it allows for the estimation of the unobserved ratio of consumption to total wealth. According to the aggregate intertemporal household budget constraint, the consumption-to-wealth ratio contains information about future variables, in particular future consumption changes and future returns to wealth.

The contemporaneous literature on the long run aggregate relationship between consumption and wealth originates from Lettau and Ludvigson (2001, 2004) who propose a cointegration approach to proxy the unobserved consumption to total wealth ratio. To this end, they regress log consumption on log assets and log earnings (as a proxy for human wealth) using US data and argue in favor of a stable cointegration relationship between these variables. From the stationary regression residuals, they calculate a proxy for the consumption to total wealth ratio (i.e, the variable "cay") and find that it has strong predictive power for (excess) stock returns. Rudd and Whelan (2006) however find no cointegration in the US upon adjusting the data to

[1]For constructive comments and suggestions, we thank Gerdie Everaert, Massimo Giuliodori, Vadym Volosovych, Agnieszka Markiewicz and participants of the following seminars and conferences: econometrics and economics seminars at the Erasmus School of Economics (Rotterdam, Netherlands), the 2018 workshop on financial econometrics and empirical modeling of financial markets at Kiel Institute for the World Economy (Kiel, Germany), the 2018 International Association for Applied Econometrics conference (Montreal, Canada), the 2018 European summer meeting of the Econometric Society (Cologne, Germany), and the Tinbergen Institute Macro Research Day (Rotterdam, Netherlands).

make it more consistent with the underlying intertemporal household budget constraint, i.e., they argue that "cay" is not stationary.[2] Their finding suggests that results obtained from the cointegration approach to measure wealth effects on consumption and to predict stock returns using the estimated consumption-wealth ratio "cay" are spurious.[3] In a recent contribution, Bianchi et al. (2017) acknowledge these issues and - after adjusting the data along the lines of Rudd and Whelan (2006) and failing to find stationarity for the standard "cay" measure - propose a new proxy for the consumption-wealth ratio obtained from a regression that includes a two-state Markov switching intercept. This allows for regime shifts in the consumption to wealth ratio which they link to the US Federal Reserve's monetary policy. They argue that the consumption-wealth ratio obtained from this approach is stationary and has stronger predictive ability for (excess) stock returns when compared to the traditional "cay" variable.

This paper contributes to the literature by estimating the long run consumption-wealth relationship using an alternative empirical approach. In particular, we propose an unobserved component model applied to US data over the period 1951Q4-2016Q4. The regression equation of log consumption on log assets and log earnings is augmented with an integrated unobserved component (see e.g. Harvey et al., 1986; Canarella et al., 1990; Sarantis and Stewart, 2001; Planas et al., 2007; Everaert, 2010, for the inclusion of such a component in regressions conducted in a different context). This inclusion allows us to reliably estimate the long run relationship between consumption and total household wealth, even though consumption, assets and earnings are not cointegrated. Our unobserved component model is estimated using Bayesian state space methods with model selection along the lines of Frühwirth-Schnatter and Wagner (2010). This allows for the calculation of the posterior probability that an integrated unobserved component is present in the regression equation. Posterior distributions are calculated for the elasticities of consumption to assets and earnings and these elasticities are compared to elasticities obtained for models without an integrated unobserved component. An alternative "cay" variable - i.e., the stationary part of the consumption to wealth ratio - is calculated from this set-up and its persistence and predictive ability for (excess) stock returns are evaluated and compared to that of the standard "cay" variable.

The paper contains the following results. Using standard frequentist cointegration tests, we confirm that the evidence in favour of a stable cointegrating relationship between consumption, earnings and assets in the US is very weak. Our Bayesian unobserved component approach with model selection strongly supports the presence

[2]As far as international evidence is concerned, Slacalek (2004) fails to find evidence in favor of a stable cointegrating relationship between consumption, earnings and assets in a sample of 26 countries.

[3]Given considerations like absence of cointegration and instability of the cointegrating vector, Carroll et al. (2011) argue against cointegration methods to measure wealth effects and instead propose an indirect approach based on the consumption Euler equation and stickiness in consumption growth.

of an unobserved integrated component in the consumption equation. We argue that a model with an integrated unobserved component added to the regression is preferred over alternative options to deal with the non-stationarity of the consumption-to-wealth ratio such as the modelling of regime switches in its mean. With respect to the estimates of the elasticities of consumption to assets and earnings we find, in line with the previous literature, that asset wealth has a much smaller impact on consumption than earnings (as a proxy for human wealth), and that non-stock asset wealth (i.e., housing wealth) is more important for consumption than stock assets (see e.g., Davis and Palumbo, 2001; Carroll et al., 2011). Importantly, we find that the estimated elasticities for assets (and their components) tend to be overestimated when we wrongfully exclude the unobserved integrated component from the model. Hence, the failure to appropriately account for the non-stationarity in the consumption equation leads to elasticity estimates that are misleading. We further provide an interpretation for the unobserved integrated component and test this interpretation. In particular, we argue that financial liberalization has, by relaxing liquidity constraints of consumers, permanently increased the consumption-to-wealth ratio over the sample period. Finally, we evaluate both the in-sample and out-of-sample predictive ability for excess stock returns of our new "cay" variable, i.e., the stationary part of the consumption to wealth ratio. In-sample, we find that its predictive ability for future excess stock returns, while diminished compared to that of the traditional "cay" variable, is statistically and economically significant and in line with the univariate predictability results typically reported in the literature for excess stock returns using other predictors (see e.g. Ferson et al., 2003, for an overview). Out-of-sample, we find that its predictive ability for future excess stock returns is comparable to that of the standard "cay" variable.

The structure of the paper is the following. Section 3.2 derives the estimable equations that relate consumption to earnings and asset wealth (and its components). Section 3.3 provides a brief description of the data while Section 3.4 provides evidence on cointegration between consumption, assets and earnings based on standard frequentist cointegration tests. Section 3.5 presents and discusses our unobserved component approach and the results obtained using this method. A theoretical interpretation of the estimated integrated unobserved component is presented and tested and the predictive ability for excess stock returns of our alternative "cay" is discussed. Finally, Section 3.6 concludes.

3.2 Theoretical framework

This section derives two estimable equations that relate consumption to earnings and assets and to earnings and asset components (i.e., stock wealth and non-stock wealth). The derivations are largely based on the framework considered initially by Campbell and Mankiw (1989) and then explored further by Lettau and Ludvigson (2001, 2004). Note that linearization constants are ignored throughout the section.

The per period budget constraint of a representative consumer is given by,

$$\frac{A_{t+1}}{1+r_{t+1}} = A_t + Y_t - C_t \tag{3.1}$$

where A_t are real assets, Y_t is real disposable labor income (earnings), C_t is real consumption and r_t is the real rate of return. Alternatively, write

$$\frac{W_{t+1}}{1+r_{t+1}} = W_t - C_t \tag{3.2}$$

where $W_t \equiv A_t + H_t$ is total wealth and H_t is human wealth.

To reconcile both eqs. (3.1) and (3.2), note that

$$H_t = Y_t + \frac{H_{t+1}}{1+r_{t+1}} \tag{3.3}$$

which is consistent with the definition of human wealth as the presented discounted value of future earnings.[4]

After log-linearizing eq. (3.2) and solving the resulting log-linearized per period constraint forward, we can write

$$c_t - w_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}) + \lim_{k\to\infty} \rho^k E_t(c_{t+k} - w_{t+k}) \tag{3.4}$$

where c_t is the log of real consumption C_t, w_t is the log of total real wealth W_t, E_t is the expectation operator conditional on period t information and ρ is the discount factor $(0 < \rho < 1)$.[5] The transversality condition $\lim_{k\to\infty} \rho^k E_t(c_{t+k} - w_{t+k}) = 0$ is imposed so that

$$c_t = w_t + n_t \tag{3.5}$$

where $n_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j})$.

We then log-linearize $W_t \equiv A_t + H_t$ to obtain $w_t = \alpha a_t + \beta h_t$ so that eq. (3.5) becomes

$$c_t = \alpha a_t + \beta h_t + n_t \tag{3.6}$$

where a_t is the log of assets A_t, h_t is the log of human wealth H_t, α is the elasticity

[4]For ease of exposition, we do not decompose the return on total wealth into a return on human wealth and a return on asset wealth hence effectively assuming these returns are equal. The framework can be easily extended to incorporate this distinction but this does not offer additional insight.

[5]In particular, $\rho = 1 - \frac{C}{W}$ where C and W are the steady state values of C_t and W_t around which we linearize.

of consumption with respect to assets and β is the elasticity of consumption with respect to human wealth.[6]

Since log human wealth h_t is unobserved, we log-linearize eq. (3.3), solve the resulting expression forward and impose a transversality condition to obtain

$$h_t = y_t + m_t \tag{3.7}$$

where $m_t = E_t \sum_{j=1}^{\infty} \bar{\rho}^j (\Delta y_{t+j} - r_{t+j})$ with discount factor $\bar{\rho}$ $(0 < \bar{\rho} < 1)$.[7]

Substituting eq. (3.7) into eq. (3.6) then gives the baseline equation,

$$c_t = \alpha a_t + \beta y_t + z_t \tag{3.8}$$

with $z_t = n_t + \beta m_t$.

If we decompose assets A_t into stock wealth A_t^s (financial wealth) and non-stock wealth A_t^{ns} (mainly housing wealth), we have $W_t \equiv A_t^s + A_t^{ns} + H_t$ and we can derive the extended equation,

$$c_t = \alpha^s a_t^s + \alpha^{ns} a_t^{ns} + \beta y_t + z_t \tag{3.9}$$

where a_t^s is the log of stock wealth A_t^s, a_t^{ns} is the log of non-stock wealth A_t^{ns}, α^s is the elasticity of consumption with respect to stock wealth and α^{ns} is the elasticity of consumption with respect to non-stock wealth.[8]

This set-up allows for the estimation of the elasticities of consumption to assets and to asset components, but also for the construction of a proxy for the consumption to total wealth ratio $c_t - w_t$, i.e., the estimated variable z_t - which in the case of eq. (3.8) - is commonly denoted by "cay". The ways to estimate these equations are discussed in detail in Sections 3.4 and 3.5 after a description of the data is first given in the next section.

3.3 Data

For the estimation of eqs. (3.8) and (3.9) we use quarterly US data over the period $1951Q4 - 2016Q4$. A detailed description of the data can be found in Appendix 3A. Our dataset is constructed identically as the dataset considered by Lettau and Ludvigson (2015). For c_t we use the log of real per capita total personal consumption

[6] We have $\alpha = \frac{A}{W}$ and $\beta = \frac{H}{W}$ where A, H and W are the steady state values of A_t, H_t and W_t around which we linearize.

[7] In particular, $\bar{\rho} = 1 - \frac{Y}{H}$ where Y and H are the steady state values of Y_t and H_t around which we linearize.

[8] We have $\alpha^s = \frac{A^s}{W}$ and $\alpha^{ns} = \frac{A^{ns}}{W}$ where A^s, A^{ns} and W are the steady state values of A_t^s, A_t^{ns} and W_t around which we linearize.

expenditures.[9] For y_t we use the log of real per capita disposable labor income. For a_t we use the log of real per capita household total net worth which includes stock and non-stock financial assets, housing wealth and durable goods.[10] For a_t^s we use the log of real per capita stock market assets while for a_t^{ns} we use the log of real per capita non-stock assets (i.e., real estate, non-stock financial assets, durable goods) minus liabilities. The asset variables a_t, a_t^s and a_t^{ns} are all measured at the end of the period.

3.4 Cointegration

This section investigates whether regression equations (3.8) and (3.9) constitute cointegrating relationships. To this end, first we discuss the integratedness of the variables included in these equations. Next, we conduct a battery of standard frequentist cointegration tests and discuss their results.

3.4.1 Integrated variables

Figure 3.1 presents the variables c_t, y_t, a_t, a_t^s and a_t^{ns} (logs) and Δc_t, Δy_t, Δa_t, Δa_t^s and Δa_t^{ns} (growth rates) used in our analysis. From the figure, we note that the variables c_t, y_t, a_t, a_t^s and a_t^{ns} are stochastically trended. In particular, augmented Dickey-Fuller tests (reported in Appendix 3B) suggest that they are integrated of order one - $I(1)$ - and become integrated of order zero - $I(0)$ - upon first differencing, i.e. implying that the growth rates Δc_t, Δy_t, Δa_t, Δa_t^s and Δa_t^{ns} are stationary. With respect to the stationarity of these growth rates, it should be noted however that Dickey-Fuller tests may fail to detect a unit root if it underlies a volatile high frequency component. As such, growth rates may *appear* stationary rather than be stationary. We argue below that due to financial liberalization, aggregate consumption growth Δc_t contains a slow moving low frequency stochastic trend underneath its volatile high frequency component.

3.4.2 Cointegration

If the regressions given by equations (3.8) and (3.9) are believed to consist of integrated $I(1)$ variables, then the standard approach to estimate the elasticities α, β, α^s and α^{ns} is to estimate these equations as cointegrating regressions (see Engle and

[9] Lettau and Ludvigson (2001, 2004) originally used expenditures on nondurable goods and services as a proxy for consumption but they recently switched to the use of total personal consumption expenditures (see Lettau and Ludvigson, 2015).

[10] Rudd and Whelan (2006) argue in favor of excluding durable goods from assets as c_t already includes expenditures on durable goods. However, as durable goods are not fully consumed in the period of purchase, we follow Lettau and Ludvigson (2004, 2015) and do not exclude them from net asset wealth a_t. Our results are robust to using a definition of wealth that excludes durable goods however. These results are not reported but are available from the authors upon request.

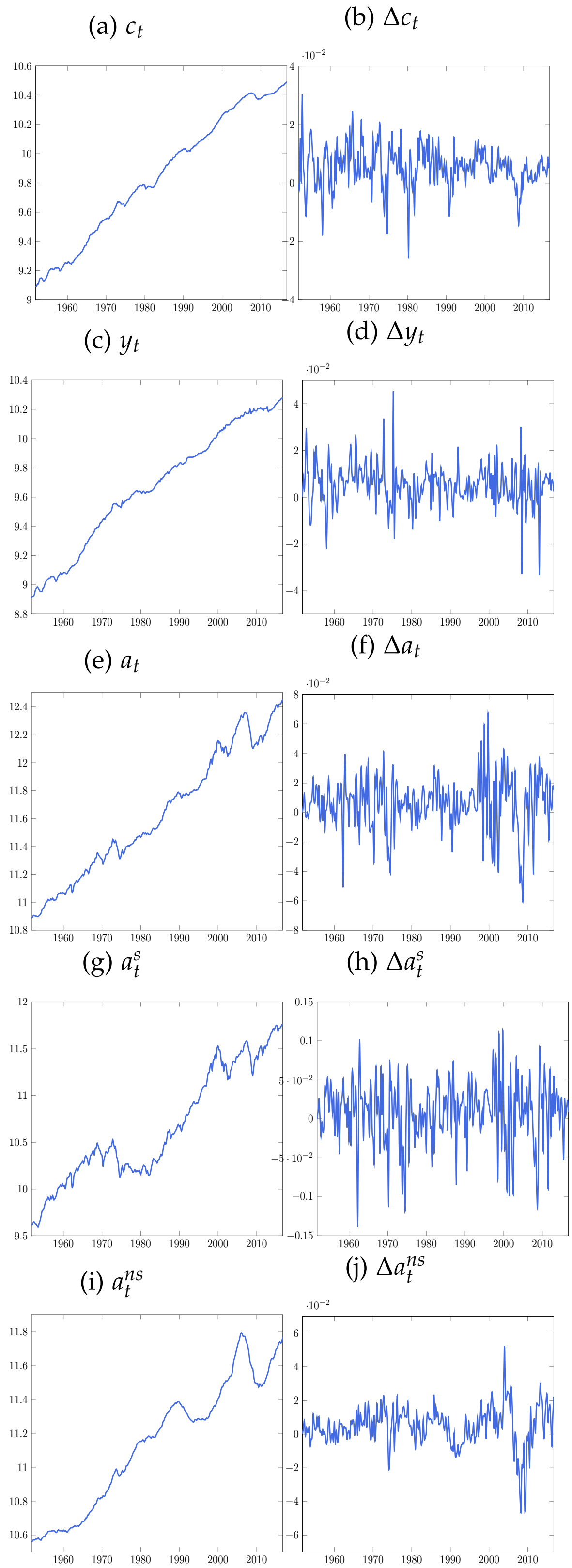


Figure 3.1: Real per capita personal consumption expenditures (c), disposable labor income (y), net assets (a), net stock wealth (a^s) and net non-stock wealth (a^{ns}) - US data $1951Q4 - 2016Q4$.

Granger, 1987). For this approach to be valid, the term z_t in both equations should be stationary, i.e., the variables c_t, y_t and a_t in eq. (3.8) and the variables c_t, y_t, a_t^s and a_t^{ns} in eq. (3.9) must be cointegrated. In the following subsections we first use standard frequentist cointegration tests to find out whether z_t is stationary. We then provide potential reasons why z_t is found to be non-stationary, and finally we discuss the implications of a non-stationary z_t.

Testing whether z_t is stationary

To check whether z_t is stationary or not, we conduct a standard Engle-Granger cointegration test (see Engle and Granger, 1987) and report the results in Table 3.1. From the table, we note that there is very little evidence in favor of cointegration between the variables c_t, y_t and a_t or between the variables c_t, y_t, a_t^s and a_t^{ns}. This is the case for the full sample period (the period $1951Q4-2016Q4$) as well as for the sample that excludes the years from the Great Recession onward (the period $1951Q4-2007Q3$). We have also conducted a number of alternative cointegration tests, the results of which are reported in Appendix 3B. These tests also strongly suggest that there is no cointegration between the variables considered. As we argue in the appendix, the failure of finding cointegration does not seem to originate from statistical issues - i.e. the lack of power to reject a false null hypothesis - but rather suggests that there is in fact a unit root present in z_t.

c, a, y		c, a^s, a^{ns}, y	
$1951Q4-2016Q4$	$1951Q4-2007Q3$	$1951Q4-2016Q4$	$1951Q4-2007Q3$
Dickey-Fuller t-statistic			
-2.32	-2.57	-2.36	-2.47
5% and 10% critical values (3 variables)		5% and 10% critical values (4 variables)	
5%	-3.74	5%	-4.10
10%	-3.45	10%	-3.81

Notes: The null hypothesis tested is the no cointegration hypothesis. A constant is included in the cointegrating equation. The 5% and 10% critical values are taken from MacKinnon (2010). The number of lags included in the augmented Dickey-Fuller regression is based on the Bayesian information criterion.

Table 3.1: Engle-Granger cointegration test between c, a and y and between c, a^s, a^{ns} and y

Reasons why z_t is non-stationary

There are different potential reasons as to why eqs. (3.8) and (3.9) are not cointegrating regressions. First, the stationarity of z_t requires the stationarity of the term n_t in eq. (3.5). Since the result in eq. (3.5) is obtained after imposing a transversality condition, a violation of this condition renders n_t in eq. (3.5) non-stationary. Additionally, the log-linearization conducted to derive eq. (3.5) pushes potentially non-stationary higher-order terms in n_t. The same arguments can be evoked when considering the stationarity of the term m_t in eq. (3.7), which also is a component of z_t. Second, the model presented in Section 3.2 assumes stability in the steady state ratios of the model variables and hence in the resulting elasticities. This assumption may not hold in practice.[11] Structural instability in the cointegrating equation may lead to an $I(1)$ component in z_t.[12] Third, from the definition of the terms n_t in eq. (3.5) and m_t in eq. (3.7) these terms are stationary only if the variables r_t, Δc_t, and Δy_t in the model are stationary. As argued by Bianchi et al. (2017), regime shifts in US monetary policy may - through r_t - have caused shifts in the mean of the consumption to wealth ratio, rendering it non-stationary. In this paper, we instead focus on aggregate consumption growth Δc_t. In what follows we argue that financial liberalization occurring over the sample period has rendered Δc_t non-stationary, i.e. underneath the volatile high frequency component which is apparent from Figure 3.1, there is a slow moving low frequency stochastic trend.

Implications of a non-stationary z_t

The estimation of the relationship given by eq. (3.8) or eq. (3.9) as a cointegrating relationship using standard methods like static OLS or dynamic OLS is spurious if z_t is non-stationary (see Granger and Newbold, 1974; Phillips, 1986). Highly significant OLS estimates could be obtained for the elasticities α and β with high R^2's even if c_t and the regressors a_t and y_t are completely independent merely because these variables are all stochastically trended. While it is unlikely that the variables in eqs. (3.8) and (3.9) are completely independent, the estimates for the elasticities obtained via standard cointegration analysis are nonetheless unreliable if z_t contains a unit root. Additionally, the non-stationarity of the variable z_t may invalidate its use as a predictor for other variables, in particular (excess) stock returns (see e.g. Rudd and Whelan, 2006). These issues are tackled in the next section where we discuss an alternative empirical approach based on an unobserved component model.

[11] For instance, different forms of heterogeneity at the micro level may imply structural instability in the aggregate relationship estimated using time series data (see Cooper, 2016, and references therein).

[12] To see this, note that if the true relationship between c_t, a_t and y_t is given by $c_t = \alpha_t a_t + \beta_t y_t + v_t$ where the time-varying parameters α_t and β_t are given by $\alpha_t = \alpha + \tilde{\alpha}_t$ and $\beta_t = \beta + \tilde{\beta}_t$ - i.e., consisting of a constant and a time-varying component where the latter can be stationary or integrated - then estimating $c_t = \alpha a_t + \beta y_t + z_t$ causes z_t to have an $I(1)$ component since $z_t = v_t + \tilde{\alpha}_t a_t + \tilde{\beta}_t y_t$.

3.5 Unobserved component model

We can reliably estimate the long-run relationship between c_t, a_t and y_t in eq. (3.8) or between c_t, a_t^s, a_t^{ns} and y_t in eq. (3.9) - even when these variables are not cointegrated - using an unobserved component or state space framework (see Harvey, 1989; Durbin and Koopman, 2001). In such a set-up, the omitted $I(1)$ component in z_t can be explicitly added to the regression equation as an unobserved component and estimated together with the parameters - among which are the elasticities α, α^s, α^{ns} and β - of the model (see e.g. Harvey et al., 1986; Canarella et al., 1990; Planas et al., 2007; Everaert, 2010). Section 3.5.1 presents the specification of the unobserved component model. Section 3.5.2 discusses the methodology used to estimate the model. Section 3.5.3 presents the main estimation results.

3.5.1 Empirical specification

Set-up

We can write equations (3.8) and (3.9) in general form as,

$$c_t = x_t\phi + z_t \tag{3.10}$$

where $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ and $\phi = \begin{bmatrix} \alpha & \beta \end{bmatrix}'$ for eq. (3.8) or $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$ and $\phi = \begin{bmatrix} \alpha^s & \alpha^{ns} & \beta \end{bmatrix}'$ for eq. (3.9).

The unobserved variable z_t is modelled as the sum of an $I(1)$ non-stationary component μ_t and an $I(0)$ stationary component v_t. As such, we have,

$$z_t = \mu_t + v_t \tag{3.11}$$

The non-stationary component μ_t is modelled as a random walk process, i.e.,

$$\mu_t = \mu_{t-1} + \eta_t \tag{3.12}$$

where $\eta_t \sim iid\mathcal{N}\left(0, \sigma_\eta^2\right)$.

Following the literature where dynamic OLS is typically applied to the estimation of regression equations between consumption, earnings and assets, the stationary component v_t is modelled as consisting of an error term ε_t and lags, leads and contemporaneous values of the first difference of the regressors x_t, i.e.,

$$v_t = \sum_{j=-p}^{p} \Delta x_{t+j}\rho_j + \varepsilon_t \tag{3.13}$$

where $\varepsilon_t \sim iid\mathcal{N}\left(0, \sigma_\varepsilon^2\right)$.[13]

Discussion

The presence of an integrated unobserved component μ_t in eq. (3.10) may have multiple causes.[14] As noted in Section 3.4.2 above, the reason for failing to find cointegration between the variables c_t, y_t and a_t - or between the variables c_t, y_t, a_t^s and a_t^{ns} - may be due to a violation of the transversality condition, the neglect of potentially integrated higher-order terms in the conducted log-linearizations or structural instability in the steady state ratios of the model variables. And while Bianchi et al. (2017) argue that monetary policy shifts render the returns on wealth non-stationary, this paper focusses instead on financial liberalization and its impact on aggregate consumption growth (see Section 3.5.4). Of course, objections can be raised to giving an integrated variable or unit root interpretation to some of these failures of finding cointegration. For instance, violations of the transversality condition may be short-lived (i.e., bubbles tend to burst). However, for other failures this concern seems unwarranted. For example, the neglected higher-order terms in the log-linearizations are functions of the levels of the variables in the model and are therefore unquestionably integrated variables. Additionally, even if one objects to the principle of there being an integrated component in this context, this component may actually provide the best way to approximate the non-stationarity of z_t *within a given sample period*. Indeed, as we detail in Appendix 3C, using an alternative and more general modelling approach for the unobserved component suggests that the non-stationarity of z_t is best modelled through an integrated variable. More specifically, we find that the data supports a regression model with an integrated unobserved component included to capture non-stationarity rather than a regression model containing a Markov switching intercept along the lines of Bianchi et al. (2017). Before discussing the results of the estimation of the unobserved component model, the next section first elaborates on the methodology used.

3.5.2 Methodology

We first discuss the advantages of Bayesian estimation. Then, we present the Bayesian model selection approach to determine whether or not a non-stationary unobserved component is present in the regression. Finally, we discuss our choice of parameter priors. The general outline and technical details of the Gibbs sampling algorithm together with a convergence analysis of the sampler are provided in Appendix 3D.

[13]The results reported in this section change very little if, additionally, lags of the first difference of the dependent variable c_t are added to the component v_t.

[14]Instead of an "unobserved component", the variable μ_t could alternatively be denoted as a "time-varying intercept" without changing the implications of the results found in the paper.

Bayesian estimation

Using a standard classical approach to state space estimation, the Kalman filter could be applied to estimate the unobserved component and calculate the likelihood, where the latter would be maximized with respect to the model parameters using an iterative numerical procedure.[15] This paper instead follows a Bayesian approach. In particular, we use a Gibbs sampling approach which is a Markov Chain Monte Carlo (MCMC) method used to simulate draws from the intractable joint posterior distribution of the parameters and the unobserved state using only tractable conditional distributions. Our Bayesian approach has a number of advantages. First, as discussed in the next section, model selection allows for the calculation of the posterior probability that an integrated unobserved component is present in the regression, i.e., we calculate the probability of a model with integrated unobserved component versus a model without integrated unobserved component. Second, model averaging is possible so that we may calculate parameter estimates - in particular, elasticities - averaged across both models. In this way, valid parameter estimates can be obtained for any value of the posterior probability that a non-stationary unobserved component is present in the regression. This stands in contrast to the standard classical cointegration approach where valid parameter estimates can only be obtained under stationarity, i.e., when there is no integrated unobserved component in the regression error term. Third, the Gibbs sampler provides small sample posterior distributions of the parameters making it possible to avoid the use of asymptotic approximations to parameter distributions.[16]

Model selection

We test whether to include or exclude the integrated unobserved component to the regression equation using the stochastic model selection approach for Bayesian state space models as developed by Frühwirth-Schnatter and Wagner (2010). Testing whether or not an integrated unobserved component μ_t is present in eq. (3.10) amounts to testing $\sigma_\eta^2 > 0$ against $\sigma_\eta^2 = 0$. This is a non-regular testing problem from a classical viewpoint as the null hypothesis lies on the boundary of parameter space. Our Bayesian approach is convenient to deal with this problem. In a Bayesian setting each of the two potential models - i.e. the model for c_t that includes the integrated

[15]Under stationarity assumptions, the obtained maximum likelihood estimates are consistent and asymptotically Gaussian provided that the model is identified (see e.g, Hamilton, 1994). Chang et al. (2009) show that these asymptotic properties can be extended to state space models with integrated observed and latent variables.

[16]Further advantages compared to the standard classical maximum likelihood (ML) estimation approach to state space models are (i) the fact that Gibbs sampling is computationally easier to implement than ML estimation and, as such, does not suffer from the numerical optimization problems inherent to ML estimation (see Kim and Kim, 2011) and (ii) the fact that both the parameters and the unobserved state are treated as random variables in a Bayesian setting whereas the traditional ML approach treats the ML estimates of the parameters as if they are the true values hence neglecting parameter uncertainty when conducting inference on the unobserved state (see Kim and Nelson, 1999).

unobserved component and the model for c_t that excludes the integrated unobserved component - is assigned a prior probability, and the posterior probability of each model is then calculated conditional on the data. Frühwirth-Schnatter and Wagner (2010) extend the Bayesian model selection approach of George and McCulloch (1993) to state space models. Following their approach, we consider a non-centered parameterization of the unobserved component μ_t. A binary stochastic indicator is then assigned to the integrated unobserved component so that it is either included in or excluded from eq. (3.10). This indicator is sampled together with the model parameters in our Gibbs sampling algorithm.

Non-centered specification

We can rewrite eq. (3.12) as

$$\mu_t = \mu + \sigma_\eta \mu_t^* \tag{3.14}$$

$$\mu_t^* = \mu_{t-1}^* + \eta_t^* \qquad \mu_0^* = 0 \qquad \eta_t^* \sim iid\mathcal{N}\left(0, 1\right) \tag{3.15}$$

where μ is the initial value of μ_t if μ_t is time-varying ($\sigma_\eta^2 > 0$) and it is the constant value of μ_t when μ_t is constant ($\sigma_\eta^2 = 0$). Crucially, the non-centered specification is not identified as the signs of σ_η - i.e., the square root of the variance σ_η^2 - and μ_t^* in eq. (3.14) can be changed without changing their product. As a result of this non-identification, the likelihood is symmetric around 0 along the σ_η dimension. When $\sigma_\eta^2 > 0$, the likelihood is bimodal with modes $-\sigma_\eta$ and σ_η. When $\sigma_\eta^2 = 0$, the likelihood is unimodal around zero. Allowing for non-identification of σ_η therefore provides useful information on whether $\sigma_\eta^2 > 0$, and this non-identification can be exploited when drawing σ_η and μ_t^* in the Gibbs algorithm through the use of a random sign switch, i.e., when sampling we multiply both by -1 with probability 0.5 and leave both unaltered with probability 0.5.

Selection of the integrated unobserved component

The non-centered parameterization is useful for model selection as the transformed component μ_t^*, in contrast to μ_t, does not degenerate to a static component if the innovation variance equals zero. This means that if the variance $\sigma_\eta^2 = 0$, then $\sigma_\eta = 0$ in eq. (3.14) and the time-varying part μ_t^* of the unobserved component μ_t drops from the model. Hence, in the non-centered parameterization the presence or absence of a non-stationary unobserved component can be expressed as a standard variable selection problem. In particular, we write

$$\mu_t = \mu + \iota \sigma_\eta \mu_t^* \tag{3.16}$$

where ι is a binary inclusion indicator which is either 0 or 1. If $\iota = 1$, there is an integrated unobserved component, μ is the initial value of μ_t and σ_η is estimated from the data. If, on the other hand, $\iota = 0$, there is no integrated unobserved component, μ_t becomes constant as $\mu_t = \mu$ and σ_η is set to 0. The binary indicator ι is sampled together with the other parameters so that from its posterior distribution we can calculate the posterior inclusion probability of the integrated unobserved component in the regression.

Parameter priors

Our Bayesian estimation approach requires choosing prior distributions for the model parameters.

Prior for the binary indicator ι

For the binary inclusion indicator, we assume a Bernoulli prior distribution with probability p_0. When calculating the posterior probability of the unobserved integrated component in the regression, we set $p_0 = 0.5$ but also report results for $p_0 = 0.25$ and $p_0 = 0.75$.

Prior for the innovation variance σ_η^2 of the unobserved component

Following Frühwirth-Schnatter and Wagner (2010), the standard inverse gamma (IG) prior for the variance of the innovation to the unobserved component is replaced by a Gaussian prior centered at zero for the square root of the variance. The reason for this is that when using the standard IG prior distribution for variance parameters, the choice of the shape and scale hyperparameters that define this distribution has a strong influence on the posterior distribution when the true value of the variance is close to zero. More specifically, as the IG distribution does not have probability mass at zero, using it as a prior distribution tends to push the posterior density away from zero. This is of particular importance when estimating the variance σ_η^2 of the innovation to the unobserved component μ_t as we want to decide whether or not to include this component in the regression. As can be noted from equations (3.10), (3.11) and (3.14), since σ_η is a regression coefficient in the consumption equation, a further important advantage of the non-centered parameterization is therefore that it allows us to replace the standard IG prior on the variance parameter σ_η^2 by a Gaussian prior centered at zero on σ_η. Centering the prior distribution at zero makes sense as, for both $\sigma_\eta^2 = 0$ and $\sigma_\eta^2 > 0$, σ_η is symmetric around zero. Frühwirth-Schnatter and Wagner (2010) show that the posterior density of σ_η is much less sensitive to the hyperparameters of the Gaussian distribution and is not pushed away from zero when $\sigma_\eta^2 = 0$. In Table 3.2 we report the prior distributions assumed for the model parameters. As can be seen in the table, we use a Gaussian prior distribution for σ_η

with mean zero and a variance equal to 0.10. The variance is chosen such that the prior distribution has support over a sufficiently large range of relevant parameter values.

Other priors

As can be seen in Table 3.2, we also use Gaussian prior distributions centered at zero for the elasticities ϕ, for the constant μ of the integrated unobserved component and for the coefficients ρ on the contemporaneous values and leads and lags of the first differences of the regressors. Again, the variances of these prior distributions are chosen such that the distributions have support over a sufficiently large range of relevant parameter values, i.e., a unit variance is used for the prior distributions of ϕ, μ and ρ. Finally, for the variance σ_ε^2 of the error term ε we use an IG prior distribution with a relatively high belief equal to 0.01 and a relatively low strength equal to 0.01 (see Bauwens et al., 2000, for details on prior beliefs and strengths).[17] By giving a relatively high prior value to the parameter σ_ε^2, we give a relatively high weight to the stationary component in the regression v_t compared to the integrated component μ_t. In general, all priors are rather flat so that the results reported in the next section are driven mostly by the data and are not very sensitive to the priors chosen.

Gaussian priors $\mathcal{N}(b_0, V_0)$				Percentiles	
		mean (b_0)	variance (V_0)	5%	95%
Elasticities on regressors x_t	ϕ	0.00	1.00	-1.64	1.64
Constant $I(1)$ component	μ	0.00	1.00	-1.64	1.64
Square root variance $I(1)$ component	σ_η	0.00	0.10	-0.52	0.52
Coeff. on lags/leads of Δx_t (DOLS terms)	ρ	0.00	1.00	-1.64	1.64
Inverse Gamma prior $IG(\nu_0 T, \nu_0 T \sigma_0^2)$				Percentiles	
		belief (σ_0^2)	strength (ν_0)	5%	95%
Variance error term ε_t	σ_ε^2	0.01	0.01	0.004	0.12

Notes: The basic regression equation is $c_t = x_t\phi + \mu_t + v_t$. The random walk I(1) component is $\mu_t = \mu + \iota\sigma_\eta \mu_t^*$ with $\mu_t^* = \mu_{t-1}^* + \eta_t^*$. The stationary $I(0)$ component is $v_t = \sum_{j=-p}^{p} \Delta x_{t+j}\rho_j + \varepsilon_t$. With $p = 6$ and data available over the period 1951Q4 – 2016Q4, the effective sample period is 1953Q3 – 2015Q2 and the effective sample size is $T = 248$ (i.e., 261 observations minus 1 for first-differencing and minus 12 for constructing leads and lags).

Table 3.2: Prior distributions regression parameters

[17] Note that the strength 0.01 times the sample size T can be interpreted as the number of fictional observations used to construct the prior belief.

3.5.3 Results

This section presents the results of the estimation of the unobserved component model. Table 3.3 presents the posterior probabilities that there is an integrated unobserved component present in the basic regression eq. (3.10). These are reported for different prior probabilities p_0 and for the two regression specifications that we consider, i.e., for regressor vector $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ (panel A) and regressor vector $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$ (panel B). The results provide strong evidence that there is an unobserved random walk component present in the regression, i.e., all posterior probabilities are found to be equal to 1.

	(A) $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$	(B) $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$
$p_0 = 0.5$	1	1
$p_0 = 0.75$	1	1
$p_0 = 0.25$	1	1

Notes: The regression equation is $c_t = x_t\phi + \mu_t + v_t$. Reported is the posterior inclusion probability of the integrated unobserved component μ_t. It is calculated as the average of the 10.000 ι's with each ι sampled in a Gibbs iteration. The prior distribution of the binary indicator ι is Bernoulli with probability p_0. The effective sample period is $1953Q3 - 2015Q2$.

Table 3.3: Posterior inclusion probabilities $p(\iota = 1)$ of an integrated unobserved component (for different prior inclusion probabilities p_0)

In Table 3.4 we present the posterior means and 90% highest posterior density (HPD) intervals of the posterior distributions for the fixed parameters of the unobserved component model given by eqs. (3.10), (3.11), (3.13), (3.16) and (3.15) with the exception of the coefficients ρ_j in eq. (3.13) which are excluded due to space constraints. Again, we present results for regressor vector $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ (panel A) and for regressor vector $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$ (panel B). Furthermore, we present results both with the binary indicator set to 1 and with the binary indicator set to 0. Setting $\iota = 1$ is in line with the posterior inclusion probabilities equal to 1 as reported in Table 3.3, i.e., the integrated component is included in the model and estimated. Setting $\iota = 0$ is in line with the models estimated in the existing literature, i.e., the non-stationarity of z_t in eq. (3.10) is typically not accounted for.[18] From the table we note that when we neglect the non-stationary component in z_t (i.e. when $\iota = 0$) the impact of log assets a_t on log consumption c_t is somewhat overestimated, i.e., in

[18]Frequentist estimates using dynamic least-squares (DLS) like in Lettau and Ludvigson (2004) or (2015) yield coefficients on a_t, y_t, a_t^s and a_t^{ns} that are mostly similar to the ones reported in Table 3.4 for which $\iota = 0$. When the frequentist coefficients are different (for α^{ns} and μ), these coefficients are even further away from the ones with the assumption that $\iota = 1$ than the Bayesian estimates with $\iota = 0$.

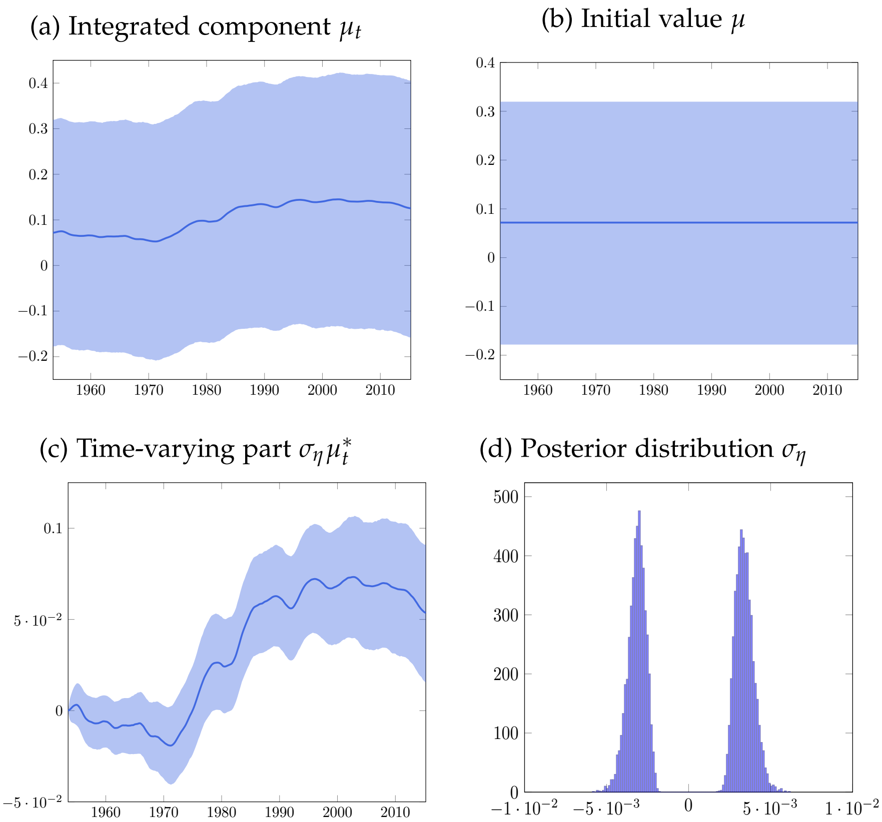
panel A the elasticity α is found to be equal to 0.27 when $\iota = 0$ and equal to 0.24 when $\iota = 1$. From panel B in the table we find that this difference can be attributed to the non-stock part of assets a^{ns} as α^{ns} equals 0.25 when $\iota = 0$ and only 0.18 when $\iota = 1$ (while the estimates for α^s are essentially the same when $\iota = 0$ and when $\iota = 1$). Panel B of the table further shows that non-stock asset wealth, which consists mainly of housing wealth, has a larger long run impact on consumption than stock wealth. This finding is in line with results reported in the literature (see e.g. Davis and Palumbo, 2001; Carroll et al., 2011). The standard deviation $|\sigma_\eta|$ of the error term of the integrated random walk component μ_t is estimated only when $\iota = 1$ and is found to be larger than zero both in panels A and B. This result for $|\sigma_\eta|$ suggests that there is important time-variation in μ_t and corroborates the finding of a posterior inclusion probability $p(\iota = 1)$ equal to 1 as reported in Table 3.3.

	(A) $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$		(B) $x_t = \begin{bmatrix} a^s_t & a^{ns}_t & y_t \end{bmatrix}$	
	(1) $\iota = 1$	(2) $\iota = 0$	(1) $\iota = 1$	(2) $\iota = 0$
α	0.2382	0.2728	-	-
	[0.1722,0.3041]	[0.2405,0.3050]		
α^s	-	-	0.0817	0.0881
			[0.0428,0.1243]	[0.0763,0.1000]
α^{ns}	-	-	0.1783	0.2486
			[0.1175,0.2391]	[0.2078,0.2895]
β	0.7209	0.7575	0.7161	0.7115
	[0.6412,0.8004]	[0.7218,0.7934]	[0.6249,0.8045]	[0.6662,0.7576]
μ	0.0718	-0.6491	0.0424	-0.7449
	[-0.1781,0.3196]	[-0.7226,-0.5753]	[-0.1800,0.2778]	[-0.8554,-0.6345]
$\vert\sigma_\eta\vert$	0.0033	-	0.0035	-
	[0.0025,0.0043]		[0.0026,0.0045]	
σ^2_ε	.00028	.00055	.00027	.00045
	[.00024,.00032]	[.00048,.00064]	[.00023,.00032]	[.00039,.00052]

Notes: Reported are the posterior mean with 90% HPD interval (in square brackets). In panel A of the table the coefficient vector is $\phi = \begin{bmatrix} \alpha & \beta \end{bmatrix}'$ and in panel B it is $\phi = \begin{bmatrix} \alpha^s & \alpha^{ns} & \beta \end{bmatrix}'$. The random walk I(1) component is $\mu_t = \mu + \iota\sigma_\eta\mu^*_t$ with $\mu^*_t = \mu^*_{t-1} + \eta^*_t$. The stationary $I(0)$ component is $v_t = \sum_{j=-p}^{p} \Delta x_{t+j}\rho_j + \varepsilon_t$. The coefficients ρ_j are excluded from the table due to space constraints. With $p = 6$ and data available over the period $1951Q4 - 2016Q4$, the effective sample period is $1953Q3 - 2015Q2$ and the effective sample size is $T = 248$ (i.e., 261 observations minus 1 for first-differencing and minus 12 for constructing leads and lags).

Table 3.4: Posterior distributions parameters of equation
$c_t = x_t\phi + \mu_t + v_t$

Figure 3.2 presents the estimated random walk μ_t and its components as obtained from the estimation of eq. (3.10) with $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ and $\iota = 1$, i.e. as obtained from the estimates reported in Table 3.4 panel A with $\iota = 1$. Results obtained with $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$ and $\iota = 1$ are very similar and therefore not reported. The upper left panel of the figure presents μ_t. From the non-centered specification given by eq. (3.14), the initial value μ of the random walk is presented in the upper right panel of the figure while the time-varying part $\sigma_\eta \mu_t^*$ of the random walk is presented in the lower left panel. Based on these figures we confirm that there is considerable time-variation in μ_t. The rather wide 90% HPD intervals around the posterior mean of μ_t stem mainly from uncertainty surrounding the initial value μ while the HPD intervals around the time-varying part $\sigma_\eta \mu_t^*$ are much narrower. The posterior distribution of σ_η (i.e., the square root of the variance σ_η^2) presented in the lower right panel of the figure is clearly bimodal and therefore again constitutes evidence that points toward time-variation in μ_t and thus to the presence of a random walk μ_t in eq. (3.10).

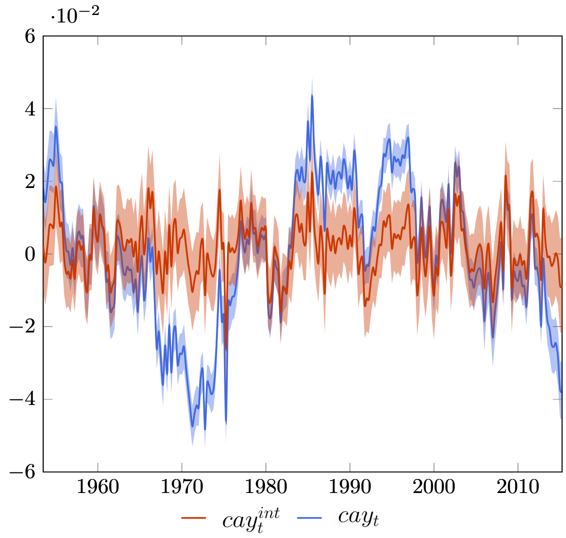


Note: Depicted in the first three figures are the posterior means with shaded areas denoting the 90% HPD interval. All figures are based on the results of Table 3.4 panel A with $\iota = 1$. The effective sample period is 1953Q3 − 2015Q2.

Figure 3.2: The integrated component μ_t, its initial value μ and time-varying part $\sigma_\eta \mu_t^*$, and the posterior distribution of the square root of its error variance σ_η

Figure 3.3 then presents the posterior means and 90% HPD intervals of the stationary component v_t both for $\iota = 0$, i.e. when no integrated unobserved component is included in the model, and for $\iota = 1$, i.e. when the non-stationary random walk

μ_t is included in the model and estimated. In the former case, v_t corresponds to the traditional proxy for the consumption to total wealth ratio "cay" estimated in the literature so we denote it by cay_t. We find that it is nearly identical to the standard "cay" as calculated and reported by Lettau and Ludvigson (2015). In the latter case, v_t constitutes a new "cay" obtained after controlling for an unobserved integrated component. We denote this series by cay_t^{int}. The figure reveals that cay_t^{int} is considerably less persistent (i.e. more stationary) than cay_t as the non-stationarity in z_t in eq. (3.10) is entirely soaked up by μ_t in this case.[19] The variable cay_t^{int} can be interpreted as the stationary or transitory component of the consumption-to-wealth ratio while the integrated unobserved component μ_t constitutes the permanent component of the consumption-to-wealth ratio. In Section 3.5.5, we take a closer look at cay_t^{int} but first, in Section 3.5.4, we present an interpretation for the unobserved integrated component μ_t.



Notes: Depicted are the posterior means. The shaded areas denote the 90% HPD interval. cay_t^{int} is calculated from the results of Table 3.4 panel A with $\iota = 1$. cay_t is calculated from the results of Table 3.4 panel A with $\iota = 0$. The effective sample period is 1953Q3 − 2015Q2.

Figure 3.3: The stationary component v_t for $\iota = 1$ (cay_t^{int}) and $\iota = 0$ (cay_t)

3.5.4 Interpretation of the unobserved component μ_t

In this section we first link the estimated integrated unobserved component found in the regression of consumption on assets and earnings to a proxy for financial liberalization. Second, we discuss and estimate the theoretical channel by which the unobserved component - interpreted as stemming from financial liberalization -

[19]Moreover, note from the figure that the HPD interval around cay_t^{int} is wider than that around cay_t which stems from the fact that the estimation of cay_t^{int} entails the estimation of both fixed parameters and a time-varying state - i.e. the unobserved component μ_t - while the estimation of cay_t entails only the estimation of fixed parameters.

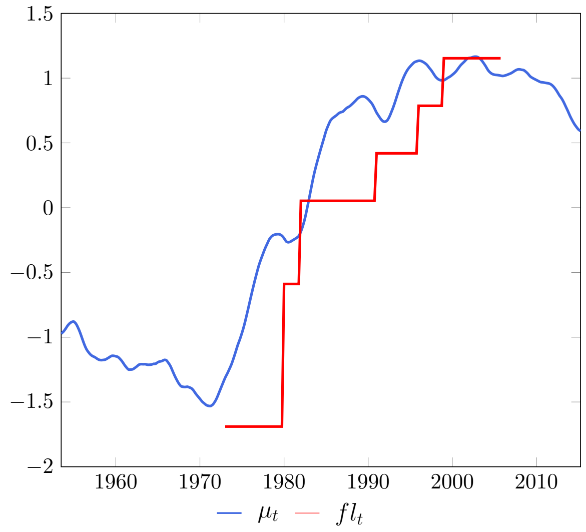
affects the consumption-to-wealth ratio.

Linking the unobserved component to financial liberalization

By relaxing liquidity constraints, financial liberalization may have increased the propensity to consume out of (total) wealth over time, and thereby raised the consumption to wealth ratio. Figure 3.4 shows the estimated unobserved component μ_t and Abiad et al. (2010)'s proxy for financial liberalization in the US, which we denote by fl_t and which is available over the period $1973Q1 - 2005Q4$. Note that in the figure both variables are re-scaled so as to make them comparable graphically. The financial liberalization index of Abiad et al. (2010) is a mixture of indicators of financial development (credit controls and ceilings, interest rate liberalization, capital account transactions, securities market development, banking sector supervision). More details on this index are provided in Appendix 3A. We choose this particular proxy over other proxies because - since it is based on readings of laws and regulations - it is more likely to be driven by credit supply and less by demand.[20] From the figure, we note the similar trend in both measures. This suggests that financial liberalization may be - at least partially - responsible for the structural increase in the proxied consumption-to-wealth ratio and hence for the failure to find a stationary long-run relationship (i.e. cointegration) between consumption and wealth (where the latter is proxied by assets and earnings). We note that the structural increase in the (unobserved) US consumption to total wealth ratio due to financial liberalization is in line with the structural decrease in the (observed) US household saving to disposable income ratio as documented by Carroll et al. (2012). They note that this development can be largely attributed to financial liberalization.

A more formal approach however is needed to investigate the financial liberalization interpretation of μ_t. To this end, we conduct Engle-Granger cointegration tests between consumption, assets, earnings *and* our proxy for financial liberalization. We note that c_t, a_t, y_t and μ_t are cointegrated by construction since the unobserved component μ_t is added to the regression equation for that specific purpose. Finding cointegration between c_t, a_t, y_t and fl_t however when - as noted in Section 3.4.2 - there is no cointegration between c_t, a_t and y_t would provide strong support for the liberalization story. The results of the conducted tests are presented in Table 3.5. We test for cointegration between c_t, a_t, y_t and fl_t/fl_t^+ where fl_t^+ equals fl_t over the period $1973Q1 - 2005Q4$ after which it is set to the last available value of fl_t for the remainder of the sample which is a value that indicates full financial liberalization.

[20]This in contrast to alternative measures such as household liabilities to disposable income or the credit easing accumulated (CEA) index - see Carroll et al. (2012) - which is strongly based on the household liabilities ratio. Upon using the CEA index instrumented by the Abiad et al. (2010) index, we find similar results as those reported in this section for the Abiad et al. (2010) index.



Notes: Depicted is the posterior mean of μ_t re-scaled by subtracting its mean and dividing by its standard deviation. μ_t is calculated from the results of Table 3.4 panel A with $\iota = 1$. Depicted is Abiad et al. (2010)'s index of financial liberalization fl_t re-scaled by subtracting its mean and dividing by its standard deviation. The effective sample period is 1953Q3 − 2015Q2 but fl_t is only available over the period 1973Q1 − 2005Q4.

Figure 3.4: The unobserved component μ_t and Abiad et al. (2010)'s index of financial liberalization fl_t

We also test for cointegration between c_t, a_t^s, a_t^{ns}, y_t and fl_t/fl_t^+. From the table, we note that the null hypothesis of no cointegration is rejected at the 10% level for all the conducted regressions between the variables c_t, a_t, y_t and fl_t/fl_t^+. For the variables c_t, a_t^s, a_t^{ns}, y_t and fl_t/fl_t^+, the null of no cointegration is rejected at the 10% level only over the sample period 1973Q1 − 2016Q4 (i.e., for the largest sample size which provides more power to the test). All in all, the results presented provide reasonable evidence that the lack of cointegration between consumption, assets and earnings and, therefore, the presence of an integrated unobserved component in the relationship between these variables - which implies a non-stationary consumption-to-wealth ratio $c_t - w_t$ - can be attributed to financial liberalization. The theoretical channel by which this occurs is investigated in the next section.

Channel

The theoretical framework of Section 3.2 is based only on the budget constraint of a representative consumer. To incorporate financial liberalization into our model, we now also impose behavioral restrictions on the representative consumer. In particular, we consider a first-order condition that incorporates a potentially binding liquidity constraint (see e.g. Zeldes, 1989), i.e.,

$$E_t\left[\delta R_{t+1}\frac{u'(C_{t+1})}{u'(C_t)}(1+\lambda_t)\right] = 1 \tag{3.17}$$

c, a, y, fl			c, a^s, a^{ns}, y, fl		
$73Q1-05Q4$	$73Q1-16Q4$	$73Q1-07Q3$	$73Q1-05Q4$	$73Q1-16Q4$	$73Q1-07Q3$
Dickey-Fuller t-statistic					
-3.82	-4.09	-3.98	-3.81	-4.25	-3.99
5% and 10% critical values (4 variables)			5% and 10% critical values (5 variables)		
5%	-4.10		5%	-4.41	
10%	-3.81		10%	-4.13	

Notes: The null hypothesis tested is the no cointegration hypothesis. A constant is included in the cointegrating equation. The 5% and 10% critical values are taken from MacKinnon (2010). The number of lags included in the augmented Dickey-Fuller regression is based on the Bayesian information criterion. The sample $1973Q1-2005Q4$ uses Abiad et al. (2010)'s index of financial liberalization fl_t which is only available over this period. The samples $1973Q1-2016Q4$ and $1973Q1-2007Q3$ use the financial liberalization variable fl_t^+ which equals Abiad et al. (2010)'s index fl_t over the period $1973Q1-2005Q4$ after which it is set to the last value fl_t takes for the remainder of the sample which is a value indicating full financial liberalization.

Table 3.5: Engle-Granger cointegration test between c, a, y and fl and c, a^s, a^{ns}, y and fl

where δ is the consumer's discount factor, $R_t = 1 + r_{t+1}$ is the gross real rate of return on assets, $u'(C_t)$ is marginal utility of consumption with $u(C_t)$ the utility function and C_t the period t consumption level, and λ_t is the (normalized) Lagrange multiplier associated with the period t liquidity constraint which is positive when the constraint is binding and zero when the constraint is not binding. From eq. (3.17), we can write $\delta R_{t+1}\frac{u'(C_{t+1})}{u'(C_t)}(1+\lambda_t) = 1 + e_{t+1}$ where e_{t+1} is an expectation error uncorrelated with period t information. We can then specify the utility function as being of the CRRA type so that $u(C) = \frac{C^{1-\theta}}{1-\theta}$ with coefficient of relative risk aversion $\theta > 0$ and write $\delta R_{t+1}\left(\frac{C_{t+1}}{C_t}\right)^{-\theta}(1+\lambda_t) = 1 + e_{t+1}$. After taking logs of both sides of this expression and solving for the growth rate in consumption $\Delta c_{t+1} = c_{t+1} - c_t = \ln(C_{t+1}) - \ln(C_t)$, we obtain,

$$\Delta c_{t+1} = \frac{1}{\theta}\ln\delta + \frac{1}{\theta}\ln R_{t+1} + \frac{1}{\theta}\ln(1+\lambda_t) - \frac{1}{\theta}(1+e_{t+1}) \tag{3.18}$$

Financial liberalization can be expected to make liquidity constraints less binding, thereby reducing λ_t and leading to a lower future consumption growth rate Δc_{t+1}. If financial liberalization is (stochastically) trended, aggregate consumption growth is non-stationary. And if the trend in financial liberalization is upward, then consumption growth decreases permanently. If future consumption growth is permanently reduced, the intertemporal budget constraint then suggests that - ceteris paribus - the (log) current consumption-to-wealth ratio $c_t - w_t$ can increase permanently. This should be clear from eq. (3.5), which is repeated here for convenience, i.e.,

$$c_t - w_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}) \tag{3.19}$$

The proposed channel can be tested by conducting regressions of the present discounted value of future consumption growth $\sum_{j=1}^{h} \rho^j \Delta c_{t+j}$ - with h the considered horizon - on the integrated unobserved component μ_t, which is the permanent component of the consumption-to-wealth ratio $c_t - w_t$. The financial liberalization interpretation of μ_t suggests that the impact of μ_t should be negative, i.e., higher financial liberalization and therefore a higher μ_t and $c_t - w_t$ implies lower future aggregate consumption growth. In Table 3.6, we present the results of the estimation of this relationship for discount factors ρ equal to 1 and 0.99. Because μ_t is non-stationary and Δc_t is expected to be non-stationary - whereby considering longer horizons exacerbates the problem as summing consumption growth rates increases their persistence by construction - our estimation method must be such that spurious results are avoided. As noted by Hamilton (1994, pages 561-562), this can be achieved by a Cochrane-Orcutt adjustment for first-order serial correlation in the residuals of the regression of $\sum_{j=1}^{h} \rho^j \Delta c_{t+j}$ on μ_t (which is asymptotically equivalent to first-differencing the regression equation). In the table we further report the results of a Cochrane-Orcutt regression of $\sum_{j=1}^{h} \rho^j r_{t+j}$ on μ_t. We do this because from eq. (3.19), it can be seen that an integrated unobserved component μ_t leading to a structural increase in the consumption to wealth ratio $c_t - w_t$ could stem from a negative impact of that component on the present discounted value of aggregate consumption growth, but also from a positive impact of that component on the present discounted value of the returns on wealth. Since no data are available for the returns on total wealth, we use real stock market returns $r_{s,t}$ as a proxy for r_t (see Appendix 3A for details). The results reported in the table show that there is indeed a negative impact of the unobserved component μ_t on the present discounted value of future consumption growth, which is significant for all horizons considered with the exception of the one quarter horizon case. This result provides further support for the interpretation of the integrated unobserved component μ_t as stemming from financial liberalization and acting through the channel described above. On the other hand, while the impact of μ_t on the present discounted value of future returns on wealth (proxied by stock market returns) is as expected positive, it is never significant.

3.5.5 Characteristics of the cay^{int} variable

Following the discussion of the non-stationary component of the consumption-to-wealth ratio $c_t - w_t$, we now take a closer look at the stationary component of $c_t - w_t$, which we denoted in Section 3.5.3 by cay_t^{int}. The persistence and stationarity prop-

	$\rho = 1$					$\rho = 0.99$				
	Horizon h (in quarters)					Horizon h (in quarters)				
$m_t =$	1	16	32	48	64	1	16	32	48	64
Δc_t	-0.02	-1.24	-2.56	-1.54	-2.63	-0.02	-1.25	-2.32	-1.50	-2.16
	(-0.91)	(-2.21)	(-3.86)	(-1.98)	(-3.43)	(-0.92)	(-2.38)	(-3.85)	(-2.35)	(-3.41)
$r_{s,t}$	0.10	2.91	2.78	6.18	1.19	0.10	2.64	2.64	5.00	1.94
	(0.61)	(1.28)	(0.68)	(1.12)	(0.16)	(0.61)	(1.25)	(0.74)	(1.11)	(0.36)

Notes: The table reports maximum likelihood estimates of the parameter b with t-statistics between brackets. The t-statistics are calculated from standard errors based on outer gradient products. Δc_t is the growth rate in real per capita personal consumption expenditures and $r_{s,t}$ is the real stock market return. For μ_t the posterior mean of the integrated unobserved component is used which is obtained from estimating the unobserved component model discussed above. The effective sample period is different in every case depending on the horizon h considered.

Table 3.6: Cochrane-Orcutt estimation of equation $\sum_{j=1}^{h} \rho^j m_{t+j} = a + b\mu_t + \epsilon_{t+h}$ (with $\epsilon_{t+h} = \delta\epsilon_{t+h-1} + \varepsilon_{t+h}$)

erties of the *cay* variables calculated from the unobserved component model - i.e. cay_t^{int} which is calculated from the model with an unobserved integrated component included and estimated, and cay_t which is calculated from the standard model with no unobserved integrated component included - are quite different. The AR(1) coefficient obtained from a regression of each *cay* on its own lag and a constant shows that cay_t^{int} - with an AR(1) coefficient of less than 0.5 - is considerably less persistent than the standard cay_t - which has an AR(1) coefficient equal to 0.91. We also conduct an (augmented) Dickey-Fuller unit root test on the standard cay_t variable, which shows that a unit root cannot be rejected using the standard critical values at both the 5% and even 10% levels of significance. This confirms the results reported above in Table 3.1 for the standard cointegration approach. The cay_t^{int} variable, on the other hand, is stationary by construction.

The findings concerning the persistence and stationarity of the variables cay_t^{int} and cay_t are important to evaluate their predictive ability for excess stock returns. According to the theory discussed in Section 3.2, the consumption to total wealth ratio is expected to have predictive power for the returns on wealth. The literature has in particular focussed on the ability of the "cay" proxy to predict future excess stock returns, as much of the variation in "cay" is attributed to the stock market component of assets a_t around the less variable consumption c_t and earnings y_t variables (see e.g, Lettau and Ludvigson, 2004). As noted by Ferson et al. (2003), if underlying *expected* excess returns are persistent then using highly persistent (i.e. non-stationary) regressors in typical forecasting models of excess returns will yield spurious results. Moreover, as noted by Rudd and Whelan (2006), this problem is likely more serious when longer horizon excess returns are used, as these are more persistent by construction. Since the variable cay_t^{int} is stationary by construction while the evidence reported above suggests that the standard cay_t variable is not stationary, it is useful to investigate the predictive power of cay_t^{int} for excess stock returns and compare it to the potentially spurious predictive ability of the cay_t variable. We consider both the in-sample and out-of-sample predictive ability for excess stock returns of our cay_t^{int} variable as calculated from a regression of c_t on a_t and y_t that contains an integrated unobserved component. Excess stock returns, denoted by $r_{s,t}^e$, are defined as the difference between the log real stock market return and the log real three-month Treasury bill rate. More details on this series and its calculation are provided in Appendix 3A. We note that the results for stock returns *not* in excess of a risk-free rate are very similar to those for excess stock returns. Hence, we follow the literature which has focussed especially on excess returns and report these results. The results for returns that are not in excess of a risk-free rate are unreported but available from the authors upon request.

Table 3.7 presents the results of in-sample forecast regressions at different horizons for excess stock returns using as predictors the cay_t^{int} and cay_t variables. Following the literature, we consider horizons of one, four, eight, twelve and sixteen quarters and we report the regression coefficient on each "cay" variable of the forecast regression for $r_{s,t}^e$, its corresponding Newey-West corrected t-statistic, and the adjusted R^2 of the forecast regression. From the t-statistics and adjusted R^2's reported in the table, we note that the standard cay_t variable has strong predictive power for excess stock returns and that this predictive ability increases considerably when longer horizons are considered. However, since the discussion of the previous section casts doubt on the stationarity of the variable cay_t, these results may be spurious. It is therefore interesting to note that our variable cay_t^{int}, which is stationary by construction, still has considerable predictive power for excess stock returns. As can be seen when comparing the t-statistics and R^2's in the table, the predictive power of cay_t^{int} is lower compared to that of cay_t, but it is nonetheless still important. We find t-statistics of the regression coefficient on cay_t^{int} in the forecast regression above 2.5 for horizons from four to sixteen quarters and R^2's of the forecast regression as high as 10% and 12% at eight and twelve quarter horizons respectively. Ferson et al. (2003) argue that R^2's of this magnitude can be considered economically significant. Moreover, the magnitudes of the R^2's reported in Table 3.7 are in accordance with the univariate predictability results typically reported in the literature using other predictors for excess stock returns (see Ferson et al., 2003, for an overview).

	Horizon h (in quarters)				
$k_t =$	1	4	8	12	16
cay_t^{int}	1.50	5.93	10.79	10.93	9.32
	(1.80)	(3.16)	(4.49)	(3.61)	(2.68)
	[0.01]	[0.06]	[0.12]	[0.10]	[0.09]
cay_t	0.73	2.91	5.54	7.20	8.27
	(2.71)	(3.21)	(4.37)	(5.60)	(6.91)
	[0.02]	[0.10]	[0.21]	[0.27]	[0.31]

Notes: The effective sample period is 1953Q3 – 2015Q2. The table reports OLS estimates of the parameter b with Newey-West corrected t-statistics between brackets and the adjusted R^2 of the regression between square brackets. $r^e_{s,t}$ is the stock excess return. cay_t^{int} is the estimated stationary part of the log consumption to wealth ratio as obtained from the model containing an integrated unobserved component. cay_t is the estimated log consumption to wealth ratio as obtained from the standard model without an integrated unobserved component.

Table 3.7: In-sample forecast regressions for excess stock returns $\sum_{j=1}^{h} r^e_{s,t+i} = a + bk_t + \varepsilon_{t+h}$

We next consider the the out-of-sample forecast performance of the cay_t^{int} variable for excess stock returns. In particular, our evaluation is based on root mean squared error (RMSE) ratios calculated from 60-quarter rolling forecasting regressions for excess stock returns, again over different horizons. Table 3.8 presents RMSE ratios which are calculated as the ratio of the RSME based on a forecast regression for cay^{int} over the RSME based on a forecast regression for an alternative predictor. As alternative predictors for the excess stock returns $r^e_{s,t}$, we consider the variable cay_t, the lagged excess stock return $r^e_{s,t-1}$ (i.e., assuming an AR(1) process for excess returns) and a constant c (i.e., using the sample mean of $r^e_{s,t}$ as a predictor). A ratio below one means that the cay_t^{int} based forecast model performs better than the alternative forecast model and a ratio above one means that the cay_t^{int} based model performs worse. We also calculate the modified Diebold-Mariano (MDM) statistic that tests the null hypothesis that the mean squared error (MSE) of the forecasts obtained with cay_t^{int} is the same as the one obtained from the alternative forecast model considered. The p-value of this test is reported between square brackets. From the table we note that, based on the reported RMSE ratios, the cay_t^{int} variable performs worse than cay_t at longer horizons (i.e., at horizons of twelve and sixteen quarters) and better at shorter horizons (i.e., at horizons of four and eight quarters). The reported MDM statistics however suggest that - with the exception of the sixteen quarter horizon case - these differences are not significant. Hence, we can conclude that the predictive ability of cay_t^{int} for excess stock returns is largely comparable to that of cay_t. The table further shows that the RMSE ratios obtained from using cay_t^{int} as a predictor for excess stock returns versus lagged returns or a simple constant are lower than one at all horizons.

This suggests out-of-sample prediction using cay_t^{int} which is superior to that which can be achieved by these naive models. However, upon looking at the p-values of the MDM statistics reported in the table, we find that these differences are seldom significant (i.e., only in the eight quarter horizon case).

	Horizon h (in quarters)				
$k_t =$	1	4	8	12	16
cay_t	1.00	0.97	0.95	1.06	1.22
	[0.59]	[0.58]	[0.60]	[0.17]	[0.02]
$r^e_{s,t-1}$	0.98	0.98	0.96	0.95	0.95
	[0.88]	[0.11]	[0.03]	[0.21]	[0.20]
c	0.99	0.99	0.96	0.97	0.96
	[0.70]	[0.35]	[0.05]	[0.29]	[0.38]

Notes: The effective sample period is $1953Q3 - 2015Q2$. The table reports root mean squared error (RMSE) ratios obtained from out-of-sample h-period ahead forecasts of the excess stock returns $r^e_{s,t}$ using 60-quarter rolling subsamples. Forecasts are based on the predictive variables cay_t^{int} and k_t where k_t is either cay_t, the lagged excess return $r^e_{s,t-1}$ or a constant c. RMSE ratios are calculated as the ratio of the RSME based on cay^{int} as a predictive variable over the RSME based on k_t as a predictive variable. A ratio below 1 means that the cay^{int} based forecast model performs better than the alternative forecast model and a ratio above 1 means that the cay^{int} based model performs worse. Between square brackets is the p-value of the modified Diebold-Mariano statistic that tests the null hypothesis that the mean squared error (MSE) of the forecasts obtained with cay_t^{int} and k_t are the same. cay_t^{int} is the estimated stationary part of the log consumption to wealth ratio as obtained from the model containing an integrated unobserved component. cay_t is the estimated log consumption to wealth ratio as obtained from the standard model without an integrated unobserved component.

Table 3.8: Out-of-sample forecast evaluations for excess stock returns ($RMSE_{cay_t^{int}}/RMSE_{k_t}$ measure)

3.6 Conclusions

This paper proposes an alternative empirical approach to study the long run aggregate relationship between household consumption and household wealth, where household wealth consists of tangible assets and unobserved human wealth. The evidence in favor of a stable cointegrating relationship between consumption, assets and earnings (as a proxy for human wealth) in the US is weak. Hence, the consumption to total wealth ratio (i.e., the variable "cay") estimated from such a relationship is non-stationary - rendering it inadequate to predict excess stock returns - while the elasticities of consumption to wealth estimated from this type of regression are unreliable.

The approach followed in this paper applies an unobserved component model to US data over the period $1951Q4 - 2016Q4$ whereby the regression of consumption on assets and earnings is augmented with an integrated unobserved component. Our results strongly support the presence of an integrated unobserved component in the consumption equation. The residuals of this regression are stationary because consumption, assets, earnings *and* the integrated unobserved component are cointegrated by construction. The elasticities of consumption to assets and earnings are positive and those estimated for assets (and their components) tend to be lower compared to the case where no integrated component is added to the regression. We interpret the integrated unobserved component as stemming from financial liberalization which, by relaxing liquidity constraints of consumers, has permanently increased the consumption-to-wealth ratio over the sample period. We calculate an alternative "cay" variable, i.e., the stationary part of the consumption-to-wealth ratio, which is much less persistent than the traditional "cay" variable. In-sample, we find that its predictive ability for future excess stock returns, while diminished compared to that of the traditional "cay" variable, is statistically and economically significant and in line with the univariate predictability results typically reported in the literature for excess stock returns using other predictors. Out-of-sample, we find that its predictive ability for future excess stock returns is comparable to that of the standard "cay" variable.

3.7 Appendix

Appendix 3A. Data

Quarterly seasonally adjusted data for consumption, earnings (disposable labor income), population and the price deflator are collected from the National income and Product Accounts (NIPA) from the Bureau of Economic Analysis (BEA) at the U.S. Department of Commerce. The assets (wealth) data are collected from the Flow of Funds Accounts of the Board of Governors of the Federal Reserve System.

Consumption is measured as total personal consumption expenditures (line 1 of NIPA Table 2.3.5).

Earnings are defined as the sum of compensation for employees (line 2 of NIPA Table 2.1) plus personal current transfer receipts (line 16) minus contributions for domestic government social insurance (line 25) and minus personal labor taxes. Personal labor taxes are derived by first calculating the labor income fraction of total income, and subsequently using this ratio to back out the share of labor taxes from the total personal current taxes (line 26). The labor income to total income ratio is defined as the ratio of wages and salaries (line 3) to the sum of wages and salaries (line 3), proprietors' income (line 9), rental income (line 12) and personal income receipts on assets (line 13).

Assets are defined as the net worth of households and nonprofit organizations, measured at the end of the period. Stock market wealth is defined as households' and nonprofit organizations' holdings of corporate equities, mutual fund shares, life insurance reserves, and private and public pension entitlements. Non-stock wealth is defined as non-stock assets minus liabilities. The non-stock assets consist of households' and nonprofit organizations' holdings of consumer durable goods, real estate, and non-stock financial assets (total currency and deposits including money market fund shares, debt securities, mortgages, proprietors' equity in non-corporate business and other assets). Liabilities include all loans, such as mortgages, consumer debt and other loans.

Stock returns are the returns (excluding dividends) of the value-weighted CRSP index from the Center for Research in Security Prices. The CRSP index is a broad stock market index including the NYSE, AMEX, NASDAQ and ARCA, and the data are collected from CRSP via Wharton Research Data Services (WRDS).

Excess stock returns are defined as the difference between the quarterly log real stock market return (as stated above) and the quarterly log real 3-month Treasury Bill return (i.e., the "risk free rate"). The 3-month Treasury Bill data is the secondary market rate, not seasonally adjusted, collected from the Federal Reserve Bank of St.Louis.

Financial liberalization is proxied by the Index of Financial Reform by Abiad et al. (2010). The annual index covers the period 1973-2005 and includes seven different dimensions of financial sector policy: credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets, banking regulations and restrictions on the capital account. Liberalization scores for each category are combined in a graded index which is normalized from zero to one.

All series except the financial liberalization proxy are deflated with the price index for total personal consumption expenditures (line 1 of NIPA Table 2.3.4) with base year 2009 = 100. All variables except the (excess) stock returns and the financial liberalization proxy are further expressed in per capita terms, with population data also collected from the NIPA (line 40 of Table 2.1).

Appendix 3B. Unit root and cointegration tests

In Table 3.9 we present the t-statistics from the Augmented Dickey-Fuller Unit root tests for the variables c, y , a, a^s and a^{ns}. In Table 3.10 we present a summary of the results of a number of additional tests conducted to determine whether there is cointegration between the variables c, a and y or between the variables c, a^s, a^{ns} and y. These tests by and large suggest that there is no cointegration between the variables c, a and y nor between the variables c, a^s, a^{ns} and y. We note that some of these tests like the Engle and Granger (1987), Phillips and Ouliaris (1990), and Johansen (1988, 1991) tests have the absence of cointegration as the null hypothesis while others like Park (1990)'s added variable test have the presence of cointegration as the null hypothesis. According to Park (1990) and Ogaki and Park (1997), the inability to reject the null hypothesis of a unit root in the variable z_t in eqs. (3.8) and (3.9) may be due to a potential lack of power of cointegration tests that have the absence of cointegration as the null hypothesis. Park's (1990) added variable test has cointegration as the null hypothesis and - for the full sample period - cannot reject the null of cointegration when a linear deterministic time trend is added to mimic the potential stochastic trend in z_t, but does reject cointegration when the potential stochastic trend is mimicked in a more general and realistic way through the addition of a linear, quadratic and cubic time trend to the regression. This suggests that the failure of finding cointegration does not stem from statistical issues - i.e., the lack of power to reject a false null hypothesis - of standard cointegration tests. Rather, it suggests that there is in fact a unit root present in z_t.

	Level		1st difference	
c_t	-1.28	[0.64]	-7.90	[0.00]
y_t	-1.91	[0.33]	-15.76	[0.00]
α_t	-0.02	[0.96]	-12.74	[0.00]
α_t^s	-0.40	[0.91]	-14.50	[0.00]
α_t^{ns}	-0.80	[0.82]	-3.43	[0.01]

Notes: Reported are the Augmented Dickey-Fuller t-statistics. The null hypothesis tested is the existence of a unit root. MacKinnon (1996) one-sided p-values are presented in square brackets. A constant is included in the augmented Dickey-Fuller regression, and the number of lags included is based on the Bayesian information criterion.

Table 3.9: Augmented Dickey-Fuller unit root tests

"

	c, a, y		c, a^s, a^{ns}, y	
Sample	$1951Q4-2016Q4$	$1951Q4-2007Q3$	$1951Q4-2016Q4$	$1951Q4-2007Q3$
Engle-Granger	No	No	No	No
Phillips-Ouliaris	No	No	No	No
Johansen Trace 1 lag	No	No	No	No
Johansen Max Eig. 1 lag	No	No	No	No
Park's H(0,1) test	Yes	No	Yes	No
Park's H(0,3) test	No	No	No	No

Notes: The residual-based Engle-Granger and Phillips-Ouliaris cointegration tests and the Johansen Trace and Maximum Eigenvalue methodology test the null hypothesis of no cointegration, whereas Park's H(q, p) added variable test, with time trends of powers q up to order p, evaluates the null hypothesis of cointegration. Conclusions are based on 5% significance levels.

Table 3.10: A battery of frequentist tests for cointegration between c, a and y and between c, a^s, a^{ns} and y

Appendix 3C. A more general unobserved component model

We also consider and estimate a more general unobserved component model. Specifically, we model the unobserved component μ_t as a weighted average of two random walks, $\breve{\mu}_t$ and $\tilde{\mu}_t$, with the weights given by a regime switching variable S_t, i.e.,

$$\mu_t = (1 - S_t)\breve{\mu}_t + S_t\tilde{\mu}_t \tag{3.20}$$

The variable S_t is assumed to follow a first-order two-state Markov switching process (i.e., it takes on either the value of 0 or the value of 1). As in Section 3.5.2, we specify the random walks in non-centered form as,

$$\breve{\mu}_t = \mu' + \sigma'_\eta \breve{\mu}^*_t = \mu' \tag{3.21}$$

and

$$\tilde{\mu}_t = \mu + \sigma_\eta \mu^*_t \tag{3.22}$$

where $\breve{\mu}^*_t$ and μ^*_t are standardized random walks given by $\breve{\mu}^*_t = \breve{\mu}^*_{t-1} + \eta'_t$ with $\breve{\mu}^*_0 = 0$ and $\eta'_t \sim iid\mathcal{N}(0,1)$, respectively $\mu^*_t = \mu^*_{t-1} + \eta^*_t$ with $\mu^*_0 = 0$ and $\eta^*_t \sim iid\mathcal{N}(0,1)$. In eq. (3.21), we assume that $\sigma'_\eta = 0$ so that $\breve{\mu}_t$ is constant and the unobserved component μ_t is a constant μ' in one regime and follows a standard random walk with initial value μ in the other regime. Using eqs. (3.21) and (3.22) into eq. (3.20) then gives,

$$\mu_t = (1 - S_t)\mu' + S_t\mu + S_t\sigma_\eta\mu^*_t \tag{3.23}$$

This specification nests a number of models. First, if $\sigma_\eta = 0$, the consumption equation does not contain an unobserved integrated process but includes a Markov switching intercept along the lines of Bianchi et al. (2017). Second, if $\mu = \mu'$, the unobserved component is given by $\mu_t = \mu + S_t\sigma_\eta\mu^*_t$. This model is similar in spirit to a mixture innovation model along the lines of McCulloch and Tsay (1993), i.e., if the variable $S_t = 0$ then $\mu_t = \mu$ and the unobserved component is constant while if $S_t = 1$ then $\mu_t = \mu + \sigma_\eta\mu^*_t$ and the unobserved component follows a random walk. Third, if $S_t = 1$ $(\forall t)$, the model collapses to the model discussed in Sections 3.5.1 and 3.5.2 of the main text, i.e., with an unobserved component given by $\mu_t = \mu + \sigma_\eta\mu^*_t$. Upon estimation of the state space model presented in the text with a more general specification for the unobserved component μ_t as given by eq. (3.23), we do indeed estimate $S_t = 1$ $(\forall t)$ while we find $\sigma_\eta \neq 0$ so that this model collapses to the model presented in the main text of this paper. We do not present the estimation details nor the estimation results for this model but these are available from the authors upon request.

Appendix 3D. Gibbs sampler

This appendix first briefly presents the steps of the Gibbs sampler. Then, technical details are discussed in Section 3D-2. Finally, a convergence analysis is provided in Section 3D-3.

3D-1. General outline

We collect the constant parameters in a vector Γ, i.e., $\Gamma = (\iota, \phi, \rho, \mu, \delta, \sigma_\eta, \sigma_\varepsilon^2)$. The Gibbs approach allows us to simulate draws from the intractable joint posterior distribution of parameters Γ and state μ^*, i.e., $f(\Gamma, \mu^*|data)$, using only tractable conditional distributions. In particular, given the prior distribution of the parameter vector $f(\Gamma)$ and an initial draw for μ^* taken from its prior distribution, the following steps are implemented:

1. Sample the constant parameters Γ conditional on the unobserved state μ^* and the data

   (a) Sample the binary indicator ι marginalizing over the parameter σ_η for which variable selection is carried out (see Frühwirth-Schnatter and Wagner, 2010).

   (b) If $\iota = 1$, sample the parameters ϕ, ρ, μ, σ_η, σ_ε^2 and - if applicable - δ. If $\iota = 0$, sample the parameters ϕ, ρ, μ and σ_ε^2 and - if applicable - δ. In the latter case, we set $\sigma_\eta = 0$.

2. Sample the unobserved state μ^* conditional on the constant parameters Γ and the data. To this end, if $\iota = 1$, we use the multimove sampler for state space models of Carter and Kohn (1994)(see also Kim and Nelson, 1999). If $\iota = 0$, we draw μ^* from its prior distribution. To exploit the non-identification of the non-centered specification discussed in Section 3.5.2, we conduct a random sign switch on μ^* and σ_η, i.e., with probability 0.5 we multiply both by -1 and with probability 0.5 we leave both unaltered.

These steps are iterated J times and in each iteration Γ and μ^* are sampled. After a number of burn-in draws B, the sequence $(B+1, ..., J)$ of draws of Γ and μ^* approximates a sample from the posterior distributions of Γ and μ^*. The results reported below are based on $J = 20.000$ iterations with the first $B = 10.000$ draws discarded as a burn-in sequence, i.e., the reported results are all based on posterior distributions constructed from $J - B = 10.000$ draws. Note further that from the distribution of the binary indicator ι, we calculate the posterior probability that there is an unobserved integrated component in regression eq. (3.10) as the fraction of ι's that are equal to 1 over the $J - B$ draws of the Gibbs sampler.

3D-2. Details on the steps of the sampler

Sample the constant parameters Γ

The parameters contained in Γ can be sampled from a standard regression model,

$$y = w^r \gamma^r + \chi \tag{3.24}$$

where y is a $T \times 1$ vector containing T observations on the dependent variable, w is a $T \times M$ matrix containing T observations of M predictor variables, γ is the $M \times 1$ parameter vector and χ is the $T \times 1$ vector of error terms for which $\chi \sim iid\mathcal{N}\left(0, \sigma_\chi^2 I_T\right)$. If the binary indicators κ are equal to 1 then the restricted parameter vector γ^r and the corresponding restricted predictor matrix w^r are equal to γ respectively w. Otherwise, the restricted γ^r and w^r exclude those elements in w and γ for which the corresponding binary indicators κ are equal to 0. The prior distribution of γ^r is given by $\gamma^r \sim \mathcal{N}\left(b_0^r, B_0^r \sigma_\chi^2\right)$ with b_0^r a $M^r \times 1$ vector and B_0^r a $M^r \times M^r$ matrix. The prior distribution of σ_χ^2 is given by $\sigma_\chi^2 \sim \mathcal{IG}\left(s_0, S_0\right)$ with scalars s_0 (shape) and S_0 (scale). The posterior distributions (conditional on y, w^r, and κ) of γ^r and σ_χ^2 are then given by $\gamma^r \sim \mathcal{N}\left(b^r, B^r \sigma_\chi^2\right)$ and $\sigma_\chi^2 \sim \mathcal{IG}\left(s, S^r\right)$ with

$$\begin{aligned}
B^r &= \left[(w^r)' w^r + (B_0^r)^{-1}\right]^{-1} \\
b^r &= B^r \left[(w^r)' y + (B_0^r)^{-1} b_0^r\right] \\
s &= s_0 + T/2 \\
S^r &= S_0 + \frac{1}{2}\left[y'y + (b_0^r)'(B_0^r)^{-1} b_0^r - (b^r)'(B^r)^{-1} b^r\right]
\end{aligned} \tag{3.25}$$

Following Frühwirth-Schnatter and Wagner (2010), we marginalize over the parameters γ when sampling κ and then draw γ^r conditional on κ. The posterior distribution of the binary indicators κ is obtained from Bayes' theorem as

$$p(\kappa | y, w, \sigma_\chi^2) \propto p(y | \kappa, w, \sigma_\chi^2) p(\kappa) \tag{3.26}$$

where $p(\kappa)$ is the prior distribution of κ and $p(y|\kappa, w, \sigma_\chi^2)$ is the marginal likelihood of regression eq. (3.24) where the effect of the parameters γ has been integrated out. We refer to Frühwirth-Schnatter and Wagner (2010) (their eq. (25)) for the closed-form expression of the marginal likelihood for the regression model of eq. (3.24).

Sample the binary indicator ι

Our regression has one binary indicator ι, so $\kappa = \iota$. We sample ι by calculating the marginal likelihoods $p(y|\iota = 1, w, \sigma_\chi^2)$ and $p(y|\iota = 0, w, \sigma_\chi^2)$ (see Frühwirth-Schnatter and Wagner, 2010, for the correct expressions). Upon combining the marginal likelihoods with the Bernoulli prior distributions of the binary indicators $p(\iota = 1) = p_0$ and $p(\iota = 0) = 1 - p_0$, the posterior distributions $p(\iota = 1|y, w, \sigma^2_\chi)$ and $p(\iota = 0|y, w, \sigma^2_\chi)$ are obtained from which the probability

$$prob(\iota = 1|y, w, \sigma^2_\chi) = \frac{p(\iota = 1|y, w, \sigma^2_\chi)}{p(\iota = 1|y, w, \sigma^2_\chi) + p(\iota = 0|y, w, \sigma^2_\chi)}$$

is calculated which is used to sample ι, i.e., draw a random number r from a uniform distribution with support between 0 and 1 and set $\iota = 1$ if $r < prob(.)$ and $\iota = 0$ if $r > prob(.)$.

Sample the other parameters in Γ

We then sample the regression coefficients ϕ, ρ, μ and σ_η and the regression error variance σ^2_ε conditional on ι, the data and the unobserved component μ^*_t. The dependent variable is $y = c$ where c is the $T \times 1$ vector containing consumption c_t stacked over time while the error term is $\chi = \varepsilon$ with ε containing ε_t stacked over time and where the variance is given by $\sigma^2_\chi = \sigma^2_\varepsilon$. When $\iota = 1$, we have $w^r = w = \begin{bmatrix} x & \Delta x_{-p} & ... & \Delta x_{+p} & e & \mu^* \end{bmatrix}$ and $\gamma^r = \gamma = \begin{bmatrix} \phi' & \rho'_{-p} & ... & \rho'_{+p} & \mu & \sigma_\eta \end{bmatrix}'$ where e is a $T \times 1$ vector of ones and μ^* is a $T \times 1$ vector containing μ^*_t stacked over time. With x and every Δx_j (for $j = -p ... + p$) being $T \times K$ matrices then ϕ and every ρ_j are $K \times 1$ vectors and we have $M = K(2p + 2) + 2$. When $\iota = 0$, we have $w^r = \begin{bmatrix} x & \Delta x_{-p} & ... & \Delta x_{+p} & e \end{bmatrix}$ and $\gamma^r = \begin{bmatrix} \phi' & \rho'_{-p} & ... & \rho'_{+p} & \mu \end{bmatrix}'$. In this case, we have $M^r = K(2p + 2) + 1$. Once the matrices of eq. (3.24) are determined, the parameters γ^r and σ^2_χ can be sampled from the Gaussian posterior distributions given above with the prior distributions as specified in Table 3.2 in the text.[21]

Sample the unobserved state μ^*

If $\iota = 0$, the unobserved component is drawn from its prior distribution. In particular, μ^*_t is drawn from eq. (3.15), i.e., as a cumulative sum of standard normally distributed shocks η^*_t so $\mu^*_t = \sum_{s=1}^{t} \eta^*_s$. If $\iota = 1$, the unobserved component μ^*_t is sampled conditional on the constant parameters and on the data using a state space approach. In particular, we use the forward-filtering backward-sampling approach discussed in detail in Kim and Nelson (1999) to sample the unobserved state. The general form of

[21]From the specification of the prior distributions in Table 3.2, we note that $s_0 = \nu_0 T = 0.01T$, $S_0 = \nu_0 T \sigma^2_0 = 0.01 \times T \times 0.01$ and that b^r_0 is a $M^r \times 1$ vector of zeros. Further, B^r_0 is an $M^r \times M^r$ diagonal matrix containing as elements the variances 0.1 (for parameter σ_η) or 1 (for all other regression parameters) - i.e., the variable V_0 - divided by the prior belief for σ^2_ε - i.e., the variable σ^2_0 in Table 3.2.

the state space model is given by

$$Y_t = ZS_t + V_t, \qquad V_t \sim iid\mathcal{N}(0, H), \tag{3.27}$$

$$S_t = TS_{t-1} + KE_t, \qquad E_t \sim iid\mathcal{N}(0, Q), \tag{3.28}$$

$$S_0 \sim iid\mathcal{N}(s_0, P_0), \tag{3.29}$$

(where $t = 1, ..., T$) with observation vector Y_t ($n \times 1$), state vector S_t ($n^s \times 1$), error vectors V_t ($n \times 1$) and E_t ($n^{ss} \times 1$ with $n^{ss} \leq n^s$) that are assumed to be serially uncorrelated and independent of each other, and with the system matrices that are assumed to be known (conditioned upon) namely Z ($n \times n^s$), T ($n^s \times n^s$), K ($n^s \times n^{ss}$), H ($n \times n$), Q ($n^{ss} \times n^{ss}$) and the mean s_0 ($n^s \times 1$) and variance P_0 ($n^s \times n^s$) of the initial state vector S_0. As eqs. (3.27)-(3.29) constitute a linear Gaussian state space model, the unknown state variables in S_t can be filtered using the standard Kalman filter. Sampling $S = [S_1, \ldots, S_T]$ from its conditional distribution can then be done using the multimove Gibbs sampler of Carter and Kohn (1994). Given our state space system presented in eqs. (3.10), (3.11), (3.13), (3.14) and (3.15) we have $n = n^s = n^{ss} = 1$. The matrices are then given by $Y_t = c_t - x_t\phi - \mu - \sum_{j=-p}^{p} \Delta x_{t+j}\rho_j$, $Z = \sigma_\eta$, $S_t = \mu_t^*$, $V_t = \varepsilon_t$, $H = \sigma_\varepsilon^2$, $T = 1$, $K = 1$, $E_t = \eta_t^*$, $Q = 1$, $s_0 = \mu_0^* = 0$ and $P_0 = 10^{-6}$.

3D-3. Convergence analysis

We analyse the convergence of the MCMC sampler using the simulation inefficiency factors as proposed by Kim et al. (1998) and the convergence diagnostic of Geweke (1992) for equality of means across subsamples of draws from the Markov chain (see Groen et al., 2013, for a similar convergence analysis).

For each fixed parameter and for every point-in-time estimate of the unobserved component, we calculate the inefficiency factor as $IF = 1 + 2\sum_{l=1}^{m} \kappa(l, m)\widehat{\theta}(l)$ where $\widehat{\theta}(l)$ is the estimated the l-th order autocorrelation of the chain of retained draws and $\kappa(l, m)$ is the kernel used to weigh the autocorrelations. We use a Bartlett kernel with bandwidth m, i.e. $\kappa(l, m) = 1 - \frac{l}{m+1}$ where we set m equal to 4% of the retained sampler draws $J - B = 10.000$ (see 3D-1). If we assume that n draws are sufficient to cover the posterior distribution in the ideal case where draws from the Markov chain are fully independent, then $n \times IF$ provides an indication of the minimum number of draws that are necessary to cover the posterior distribution when the draws are not independent. Usually, n is set to 100. Then, for example, an inefficiency factor equal to 20 suggests that we need at least 2.000 draws from the sampler for a reasonably accurate analysis of the parameter of interest. Additionally, we also compute the p-values of the Geweke (1992) test which tests the null hypothesis of equality of the means of the first 20% and last 40% of the retained draws obtained from the sampler for each fixed parameter and for every point-in-time estimate of the unobserved component. The variances of the respective means are calculated using the Newey and West (1987) robust variance estimator using a Bartlett kernel with bandwidth equal to 4% of the respective sample sizes.

In Table 3.11 we present the convergence analysis corresponding to the results in Table 3.4. The convergence results are reported for individual parameters or for parameter groups. Groups are considered when the parameters can be meaningfully grouped which is the case for the k elasticity parameters in ϕ (with $k = 2$ or $k = 3$ depending on whether $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ or $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$), for the $k \times (p+1)$ parameters ρ of the DOLS specification of the stationary component v_t (where, given $p = 6$, we have 26 or 39 parameters depending on whether $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ or $x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$), and for the unobserved component μ^* which is a state, i.e. a time series of length $T = 248$. We report statistics of the distributions of the inefficiency factors for every parameter or parameter group, i.e., median, minimum, maximum, and - for the state μ^* - the 5% and 10% quantiles. These statistics are identical for the non-grouped parameters. We also report rejection rates of the Geweke tests conducted both at the 5% and 10% significance levels. These rates are equal to the number of rejections of the null hypothesis of the test per parameter group divided by the number of parameters in a parameter group. These rates can only be 0 or 1 for individual parameters but can lie between 0 and 1 for the grouped parameters.

The calculated inefficiency factors suggest that the MCMC sampler performs well and all parameters are well converged using our retained 10.000 draws. An accurate analysis could even have been conducted with less than 10.000 draws. From the table we note that more draws are required when the integrated unobserved component (UC) is included and estimated, i.e. for cases where $\iota = 1$, while the inefficiency factors are all close to 1 when the estimated model is a standard regression, i.e. when $\iota = 0$. When $\iota = 1$, the most draws are required to estimate the posterior distribution of the initial values μ of the unobserved component. That this parameter is somewhat harder to estimate is not surprising and is also clear from inspection of the wide 90% HPD interval surrounding its posterior mean depicted in Figure 3.2 (corresponding to the convergence results in Table 3.11 with $x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$ and $\iota = 1$). Our findings for the inefficiency factors are corroborated by the results for the Geweke (1992) test for equality of means across subsamples of the retained draws. The reported rejection rates are with few exceptions equal to 0, which strongly suggest that the means of the first 20% and last 40% of the retained draws are equal. Occasionally, high rejection rates rates are observed, in particular again for μ and sometimes for the elasticities ϕ. We argue that these high rejection rates are due to the particular sample of draws and are not indicative of non-convergence as these rejection rates are not withheld when we rerun the sampler using another seed. Hence, in general, we can conclude that the convergence of the sampler for the retained number of draws is satisfactory.

Regressors	UC	Parameters	Number	Inefficiency factors (Stats distribution) Median	Min	Max	5%	10%	Convergence (Rejection rates) 5%	10%
$x_t = \begin{bmatrix} a_t & y_t \end{bmatrix}$	$\iota = 1$	ϕ	2	16.15	9.12	23.18	-	-	0.00	0.00
		μ	1	55.42	55.42	55.42	-	-	0.00	0.00
		$\lvert\sigma_\eta\rvert$	1	28.68	28.68	28.68	-	-	0.00	0.00
		σ_ε^2	1	1.13	1.13	1.13	-	-	0.00	0.00
		ρ	26	1.44	1.02	1.86	-	-	0.00	0.08
		μ^*	248	1.07	0.83	1.16	0.92	1.12	0.00	0.02
	$\iota = 0$	ϕ	2	0.83	0.83	0.83	-	-	0.00	0.00
		μ	1	0.78	0.78	0.78	-	-	0.00	0.00
		$\lvert\sigma_\eta\rvert$	1	-	-	-	-	-	-	-
		σ_ε^2	1	1.03	1.03	1.03	-	-	0.00	0.00
		ρ	26	0.95	0.81	1.18	-	-	0.04	0.08
		μ^*	248	-	-	-	-	-	-	-
$x_t = \begin{bmatrix} a_t^s & a_t^{ns} & y_t \end{bmatrix}$	$\iota = 1$	ϕ	3	23.96	17.30	26.83	-	-	0.67	0.67
		μ	1	27.34	27.34	27.34	-	-	1.00	1.00
		$\lvert\sigma_\eta\rvert$	1	15.93	15.93	15.93	-	-	0.00	0.00
		σ_ε^2	1	1.12	1.12	1.12	-	-	0.00	0.00
		ρ	39	1.83	0.95	4.02	-	-	0.08	0.15
		μ^*	248	0.93	0.84	1.14	0.88	1.07	0.00	0.00
	$\iota = 0$	ϕ	3	1.09	1.05	1.17	-	-	0.00	0.00
		μ	1	0.86	0.86	0.86	-	-	0.00	0.00
		$\lvert\sigma_\eta\rvert$	1	-	-	-	-	-	-	-
		σ_ε^2	1	0.91	0.91	0.91	-	-	0.00	0.00
		ρ	39	0.94	0.80	1.25	-	-	0.05	0.10
		μ^*	248	-	-	-	-	-	-	-

Notes: The convergence analysis corresponds to the results reported in Table 3.4. The statistics of the distribution of the inefficiency factors are presented in columns 5 to 9 for every parameter or group of parameters. These statistics are identical when parameters are considered individually as only one inefficiency factor is calculated in these cases. The inefficiency factors are calculated for every fixed parameter and for every point-in-time estimate of the unobserved component using a Bartlett kernel with bandwidth equal to 4% of the 10.000 retained sampler draws. The rejection rates of the Geweke (1992) test conducted at the 5% and 10% levels of significance are reported in columns 10 and 11. These rates are equal to the number of rejections of the null hypothesis of the test per parameter group divided by the number of parameters in a parameter group. These rates are either 1 or 0 for parameters that are considered individually. They are based on the p-value of the Geweke test of the hypothesis of equal means across the first 20% and last 40% of the 10.000 retained draws which is calculated for every fixed parameter and for every point-in-time estimate of the unobserved component. The variances of the respective means in the Geweke (1992) test are calculated with the Newey and West (1987) robust variance estimator using a Bartlett kernel with bandwidth equal to 4% of the respective sample sizes.

Table 3.11: Inefficiency factors and convergence diagnostics (results Table 3.4)

4 Determinants of International Consumption Risk Sharing in Developing Countries

4.1 Introduction

If markets are complete, economic agents, or countries, can pool their resources and thereby eliminate any differences in consumption growth between themselves according to conventional macroeconomic theory. International consumption risk sharing thus enables consumption smoothing, which creates welfare gains through lower volatility of aggregate consumption. Although theory predicts full risk sharing, in reality, aggregate consumption is highly sensitive to domestic income shocks and the empirical evidence shows fairly limited international consumption risk sharing among countries, see e.g. Canova and Ravn (1996), Lewis (1996) and Bai and Zhang (2012). Common explanations to this include financial market incompleteness, frictions and high financial transaction costs, although there is quite some disagreement regarding the empirical relationship between financial globalization, integration and risk sharing.[1]

There is a broad literature on international consumption risk sharing starting from Backus et al. (1992), Obstfeld (1993), Stockman and Tesar (1995), Sorensen and Yosha (1998), however most studies focus only on advanced economies. Exceptions such as Kose et al. (2009), Flood et al. (2012), Bai and Zhang (2012) and Fuleky et al. (2015), found that international consumption risk sharing is generally lower in developing countries, but the main constraints on international risk sharing in these countries

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[1]Financial globalization and integration should increase the set of available financial contracts, reducing the problem of market incompleteness. Studies like Artis and Hoffmann (2008) and Bai and Zhang (2012), that compare international consumption risk sharing during periods of different degrees of financial globalization, find that international risk sharing was not significantly higher during periods of higher financial integration. However, other studies like Imbs (2006), Corcoran (2007) and Hevia and Serven (2013) found that financial linkages increase consumption correlations.

have so far not been identified. Some studies, such as Corcoran (2007) and Ventura (2008), point to the importance of financial integration for improving international risk sharing in developing countries. However, while Kose et al. (2009) and Flood et al. (2012) show that financial globalization and integration improve international risk sharing in advanced economies, they found that emerging markets and developing countries seem unable to benefit from this. Kose et al. (2009) note that the capital flows to emerging markets tend to be concentrated in typically procyclical portfolio debt, as compared to the more stable FDI and portfolio equity flows, which could prevent emerging market economies from benefiting from financial openness in terms of risk sharing.

This paper aims to identify determinants of international consumption risk sharing with a focus on developing countries. As consumption growth in developing countries is generally volatile, and much more so than in advanced economies, there are high potential welfare gains from increased consumption smoothing especially in less developed countries. To this end, I study international consumption risk sharing in a panel of 120 advanced and developing countries over the time period 1970-2014.

My first finding is that, in contrast to the findings of some previous studies, conventional risk sharing determinants such as capital account openness and total external liabilities to GDP do have a significant impact on also developing countries' risk sharing capacities. Secondly, I show that this conclusion holds also for a broad measure of financial liberalization, namely an index of financial reform. In addition to looking at the capital account, the financial reform index includes six further dimensions of financial sector policy, which are credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets and banking regulations. As the financial market restrictions are generally more stringent and extend to a broader number of sectors in developing than advanced economies, this index is more suitable as a proxy for financial openness in poorer developing countries than a measure looking solely at the capital account. Once this broader financial liberalization measure is used, the estimated degree of international consumption risk sharing in less developed countries rises from around 27 % to between 35-50 %. The effect of financial liberalization in emerging markets is however much less distinct, and the results reveal that only capital account openness seems to have a positive impact on international consumption risk sharing in these countries.

Further, I add to the risk sharing literature by showing that a larger share of low income households and higher domestic income inequality can explain a part of the difference in risk sharing between developing and advanced countries. High poverty rates and inequality may exclude a large share of the population from participating in international financial markets, thus reducing domestic financial access, which reduces international consumption risk sharing in the aggregate and causes a risk sharing gap between the country groups. My study also confirms the findings of Hadzi-Vaskov (2006) and Balli and Rana (2014), that the size of migrant remittances (money transfers by migrant workers to their home country) improve risk sharing in developing countries. Finally, I find that official development assistance and foreign aid do not significantly impact consumption risk sharing in developing countries.

My main conclusion is thus that financial market restrictions, lower financial integration and a higher share of hand to mouth consumers in the less developed countries can partly explain why developing countries share substantially less consumption risk internationally than advanced economies.

The second aim of this paper is to exploit the cross-sectional dependence when estimating the degree of international consumption risk sharing between individual countries and country groups. Most economies are very likely influenced by unobserved common factors such as global business cycles or financial globalization, and Chudik and Pesaran (2013) even claim that some form of cross-sectional correlation of errors in panel data applications in economics is likely to be the rule rather than the exception. I therefore allow for a common unobserved factor in the data, which is allowed to have a differential impact on the different countries in the sample. Cross-sectional dependence has, despite its recurrence, so far been largely overlooked in the risk sharing literature, with the exception of Fuleky et al. (2015). This paper thereby contributes to the risk sharing literature by using a more appropriate approach when examining the effect of financial integration and inequality on degree of consumption risk sharing than previously. When I recover the unobserved component and assume that there is only one, I find that global economic and financial uncertainty and US monetary policy can explain around a quarter of the variation of this unobserved component. It thus seems like the unobserved common factor picks up short-term or business cycle factors that have a heterogeneous impact on risk sharing in the different countries.

The rest of the paper is structured as follows: Section 4.2 presents the basic theoretical framework underlying the idea of international risk sharing. Section 4.3 outlines the empirical implementation strategy and discusses some estimation issues. Section 4.4 presents the data. The results are presented and discussed in section 4.5 and Section 4.6 concludes.

4.2 International Risk Sharing

This section provides a theoretical discussion of international risk sharing and its determinants. The first subsection lays out a model of complete financial markets and full risk sharing, whereas the second subsection looks at the determinants of partial risk sharing (especially in developing countries), elaborating on the discussion already given in the introduction. Particular attention is given to the degree of financial integration, the prevalence of poverty and income inequality in the respective countries. The third subsection gives an overview of the current literature.

4.2.1 Full risk sharing

The empirical consumption risk sharing specification was originally developed by among others Mace (1991) for the study of domestic consumption risk sharing, and was later extended by Lewis (1996) to an international setting. The underlying theoretical framework of full consumption risk sharing can be derived from the Arrow-Debreu equilibrium as outlined in Mace (1991). Consider a social planner's problem[2] of maximizing utility over I countries with representative agents with state contingent utility functions $U_i(c_{it}(s^t), s^t)$ where $i = 1, \ldots, I$ is the country index, $c_{it}(s^t)$ is the country i consumption at time t given the state of nature s^t. The state of nature affects both consumption and the utility function, for instance through a preference change.

Utility is maximized subject to the representative agents' resource constraints. By combining the first order conditions for two distinct countries i, j we have that for all dates t and all states s^t

$$\frac{U_i^c(c_{it+1}(s^{t+1}))}{U_i^c(c_{it}(s^t))} = \frac{U_j^c(c_{jt+1}(s^{t+1}))}{U_j^c(c_{jt}(s^t))} = \frac{\lambda_{t+1}(s^{t+1})}{\lambda_t(s^t)} = \lambda(s) \;\; \forall\, i, j, t \tag{4.1}$$

where $U_i^c(.)$ denotes the derivative of $U_i(.)$ w.r.t. consumption and is the marginal utility of consumption, and $\lambda_t(s^t)$ is the Lagrange multiplier on the resource constraint. Equation (4.1) implies that if markets are complete, then marginal utility growth should be the same for all agents and countries at all times t. In an international setting, this implies that relative shocks to home or foreign output should not affect the relative consumption growth rates in the different countries. All shocks should be equally shared across countries, only global shocks should matter for consumption growth. Hence the consumption allocation is said to satisfy full consumption risk sharing if the ratio of marginal utilities of consumption between any two

[2] Although the existence of a global social planner can be questioned, if markets are complete and competitive and there are no externalities, the competitive equilibrium allocation is the same as the one chosen by the social planner.

countries is constant across all times t and states of nature s^t.

If we assume that preferences are of a constant relative risk aversion (CRRA) form and allow the utility function of the representative consumer to also feature a country and time specific preference shock $b_{it}(s^t)$, we can write the utility function as

$$U_i(c_{it}(s^t), s^t) = exp\ (b_{it}(s^t)) \frac{c_{it}(s^t)^{1-\sigma} - 1}{1-\sigma} \tag{4.2}$$

After some algebra and rearrangement[3], we can write the full risk sharing condition for the preferences specified above as

$$\Delta \ln(c_{it}) = \Delta \ln(C_t) + \frac{1}{\sigma}(\Delta b_{it} - \Delta B_t) \tag{4.3}$$

where the capital letters C_t and B_t represent the population averages of consumption and the preference shocks and Δ denote changes such as $\Delta\ln(c_{it}) = \ln(c_{it}(s^t)) - \ln(c_{it-1}(s^{t-1}))$. The full consumption risk sharing equation thus states that if markets are complete, country-specific consumption growth should only be dependent on the global consumption growth and on the idiosyncratic and global changes in preferences.

4.2.2 Partial risk sharing

The previous section assumed complete financial markets and full capital mobility. However in reality, state contingent securities for each and every possible state of nature do not exist, although financial innovation has expanded the set of available and tradable assets during the past 30 years (Lane and Milesi-Ferretti, 2007). Limited contract enforceability furthermore provides an impediment to risk sharing, and capital mobility is often also restricted by capital controls. Financial markets in especially developing countries are not fully liberalized but also subject to further restrictions on the banking sector, interest rates and credit and securities markets. As Moser et al. (2005) pointed out, differences in investor protection, financial regulation and accounting standards affect transaction and information costs, which in turn increase the attractiveness of domestic investments relative to foreign ones. Also, even though the financial sector is in theory fully open, it might be that there are other (potentially unobserved) factors preventing the country from being fully integrated into the international financial markets. If individuals over-weigh domestic assets in their investment portfolios, they will not share consumption risks optimally with foreigners, which in turn prevents the convergence of marginal rates of substitution between countries (Lewis, 1996). Instead, domestic output changes might have (potentially

[3] Appendix 4A provides a full derivation of the empirical international risk sharing equation.

large) influences on the growth rate of consumption.

There is a substantial literature that has rejected the hypothesis of full international risk sharing,[4] and the estimates for the degree of risk being shared internationally range between 10-60 % in the literature. The empirical results regarding the effect of financial globalization on risk sharing are however inconclusive. Bai and Zhang (2012) and Fuleky et al. (2015) compared the degree of international consumption risk sharing during periods of financial globalization (between the 1980's and today) to periods of lower financial integration, and found no difference in the two time samples. Artis and Hoffmann (2012) however reached the opposite conclusion and found that international consumption risk sharing has increased due to financial integration since the 1990's, and Imbs (2006), Hevia and Serven (2013) and Corcoran (2007) also concluded that financial linkages increase consumption correlations in samples including both advanced and developing countries. Flood et al. (2012) and Kose et al. (2009) found some evidence that financial integration improve international risk sharing in developed countries, however in developing countries it seems like financial globalization has not helped the countries smooth consumption. The channel through which the increase in international consumption risk sharing has occurred is according to Artis and Hoffmann (2012) through the increase in international capital income flows. Relatedly Volosovych (2013) points to income risk sharing via portfolio diversification as one of the main channels through which international income (but also consumption) risk sharing occurs. Both Becker and Hoffmann (2006) and Artis and Hoffmann (2012) distinguish between permanent (or long term) and transitory shocks short term shocks, and posit that the permanent shocks are generally smoothed on the international financial market, whereas short-term shocks are smoothened through savings and dissavings.

The standard macroeconomic model assumes that all individuals can afford to participate in the international financial markets, ignoring individuals living hand-to-mouth. Poverty or income inequality might prevent some individuals from saving or participating in international financial markets. Consequently, a large share of poor individuals or inequality could increase the share of hand-to-mouth consumers within that country. As the consumption growth of individuals with binding budget constraints is largely dependent on the change in these individuals' disposable income, a large share of hand-to-mouth consumers in the population implies that there are fewer individuals that are able to pool their consumption risks through international financial markets. This is consistent with the findings of Antonakakis and Scharler (2012), who find that international risk sharing is lower in countries

[4]see among others Mace (1991), Backus et al. (1992), Obstfeld (1993), Lewis (1996), Kose et al. (2009), Artis and Hoffmann (2012) and Fuleky et al. (2015).

where credit constraints are more binding. Even though the relative contribution of poor and low income households' to aggregate consumption tends to be smaller than for wealthier households, if a very large share of the population falls into this low income category, which is often the case in developing countries, these households' contribution to aggregate consumption is non-negligible. Especially as the marginal propensity to consume is generally higher for poor households than rich ones, a high share of hand-to-mouth consumers could have a decreasing effect on risk sharing in the aggregate.

High inequality is also associated with higher risks of social unrest and political instability (Barro, 2000), which affects the types of capital flowing into the country. As the risk of social unrest or political instability is typically higher during economic downturns, high inequality and thereby higher political risks might amplify the typical procyclicality of capital flows to emerging market and developing countries. Higher procyclicality reduces the "hedging" benefit of international financial market participation, and might even increase the correlation between capital flows and domestic output, thus affecting international risk sharing negatively. However, foreign aid and remittance flows from migrant workers abroad, which typically are countercyclical, can insulate the consumption in the receiver economy from domestic output shocks, thus improving risk sharing. On the other hand, if the remittance flows are procyclical, they might even aggravate the impact of an adverse domestic shocks (Balli and Rana, 2014).

4.3 Method

4.3.1 Empirical specification

Baseline regression

Equation (4.3) can be used for testing the international consumption risk sharing relationship using the following empirical specification

$$\Delta\ln(c_{it}) - \Delta\ln(C_t) = \alpha_i + \beta_i\big(\Delta\ln(y_{it}) - \Delta\ln(Y_t)\big) + \epsilon_{it} \tag{4.4}$$

where c_{it} and y_{it} denotes per capita consumption and GDP of country i in year t and C_t and Y_t denotes global per capita consumption and GDP in year t. Individual country effects that capture time-invariant heterogeneity are represented by α_i, and ϵ_{it} is an error term which is a time-varying component that captures both idiosyncratic and global preference shocks as well as potential measurement errors in the consumption and income data. To allow for partial risk sharing, changes in GDP are also included in the model. Moreover, as it is not possible to insure against global shocks, the global fluctuations in consumption and GDP are subtracted from the country specific growth rates.

For notational simplicity I let $\Delta\tilde{c}_{it} = \Delta ln\ (c_{it}) - \Delta ln\ (C_t)$ and $\Delta\tilde{y}_{it} = \Delta ln\ (y_{it}) - \Delta ln(Y_t)$. Using this simplification the standard international consumption risk sharing model can be rewritten as

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \epsilon_{it} \tag{4.5}$$

Full risk sharing, according to the standard complete markets model, implies that the change in domestic consumption should be uncorrelated with changes in domestic output growth. This implies testing the hypothesis $\beta_i = 0$. As argued by Asdrubali et al. (1996), even if the null hypothesis of full risk sharing is rejected, β_i can still be interpreted as a measure of market incompleteness and represent the share of consumption risk not shared internationally. As the estimate for β_i is typically between 0 and 1, $1 - \beta_i$ can be seen as a measure of international consumption risk sharing, where a measure of 0 indicates no risk sharing and 1 denotes perfect risk sharing.

Determinants of international risk sharing

In order to characterize the effect of financial openness, hand-to-mouth consumers, remittances and foreign aid on the degree of international consumption risk sharing, equation (4.5) is extended. This is done by parametrizing β as a linear function of the country- and time-varying parameters of interest so that $\beta_{it} = \beta_i + \mu_i x'_{it}$ where μ_i is a $1 \times K$ coefficient matrix and x_{it} is a $1{\times}K$ matrix containing K of the time-varying and country-specific characteristics of interest; a measure of financial liberalization or integration, an inequality index or a measure of the share of low income households, remittance flows and foreign aid. When plugging in the augmented specification of β_i into the panel regression in (4.5), it is possible to directly determine the impact of financial liberalization and other parameters of interest on the degree of international risk sharing. The extended risk sharing panel regression model can be written as

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \mu_i x'_{it} \Delta\tilde{y}_{it} + \epsilon_{it} \tag{4.6}$$

Within this framework, the degree of risk sharing is now equal to $(1 - \beta_i - \mu_i x'_{it})$. Estimates of $\mu_i x'_{it}$ capture the extent to which risk sharing is affected by the financial integration, inequality or headcount poverty rates. If the sign on μ_i is positive, this indicates that the higher the value of x_{it}, the lower is the degree of risk sharing. The coefficient on inequality and headcount poverty is expected to be positive, as a higher share of hand-to-mouth consumers are expected to reduce risk sharing. As financially open economies are expected to share more risk internationally, the coefficient on financial liberalization and integration should be negative. As foreign aid and remittance flows are predicted to increase risk sharing, their coefficients are also expected to be negative.

4.3.2 Estimators

Basic estimators

The most basic panel estimator used is the within group (WG) estimator, also called the fixed effects (FE) estimator, that assumes slope homogeneity but allows for country fixed effects. As the countries included in the study differ significantly from each other in terms of economic and political structures, there might be some cross-country heterogeneity in the impact of output growth on consumption growth as well. In order to avoid potentially biased and inconsistent estimators by forcing the regression slope parameters to be identical across countries, the mean group (MG) estimator is also computed. The consistent MG estimator is the cross-sectional average of the OLS estimators resulting from running the model separately for each country included in the panel.

Cross-sectional dependence and Common Correlated Effects (CCE) estimators

An issue generally overlooked in the risk sharing literature is the observation that many countries are subject to common factors, such as globalization or financial innovation contributing towards making financial markets more complete. If there is some unobserved common factor casting a potentially heterogeneous influence on output and consumption growth in several countries, this will appear in the residual and cause error cross-sectional dependence.

To correct for the cross-sectional dependence, the conventional consumption risk sharing relationship is augmented by a common factor loading in the panel regression error. The error term ϵ_{it} therefore consists of an unobserved common factor f_t with the factor loading γ_i, and ε_{it} which is i.i.d. in both time and space. As I allow for heterogeneous cross-sectional dependence, γ_i can differ between countries. Hence

$$\epsilon_{it} = \varepsilon_{it} + \gamma_i f_t \tag{4.7}$$

Using (4.7), the international risk sharing model can be written as

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \gamma_i f_t + \varepsilon_{it} \tag{4.8}$$

If the unobserved common factor is ignored, but correlated with the regressor, the orthogonality condition is violated as $\text{plim}\big(\frac{1}{n}\Delta\tilde{y}_{it}e_{it}\big) = \text{plim}\big(\frac{1}{n}\Delta\tilde{y}_{it}(\gamma_i \text{f}_t + \varepsilon_{it})\big) \neq 0$.

This prevents the explanatory variables from becoming asymptotically uncorrelated with the disturbances, in addition to causing higher estimator variance. In that case the estimated coefficients will be inconsistent and suffer from omitted variable bias. (Pesaran, 2006)

To exploit the cross-sectional dependence in the data, the Common Correlated Effect (CCE) estimator, developed by Pesaran (2006), is used. The CCE estimator filters the country-specific regressors by the common cross-sectional averages, such that asymptotically, as N tends to infinity, the differential effects of the unobserved common factors are eliminated.[5] Pesaran (2006) shows that the unobserved component f_t can be approximated by

$$f_t = \frac{1}{\bar{\gamma}}\left[\bar{y}_t - \beta\bar{x}_t - \bar{\eta} - \bar{\varepsilon}_t\right] \tag{4.9}$$

where y and x are the dependent and independent variables, the bar denotes cross-sectional averages of the series, $\bar{\gamma}$ is the cross-sectional average of the factor loading on the unobserved component and $\bar{\eta}$ is the average fixed effect. In practice this means that the time-varying unobserved common factor can be approximated by the cross-sectional averages of the dependent variable and the individual specific regressors. The CCE estimator for the baseline regression can thus be estimated from the following regression:

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i\Delta\tilde{y}_{it} + \theta_i^1\overline{\Delta c_t} + \theta_i^2\overline{\Delta y_t} + \varepsilon_{it} \tag{4.10}$$

where the bar denotes cross-sectional averages of the series. The CCE estimator is thus the model (4.5) augmented with the cross-sectional averages of the regressors and the dependent variable, which can be estimated with OLS. For the extended model, the regression equation for the CCE estimator is:

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i\Delta\tilde{y}_{it} + \mu_i x_{it}'\Delta\tilde{y}_{it} + \theta_i^1\overline{\Delta c_t} + \theta_i^2\overline{\Delta y_t} + \theta_i^3\overline{x_t'\Delta y_t} + \varepsilon_{it} \tag{4.11}$$

In case the individual slope coefficients are identical, the observations can be pooled over the cross-sectional units. Pesaran (2006) denotes this pooled version of the CCE estimator as CCEP. Even though the slope coefficients on the estimated parameters are the same for all cross sections in the panel, the slope coefficient of the common unobserved factor is allowed to differ across countries. The Common Correlated Effects Mean Group (CCEMG) estimator for the heterogeneous panel is obtained by taking the simple average of the individual CCE estimators.

[5] Pesaran (2006) shows that the estimates are unbiased for as samples as small as N=30 and T=20, as long as the number of unobserved factors do not exceed the number of individual specific regressors and a constant.

In the international consumption risk sharing specification in equation (4.5), the cross-sectional averages of both consumption and output growth are already included in the model. However, the cross-sectional dependence correction in (4.5) is homogeneous, as it imposes that the common unobserved factor has the same effect on all countries. As the countries included in the sample are arguably heterogeneous with respect to economic and political structure, it is very likely that if there is some unobserved common factor affecting the risk sharing relationship, the common factor will have a differential effect on the different countries. Thus, even though the equation for international risk sharing by construction corrects for homogeneous cross-sectional dependence, there might still be *heterogeneous* error cross-sectional dependence in the panel, which warrants the use of the CCE estimator.

4.4 Data

The full data sample consists of an unbalanced panel of 120 countries over the time period 1970-2014. The sample, listed in Appendix 4B, contains 30 advanced economies and 90 developing countries. The developing countries are in turn divided into two groups, one for emerging markets (41 countries) and one for less developed countries (49 countries).[6] The countries included in the sample together accounted for 97.5 % of world GDP in 2011. Summary statistics for all the subsamples are presented in Table 4.10 in Appendix 4B.

Annual country level PPP-adjusted real consumption, real output (GDP) and population data were collected from Penn World Table 9.0 (Feenstra et al., 2015). Global per capita GDP and consumption growth rates are defined as the respective aggregated growth rates. The varying quality of international consumption data is however a major drawback. Deaton and Heston (2010) note that 'the international accounts are no better than the national accounts of the participating countries', indicating that caution is warranted especially with the national accounts data provided by countries whose statistical capacity is weak. To avoid potential problems relating to measurement error, the sample only contains countries with an average statistical capacity above 50.[7]

There are several indices of financial liberalization and integration available for the extended analysis, and in this study we use three different measures. Financial liberalization is proxied by Abiad et al.'s (2010) Index of Financial Reform. The

[6] Advanced countries are the countries classified as High income countries by the World Bank since 1990. The emerging market sample consists of countries that are commonly listed as emerging markets.

[7] The World Bank Statistical Capacity Index ranges between 0-100, where 100 denotes very high statistical capacity. In 2004 the average score was 64.

index, covering the 86 of the countries in the study over the period 1973-2005, looks at seven different dimensions of financial sector policy, namely credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets, banking regulations and restrictions on the capital account. Liberalization scores for each category are then combined in a graded index that is normalized from zero to one.

An alternative measure of financial liberalization is the Chinn and Ito (2006) index that measures a country's degree of capital account openness. The index is available for 115 of the included countries and covers 1970-2014. It is based on the binary variables that codify the index of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), and ranges between zero and one. It is used to test the robustness of the results to the financial openness specification and the time dimension.

Finally, we also use a de facto measure of financial integration. In the previous literature, the ratio of foreign liabilities or assets to GDP, has been used heavily. This financial integration measure can on the one hand be seen as a measure of the internationalization and depth of the financial market, but on the other hand as a reflection of the financial globalization. The data on external asset holdings by Lane and Milesi-Ferretti (2007) are collected from the External Wealth of Nations database, and covers the full sample. As the correlation between the series of total foreign liabilities to GDP and total foreign assets to GDP is very high, 0.99, I only use the series of total foreign liabilities to GDP in the study.

Data on income inequality, measured by the Gini coefficient, are collected from the Standardized World Income Inequality Database, SWIID 6.2 (Solt, 2016). The SWIID uses data from several reliable sources to make an net income (post-tax, post-transfer) inequality measure which is comparable across countries and over time. These data are available from 1970 onward for the full sample. The Gini index ranges between zero and 100, where a higher coefficient implies higher income inequality. To facilitate the interpretation and the comparison of the estimated coefficients in the models, the Gini coefficient is divided by 100 so as to range from zero to one.

The share of individuals with low income in the population is represented by threshold adjusted headcount poverty rates, which denote the percentage of the population living on less than $100 per month in 2011 PPP. The data are collected from the World Bank's database Povcalnet (2017).[8] The threshold-adjusted headcount poverty data are available for 111 countries from 1981 onward. As the data are not collected every year (but typically every 3-4 years) and the low income population shares can

[8] For Argentina and Uruguay the headcount poverty data is only available for the urban population. As the rural population accounted for only 6 % of the population in Uruguay and 9 % in Argentina in 2010 (WDI, 2017), the aggregate number is not expected to differ substantially from the urban one.

be assumed to be fairly stable in the short run, the data are linearly intrapolated into a time series.

Migrant workers' remittances to developing countries are defined as received personal remittances to GDP. These data are available for 89 of the developing countries in the study from 1970 onwards, and are collected from the World Development Indicator WDI (2017) database provided by the World Bank.

Foreign aid is defined as net official development assistance and official aid received as a fraction of GDP. The data, available for all the 78 developing countries that have received any official development aid since 1970, are also collected from the WDI (2017) database.

For the analysis of the unobserved common component, global output growth volatility, the Global Economic Policy Uncertainty Index (EPU), the Effective Federal Funds rate, US real M2 growth and Global Stock price volatility are also used. The Global EPU index that measures policy-related economic uncertainty, constructed by Baker et al. (2018), is based on newspaper coverage of policy-related economic uncertainty, disagreement among economic forecasters and expiring tax agreements in a large number of different countries. The Fed Funds rate, US real M2 growth (%) and the stock price volatility index are all collected from the Federal Reserve Bank of St. Louis (FRED, 2018). Global output growth volatility is defined as the standard deviation of Δy across countries.

4.5 Results

4.5.1 The baseline risk sharing regression

The baseline risk sharing regression equation (4.5) is first estimated on an unbalanced panel containing the full set of countries over the time period 1970-2014. The results for the different estimators, the within group (WG), mean group (MG) and pooled and mean group CCE estimators CCEP and CCEMG are all presented in Table 4.1.

The coefficient on idiosyncratic output growth, $\Delta\tilde{y}_{it}$, is clearly significant in all cases and positive, as expected. If one uses $1 - \hat{\beta}$ as a measure for international risk sharing (IRS), where $\hat{\beta}$ denotes the estimated coefficient on idiosyncratic output growth, the countries included in the study are suggested to share on average 31-33 % of consumption risk internationally, depending on the estimator.

In order to decide which estimator is the preferred one, diagnostic tests are conducted.[9] As can be seen from Table 4.1, Pesaran's 2004 test for cross-sectional depen-

[9] Panel unit root tests have been conducted to confirm that all the time series ($\Delta\tilde{c}$, $\Delta\tilde{y}$ and the inter-

	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.677***	0.687***	0.670***	0.676***
	(0.024)	(0.023)	(0.025)	(0.025)
IRS	0.323***	0.313***	0.330***	0.324***
R^2	0.55	0.55	0.60	0.61
DW	1.99	1.85	2.00	1.86
CD	25.2***	24.5***		
N	120	120	120	120
Obs.	4,370	4,370	4,370	4,370
Years	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014

Note: White standard errors for the WG and CCEP estimators and nonparametric ones for the MG and CCEMG estimators are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. For MG and CCEMG the R^2 and DW test statistics are the average statistics over the cross sections. IRS=1-$\hat{\beta}$.

Table 4.1: Consumption risk sharing estimates for the full sample

dence[10] (CD) rejects the null hypothesis of no cross-sectional dependence for both the WG and MG estimator. Despite the correction for homogeneous cross-sectional dependence induced by the risk sharing specification, the basic estimators thus still seem to suffer from cross-sectional dependence. This implies that the CCE estimators are preferred. Here the different estimators produce quite similar coefficients, but in general the results from the non-CCE estimators should be interpreted with caution. In the extended model the estimated coefficients for the CCE models and non-CCE models are however in some cases significantly different.[11] As the panel Durbin-Watson (DW) tests for the WG and CCEP estimator and the cross-sectional averages of the individual DW statistics for the MG and CCEMG estimator are reasonably close to 2, one can conclude that none of the models seem to suffer from autocorrelation. According to the CCE estimators, countries share on average between 32-33 % of their consumption risk internationally. This number is in line with the findings of Fuleky et al. (2015), who control for cross-sectional dependence in a similar manner.

action term series) are stationary.

[10]The test statistic is $CD_P = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}$ where ρ_{ij} is the pair-wise country cross-correlation coefficient. Under the null hypothesis of no cross-sectional dependence the statistic asymptotically follows a standard normal distribution.

[11]To assess the hypothesis of slope heterogeneity and determine whether more weight should be given to the pooled or the mean group estimators, a Hausman test is conducted. The Hausman test statistic is however negative, which is a problem as the test statistic is assumed to follow a χ^2 distribution. Therefore no conclusion can be drawn based on the test and the test statistic is not reported in this case.

Risk sharing coefficients for individual countries

To illustrate how the degree of international risk sharing differs for each individual country, the results from the individual CCE risk sharing regressions used to calculate the CCEMG estimator are presented in Table 4.2. Most of the estimated coefficients are significant, of expected sign and between zero and one. However, there seems to be substantial heterogeneity in the estimated slope coefficients. If 1-$\hat{\beta}_i$ is used as a measure of the degree of consumption risk sharing for each country i, most countries seem to be sharing between 0 to 80 % of their consumption risk internationally.

Risk sharing in the different country groups

As the degree of risk sharing between advanced and developing countries seems to differ substantially, the risk sharing coefficients are estimated separately for the developing and advanced economies. As can be seen from the regression results for the separate country groups in the upper part of Table 4.3, all the estimated coefficients are again significant and of the expected sign. The degree of risk sharing is now substantially and significantly higher in the advanced economies, where between 44-72 % of income risks are shared internationally, whereas the corresponding number in the developing countries is only 26-30 %. The finding that developing countries share significantly less risk internationally than advanced countries is in line with earlier findings by e.g. Kose et al. (2009) and Fuleky et al. (2015), although a risk sharing coefficient of 0.72 is at the higher end of the spectrum of previously estimated coefficients for the advanced economies.[12]

The developing country sample is further split into groups containing 41 emerging markets (EM) countries and 49 less developed countries (LDC's). Risk sharing in the emerging markets lies at 26-32% and is thus significantly lower than in the full sample and also somewhat higher (although not significantly so) than in the less developed countries, where the countries share on average between 25-29 % of their consumption risk. This finding of low levels of consumption risk sharing in the developing and emerging market countries is in line with the findings of Kose et al. (2009). They hypothesize that one possible reason to this phenomenon is that capital flows to the emerging markets are generally procyclical. This procyclicality prevents these countries from using the capital flows to smooth their consumption, as capital is leaving the country in times when it might be needed the most. This might instead aggravate the dependence of consumption changes on domestic output fluctuations and suppress international risk sharing.

Wald tests evaluating the null hypothesis of identical estimated coefficients for the full sample and the different subsamples reveal that rich, and to some extent also

[12] Fuleky et al. (2015) and Kose et al. (2009) found that advanced countries share around 30-50 % of their short run consumption risks internationally, whereas developing countries generally share only around 10-30 %. Most related studies have arrived at estimates in the same range.

Country	$\hat{\beta}_i$	se_i	Country	$\hat{\beta}_i$	se_i	Country	$\hat{\beta}_i$	se_i
Albania	**0.691**	(0.12)	Guatemala	**0.400**	(0.11)	Norway	0.012	(0.05)
Argentina	**1.031**	(0.06)	Guinea	**1.105**	(0.06)	Pakistan	**0.999**	(0.11)
Armenia	**0.286**	(0.12)	Honduras	**0.461**	(0.17)	Panama	**0.555**	(0.17)
Australia	**0.330**	(0.10)	Hong Kong	**0.253**	(0.07)	Paraguay	0.219	(0.28)
Austria	**0.821**	(0.09)	Hungary	**0.901**	(0.10)	Peru	**0.914**	(0.06)
Azerbaijan	0.201	(0.10)	Iceland	**0.518**	(0.07)	Philippines	**0.665**	(0.05)
Bangladesh	**0.899**	(0.06)	India	**0.866**	(0.05)	Poland	**0.721**	(0.14)
Belarus	-0.016	(0.20)	Indonesia	**0.637**	(0.05)	Portugal	**0.685**	(0.09)
Belgium	**0.662**	(0.09)	Ireland	**0.571**	(0.09)	Romania	**0.798**	(0.07)
Bhutan	**0.496**	(0.13)	Israel	**0.773**	(0.15)	Russia	**0.429**	(0.09)
Bolivia	**0.367**	(0.13)	Italy	**0.846**	(0.07)	Rwanda	**0.962**	(0.18)
Bosnia & Herzegovina	**0.836**	(0.11)	Jamaica	**0.432**	(0.13)	Senegal	**0.647**	(0.08)
Botswana	**0.367**	(0.12)	Japan	**0.648**	(0.04)	Serbia	**0.419**	(0.13)
Brazil	**1.105**	(0.08)	Jordan	**0.810**	(0.06)	Singapore	0.115	(0.07)
Bulgaria	**1.081**	(0.15)	Kazakhstan	**0.583**	(0.18)	Slovakia	**0.858**	(0.12)
Burkina Faso	**1.080**	(0.21)	Kenya	**0.949**	(0.13)	Slovenia	**0.516**	(0.11)
Cambodia	0.119	(0.06)	Kyrgyzstan	0.210	(0.13)	South Africa	**0.589**	(0.07)
Cameroon	**0.769**	(0.10)	Laos	**0.686**	(0.10)	South Korea	**0.707**	(0.06)
Canada	**0.424**	(0.07)	Latvia	**1.318**	(0.15)	Spain	**0.912**	(0.06)
Chile	**0.839**	(0.09)	Lesotho	**0.705**	(0.11)	Sri Lanka	**1.025**	(0.10)
China	**0.766**	(0.08)	Lithuania	**0.881**	(0.17)	Suriname	**1.712**	(0.41)
Colombia	**0.851**	(0.07)	Luxembourg	**0.171**	(0.07)	Swaziland	0.301	(0.32)
Costa Rica	**0.647**	(0.14)	Macedonia	**0.772**	(0.12)	Sweden	**0.665**	(0.10)
Croatia	**0.699**	(0.08)	Madagascar	**0.998**	(0.04)	Switzerland	**0.644**	(0.09)
Cyprus	**0.508**	(0.07)	Malawi	**0.772**	(0.16)	Syria	**0.776**	(0.07)
Czech Republic	**0.768**	(0.13)	Malaysia	**0.729**	(0.08)	Taiwan	**0.640**	(0.07)
Denmark	**0.882**	(0.11)	Malta	**0.388**	(0.09)	Tajikistan	**0.283**	(0.11)
Dominican Republic	0.226	(0.17)	Mauritius	**0.665**	(0.15)	Tanzania	**0.953**	(0.04)
Ecuador	**0.602**	(0.14)	Mexico	**0.836**	(0.05)	Thailand	**0.679**	(0.17)
Egypt	**0.745**	(0.06)	Moldova	**1.224**	(0.08)	Tunisia	**0.857**	(0.13)
El Salvador	**0.647**	(0.18)	Mongolia	0.325	(0.23)	Turkey	**0.617**	(0.13)
Estonia	**0.870**	(0.14)	Montenegro	**0.714**	(0.15)	Uganda	**0.779**	(0.07)
Ethiopia	**0.665**	(0.09)	Morocco	**0.855**	(0.09)	Ukraine	**0.957**	(0.06)
Fiji	**0.499**	(0.19)	Mozambique	**0.530**	(0.20)	UK	**0.856**	(0.09)
Finland	**0.518**	(0.07)	Namibia	**0.372**	(0.16)	United States	**0.664**	(0.05)
France	**0.886**	(0.05)	Nepal	**0.650**	(0.09)	Uruguay	**0.945**	(0.06)
Georgia	1.205	(0.73)	Netherlands	**0.682**	(0.10)	Uzbekistan	**0.484**	(0.04)
Germany	**0.702**	(0.09)	New Zealand	**0.489**	(0.06)	Venezuela	0.124	(0.22)
Ghana	**0.723**	(0.12)	Niger	**1.011**	(0.22)	Vietnam	0.147	(0.11)
Greece	**0.668**	(0.09)	Nigeria	**1.354**	(0.24)	Zambia	**0.719**	(0.09)

Note: Coefficients significant at 5 % level in bold, standard errors in parentheses. The risk sharing coefficient for each country i is $1 - \hat{\beta}_i$.

Table 4.2: Estimated β coefficients from the individual CCE regressions for each country

emerging market countries, share significantly different degrees of consumption risk internationally than the rest of the sample. Based on the results from the CD test, the CCE estimators are preferred to the basic ones in all samples, and the CCE estimators now produce significantly different results compared to the basic estimators for the advanced country sample. Ignoring heterogeneous cross-sectional dependence implies that international risk sharing is underestimated by as much as 11 percentage points for those countries.[13]

The common factor

If we assume that there is only one unobserved common component (although there can be several) approximated by $\hat{f}_t$ in equation (4.9), this factor $\hat{f}_t$ can be identified up to a scaling factor ($\bar{\gamma}$). These common factors for the different samples are presented in Figure 4.1. From there can be seen that the common component for the different country groups differ somewhat, where the biggest difference is found between the common component for the advanced economies and the other samples.

Global business cycle synchronization, global economic uncertainty and monetary policy are all common factors that could affect individuals' decisions to share their consumption risks internationally, but the aggregate impact could vary between countries. Table 4.4 shows the results from regressing the common unobserved component $\hat{f}_t$ on potential determinants such as the global output growth volatility, US monetary policy measures like the Fed Funds rate and US real M2 growth (which are generally also perceived as global monetary policy measures), and financial market uncertainty measures like the global stock price volatility and the Global Economic Policy Uncertainty (EPU) Index. As can be seen from the table, these global uncertainty and monetary policy variables can explain around 18-28 % of the variation in the common factor in the different samples. It thus seems like the latent factor to some extent captures the short run effects of the global financial business cycle on risk sharing. Hence, for the advanced economies global uncertainty and monetary policy reduces the positive impact of risk sharing, as the degree of risk sharing in Table 4.3 is estimated to be much higher once we take this common effect into account.

This finding is somewhat related to the findings of Artis and Hoffmann (2012) and Becker and Hoffmann (2006), who make a distinction between consumption risk sharing patterns over the long-term through international financial markets, and short-term via savings and dissavings. My result however indicate that the short run variation in advanced economies comes not only from savings and dissavings, but also to some extent from global monetary policy and financial markets.

[13]The Hausman tests yield negative test statistics for most subsamples and are therefore not reported.

	Developing countries				Advanced economies			
	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.736***	0.728***	0.722***	0.701***	0.395***	0.564***	0.284***	0.480***
	(0.026)	(0.026)	(0.028)	(0.030)	(0.026)	(0.040)	(0.028)	(0.039)
IRS	0.264***	0.272***	0.278***	0.299***	0.605***	0.436***	0.716***	0.520***
R^2	0.59	0.57	0.63	0.64	0.38	0.49	0.55	0.61
DW	2.02	1.92	2.05	1.96	1.65	1.66	1.65	1.68
CD	19.4***	15.8***			25.7***	3.8***		
Wald	-1.71*	-1.17	-1.38	-0.65	7.99***	2.65***	10.33***	4.26***
N	90	90	90	90	30	30	30	30
Obs.	3,051	3,051	3,051	3,051	1,319	1,319	1,319	1,319
Years	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014

	Less developed countries				Emerging market countries			
	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.749***	0.720***	0.730***	0.708***	0.709***	0.737***	0.684***	0.725***
	(0.032)	(0.040)	(0.034)	(0.049)	(0.039)	(0.033)	(0.033)	(0.035)
IRS	0.251***	0.280***	0.270***	0.292***	0.291***	0.263***	0.316***	0.275***
R^2	0.58	0.51	0.63	0.59	0.61	0.65	0.67	0.71
DW	2.08	1.98	2.09	1.98	1.84	1.84	1.83	1.86
CD	9.2***	4.0***			8.8***	3.1***		
Wald	-1.81*	-0.72	-1.41	-0.59	-0.71	-1.26	-0.33	-1.14***
N	49	49	49	49	41	41	41	41
Obs.	1,657	1,657	1,657	1,657	1,394	1,394	1,394	1,394
Years	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014	1970-2014

Note: Estimation of equation (5) for WG and MG estimator and equation (9) for CCEP and CCEMG. White standard errors for the WG and CCEP estimators and nonparametric ones for the MG and CCEMG estimators are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. For MG and CCEMG the R^2 and DW test statistics are the average statistics over the cross sections. IRS=1-$\hat{\beta}_i$ and denotes the international risk sharing coefficient. Wald test tests whether the estimated risk sharing coefficients for the subsamples are significantly different from the ones for the full sample, with $H_0 : \beta_{All} = \beta_{country\ group}$.

Table 4.3: Consumption risk sharing estimates for the full sample

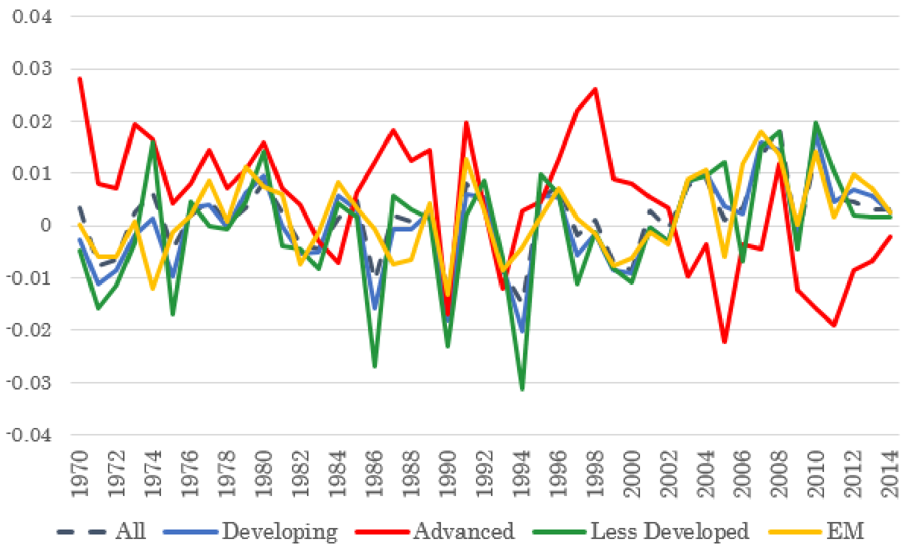


Figure 4.1: The common factor in the different samples

Sample:	All	Developing	Advanced	EM	Less Developed
St. Dev Δy	-0.111**	-0.130**	0.069	-0.057	-0.174**
	(0.042)	(0.049)	(0.071)	(0.047)	(0.068)
Fed Funds rate	-0.071**	-0.096**	0.174***	-0.072**	-0.109**
	(0.03)	(0.04)	(0.05)	(0.03)	(0.05)
Real M2 growth (%)	-0.084**	-0.095**	0.038	-0.046	-0.150***
	(0.032)	(0.038)	(0.055)	(0.037)	(0.052)
Stock price volatility	-0.030	-0.043	0.036	-0.056**	-0.031
	(0.024)	(0.028)	(0.041)	(0.027)	(0.039)
EPU Index	0.005	0.007*	-0.010*	0.008**	0.007
	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)
Constant	0.015**	0.016**	-0.005	0.011	0.019*
	(0.003)	(0.008)	(0.012)	(0.008)	(0.011)
R^2	0.25	0.27	0.28	0.18	0.25
Obs	40	40	40	40	40

Note: Dependent variable: the common factor. Standard errors in parentheses, symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively.

Table 4.4: Determinants of the common factor in the different samples

4.5.2 Determinants of international risk sharing

The analysis is now extended to regression models (4.6) and (4.11), to see how international consumption risk sharing is affected by financial liberalization, as measured either by the Financial reform index ($FinRef$) or the Chinn-Ito capital account openness index (*KaOpen*), financial integration as measured by total external liabilities to GDP (*Liab*), and hand-to-mouth consumers as measured by income inequality (*Gini*) and low income population ratios (LIR). For the developing countries the effects of migrant remittances (*Remit*) and official development assistance and foreign aid (ODA) on international risk sharing are also investigated. The time period under consideration varies with the included variables, with the time period starting between 1970-1981 and ending between 2005 and 2014.

As the time series are relatively short, the CCEMG estimator, which consists of the cross-sectional average of the individual CCE estimators, cannot be accurately estimated for the models including several regressors due to insufficient degrees of freedom.[14] In the baseline risk sharing models the results for the CCEMG estimator were however in most cases fairly similar to the ones obtained by the CCEP estimators. This suggests that using only the pooled version of the CCE estimator might be sufficient despite the fact that it ignores heterogeneity. As the Pesaran CD test moreover indicates that all the models suffer from cross-sectional dependence, only the results for the CCEP estimator are presented.

Full sample

The extended models including interaction terms for the different measures of financial openness and hand-to-mouth consumers are first estimated for the full unbalanced sample.[15]

As can be seen from the results in Table 4.5, the estimated coefficients on the idiosyncratic output variations are still significant for all models, and the interaction terms including the different measures of financial liberalization and integration are all significant and of the expected negative sign except in column (v). There is thus some evidence that financial liberalization, measured either by the financial reform index or capital account openness, or financial integration, represented by total external liabilities to GDP, significantly enhances international consumption risk sharing. The coefficients on $FinRef$ and $KaOpen$ are relatively large, and to allow for the comparison of the estimated coefficients, normalized coefficients are presented in Table

[14]As the CCE estimators include also the cross sectional averages of the regressors and the dependent variable, the extended models involves the estimation of 10 coefficients. Moreover, as there is not very much variation in the series for financial openness, inequality and hand-to-mouth indicators on the country level, this leads to severe multicollinearity problems in the mean group estimators.

[15]The extended models including all variables of interest are presented in this section. The results of regressions including only one risk sharing determinant at a time are presented in Tables 4.12 and 4.13 in Appendix 4C.

4.14 in Appendix 4C. From there can be seen that the effects of financial reform and capital account openness (when significant) on risk sharing are quite substantial. On the other hand, de facto financial integration, measured as total external liabilities to GDP, seems to have only a marginal impact on risk sharing as the coefficient on *Liab* is fairly small.

The share of low income individuals in the population (LIR) and income inequality (*Gini*) both have a significantly negative impact on risk sharing in models (ii), (iii), (v) and (vi), where the sample is longer and $KaOpen$ and *Liab* are used as measures of financial integration, but not in models (i) and (iv) including $FinRef$. The coefficients are large (see the normalized coefficients in Table 4.14, Appendix 4C) and positive when significant, indicating that a higher share of low income individuals and higher inequality have a large negative impact on international risk sharing. The risk sharing coefficient, once financial integration, inequality or the share of low income individuals and cross sectional dependence is controlled for, increases from around 0.33 to between 0.34-0.40, depending on the model used.

Subsamples

In this section, the models are re-estimated for the sub-samples of 90 developing countries and 30 advanced countries. The sample of developing countries is furthermore split into a group of 49 less developed countries and a group of 41 emerging market countries.[16]

Developing countries

The results for the sample of developing countries are presented in Table 4.6, where the analysis has been extended to include also the impact of migrant remittances (*Remit*) and official development assistance and foreign aid per GDP (ODA).

Just like in the full sample, the estimated β's are all significant and the different measures of financial openness have a positive and significant impact on risk sharing in all models except for the one in column (vii). Contrary to some of the previous findings in the literature, this result implies that financial liberalization, but also financial integration, enhance international risk sharing in developing countries. As can be seen from Table 4.14 with the normalized coefficients in Appendix 4C, also financial integration, *Liab*, seems to have a substantial economic impact on risk sharing in developing countries.

There is some evidence that hand-to-mouth households, as proxied either by low income ratios or income inequality, have a negative impact on international risk sharing, as the interaction terms including LIR and *Gini* are positive and significant in

[16] The extended models including all variables of interest are presented in this section. The results of regressions including only one risk sharing determinant at a time are presented in Tables 4.12 and 4.13 in Appendix 4C.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$\Delta\tilde{y}$	0.695***	0.453***	0.303***	0.907***	0.596***	0.584***	0.790***	0.791***	0.672***
	(0.133)	(0.092)	(0.076)	(0.068)	(0.049)	(0.030)	(0.036)	(0.035)	(0.028)
$FinRef * \Delta\tilde{y}$	-0.377***			-0.505***			-0.350***		
	(0.079)			(0.102)			(0.071)		
$KaOpen * \Delta\tilde{y}$		-0.348***			-0.075			-0.335***	
		(0.063)			(0.070)			(0.059)	
$Liab * \Delta\tilde{y}$			-0.006***			-0.005***			-0.006***
			(0.001)			(0.001)			(0.001)
$Gini * \Delta\tilde{y}$	0.273	0.899***	0.912***						
	(0.302)	(0.211)	(0.198)						
$LIR * \Delta\tilde{y}$				-0.010	0.305***	0.280***			
				(0.074)	(0.072)	(0.066)			
$FinRef$	0.056***			0.050***			0.031***		
	(0.010)			(0.010)			(0.008)		
$KaOpen$		0.009**			0.005			0.005	
		(0.004)			(0.007)			(0.004)	
$Liab$			-0.001**			-0.001***			-0.001*
			(0.001)			(0.000)			(0.000)
$Gini$	-0.059	-0.017	-0.009						
	(0.048)	(0.028)	(0.025)						
LIR				-0.124***	-0.060***	-0.076***			
				(0.036)	(0.020)	(0.015)			
IRS	0.400***	0.378***	0.361***	0.387***	0.349***	0.339***	0.390***	0.371***	0.338***
	(0.024)	(0.028)	(0.026)	(0.033)	(0.023)	(0.021)	(0.025)	(0.028)	(0.028)
R^2	0.73	0.72	0.70	0.80	0.75	0.73	0.71	0.65	0.64
DW	2.04	2.05	2.10	2.20	2.13	2.14	1.95	1.97	2.09
N	83	114	118	79	110	113	86	114	118
Obs.	2,226	3,739	3,825	1,696	3,072	3,140	2,309	4,039	4,161
Years	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1973-2005	1970-2014	1970-2014

Note: Estimation of model (10) using CCEP, White standard errors are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}. As not all series are available for all countries or for the full sample period, the N and T between the different models vary.

Table 4.5: Consumption risk sharing CCEP estimates for the full sample

the models in columns (iii), (v) and (vii)-(ix). The previous finding by Hadzi-Vaskov (2006) that remittances have a significantly positive impact on risk sharing holds also once financial liberalization, income inequality and cross-sectional dependence are controlled for, as the coefficient is both negative and significant in two thirds of the models. Finally, we look at whether official development assistance and foreign aid to GDP (ODA) has an effect on risk sharing in the developing countries. It appears that ODA has no significant impact on international consumption risk sharing. For convenience, only the model including only the effect of foreign aid on risk sharing is presented in Table 4.6, column (x), but the same conclusions are reached once the other determinants of consumption risk sharing are included in the model.

When controlling for financial liberalization and integration, inequality and remittances the risk sharing coefficient increases from the baseline case of around 0.26-0.30 to between 0.27-0.39, depending on the model used. The models adjusting for $FinRef$ show a much higher upward adjustment in the estimated international consumption risk sharing coefficient IRS than the ones using *KaOpen* or *Liab*. This result indicates that it is not only the degree of capital account openness and capital flows that matter for risk sharing in developing countries, but also other dimensions of financial sector policy. Thus when adjusting for a broader dimension of financial liberalization, the gap in risk sharing between developing and advanced countries is much smaller.[17]

Ignoring any general equilibrium effects, if the financial systems in the less developed countries were as integrated into the international financial markets as the ones in the advanced economies, and low income ratios (or income inequality) were at the same levels as in the advanced economies, the developing countries would *ceteris paribus* share approximately as much risk internationally as the advanced economies. It thus seems like the level of financial openness and hand-to-mouth consumers can at least partly explain the gap in international risk sharing between developing and advanced economies. These results thus suggest that there are potential welfare gains through improved consumption risk sharing from increased financial liberalization, integration and reduced inequality in developing countries.

[17] This result does not seem to be driven by the difference in the sample length, as when the models are re-estimated to end in 2006 the IRS for the models using *KaOpen* and LIR are in the same range as they are in the full sample.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
$\Delta\tilde{y}$	1.160***	0.625***	0.523***	0.701***	0.522***	0.836***	0.605***	0.668***	0.670***	0.674***
	(0.225)	(0.158)	(0.125)	(0.137)	(0.123)	(0.098)	(0.057)	(0.048)	(0.041)	(0.038)
$FinRef * \Delta\tilde{y}$	-0.384***					-0.311**				
	(0.124)					(0.151)				
$KaOpen * \Delta\tilde{y}$		-0.247***	-0.252***				-0.089			
		(0.087)	(0.081)				(0.094)			
$Liab * \Delta\tilde{y}$				-0.103***	-0.068**			-0.066*	-0.078**	
				(0.037)	(0.033)			(0.037)	(0.034)	
$Remit * \Delta\tilde{y}$	-0.012**	-0.008***		-0.004		-0.015**	-0.006*	-0.004		
	(0.005)	(0.003)		(0.003)		(0.008)	(0.003)	(0.003)		
$Gini * \Delta\tilde{y}$	-0.683	0.538	0.714***	0.254	0.629**					
	(0.482)	(0.356)	(0.276)	(0.306)	(0.264)					
$LIR * \Delta\tilde{y}$						-0.066	0.274***	0.153*	0.185***	
						(0.104)	(0.099)	(0.084)	(0.072)	
$ODA * \Delta\tilde{y}$										0.005
										(0.004)
$FinRef$	0.054***					0.027				
	(0.019)					(0.020)				
$KaOpen$		0.008	0.011*				0.002			
		(0.008)	(0.006)				(0.009)			
$Liab$				-0.006*	0.000			-0.011***	-0.004**	
				(0.003)	(0.002)			(0.003)	(0.002)	
$Remit$	0.001	0.000		-0.001		0.001	0.000	-0.001		
	(0.001)	(0.001)		(0.001)		(0.002)	(0.001)	(0.001)		
$Gini$	0.015	0.045	-0.012	-0.036	-0.011					
	(0.095)	(0.043)	(0.036)	(0.043)	(0.034)					
LIR						-0.095**	-0.080***	-0.076***	-0.062***	
						(0.043)	(0.024)	(0.025)	(0.016)	
ODA										0.000
										(0.000)
IRS	0.342***	0.283***	0.274***	0.297***	0.269***	0.391***	0.352***	0.347***	0.324***	0.302***
	(0.033)	(0.041)	(0.033)	(0.030)	(0.026)	(0.038)	(0.029)	(0.025)	(0.023)	(0.031)
R^2	0.80	0.78	0.75	0.79	0.73	0.81	0.80	0.80	0.75	0.65
DW	2.42	2.21	2.06	2.37	2.22	2.44	2.23	2.29	2.35	2.18
N	44	82	86	82	88	44	83	83	88	78
Obs.	1,057	2,131	2,616	2,102	2,611	949	2,045	2,041	2,319	2,613
Years	1973-2005	1970-2014	1970-2014	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1981-2014	1970-2014

Note: Estimation of model (10) using CCEP, White standard errors are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}. As not all series are available for all countries or for the full sample period, the N and T between the different models vary.

Table 4.6: CCEP Consumption risk sharing estimates for the Developing countries

Less Developed Countries

Next, the same models are re-estimated for the less developed countries. As can be seen from Table 4.7, financial reforms ($FinRef$) and integration ($Liab$) do have a significantly positive impact on international risk sharing also in the less developed countries. The normalized coefficients (in Table 4.15) on the interaction terms including $FinRef$ are more than twice as large as the interaction terms including $Liab$, suggesting that financial reforms have a much larger impact on risk sharing than financial integration. Capital account openness ($KaOpen$) does however not have any significant impact, thus suggesting that de facto financial openness is more important for risk sharing than de jure. Only using capital account openness as a measure for financial openness might thereby be misleading, as there seem to be several other important financial market restrictions that affect risk sharing. This result thus implies that in less developed countries, there are welfare gains from financial reforms related to entry barriers, state ownership, interest rates controls, securities and credit markets through better consumption smoothing opportunities.

Another important take-away is that a high share of low income individuals reduce risk sharing, as the interaction term including LIR is positive and significant. Also, there is some evidence that income inequality ($Gini$) reduces it too, although the negative coefficients in columns (i) and (ii) weaken this finding somewhat.

The impact of remittances on international risk sharing is somewhat ambiguous, as the coefficient on the interaction term including remittances is insignificant in most specifications except in column (iii). When remittances are included in the models, although insignificant, they still heighten the total risk sharing coefficient (IRS) substantially. Even though foreign aid and development assistance on average accounted for 7.5 % of GDP in these countries, there seem to be no significant effects of it on risk sharing (column (x)).[18]

The degree of international risk sharing once hand-to-mouth consumers and financial integration are taken into account now range between 0.27 and 0.51. Note that this range is slightly higher than for the sample including all developing countries. Noteworthy is also that the degree of risk sharing is substantially higher when the measure for financial reform is used as the measure for financial openness, and that the effect of $FinRef$ is much larger in the less developing countries than in the sub-sample for all developing countries, again highlighting the relevance of using the broader index of financial integration that looks at several dimensions of financial sector policy in the less developed countries. The potential welfare gains through risk sharing from further financial liberalization and integration and the reduction of inequality thus seem to be larger in the less developed countries than in the richer developing countries.

[18] ODA is also insignificant in models where other risk sharing determinants are included.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
$\Delta\tilde{y}$	1.385***	1.089***	0.243	0.435**	0.552***	0.422**	0.383***	0.482***	0.549***	0.673***
	(0.239)	(0.240)	(0.233)	(0.216)	(0.158)	(0.165)	(0.082)	(0.076)	(0.073)	(0.054)
$FinRef * \Delta\tilde{y}$	-0.792***	-0.553***				-0.589**				
	(0.254)	(0.202)				(0.265)				
$KaOpen * \Delta\tilde{y}$			-0.256				-0.106			
			(0.202)				(0.168)			
$Liab * \Delta\tilde{y}$				-0.172**	-0.120**			-0.126**	-0.108**	
				(0.072)	(0.050)			(0.050)	(0.045)	
$Remit * \Delta\tilde{y}$	-0.012		-0.009**	-0.007		0.029	-0.003	0.000		
	(0.013)		(0.004)	(0.004)		(0.019)	(0.003)	(0.003)		
$Gini * \Delta\tilde{y}$	-1.167**	-0.651	1.396**	0.954**	0.657*					
	(0.524)	(0.544)	(0.549)	(0.476)	(0.363)					
$LIR * \Delta\tilde{y}$						0.546**	0.535***	0.402***	0.353***	
						(0.231)	(0.124)	(0.110)	(0.096)	
$ODA * \Delta\tilde{y}$										0.004
										(0.005)
$FinRef$	0.043	0.068***				0.058				
	(0.027)	(0.025)				(0.036)				
$KaOpen$			0.017				0.003			
			(0.013)				(0.013)			
$Liab$				-0.007	-0.001			-0.014***	-0.002	
				(0.006)	(0.002)			(0.005)	(0.001)	
$Remit$	-0.005**		0.001	0.001		-0.005***	0.000	0.000		
	(0.002)		(0.001)	(0.001)		(0.002)	(0.001)	(0.001)		
$Gini$	-0.086	-0.115	0.038	-0.018	-0.007					
	(0.108)	(0.087)	(0.076)	(0.071)	(0.049)					
LIR						-0.079*	-0.030	-0.048*	-0.052***	
						(0.042)	(0.029)	(0.028)	(0.018)	
ODA										-0.001
										(0.001)
IRS	0.507***	0.409***	0.300***	0.347***	0.271***	0.447***	0.404***	0.426***	0.358***	0.296***
	(0.049)	(0.052)	(0.059)	(0.050)	(0.033)	(0.059)	(0.040)	(0.032)	(0.031)	(0.041)
R^2	0.81	0.80	0.78	0.81	0.74	0.79	0.81	0.80	0.74	0.65
DW	2.32	2.15	2.28	2.38	2.37	2.21	2.19	2.40	2.43	2.28
N	20	26	42	44	49	20	43	45	49	47
Obs.	437	566	1,012	1,047	1,326	416	1,030	1,086	1,281	1,448
Years	1973-2005	1973-2005	1970-2014	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1981-2014	1970-2014

Note: Estimation of model (10) using CCEP, White standard errors are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}. As not all series are available for all countries or for the full sample period, the N and T between the different models vary.

Table 4.7: Consumption risk sharing CCEP estimates for the Less developed countries

Emerging markets

The risk sharing estimates for the Emerging Markets, presented in Table 4.8, paint a somewhat different picture. Contrary to previous findings by among others Kose et al. (2009) and to the results for the less developed country sample, capital account openness ($KaOpen$) and to some extent financial reforms ($FinRef$) do seem to have a positive impact on risk sharing in emerging markets, although the impact of financial reforms ($FinRef$) is not robust to all model specifications. De facto financial integration ($Liab$) does however not have a significant impact on international risk sharing. Unlike for the full developing country sample and the less developed countries, neither income inequality, low income ratios nor remittances seem to have any significant impact on risk sharing, as all these interaction terms are insignificant. The same applies to foreign aid (ODA), which does not have a significant effect either.

The international consumption risk sharing coefficient increases slightly to around 0.34 once capital account openness is accounted for. Even when accounting for other (but insignificant) potential determinants of dollarization, is the total implied international risk sharing in the emerging market economies lower than in the less developed countries. The suggestion that the emerging markets do not seem to have benefited substantially from financial globalization in terms of risk sharing is in line with the results found by Kose et al. (2009). The previous conclusion that there are potential welfare gains through improved risk sharing from further financial reform and reductions in inequality thus does not seem to apply to the same extent to the emerging markets, and low financial integration does not explain why the degree of risk sharing is so much lower in the emerging market countries than in the advanced economies.

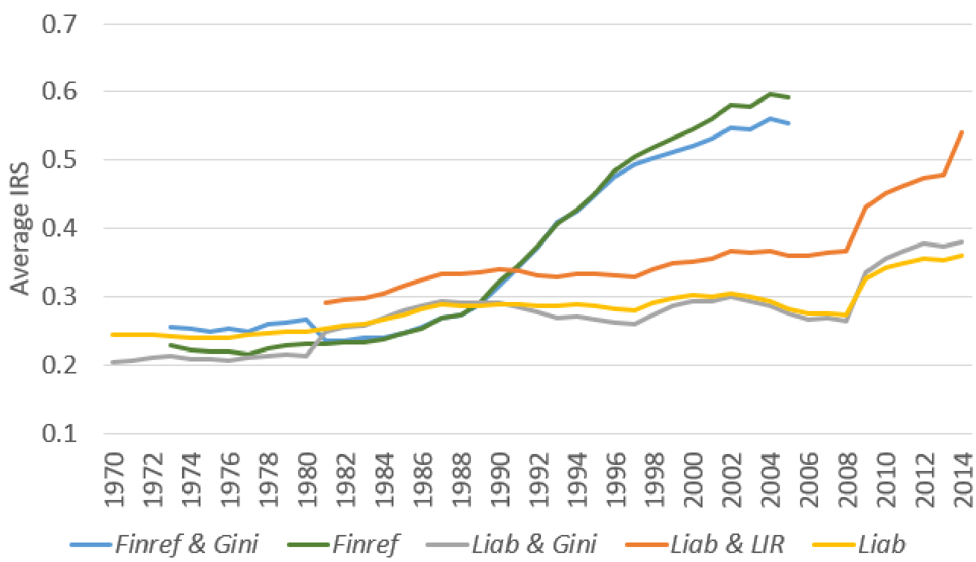
Figure 4.2 plots the evolution of the average risk sharing coefficients for the less developed countries and emerging markets over time for models including different financial integration and hand-to-mouth measures. The average degree of risk sharing has increased in both the less developed economies and the emerging markets, and most of the increase has occurred after the 1990's. Although the level of risk sharing in the less developed countries was very low in the 70's, the increase in risk sharing in the less developed countries has been much larger than in the emerging markets.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$\Delta\tilde{y}$	0.539**	0.850***	0.798***	0.942***	0.781***	0.687***	0.739***	0.809***	0.638***
	(0.231)	(0.189)	(0.165)	(0.101)	(0.060)	(0.064)	(0.054)	(0.036)	(0.040)
$FinRef * \Delta\tilde{y}$	-0.300***			-0.376***			-0.091		
	(0.116)			(0.137)			(0.098)		
$KaOpen * \Delta\tilde{y}$		-0.182**			-0.146*			-0.310***	
		(0.093)			(0.087)			(0.076)	
$Liab * \Delta\tilde{y}$			0.020			-0.011			
			(0.044)			(0.049)			
$Remit * \Delta\tilde{y}$	-0.001	0.000	0.001	-0.012	-0.009	-0.005			
	(0.006)	(0.005)	(0.006)	(0.008)	(0.006)	(0.006)			
$Gini * \Delta\tilde{y}$	0.788	-0.210	-0.309						
	(0.485)	(0.392)	(0.368)						
$LIR * \Delta\tilde{y}$				-0.082	-0.088	-0.071			
				(0.123)	(0.103)	(0.111)			
$ODA * \Delta\tilde{y}$									0.005
									(0.005)
$FinRef$	0.026			0.005			0.025*		
	(0.018)			(0.018)			(0.014)		
$KaOpen$		0.004			-0.006			0.003	
		(0.010)			(0.011)			(0.006)	
$Liab$			0.001			-0.013			
			(0.006)			(0.008)			
$Remit$	0.001	0.001	0.001	0.002	0.002	0.002			
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)			
$Gini$	0.080	-0.093	-0.087*						
	(0.107)	(0.058)	(0.049)						
LIR				-0.159***	-0.111***	-0.082***			
				(0.043)	(0.029)	(0.029)			
ODA									0.000
									(0.001)
IRS	0.267***	0.318***	0.310***	0.310***	0.335***	0.355***	0.302***	0.328***	0.354***
	(0.029)	(0.028)	(0.026)	(0.032)	(0.028)	(0.029)	(0.034)	(0.034)	(0.036)
R^2	0.85	0.80	0.80	0.88	0.82	0.82	0.74	0.72	0.68
DW	2.33	2.14	2.21	2.43	2.17	2.21	1.92	1.92	1.89
N	24	40	38	24	40	38	34	40	31
Obs.	620	1,119	1,055	533	1,015	955	845	1,357	1,165
Years	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1973-2005	1970-2014	1970-2014

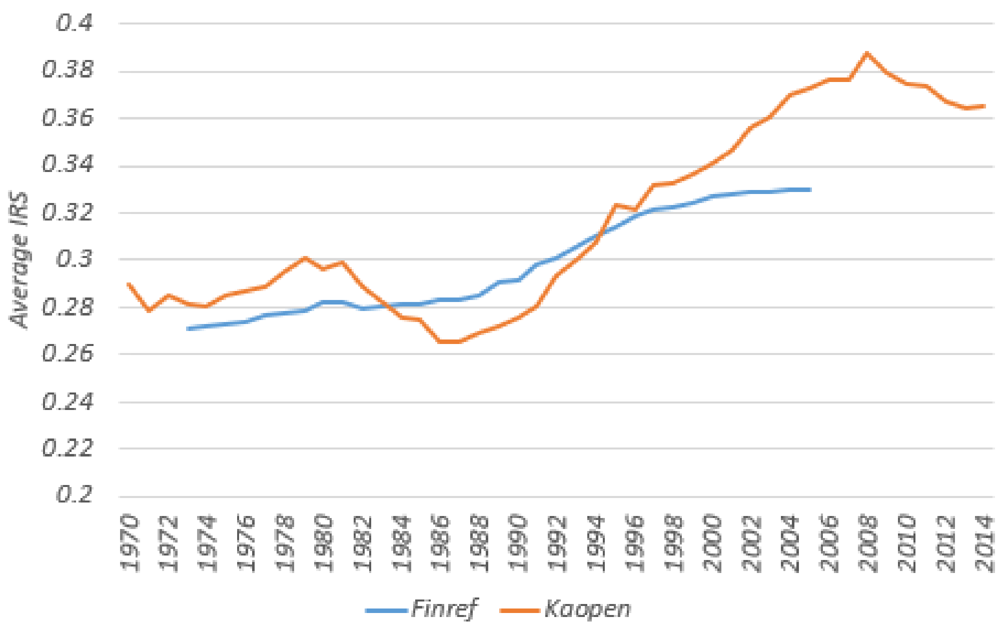
Note: Estimation of model (10) using CCEP, White standard errors are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}. As not all series are available for all countries or for the full sample period, the N and T between the different models vary.

Table 4.8: Consumption risk sharing CCEP estimates for the Emerging Markets

(a) Less Developed Countries



(b) Emerging Markets



Note: Plots of the average IRS coefficient for a number of models including financial reforms *Finref*, capital account openness *KaOpen*, foreign liabilities *Liab*, Gini and the low income ratio *LIR*.

Figure 4.2: The evolution of the IRS coefficient for some of the models

Advanced economies

Finally, we turn to the subgroup of advanced economies. As remittances to GDP ratios are very low in the advanced economies, the models are estimated without remittances. As can be seen from Table 4.9, de facto financial integration, as measured by total external liabilities to GDP (*Liab*), seems to have a significant positive impact on international risk sharing in all model specifications. This result is in line with the ones obtained by Kose et al. (2009), who found that (only) de facto measures of financial openness has a significant impact on risk sharing. The size of the coefficient is however very small, pointing to a very limited although statistically significant economic impact of financial openness on risk sharing. There is some evidence that financial reforms and capital account openness support risk sharing as well, but especially the results for *KaOpen* are not very robust to different model specifications.

In the advanced economies, the results imply that a lower share of low income households in the economy leads to higher international risk sharing as the interaction term including LIR is positive in all specifications and significant in columns (v) and (vi). Thus it seems like that also in the advanced economies does higher incomes and less hand-to-mouth consumers lead to more risk sharing internationally. Once this and financial openness is taken into account, the degree of risk sharing ranges between 65 % and 74 %. Nevertheless, the results in column (iii) implies that income inequality increases international risk sharing, as the estimated coefficient on the interaction term including *Gini* is negative. This raises questions on whether income inequality is a good proxy for the hand-to-mouth households in the economy.

4.5.3 Robustness

Next, some robustness checks of the results presented in the previous section are conducted. All the tables for the robustness tests can be found in Appendix 4C. First, the sample is reduced and ended in 2006 to avoid having the results driven by the 2007-2008 Financial Crisis. As can be seen from the results presented in Appendix 4C, Tables 4.16 and 4.17, the previous conclusions are largely unaffected by the change in the sample. This can also be seen as an indication that the difference in results between the models using $FinRef$ and *KaOpen* and *Liab* is not driven by the difference in sample length. Also, to confirm that the difference in results between the models that contain *Gini* and LIR are not mainly driven by the difference in the sample length (as the LIR series starts only in 1981), the models are estimated with LIR backwards interpolated to 1970. These results are not presented for the sake of space, but the same conclusions still hold.

One potential explanation to the negative and/or insignificant coefficients on the interaction terms for *Gini* and LIR for some of the subsamples is that inequality

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
$\Delta\tilde{y}$	0.716***	0.515***	0.570***	0.434*	0.257**	0.263***	0.515***	0.396***	0.287***
	(0.178)	(0.127)	(0.122)	(0.257)	(0.111)	(0.053)	(0.089)	(0.059)	(0.029)
$FinRef * \Delta\tilde{y}$	-0.272**			-0.207			-0.313**		
	(0.131)			(0.277)			(0.126)		
$KaOpen * \Delta\tilde{y}$		-0.103			-0.054			-0.188**	
		(0.094)			(0.113)			(0.077)	
$Liab * \Delta\tilde{y}$			-0.003***			-0.003***			-0.003***
			(0.001)			(0.001)			(0.001)
$Gini * \Delta\tilde{y}$	-0.770	-0.638	-1.008***						
	(0.588)	(0.419)	(0.373)						
$LIR * \Delta\tilde{y}$				11.39	19.04***	17.43***			
				(8.43)	(4.75)	(4.26)			
$FinRef$	0.001			0.005			-0.009		
	(0.015)			(0.014)			(0.011)		
$KaOpen$		0.015*			0.030***			0.012**	
		(0.008)			(0.012)			(0.006)	
$Liab$			0.000			-0.002*			0.000
			(0.001)			(0.001)			(0.001)
$Gini$	-0.117	-0.120*	0.012						
	(0.090)	(0.065)	(0.056)						
LIR				-1.083	-0.492	-0.469			
				(0.897)	(0.498)	(0.449)			
IRS	0.693***	0.751***	0.733***	0.651***	0.665***	0.646***	0.699***	0.743***	0.722***
	(0.035)	(0.029)	(0.029)	(0.050)	(0.036)	(0.038)	(0.036)	(0.028)	(0.028)
R^2	0.65	0.61	0.64	0.78	0.71	0.71	0.62	0.59	0.61
DW	1.72	1.82	1.77	1.97	1.88	1.91	1.66	1.80	1.79
N	25	28	30	21	24	25	25	28	30
Obs.	825	1,123	1,214	525	779	821	825	1,188	1,281
Years	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1973-2005	1970-2014	1970-2014

Note: Estimation of model (10) using CCEP, White standard errors are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}. As not all series are available for all countries or for the full sample period, the N and T between the different models vary.

Table 4.9: Consumption risk sharing CCEP estimates for the Advanced economies

and poverty are endogenously affected by financial liberalization or international consumption risk sharing. If international financial market participation takes place at the expense of the poorer individuals or if the gains from financial liberalization are concentrated mostly among the higher income individuals in the country, this could worsen poverty or inequality. However when lagged values of *Gini* and *LIR* are used for the interaction terms, presented in Tables 4.18 and 4.19, similar results are obtained, thus implying that the endogeneity concern is unfounded. The conclusion is also robust to using two or three year lags of the variables.

Third, the models are re-estimated with a sample split where Hong Kong, Singapore, Slovenia and Taiwan are classified as emerging market countries instead of advanced ones. Tables for the modified advanced country, developing country and emerging market sample are presented in Table 4.20. Generally, the previous conclusions remain and now income inequality also has a significantly negative impact on international consumption risk sharing in advanced economies in all three models where included. This thus reinforces the finding that hand to mouth consumers reduce risk sharing in advanced economies. The results are also robust to additional modifications and to the exclusion of China, but these are not reported for the sake of space.

Another concern is that I have not correctly identified the set of countries that pool their consumption risks together. I therefore estimate the degree of risk shared only between the countries within the different subsamples, presented in Table 4.21 and 4.22. The degree of risk shared only among the rich countries, the developing countries, the emerging market countries and finally the less developed countries does however not differ significantly from the amounts of risk shared with the rest of the world. OECD countries share between 37-48 % of their consumption risks between each other, and emerging market and advanced economies share roughly 31 % of their consumption risks together. Furthermore, Table 4.22 reveals that although the degree of risk shared between different geographical regions differs somewhat, the results are still in line with the results for the different country groups. Africa, with mostly less developed countries, share the least consumption risks among themselves (around 20 %), where the European countries are the ones to share most risks among themselves (around 50 %). The recent Euro crisis is a good example of how the negative output shocks were "shared" by the other EMU and European countries, and from the results can also be seen that the smaller group of EMU countries share more consumption risks among themselves than the more extended group of EU countries.

Finally, Ramsey's RESET test for model misspecification indicates that in with the exception of a few cases, the models used for all subsamples are correctly specified.

4.5.4 Discussion

My analysis shows that financial openness matters for international consumption risk sharing in the different subsamples. At the same time, the dimensions and the economic impact of financial liberalization and integration on risk sharing seems to vary significantly between the different country groups. Financial reforms and a wider range of financial sector policies have an influence on risk sharing in less developed countries, where the financial markets are generally more regulated and less developed. For emerging market economies, which are generally more financially open, the only financial market restriction that seems to matter is the degree of capital account openness. As total liabilities to GDP has a significant and economically meaningful impact on risk sharing in less developed countries but not in emerging market economies, this raises questions about the usefulness of de facto financial integration for consumption smoothing in developing countries. These results suggest that the benefits of financial reforms and liberalization for risk sharing in developing countries might be gradually receding with the level of financial development. Nevertheless, it could be that there is no significant (positive) relationship between financial integration and risk sharing in emerging markets due to the procyclicality of international capital flows, which was the explanation put forward by Kose et al. (2009). In advanced economies de facto financial integration seems to have the most robust and significant impact. However, as the capital accounts in most advanced economies are close to fully open and the additional financial restrictions are rather modest (the median score for capital account openness and financial reforms is as high as 0.94 and 0.77 respectively, where 1 is the maximum in both cases), it is not very surprising that the effects financial liberalization on international risk sharing are less relevant. Financial reforms seem to matter in countries with more closed financial systems, but when the financial market is already fairly open, the impact of further reforms or liberalization is not substantial.

Overall, a wider range of financial sector policies thus seem to impact risk sharing in less developing countries than in emerging markets. These findings are in contrast to the ones by Kose et al. (2011), who suggested that only once a country's financial sector and institutions are sufficiently developed, financial sector integration will have a significant impact on risk sharing. The earlier studies such as Flood et al. (2012), Kose et al. (2009) and Corcoran (2007) that concluded that financial integration has not enhanced risk sharing in developing countries mostly looked at the effect of financial openness as measured by total foreign assets, liabilities, portfolio equity and FDI to GDP, or compared risk sharing during time periods of higher and lower financial globalization. My results however indicate that financial liberalization, measured by capital account openness and financial reforms, are important for risk sharing also in developing countries, which might explain the difference in the conclusion compared to some earlier studies. Moreover, the global financial business cycle (as proxied by the unobserved component) does seem to have different short run effects on risk sharing in advanced and developing countries, which could also lead to different risk sharing outcomes and conclusions.

The impact on risk sharing of financial access, or hand-to-mouth consumers, if these can be approximated by low income population shares or income inequality, also show a variable pattern with regards to the level of development of the country. In less developed countries, where the level of income inequality and the fraction of low income individuals are high, risk sharing is lower as a large fraction of the population cannot afford to take part in it. The importance of these non-participants for risk sharing seems to vary with the degree of national income and level of development, as the effect is large and significant for the advanced and less developed countries, but not the emerging ones. It is nevertheless somewhat surprising that the effect of low income population ratios is negative but the impact of income inequality is positive in the advanced economies, which raises questions regarding the appropriateness of using income inequality as a proxy for hand-to-mouth consumers. Also, the appropriateness and cross-country comparability of the threshold adjusted headcount poverty rates (where the threshold was set at $100 in 2011 PPP per month) is not the optimal measure for low income population ratios. Low income population ratios using national poverty definitions would in this case be a more appropriate measure than the one currently used, but historical time series for this measure are not available for the majority of countries included in the study.

The effect of financial openness and domestic financial access thus seems to partly explain why risk sharing is lower in developing countries than in advanced ones. Nonetheless, the observation that risk sharing in emerging markets is not supported by financial reforms and lower than in less developed and less financially integrated countries raises some doubts whether financial liberalization, financial integration and lower inequality are sufficient for improving risk sharing. This furthermore has an impact on the potential welfare gains from financial reforms and deeper financial openness.

4.6 Conclusions

This paper provides an empirical examination of international consumption risk sharing and its determinants for a panel of 120 countries from 1970 to 2014. If one uses 1-$\hat{\beta}$ as a measure for international risk sharing, where $\hat{\beta}$ is the estimated coefficient on the deviation of domestic output growth from the global output growth rate, about 33 % of the consumption risks are shared internationally according to the basic risk sharing model. Advanced economies share on average between 44-72 % of their consumption risks internationally, whereas the same number for developing countries is much lower, only around 26-32 % for emerging markets and between 25-29 % for less developed countries.

Contrary to what has been reported in some previous studies, I show that financial liberalization, as measured either by an index of financial reforms, or financial integration as represented by total external liabilities to GDP, has a positive effect on international consumption risk sharing in less developed countries. In emerging markets, the impact of financial liberalization is smaller and only capital account openness is suggested to significantly enhance risk sharing. In advanced economies, financial reforms, capital account openness but in particular financial integration has a significant but small impact on risk sharing. Financial openness thus seems to matter for international consumption risk sharing. However, the importance and the dimensions of it seems to vary significantly between the different country groups. Moreover, I find evidence that part of the difference in risk sharing between the less developed countries and advanced economies can be attributed to a low domestic financial access through a high share of hand-to-mouth consumers, as approximated by either income inequality or the share of low income individuals. In emerging markets, this does however not seem to be the case. In line with the previous literature, I find some weak evidence that remittances from migrant workers provide consumption insurance in developing countries, but not so much so in emerging market countries. Foreign aid and official development assistance does however not facilitate consumption smoothing in any of the developing country groups.

Once financial openness, hand-to-mouth households and remittances are controlled for, the estimated international consumption risk sharing coefficient in less developed countries increases to 0.30-0.51. The corresponding estimate in emerging markets increases to around 0.33 once capital account openness is taken into consideration. Even though financial openness and inequality can explain a large part of the difference in risk sharing between developing and advanced economies, this explanation does not apply to emerging markets. The results are robust to a reduced sample size that excludes the 2007-2008 financial crisis, modifications of the country groups and further robustness checks.

According to my results, there are potential welfare gains in less developed countries from continuing financial liberalization, deepening financial integration and reductions in poverty and inequality through improved risk sharing. The result that financial reforms have a smaller impact on risk sharing in emerging markets however raises some questions whether the benefits of financial openness on risk sharing will gradually level off as the countries continue to develop and/or become more integrated into the global financial markets. Further research is thus needed to identify the factors that affect risk sharing in emerging market countries. It is also of importance to establish how and why the impact of financial sector reforms and inequality becomes smaller once the less developed countries progress.

Finally, despite the fact that the risk sharing relationship by construction corrects for *homogeneous* cross-sectional dependence, the international risk sharing relationship is still subject to *heterogeneous* cross-sectional dependence. If heterogeneous cross-sectional dependence is ignored, the basic risk sharing relationship in advanced economies is according to my calculations underestimated by almost 11 percentage points. According to my estimations, around a quarter of this common component which is allowed to have a heterogeneous impact on the different countries can be explained by global economic uncertainty and US monetary policy. In order to obtain unbiased estimators when studying international consumption risk sharing, cross-sectional dependence should hence be taken into account.

4.7 Appendix

Appendix 4A. Derivation of the IRS equation

The underlying theoretical framework of full consumption risk sharing can be derived from the Arrow-Debreu equilibrium as outlined in Mace (1991) and Krueger (2004): Consider a social planner's problem of maximizing utility over I countries with representative agents with state contingent utility functions $U_i(c_{it}(s^t), s^t)$, where $i = 1, \ldots, I$ is the country index, $c_{it}(s^t)$ is the consumption in country i at time t given the state of nature s^t. The state of nature affects both consumption as well as the utility function, for instance through a change of preferences. The social planner's objective is to maximize

$$\sum_i \sum_t \sum_{s^t} \alpha_i \beta^t \pi_t(s^t) U_i(c_{it}(s^t), s^t) \tag{4.12}$$

subject to the resource constraints

$$\sum_i c_{it}(s^t) \leq \sum_i y_{it}(s^t) \quad \forall\ s^t \tag{4.13}$$

where α^i is the social planner's weight on country i utility, β is the discount rate, $\pi_t(s^t)$ is the probability of state s^t occurring in time t and $y_{it}(s^t)$ is the output level of country i at time t in state s^t.

The first order condition for any country i is

$$\alpha_i \beta^t \pi_t(s^t) U_i^c(c_{it}(s^t), s^t) = \lambda_t(s^t) \tag{4.14}$$

where $U_i^c(.)$ denotes the derivative of $U_i(.)$ w.r.t. consumption and $\lambda_t(s^t)$ is the Lagrange multiplier on the resource constraint.

If we assume that preferences are of a Constant Relative Risk Aversion (CRRA) form and allow the utility function of the representative consumer to also feature a country and time specific preference shock $b_{it}(s^t)$, we can write the utility function as

$$U_i(c_{it}(s^t), s^t) = exp\ (b_{it}(s^t)) \frac{c_{it}(s^t)^{1-\sigma} - 1}{1-\sigma} \tag{4.15}$$

The first order condition for any country i at any time t can now be written as

$$\alpha_i \beta^t \pi_t(s^t) exp\ (b_{it}(s^t)) c_{it}(s^t)^{-\sigma} = \lambda_t(s^t) \tag{4.16}$$

Taking logs of equation (4.14) yields

$$\ln(c_{it}(s^t)) = \frac{1}{\sigma}\ln(\alpha_i) - \frac{1}{\sigma}\ln\left(\frac{\lambda_t(s^t)}{\beta^t \pi_t(s^t)}\right) + \frac{1}{\sigma} b_{it}(s^t) \tag{4.17}$$

In order to simplify the expression above, first note that the cross country average of (4.17) can be written as

$$\frac{1}{N}\sum_i \ln(c_{it}(s^t)) = \frac{1}{\sigma N}\sum_i b_{it}(s^t) + \frac{1}{\sigma N}\sum_i \ln(\alpha_i) - \frac{1}{\sigma}\ln\left(\frac{\lambda_t(s^t)}{\beta^t \pi_t(s^t)}\right) \tag{4.18}$$

This relationship in equation (4.18) can in turn be used to substitute out $\frac{1}{\sigma}\ln\big(\frac{\lambda_t(s^t)}{\beta^t \pi_t(s^t)}\big)$ from equation (4.17). Moreover, by denoting the population averages as[19] $\frac{1}{N}\sum_i b_{it}(s^t) = B_t(s^t)$, $\frac{1}{N}\sum_i \ln(c_{it}(s^t)) = \ln(C_t(s^t))$ and $\frac{1}{N}\sum_i \ln(\alpha_i) = \ln(\alpha)$ equation (4.17) can be rewritten as

$$\ln(c_{it}(s^t)) = \frac{1}{\sigma}\big(b_{it}(s^t) - B_t(s^t)\big) + \frac{1}{\sigma}\big(\ln(\alpha_i) - \ln(\alpha)\big) + \ln(C_t(s^t)) \tag{4.19}$$

When taking first differences of equation (4.19) the term $\frac{1}{\sigma}\big(\ln(\alpha_i) - \ln(\alpha)\big)$ disappears. By suppressing the dependence on s^t and denoting $\Delta\ln(c_{it}) = \ln(c_{it}(s^t)) - \ln(c_{it-1}(s^{t-1}))$, the equation can be written as the full risk sharing condition for the preferences specified above

$$\Delta\ln(c_{it}) = \Delta\ln(C_t) + \frac{1}{\sigma}\big(\Delta b_{it} - \Delta B_t\big) \tag{4.20}$$

[19] This derivation involves some abuse of notation, as the last two expressions are sums of logs instead of logs of sums.

Appendix 4B. Data

	$\Delta\tilde{c}$	$\Delta\tilde{y}$	*Finref*	*Kaopen*	*Liab*	*Gini*	*Assets*	*LIC*	*Remit*	*ODA*
Full sample										
Mean	0.003	0.004	0.511	0.474	1.643	0.368	1.348	0.291	-	-
Median	0.006	0.006	0.524	0.415	0.698	0.356	0.306	0.153	-	-
Std. Dev	0.066	0.072	0.301	0.363	7.322	0.098	7.436	0.316	-	-
Obs.	4,625	4,625	2,394	4,242	4,316	4,333	4,303	3,601	-	-
Countries	120	120	86	115	118	120	118	115	-	-
Start	1970	1970	1973	1970	1970	1970	1970	1981	1970	1970
End	2014	2014	2005	2014	2014	2014	2014	2014	2014	2014
Advanced Economies										
Mean	0.005	0.004	0.682	0.738	3.484	0.291	3.449	0.006	-	-
Median	0.005	0.003	0.774	1.000	0.949	0.286	0.843	0.004	-	-
Std. Dev	0.032	0.046	0.270	0.320	13.025	0.048	13.067	0.006	-	-
Obs.	1,323	1,323	825	1,194	1,284	1,259	1,284	843	-	-
Countries	30	30	25	28	30	30	30	25	-	-
Developing Countries										
Mean	0.003	0.003	0.422	0.371	0.863	0.400	0.455	0.378	0.045	0.050
Median	0.006	0.007	0.429	0.166	0.654	0.403	0.241	0.306	0.015	0.023
Std. Dev	0.076	0.080	0.278	0.325	1.570	0.095	1.889	0.313	0.092	0.065
Obs.	3,302	3,302	1,569	3,048	3,032	3,074	3,019	2,758	2,436	2,721
Countries	90	90	61	87	88	90	88	90	89	78
Less Developed Countries										
Mean	-0.003	-0.003	0.375	0.312	0.895	0.407	0.442	0.520	0.061	0.075
Median	0.001	0.000	0.333	0.166	0.635	0.405	0.203	0.549	0.022	0.055
Std. Dev	0.083	0.085	0.253	0.282	2.052	0.092	2.540	0.299	0.118	0.070
Obs.	1,703	1,703	665	1,551	1,606	1,468	1,599	1,427	1,234	1,521
Countries	49	49	27	47	49	49	49	49	48	47
Emerging Markets										
Mean	0.009	0.010	0.456	0.431	0.827	0.395	0.470	0.226	0.030	0.019
Median	0.012	0.012	0.476	0.415	0.666	0.401	0.316	0.129	0.012	0.006
Std. Dev	0.067	0.074	0.290	0.353	0.706	0.097	0.568	0.251	0.048	0.039
Obs.	1,599	1,599	904	1,497	1,426	1,606	1,420	1,331	1,202	1,200
Countries	41	41	34	40	39	41	39	41	41	31

Note: $\Delta\tilde{c}$ and $\Delta\tilde{y}$ are the deviation of log consumption and output growth from their global averages. *Finref* is a Financial Reform index, *KaOpen* is a capital account openness index, *Liab* and *Assets* represent total external liabilities and assets to GDP, *Gini* is Gini income inequality (divided by 100), *LIR* is a low income ratio (population share living on less than $100/month in 2011 PPP), *Remit* is received personal remittances to GDP and *ODA* is net official development assistance and official aid received per GDP.

Table 4.10: Data

	Δc	Δy	***FinRef***	***KaOpen***	***Liab***	***Assets***	***Gini***	***LIR***	***Remit***
Δc	1								
Δy	0.581	1.000							
FinRef	0.067	0.064	1.000						
KaOpen	0.007	0.005	0.682	1.000					
Liab	-0.020	-0.009	0.432	0.303	1.000				
Assets	-0.024	-0.013	0.425	0.282	0.994	1.000			
Gini	0.049	0.049	-0.276	-0.290	-0.118	-0.112	1.000		
LIR	0.024	0.035	-0.569	-0.511	-0.132	-0.118	0.475	1.000	
Remit	0.065	0.078	-0.059	-0.087	-0.025	-0.017	0.146	0.154	1.000
ODA	-0.032	-0.047	-0.090	-0.174	-0.070	0.018	-0.037	0.479	0.149

Table 4.11: Correlation Matrix for the full sample

List of countries

Advanced economies (30):

Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom and United States.

Developing countries (90):

Of which Emerging Market countries (41):

Argentina, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Egypt, Estonia, Hungary, India, Indonesia, Jordan, Kazakhstan, Latvia, Lithuania, Macedonia, Malaysia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Poland, Romania, Russia, Serbia, Slovakia, South Africa, South Korea, Thailand, Tunisia, Turkey, Uruguay, Venezuela and Vietnam.

Less developed countries (49):

Albania, Armenia, Azerbaijan, Bangladesh, Belarus, Bhutan, Bolivia, Burkina Faso, Cambodia, Cameroon, Dominican Republic, Ecuador, El Salvador, Ethiopia, Fiji, Georgia, Ghana, Guatemala, Guinea, Honduras, Jamaica, Kenya, Kyrgyzstan, Laos, Lesotho, Madagascar, Malawi, Mauritius, Moldova, Mongolia, Montenegro, Mozambique, Namibia, Nepal, Niger, Nigeria, Paraguay, Rwanda, Senegal, Sri Lanka, Suriname, Swaziland, Syria, Tajikistan, Tanzania, Uganda, Ukraine, Uzbekistan and Zambia.

Appendix 4C. Additional results

	Full sample					Developing countries						Advanced economies				
	(i)	(ii)	(iii)	(iv)	(v)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(iv)
$\Delta\tilde{y}$	0.790***	0.791***	0.672***	0.261***	0.560***	0.778***	0.793***	0.763***	0.722***	0.492***	0.584***	0.515***	0.396***	0.287***	0.434***	0.224***
	(0.036)	(0.035)	(0.028)	(0.074)	(0.030)	(0.041)	(0.035)	(0.036)	(0.041)	(0.116)	(0.038)	(0.089)	(0.059)	(0.029)	(0.115)	(0.044)
$FinRef * \Delta\tilde{y}$	-0.350***					-0.245***						-0.313**				
	(0.071)					(0.094)						(0.126)				
$KaOpen * \Delta\tilde{y}$		-0.335***					-0.243***						-0.188**			
		(0.059)					(0.088)						(0.077)			
$Liab * \Delta\tilde{y}$			-0.006***					-0.055**						-0.003***		
			(0.001)					(0.027)						(0.001)		
$Remit * \Delta\tilde{y}$									-0.005**							
									(0.002)							
$Gini * \Delta\tilde{y}$				1.009***						0.571**					-0.659*	
				(0.199)						(0.267)					(0.372)	
$LIR * \Delta\tilde{y}$					0.303***						0.264***					22.255***
					(0.071)						(0.080)					(4.105)
$FinRef$	0.031***					0.046***						-0.009				
	(0.008)					(0.013)						(0.011)				
$KaOpen$		0.005					0.009*						0.012**			
		(0.004)					(0.005)						(0.006)			
$Liab$			-0.001*					-0.001						0.000		
			(0.000)					(0.001)						(0.001)		
$Remit$									0.000							
									(0.000)							
$Gini$				-0.020						-0.004					0.037	
				(0.022)						(0.027)					(0.054)	
LIR					-0.060***						-0.066***					-0.220
					(0.014)						(0.015)					(0.418)
IRS	0.390***	0.371***	0.338***	0.357***	0.346***	0.325***	0.299***	0.283***	0.298***	0.268***	0.307***	0.699***	0.743***	0.722***	0.758***	0.642***
	(0.025)	(0.028)	(0.028)	(0.029)	(0.021)	(0.031)	(0.032)	(0.025)	(0.038)	(0.033)	(0.024)	(0.036)	(0.028)	(0.028)	(0.026)	(0.033)
R^2	0.71	0.65	0.64	0.66	0.69	0.74	0.68	0.68	0.68	0.70	0.71	0.62	0.59	0.61	0.59	0.657
DW	1.95	1.97	2.09	2.05	2.11	2.03	2.01	2.17	2.19	2.13	2.21	1.66	1.80	1.79	1.70	1.75
N	86	114	118	120	115	61	86	88	89	90	90	25	28	30	30	25
Years	1973-2005	1970-2014	1970-2014	1970-2014	1981-2014	1973-2005	1970-2014	1970-2014	1970-2014	1970-2014	1981-2014	1973-2005	1970-2014	1970-2014	1970-2014	1981-2014

Note: White standard errors in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1-\hat{\beta}-\hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ is the cross-sectional and time average of x_{it}.

Table 4.12: One-by-One: Consumption risk sharing estimates for the full sample, Developing countries and Advanced economies

	Less developed countries						Emerging Market economies					
	(i)	(ii)	(iii)	(iv)	(v)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	
$\Delta\tilde{y}$	0.854***	0.778***	0.790***	0.712***	0.469***	0.453***	0.739***	0.809***	0.638***	0.681***	0.668***	0.682***
	(0.052)	(0.045)	(0.043)	(0.054)	(0.172)	(0.065)	(0.054)	(0.036)	(0.059)	(0.031)	(0.138)	(0.036)
$FinRef * \Delta\tilde{y}$	-0.652***						-0.091					
	(0.187)						(0.098)					
$KaOpen * \Delta\tilde{y}$		-0.223						-0.310***				
		(0.145)						(0.076)				
$Liab * \Delta\tilde{y}$			-0.093***						0.038			
			(0.035)						(0.050)			
$Remit * \Delta\tilde{y}$				-0.006**						0.002		
				(0.002)						(0.005)		
$Gini * \Delta\tilde{y}$					0.663						0.032	
					(0.405)						(0.319)	
$LIR * \Delta\tilde{y}$						0.395***						0.036
						(0.102)						(0.091)
$FinRef$	0.052**						0.025*					
	(0.025)						(0.014)					
$KaOpen$		0.014*						0.003				
		(0.008)						(0.006)				
$Liab$			-0.001						-0.002			
			(0.001)						(0.003)			
$Remit$				-0.001						0.000		
				(0.001)						(0.001)		
$Gini$					0.022						-0.009	
					(0.042)						(0.035)	
LIR						-0.062***						-0.087***
						(0.018)						(0.022)
IRS	0.396***	0.293***	0.288***	0.321***	0.248***	0.333***	0.302***	0.328***	0.331***	0.313***	0.319***	0.309***
	(0.048)	(0.040)	(0.033)	(0.048)	(0.039)	(0.033)	(0.034)	(0.034)	(0.031)	(0.026)	(0.035)	(0.025)
R^2	0.78	0.68	0.67	0.67	0.70	0.70	0.74	0.72	0.71	0.74	0.70	0.77
DW	2.05	2.06	2.23	2.22	2.20	2.26	1.92	1.92	1.89	1.97	1.91	1.88
N	27	46	49	48	49	49	34	40	39	41	41	41
Obs.	639	1,494	1,581	1,245	1,332	1,315	845	1,357	1,299	1,145	1,375	1,105
Years	1973-2005	1970-2014	1970-2014	1970-2014	1970-2014	1981-2014	1973-2005	1970-2014	1970-2014	1970-2014	1970-2014	1981-2014

Note: White standard errors in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1-\hat{\beta}-\hat{\mu}\bar{\bar{x}}$.

Table 4.13: One-by-One: Consumption risk sharing estimates for the Less Developed countries and Emerging Market economies

	Full sample						Developing countries						Advanced economies					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)
$\Delta\tilde{y}$	0.774***	0.485***	0.315***	1.014***	0.633***	0.603***	1.251***	0.651***	0.697***	0.927***	0.637***	0.673***	0.945***	0.729***	0.814***	0.537*	0.322**	0.337***
	(0.148)	(0.099)	(0.080)	(0.077)	(0.053)	(0.031)	(0.243)	(0.165)	(0.137)	(0.109)	(0.060)	(0.048)	(0.235)	(0.179)	(0.174)	(0.319)	(0.139)	(0.068)
$FinRef * \Delta\tilde{y}$	-0.233***			-0.320***			-0.219***			-0.189**			-0.275**			-0.207		
	(0.049)			(0.065)			(0.071)			(0.091)			(0.132)			(0.277)		
$KaOpen * \Delta\tilde{y}$		-0.196***			-0.040			-0.123***			-0.044			-0.120			-0.055	
		(0.036)			(0.037)			(0.043)			(0.046)			(0.111)			(0.116)	
$Liab * \Delta\tilde{y}$			-0.060***			-0.055***			-0.116***			-0.075*			-0.087***			-0.138***
			(0.013)			(0.010)			(0.042)			(0.042)			(0.028)			(0.045)
$Remit * \Delta\tilde{y}$							-0.084**	-0.069***	-0.031	-0.112**	-0.056*	-0.034						
							(0.037)	(0.024)	(0.026)	(0.056)	(0.030)	(0.024)						
$Gini * \Delta\tilde{y}$	0.122	0.396***	0.389***				-0.315	0.237	0.107				-0.318	-0.291	-0.457***			
	(0.135)	(0.093)	(0.085)				(0.222)	(0.157)	(0.129)				(0.243)	(0.191)	(0.169)			
$LIR * \Delta\tilde{y}$				-0.005	0.181***	0.165***				-0.036	0.161***	0.089*				0.121	0.213***	0.190***
				(0.042)	(0.043)	(0.039)				(0.057)	(0.058)	(0.049)				(0.090)	(0.053)	(0.046)
$FinRef$	0.360***			0.303***			0.281***			0.136			0.008			0.036		
	(0.066)			(0.062)			(0.098)			(0.103)			(0.134)			(0.111)		
$KaOpen$		0.061**			0.032			0.047			0.011			0.146*			0.286***	
		(0.028)			(0.043)			(0.043)			(0.048)			(0.081)			(0.110)	
$Liab$			-0.140**			-0.175***			-0.156*			-0.285***			-0.222			-0.838*
			(0.070)			(0.066)			(0.083)			(0.092)			(0.355)			(0.428)
$Remit$							0.064	0.027	-0.087	0.064	-0.050	-0.077						
							(0.116)	(0.086)	(0.073)	(0.139)	(0.124)	(0.115)						
$Gini$	-0.118	-0.031	-0.016				0.021	0.066	-0.049				-0.186	-0.198*	0.019			
	(0.096)	(0.050)	(0.043)				(0.138)	(0.062)	(0.058)				(0.143)	(0.107)	(0.089)			
LIR				-0.820***	-0.340***	-0.416***				-0.521**	-0.401***	-0.355***				-0.214	-0.095	-0.090
				(0.238)	(0.114)	(0.082)				(0.237)	(0.122)	(0.115)				(0.177)	(0.096)	(0.086)
IRS	0.400***	0.378***	0.361***	0.387***	0.349***	0.339***	0.342***	0.283***	0.297***	0.391***	0.352***	0.347***	0.693***	0.751***	0.733***	0.651***	0.665***	0.646***
	(0.024)	(0.028)	(0.026)	(0.033)	(0.023)	(0.021)	(0.033)	(0.041)	(0.030)	(0.038)	(0.029)	(0.025)	(0.035)	(0.029)	(0.029)	(0.050)	(0.036)	(0.038)
R^2	0.73	0.72	0.70	0.80	0.75	0.73	0.80	0.78	0.79	0.81	0.80	0.80	0.65	0.61	0.64	0.78	0.71	0.709
DW	2.04	2.05	2.10	2.20	2.13	2.14	2.42	2.21	2.37	2.44	2.23	2.29	1.72	1.82	1.77	1.97	1.88	1.91
N	83	114	118	79	110	113	44	82	82	44	83	83	25	28	30	21	24	25
Obs.	2,226	3,739	3,825	1,696	3,072	3,140	1,057	2,131	2,102	949	2,045	2,041	825	1,123	1,214	525	779	821
Years	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014

Note: White SE in parentheses, ***, ** and * denote significance at 1%, 5% and 10 % levels. The dependent and independent variables are normalized to have a mean of zero and a standard deviation of 1.

Table 4.14: Normalized consumption risk sharing estimates for the full sample, Developing countries and Advanced economies

	Less developed countries						Emerging Market economies					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)
$\Delta\tilde{y}$	1.457***	0.248	0.416**	0.466**	0.396***	0.470***	0.591**	0.922***	0.861***	1.046***	0.852***	0.747***
	(0.251)	(0.238)	(0.207)	(0.182)	(0.085)	(0.074)	(0.253)	(0.205)	(0.178)	(0.112)	(0.065)	(0.070)
$FinRef * \Delta\tilde{y}$	-0.383***			-0.303**			-0.189***			-0.252***		
	(0.123)			(0.136)			(0.074)			(0.092)		
$KaOpen * \Delta\tilde{y}$		-0.109			-0.043			-0.110**			-0.092*	
		(0.086)			(0.069)			(0.056)			(0.055)	
$Liab * \Delta\tilde{y}$			-0.181**			-0.136**			0.026			-0.015
			(0.075)			(0.054)			(0.056)			(0.063)
$Remit * \Delta\tilde{y}$	-0.078	-0.091**	-0.065	0.241	-0.038	0.002	-0.010	-0.001	0.004	-0.079	-0.054	-0.032
	(0.080)	(0.042)	(0.040)	(0.160)	(0.030)	(0.031)	(0.047)	(0.036)	(0.039)	(0.049)	(0.034)	(0.035)
$Gini * \Delta\tilde{y}$	-0.542**	0.604**	0.388**				0.362	-0.096	-0.140			
	(0.243)	(0.237)	(0.194)				(0.223)	(0.178)	(0.167)			
$LIR * \Delta\tilde{y}$				0.364**	0.356***	0.258***				-0.035	-0.034	-0.026
				(0.154)	(0.083)	(0.071)				(0.052)	(0.040)	(0.041)
$FinRef$	0.196			0.260			0.151			0.027		
	(0.121)			(0.164)			(0.102)			(0.098)		
$KaOpen$		0.075			0.014			0.026			-0.041	
		(0.056)			(0.056)			(0.069)			(0.076)	
$Liab$			-0.203			-0.427***			0.020			-0.179
			(0.168)			(0.154)			(0.095)			(0.111)
$Remit$	-0.345**	0.082	0.116	-0.423***	-0.006	-0.058	0.132	0.089	0.103	0.198	0.169	0.196
	(0.172)	(0.119)	(0.118)	(0.152)	(0.133)	(0.119)	(0.146)	(0.097)	(0.109)	(0.184)	(0.113)	(0.124)
$Gini$	-0.123	0.047	-0.020				0.118	-0.164	-0.153*			
	(0.155)	(0.094)	(0.080)				(0.158)	(0.103)	(0.086)			
LIR				-0.412*	-0.128	-0.185*				-0.824***	-0.575***	-0.404***
				(0.218)	(0.121)	(0.110)				(0.220)	(0.148)	(0.142)
IRS	0.507***	0.300***	0.347***	0.447***	0.404***	0.426***	0.267***	0.318***	0.310***	0.310***	0.335***	0.355***
	(0.049)	(0.059)	(0.050)	(0.059)	(0.040)	(0.032)	(0.029)	(0.028)	(0.026)	(0.032)	(0.028)	(0.029)
R^2	0.81	0.78	0.81	0.79	0.81	0.80	0.85	0.80	0.80	0.88	0.82	0.823
DW	2.32	2.28	2.38	2.21	2.19	2.40	2.33	2.14	2.21	2.43	2.17	2.21
N	20	42	44	20	43	45	24	40	38	24	40	38
Obs.	437	1,012	1,047	416	1,030	1,086	620	1,119	1,055	533	1,015	955
Years	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014	1973-2005	1970-2014	1970-2014	1981-2005	1981-2014	1981-2014

Note: White SE in brackets, ***, ** and * denote significance at 1%, 5% and 10 % levels. The dependent and independent variables are normalized to have a mean of zero and a s.d. of 1.

Table 4.15: Normalized consumption risk sharing estimates for the Less Developed countries and Emerging Market economies

	All countries				Developing countries				Advanced economies			
	(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)
$\Delta\tilde{y}$	0.632***	0.414***	0.656***	0.603***	0.793***	0.847***	0.620***	0.654***	0.735***	0.654***	0.335***	0.259***
	(0.098)	(0.088)	(0.052)	(0.040)	(0.142)	(0.161)	(0.067)	(0.069)	(0.173)	(0.166)	(0.110)	(0.067)
$KaOpen * \Delta\tilde{y}$	-0.472***		-0.169**		-0.426***		-0.250*		-0.100		-0.107	
	(0.073)		(0.083)		(0.108)		(0.145)		(0.099)		(0.126)	
$Liab * \Delta\tilde{y}$		-0.007**		-0.004**		-0.130**		-0.095		-0.003*		0.000
		(0.003)		(0.002)		(0.060)		(0.063)		(0.002)		(0.002)
$Remit * \Delta\tilde{y}$					-0.006***	-0.001	-0.006	-0.003				
					(0.002)	(0.003)	(0.004)	(0.003)				
$Gini * \Delta\tilde{y}$	0.568***	0.660***			0.258	-0.100			-1.287**	-1.252**		
	(0.218)	(0.210)			(0.318)	(0.332)			(0.567)	(0.537)		
$LIR * \Delta\tilde{y}$			0.222***	0.241***			0.349***	0.213**			14.689**	19.111***
			(0.068)	(0.068)			(0.122)	(0.102)			(6.285)	(6.078)
$KaOpen$	0.017***		0.016*		0.014		0.018		0.015*		0.018*	
	(0.005)		(0.008)		(0.010)		(0.012)		(0.009)		(0.009)	
$Liab$		-0.003		-0.008**		-0.020**		-0.027**		-0.001		0.001
		(0.002)		(0.004)		(0.008)		(0.011)		(0.002)		(0.002)
$Remit$					0.000	-0.001	0.000	0.001				
					(0.001)	(0.001)	(0.001)	(0.001)				
$Gini$	-0.010	-0.034			0.055	-0.035			-0.213***	0.018		
	(0.033)	(0.027)			(0.051)	(0.054)			(0.078)	(0.063)		
LIR			-0.083***	-0.093***			-0.141***	-0.128***			-1.966*	-0.080
			(0.030)	(0.022)			(0.041)	(0.035)			(1.061)	(0.787)
IRS	0.372***	0.341***	0.348***	0.321***	0.273***	0.300***	0.343***	0.339***	0.709***	0.714***	0.649***	0.622***
	(0.028)	(0.028)	(0.027)	(0.026)	(0.038)	(0.037)	(0.038)	(0.029)	(0.033)	(0.034)	(0.053)	(0.049)
R^2	0.73	0.71	0.78	0.76	0.80	0.80	0.81	0.81	0.63	0.65	0.75	0.756
DW	2.14	2.08	2.26	2.23	2.40	2.40	2.33	2.37	1.85	1.77	2.08	2.06
N	107	108	105	106	70	69	71	70	28	30	24	25
Obs.	2,894	2,936	2,244	2,282	1,487	1,453	1,377	1,367	902	977	594	628
Years	1970-2006	1970-2006	1981-2006	1981-2006	1970-2006	1970-2006	1981-2006	1981-2006	1970-2006	1970-2006	1981-2006	1981-2006

Note: White SE in parentheses, symbols ***, ** and * denote significance at 1%, 5% and 10 % levels. IRS=$1-\hat{\beta}-\hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ is the cross-sectional and time average of x_{it}.

Table 4.16: Sample excluding the Financial crisis from 2006 onwards for all countries, Developing countries and Advanced economies

	Less developed countries				Emerging Market economies			
	(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)
$\Delta\tilde{y}$	0.919***	0.979***	0.315***	0.413***	0.741***	0.839***	0.876***	0.809***
	(0.275)	(0.211)	(0.097)	(0.111)	(0.242)	(0.267)	(0.075)	(0.080)
$KaOpen * \Delta\tilde{y}$	-0.631**		-0.296		-0.329***		-0.305**	
	(0.279)		(0.214)		(0.127)		(0.131)	
$Liab * \Delta\tilde{y}$		-0.442***		-0.230***		0.028		-0.027
		(0.094)		(0.066)		(0.051)		(0.057)
$Remit * \Delta\tilde{y}$	-0.003	-0.002	-0.003	0.000	-0.007	-0.001	-0.019**	-0.010
	(0.004)	(0.003)	(0.003)	(0.004)	(0.006)	(0.007)	(0.008)	(0.007)
$Gini * \Delta\tilde{y}$	0.103	0.064			0.238	-0.335		
	(0.639)	(0.494)			(0.508)	(0.582)		
$LIR * \Delta\tilde{y}$			0.687***	0.626***			-0.128	-0.325**
			(0.143)	(0.125)			(0.130)	(0.127)
$KaOpen$	0.011		0.012		0.025*		0.018	
	(0.015)		(0.015)		(0.013)		(0.016)	
$Liab$		-0.047***		-0.043***		0.000		-0.022*
		(0.011)		(0.010)		(0.008)		(0.011)
$Remit$	-0.001	0.000	0.001	-0.002	0.001	0.002*	0.002	0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
$Gini$	0.049	0.015			0.013	-0.072		
	(0.093)	(0.073)			(0.077)	(0.062)		
LIR			-0.110**	-0.043			-0.131***	-0.112**
			(0.048)	(0.038)			(0.044)	(0.046)
IRS	0.260***	0.342***	0.419***	0.422***	0.306***	0.283***	0.341***	0.340***
	(0.084)	(0.048)	(0.043)	(0.032)	(0.032)	(0.035)	(0.036)	(0.038)
R^2	0.80	0.82	0.84	0.83	0.82	0.82	0.85	0.851
DW	2.28	2.39	2.17	2.23	2.29	2.24	2.39	2.29
N	36	37	37	38	34	32	34	32
Obs.	703	720	697	733	784	733	680	634
Years	1970-2006	1970-2006	1981-2006	1981-2006	1970-2006	1970-2006	1981-2006	1981-2006

Note: White SE in brackets. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ is the cross-sectional and time average of x_{it}.

Table 4.17: Sample excluding the financial crisis from 2006 onwards for the Less Developed and Emerging Market sample

	Full sample						Developing countries						Advanced economies					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)
$\Delta\tilde{y}$	0.698***	0.536***	0.348***	0.887***	0.599***	0.571***	1.137***	0.690***	0.782***	0.794***	0.599***	0.651***	0.712***	0.500***	0.573***	0.317	0.225*	0.258***
	(0.136)	(0.093)	(0.076)	(0.072)	(0.050)	(0.032)	(0.221)	(0.139)	(0.129)	(0.132)	(0.061)	(0.048)	(0.179)	(0.127)	(0.125)	(0.283)	(0.117)	(0.052)
$FinRef * \Delta\tilde{y}$	-0.352***			-0.443***			-0.358***			-0.239			-0.275**			-0.086		
	(0.083)			(0.101)			(0.124)			(0.175)			(0.130)			(0.301)		
$KaOpen * \Delta\tilde{y}$		-0.373***			-0.099			-0.229***			-0.138			-0.117			0.014	
		(0.064)			(0.070)			(0.085)			(0.093)			(0.094)			(0.122)	
$Liab * \Delta\tilde{y}$			-0.006***			-0.004***			-0.079**			-0.065**			-0.002***			-0.002**
			(0.001)			(0.001)			(0.033)			(0.032)			(0.001)			(0.001)
$Remit * \Delta\tilde{y}$							-0.011**	-0.007***	-0.006*	-0.013	-0.007**	-0.005*						
							(0.005)	(0.003)	(0.003)	(0.009)	(0.003)	(0.003)						
$Gini_{-1} * \Delta\tilde{y}$	0.207	0.722***	0.819***				-0.707	0.352	0.020				-0.774	-0.564	-1.026***			
	(0.305)	(0.214)	(0.205)				(0.469)	(0.311)	(0.289)				(0.595)	(0.416)	(0.385)			
$LIR_{-1} * \Delta\tilde{y}$				0.012	0.295***	0.289***				-0.016	0.296***	0.171**				14.017	16.791***	16.303***
				(0.078)	(0.074)	(0.073)				(0.147)	(0.098)	(0.084)				(8.565)	(5.072)	(3.953)
$FinRef$	0.056***			0.056***			0.060***			0.026			0.009			-0.020		
	(0.011)			(0.011)			(0.018)			(0.023)			(0.014)			(0.015)		
$KaOpen$		0.009**			0.011			0.013*			0.010			0.015*			0.026**	
		(0.004)			(0.007)			(0.008)			(0.009)			(0.008)			(0.012)	
$Liab$			-0.001			-0.001*			-0.003			-0.011***			-0.001			-0.003*
			(0.001)			(0.001)			(0.003)			(0.003)			(0.001)			(0.001)
$Remit$							0.001	0.000	-0.001	0.000	0.001	0.000						
							(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)						
$Gini_{-1}$	-0.010	-0.016	-0.008				0.011	0.017	-0.025				-0.117	-0.120*	0.029			
	(0.049)	(0.029)	(0.026)				(0.083)	(0.039)	(0.041)				(0.087)	(0.066)	(0.054)			
LIR_{-1}				0.035	0.024	-0.009				0.067*	0.024	0.037*				-0.223	-0.187	-0.052
				(0.028)	(0.022)	(0.015)				(0.036)	(0.022)	(0.022)				(1.023)	(0.501)	(0.468)
IRS	0.409***	0.376***	0.351***	0.369***	0.359***	0.346***	0.359***	0.287***	0.306***	0.370***	0.372***	0.363***	0.700***	0.755***	0.735***	0.657***	0.657***	0.653***
	(0.025)	(0.028)	(0.028)	(0.035)	(0.023)	(0.022)	(0.032)	(0.043)	(0.029)	(0.041)	(0.029)	(0.026)	(0.036)	(0.030)	(0.029)	(0.053)	(0.040)	(0.038)
R^2	0.73	0.71	0.70	0.80	0.74	0.72	0.82	0.78	0.79	0.81	0.80	0.79	0.65	0.61	0.64	0.77	0.70	0.708
DW	2.04	2.05	2.06	2.21	2.11	2.13	2.43	2.23	2.37	2.45	2.21	2.33	1.72	1.83	1.78	1.87	1.87	1.92
N	83	114	118	79	110	113	44	82	82	44	85	85	25	28	30	21	24	25
Obs.	2,218	3,744	3,826	1,635	3,047	3,113	1,050	2,147	2,116	920	2,064	2,060	825	1,121	1,212	504	764	805
Years	1973-2005	1970-2014	1970-2014	1982-2005	1982-2014	1982-2014	1973-2005	1970-2014	1970-2014	1982-2005	1982-2014	1982-2014	1973-2005	1970-2014	1970-2014	1982-2005	1982-2014	1982-2014

Note: White SE in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels. IRS=$1-\hat{\beta}-\hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ is the cross-sectional and time average of x_{it}.

Table 4.18: Consumption risk sharing estimates using lagged values for *Gini* and *LIR* for the full, Developing and Advanced economy sample

	Less developed countries						Emerging Market economies					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)
$\Delta\tilde{y}$	1.312***	0.306	0.428**	0.207	0.306***	0.408***	0.692***	0.861***	0.830***	1.008***	0.807***	0.681***
	(0.265)	(0.198)	(0.180)	(0.165)	(0.095)	(0.076)	(0.230)	(0.182)	(0.163)	(0.125)	(0.064)	(0.068)
$FinRef * \Delta\tilde{y}$	-0.770**			-0.496**			-0.281**			-0.452***		
	(0.302)			(0.221)			(0.118)			(0.147)		
$KaOpen * \Delta\tilde{y}$		-0.249			-0.136			-0.199**			-0.271***	
		(0.185)			(0.159)			(0.091)			(0.089)	
$Liab * \Delta\tilde{y}$			-0.137**			-0.118***			0.016			0.000
			(0.054)			(0.040)			(0.044)			(0.051)
$Remit * \Delta\tilde{y}$	-0.015	-0.009**	-0.010**	0.036**	-0.004	-0.002	-0.003	0.000	0.000	-0.009	-0.005	-0.001
	(0.015)	(0.004)	(0.004)	(0.017)	(0.003)	(0.003)	(0.006)	(0.005)	(0.006)	(0.009)	(0.006)	(0.006)
$Gini_{-1} * \Delta\tilde{y}$	-1.044*	1.182**	0.897**				0.412	-0.234	-0.375			
	(0.559)	(0.461)	(0.402)				(0.472)	(0.378)	(0.363)			
$LIR_{-1} * \Delta\tilde{y}$				0.771***	0.650***	0.486***				-0.112	-0.053	-0.128
				(0.228)	(0.127)	(0.109)				(0.139)	(0.106)	(0.115)
$FinRef$	0.036			0.057			0.030*			0.024		
	(0.028)			(0.038)			(0.018)			(0.019)		
$KaOpen$		0.019			-0.001			0.003			0.002	
		(0.012)			(0.013)			(0.009)			(0.011)	
$Liab$			-0.003			-0.015***			0.003			-0.012
			(0.003)			(0.005)			(0.007)			(0.009)
$Remit$	-0.005*	0.001	-0.001	-0.005***	0.001	0.000	0.002	0.001	0.001	0.002	0.002	0.002
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$Gini_{-1}$	-0.098	-0.018	-0.021				0.062	-0.094*	-0.093*			
	(0.105)	(0.055)	(0.060)				(0.101)	(0.054)	(0.052)			
LIR_{-1}				-0.054	0.026	0.032				-0.034	-0.027	0.009
				(0.040)	(0.031)	(0.031)				(0.041)	(0.028)	(0.026)
IRS	0.528***	0.327***	0.368***	0.472***	0.434***	0.463***	0.269***	0.325***	0.310***	0.289***	0.351***	0.355***
	(0.055)	(0.056)	(0.043)	(0.052)	(0.038)	(0.032)	(0.030)	(0.028)	(0.026)	(0.031)	(0.029)	(0.030)
R^2	0.81	0.78	0.81	0.80	0.81	0.81	0.85	0.80	0.81	0.88	0.82	0.824
DW	2.25	2.34	2.41	2.18	2.19	2.30	2.32	2.15	2.22	2.40	2.29	2.262
N	20	42	44	20	45	47	24	40	38	24	40	38
Obs.	430	1,022	1,056	403	1,054	1,111	620	1,125	1,060	517	1,010	949
Years	1973-2005	1970-2014	1970-2014	1982-2005	1982-2014	1982-2014	1973-2005	1970-2014	1970-2014	1982-2005	1982-2014	1982-2014

Note: White SE in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels. IRS=$1-\hat{\beta}-\hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ is the cross-sectional and time average of x_{it}.

Table 4.19: Consumption risk sharing estimates using lagged values for *Gini* and *LIR* for the Less Developed and Emerging Market sample

	Advanced economies						Developing countries						Emerging Markets					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(i)	(ii)	(iii)	(iv)	(v)	(vi)
$\Delta\tilde{y}$	-0.078	-0.259	-0.215	0.434*	0.232**	0.254***	1.160***	0.624***	0.680***	0.836***	0.605***	0.669***	0.539**	0.801***	0.813***	0.942***	0.784***	0.689***
	(0.236)	(0.181)	(0.178)	(0.257)	(0.112)	(0.053)	(0.225)	(0.157)	(0.131)	(0.098)	(0.058)	(0.048)	(0.231)	(0.178)	(0.154)	(0.101)	(0.060)	(0.064)
$FinRef * \Delta\tilde{y}$	-0.209			-0.207			-0.384***			-0.311**			-0.300***			-0.376***		
	(0.142)			(0.277)			(0.124)			(0.151)			(0.116)			(0.137)		
$KaOpen * \Delta\tilde{y}$		-0.065			-0.036			-0.288***			-0.089			-0.214***			-0.158*	
		(0.097)			(0.114)			(0.084)			(0.094)			(0.083)			(0.087)	
$Liab * \Delta\tilde{y}$			-0.003***			-0.003***			-0.074***			-0.066*			-0.023			-0.012
			(0.001)			(0.001)			(0.011)			(0.037)			(0.019)			(0.049)
$Remit * \Delta\tilde{y}$							-0.012**	-0.007***	-0.007**	-0.015**	-0.006*	-0.004	-0.001	0.001	0.004	-0.012	-0.009	-0.005
							(0.005)	(0.003)	(0.003)	(0.008)	(0.003)	(0.003)	(0.006)	(0.005)	(0.005)	(0.008)	(0.005)	(0.006)
$Gini * \Delta\tilde{y}$	2.30***	2.31***	2.10***				-0.683	0.561	0.263				0.788	-0.084	-0.300			
	(0.790)	(0.639)	(0.610)				(0.482)	(0.353)	(0.307)				(0.485)	(0.373)	(0.361)			
$LIR * \Delta\tilde{y}$				11.4	20.3***	18.0***				-0.066	0.279***	0.154*				-0.082	-0.072	-0.068
				(8.43)	(4.75)	(4.30)				(0.104)	(0.099)	(0.083)				(0.123)	(0.102)	(0.109)
$FinRef$	-0.023			0.005			0.054***			0.027			0.026			0.005		
	(0.014)			(0.014)			(0.019)			(0.020)			(0.018)			(0.018)		
$KaOpen$		0.018*			0.031***			0.010			0.002			0.005			-0.004	
		(0.009)			(0.012)			(0.008)			(0.009)			(0.009)			(0.010)	
$Liab$			0.000			-0.002**			-0.005			-0.010***			0.000			-0.012
			(0.001)			(0.001)			(0.003)			(0.003)			(0.006)			(0.008)
$Remit$							0.001	0.000	-0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.002	0.002	0.002
							(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$Gini$	-0.117	-0.128*	-0.002				0.015	0.044*	-0.033				0.080	-0.094*	-0.130***			
	(0.093)	(0.070)	(0.055)				(0.095)	(0.026)	(0.046)				(0.107)	(0.057)	(0.049)			
LIR				-1.083	-0.305	-0.420				-0.095**	-0.080***	-0.074***				-0.159***	-0.113***	-0.081***
				(0.897)	(0.483)	(0.466)				(0.043)	(0.024)	(0.025)				(0.043)	(0.028)	(0.029)
IRS	0.567***	0.646***	0.626***	0.651***	0.665***	0.649***	0.342***	0.291***	0.306***	0.391***	0.352***	0.347***	0.267***	0.331***	0.321***	0.310***	0.333***	0.352***
	(0.036)	(0.029)	(0.027)	(0.050)	(0.036)	(0.038)	(0.033)	(0.041)	(0.029)	(0.038)	(0.029)	(0.025)	(0.029)	(0.026)	(0.026)	(0.032)	(0.028)	(0.029)
R^2	0.68	0.65	0.65	0.78	0.71	0.71	0.80	0.78	0.79	0.81	0.80	0.80	0.85	0.80	0.80	0.88	0.82	0.824
DW	1.73	1.82	1.79	1.97	1.86	1.91	2.42	2.20	2.34	2.44	2.23	2.29	2.33	2.13	2.21	2.43	2.16	2.229
N	22	25	26	21	23	24	44	84	84	44	84	84	24	42	40	24	41	39
Obs.	726	1,014	1,074	525	760	800	1,057	2,167	2,139	949	2,064	2,061	620	1,155	1,092	533	1,034	975

Note: White standard errors in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. IRS=$1-\hat{\beta}-\hat{\mu}\bar{\bar{x}}$, with $\bar{\bar{x}}$ the cross-sectional and time average of x_{it}.

Table 4.20: Estimates when Hong Kong, Singapore, Slovenia and Taiwan are classified as Emerging Markets instead of Advanced economies

	Developing countries				Advanced economies				OECD countries			
	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.752***	0.734***	0.737***	0.723***	0.336***	0.537***	0.292***	0.487***	0.512***	0.619***	0.493***	0.599***
	(0.020)	(0.025)	(0.026)	(0.030)	(0.028)	(0.045)	(0.028)	(0.042)	(0.032)	(0.039)	(0.032)	(0.040)
												0.000
IRS	0.248***	0.266***	0.263***	0.277***	0.664***	0.463***	0.708***	0.513***	0.488***	0.381***	0.507***	0.401***
R^2	0.64	0.62	0.68	0.70	0.32	0.42	0.44	0.51	0.44	0.51	0.53	0.597
DW	2.04	1.96	1.97	1.88	1.63	1.64	1.62	1.64	1.71	1.70	1.72	1.74
CD	33.2***	27.0***			14.7***	2.3**			10.4***	2.6**		
N	90	90	90	90	30	30	30	30	34	34	34	34
Obs.	3,051	3,051	3,051	3,051	1,319	1,319	1,319	1,319	1,371	1,371	1,371	1,371
Years	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014

	Emerging market countries				Less developed countries				Advanced and emerging market economies			
	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.724***	0.727***	0.692***	0.728***	0.824***	0.814***	0.741***	0.712***	0.580***	0.661***	0.568***	0.650***
	(0.031)	(0.029)	(0.040)	(0.036)	](0.014)	(0.032)	(0.033)	(0.038)	(0.027)	(0.027)	(0.027)	(0.029)
												0.000
IRS	0.276***	0.273***	0.308***	0.272***	0.176***	0.186***	0.259***	0.288***	0.420***	0.339***	0.432***	0.350***
R^2	0.66	0.68	0.72	0.76	0.77	0.69	0.85	0.80	0.52	0.58	0.57	0.641
DW	1.88	1.82	1.83	1.80	2.19	2.25	1.97	1.96	1.79	1.75	1.79	1.76
CD	19.0***	7.2***			56.5***	23.2***			18.8***	10.3***		
N	41	41	41	41	49	49	49	49	71	71	71	71
Obs.	1,394	1,394	1,394	1,394	1,657	1,657	1,657	1,657	2,713	2,713	2,713	2,713
Years	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014

Note: Estimation of equation (5) for WG and MG estimator and equation (9) for CCEP and CCEMG. White standard errors for the WG and CCEP estimators and nonparametric ones for the MG and CCEMG estimators are in parentheses. Symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. For MG and CCEMG the R^2 and DW test statistics are the average statistics over the cross sections. IRS = 1-$\hat{\beta}$ denotes the international risk sharing coefficient. Sample: 1970-2014.

Table 4.21: International consumption risk sharing estimates for risk sharing only within the subsample

	Europe				EU countries				Euro area countries			
	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.548***	0.677***	0.451***	0.585***	0.516***	0.697***	0.501***	0.635***	0.422***	0.612***	0.456***	0.598***
	(0.031)	(0.035)	(0.032)	(0.050)	(0.035)	(0.045)	(0.032)	(0.051)	(0.040)	(0.071)	(0.037)	(0.062)
												0.000
IRS	0.452***	0.323***	0.549***	0.415***	0.484***	0.303***	0.499***	0.365***	0.578***	0.388***	0.544***	0.402***
R^2	0.47	0.54	0.64	0.69	0.47	0.56	0.63	0.67	0.37	0.44	0.56	0.552
DW	1.75	1.80	1.75	1.85	1.81	1.83	1.78	1.81	1.70	1.78	1.81	1.83
CD	23.4***	9.3***			9.5***	1.3			3.1***	0.3		
N	47	47	47	47	28	28	28	28	18	18	18	18
Obs.	1,402	1,402	1,402	1,402	960	960	960	960	703	703	703	703
Years	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014

	North, Central and South America				Asia & the Pacific				Africa			
	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG	WG	MG	CCEP	CCEMG
$\Delta\tilde{y}$	0.628***	0.679***	0.581***	0.655***	0.629***	0.664***	0.635***	0.663***	0.825***	0.822***	0.806***	0.767***
	(0.059)	(0.069)	(0.063)	(0.075)	(0.033)	(0.040)	(0.033)	(0.040)	(0.028)	(0.036)	(0.039)	(0.035)
												0.000
IRS	0.372***	0.321***	0.419***	0.345***	0.371***	0.336***	0.365***	0.337***	0.175***	0.178***	0.194***	0.233***
R^2	0.45	0.51	0.54	0.60	0.55	0.55	0.60	0.61	0.65	0.62	0.78	0.771
DW	1.91	1.78	1.89	1.80	1.95	1.86	1.93	1.86	2.19	2.30	1.82	1.98
CD	3.9***	0.7			6.4***	1.2			34.3***	6.7***		
N	21	21	21	21	27	27	27	27	25	25	25	25
Obs.	909	909	909	909	1,116	1,116	1,116	1,116	943	943	943	943
Years	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014	1970 - 2014

Note: Estimation of equation (5) for WG and MG estimator and equation (9) for CCEP and CCEMG. White standard errors for the WG and CCEP estimators and nonparametric ones for the MG and CCEMG estimators are in parentheses. Symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. For MG and CCEMG the R^2 and DW test statistics are the average statistics over the cross sections. IRS = 1-$\hat{\beta}$ denotes the international risk sharing coefficient. Sample: 1970-2014.

Table 4.22: International consumption risk sharing estimates for risk sharing only within the subsample

5 Dollarization and Financial Development

with Geoffrey Bannister and Jarkko Turunen[1]

5.1 Introduction

Developing economies have made significant strides in financial development over the past decades, including through financial deepening, improvements in financial inclusion and banking sector efficiency. Financial development has, in turn, supported higher economic growth in these countries (Levine, 2005). At the same time, financial dollarization, defined as the share of foreign currency deposits/credit in total deposits/credit, remains a common and persistent phenomenon. For example, average deposit dollarization across our sample of partially dollarized developing economies was around 30 percent in 2015.

The coexistence of financial development on the one hand and dollarization on the other raises questions about the impact of foreign currency use in financial transactions on financial deepening, inclusion and efficiency. The negative aspects of partial dollarization are well documented, including risks related to currency mismatches and balance sheets (Baliño et al., 1999; Eichengreen, 2001) and weaker monetary policy transmission (Levy Yeyati, 2006). Partial dollarization has also been associated with significant financial stability risks (see e.g. Gulde et al., 2004). However, a number of authors (e.g. Hausmann (1999); De Nicolo et al. (2005) and Levy Yeyati (2006)) have also raised the possibility that, in providing financial solutions to economic agents in less-than-optimal policy environments, dollarization can support greater financial development.

We study the impact of partial (unofficial) dollarization on financial development

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in developing and emerging economies.[2][3] We refer to financial deepening, as measured by the credit-to-GDP ratio, as the readily available aggregate measure of financial development that is also closely related to economic activity. However, in line with the suggestion in recent literature (e.g. Sahay et al., 2015) that financial development is a multidimensional concept, we also examine the impact of dollarization on financial access and banking sector efficiency. We also differentiate across foreign currency deposits and credit. While the two empirical measures of dollarization are often closely correlated (see below), there are important differences in the levels of these two variables that are likely driven by both market factors – differences in supply and demand for foreign currency deposits and loans – and regulatory factors – such as restrictions on foreign currency lending.

We contribute to the existing dollarization literature by taking a broader look at the impact of dollarization on a wider set of dimensions of financial development than before. When most previous studies have focused mostly on deposit dollarization, we consider both deposit and credit dollarization, and also the aggregate mismatch between the two. We bring to bear a new dataset for a sample of 77 emerging and developing countries over the period 1996–2015 (see Appendix 5A for a detailed description). Our dataset covers more countries and a longer time period (including the global financial crisis and its aftermath) than data used in previous studies. Following Barajas et al. (2013), we study the relationship between financial development and dollarization in a framework that takes into account the joint policy and structural determinants of financial development. Finally, we study the impact of dollarization using dynamic panel GMM estimation, thus controlling for potential endogeneity of the regressors.

Our results show that financial dollarization, and deposit dollarization in particular, has a negative impact on financial development. Specifically, we find that dollarization slows down financial deepening. The aggregate difference between deposit and credit dollarization is also negatively associated with financial depth, whereas credit dollarization seems to have no significant impact on financial development. These results are robust to alternative specifications and estimation methods. The negative impact of deposit dollarization on financial depth may reflect the fact that

[2] We use the term "dollarization" to refer to the use of any foreign currency other than the legal tender, not just the dollar. Full (official) dollarization where the foreign currency is the sole legal tender, is typically adopted by countries to stabilize inflation and to promote fiscal discipline. It does not involve a currency choice by firms and households, a common feature in countries with partial dollarization.

[3] We follow most of the literature in defining dollarization as the ratio of non-local currency deposits in total deposits, and non-local currency credit over total credit, in the banking system. We do not consider non-bank financial institutions (insurance funds or pension funds, for example), and we do not include off-shore transactions or assets and liabilities to non-residents. We also do not include loans denominated in domestic currency but indexed to the exchange rate.

a share of foreign currency deposits are transferred overseas, rather than returned to the domestic economy as private credit, thus contributing to a shallower domestic financial sector. It could also reflect the existence of additional frictions and costs that inhibit further financial deepening in markets where financial assets and liabilities are denominated in two or more currencies. Our results regarding the relationship between deposit dollarization and financial depth, using a larger sample of countries and including data for more recent time periods, are broadly consistent with results in De Nicolo et al. (2005) and Court et al. (2012). We also find that, similar to De Nicolo et al. (2005), the negative impact of dollarization on financial deepening is dampened somewhat in countries with past experiences of very high inflation. Therefore, there may be country cases where dollarization helps mitigate the negative impact of past macroeconomic instability on financial development. We also find some evidence that dollarization has a negative impact on financial efficiency. Our estimations indicate that net interest margins are positively related to levels of dollarization, suggesting a negative effect on financial efficiency. However, results across model specifications vary, suggesting caution in interpreting this result. Finally, we find no evidence of an association between financial dollarization and financial access in our data.

The rest of the paper is organized as follows. In Section 5.2 we review existing literature on dollarization and financial development. We then discuss available measures of dollarization and financial development in Section 5.3 and empirical methods in Section 5.4. We present our main results in Section 5.5, with focus on the impact of dollarization on financial deepening, followed by the impact on other measures of financial development. Results from multiple robustness checks are included in Appendix 5B. We conclude with a summary of main results and policy implications in Section 5.6.

5.2 Literature and Theory

Following Ize and Yeyati (2005), we look at dollarization as the outcome of a financial equilibrium between creditors and borrowers that optimize the currency composition of their contracts, in response to certain features of the economic environment.

The portfolio approach (Ize and Yeyati, 2003) explains dollarization as a reaction to macroeconomic instability, as manifest in high inflation and exchange rate volatility. Under this approach, the domestic investor chooses the composition of investments to minimize the variance of expected returns, which depend on the volatility of inflation and the real exchange rate. This is in line with ample evidence that episodes of high inflation and real exchange rate depreciations are associated with increases in dollarization. An implication of this approach is that expectations have an important role to play, and the credibility of monetary policy and the exchange rate regime are key (Levy Yeyati, 2006). The lack of credible monetary policy and exchange rate regimes explain the persistence of dollarization, even after inflation has been tamed, usually by relying on a stable real exchange rate as a nominal anchor. Following this approach, not surprisingly, a number of authors have found that dollarization is associated with weak economic institutions (De Nicolo et al., 2005; Levy Yeyati, 2006).

The portfolio approach can be extended to the currency choice related to total incomes, rather than just financial investments. In this case, in an environment where exchange rate depreciations are contractionary, economic agents prefer foreign currency (e.g. dollars) to maintain the real value of their consumption in the face of macroeconomic uncertainty. The existence of balance sheet mismatches in highly dollarized economies tends to reinforce the contractionary effect of exchange rate deprecation, thus also explaining the persistence of dollarization (Ize and Yeyati, 2005).

A second feature that explains dollarization is the existence of market frictions or failures in credit markets. For example, Jeanne (2000) highlights how a local currency premium induced by devaluation expectations (i.e. a peso problem) leads to dollarization when liquidations are costly (the relevant market friction). Under this situation, higher credit risk on local currency loans leads creditors to prefer to lend in dollars. At the same time, this can lead to "fear of floating" or limited exchange rate flexibility to limit the currency risk on creditors' portfolios. Moral hazard, related to government guarantees or other forms of regulation in the presence of asymmetric payoffs, can also lead to dollarization, to the extent that they insure dollar creditors and borrowers from large losses in the event of a large depreciation (e.g. Burnside et al., 2001). Barajas and Morales (2003) also point to factors such as the relative market power of borrowers and central bank intervention in foreign exchange markets. The role of incomplete credit markets is also highlighted by the fact that the presence of foreign banks tends to be associated with higher dollarization. For example, Basso et al. (2011) suggest that in European transition economies there is a strong link between financial deepening, cross border banking activities and dollarization.

Empirical studies of de-dollarization also support the idea that financial dollarization has its source in both macroeconomic stability concerns and frictions in credit markets. Kokenyne et al. (2010), García-Escribano and Sosa (2011) and Catão and Terrones (2016) confirm the importance of credible macroeconomic stabilization policies to lower inflation and stabilize the exchange rate as a key component of successful de-dollarization strategies in Europe and Latin America. These authors also refer to differential prudential regulations to lower bank's incentives to transact in foreign currencies and to provide incentives for economic agents to internalize the risks of foreign currency lending and deposits. These policies have been pursued in a number of Latin American and Asian economies and include raising provisions for foreign currency loans, tighter capital requirements against open foreign exchange positions, differentiated reserve requirements and remuneration on foreign currency deposits, among others (see e.g. Catão and Terrones, 2016; Kokenyne et al., 2010). A third component of successful de-dollarization is the development of local currency capital markets, which provide alternate vehicles for longer term investment and savings.

In all these cases, financial dollarization is a response to a suboptimal policy environment, be it macroeconomic instability or underdeveloped local credit markets. A natural question is whether dollarization, in providing a solution for economic agents, opens the way for greater financial development (depth and access) or efficiency. For example, Hausmann (1999) speculates that dollarization could expand the menu of financial options available to agents and thereby improve financial stability.

There has been little or no treatment of this question in theory, but a number of authors have attempted to investigate this issue empirically, albeit with conflicting results. De Nicolo et al. (2005) posit that since dollarization offers an inflation hedge for transactions it should therefore facilitate more financial transactions on-shore than would otherwise take place.[4] They regress financial depth (M2/GDP) on a number of instruments that include the main underlying determinants of dollarization (regulatory, macroeconomic and institutional), and find that dollarization is not associated with deeper financial markets, except in high inflation countries. Following De Nicolo et al. (2005), Levy Yeyati (2006) regresses financial depth on a dollarization legal restrictions index (as an instrument for dollarization) and finds a significant positive relationship, which could be interpreted as evidence that more dollarization is associated with shallower financial markets. Court et al. (2012) study 44 dollarized banking systems using two-stage least-squares to deal with endogeneity, and find that dollarization has a consistent and significant negative coefficient on financial deepening. On the other hand, Reinhart et al. (2014), studying different aspects of dollarization in a sample of emerging and developing countries, find that the joint existence of domestic dollarization and external liability dollarization appears to have a positive effect on financial deepening.

There have been even fewer systematic investigations of the effects of dollarization on financial access or efficiency. To our knowledge, the only study in this area is Honohan and Shi (2001), who look at the relationship between dollarization, the

[4]This is also supported by overwhelming evidence that countries that force conversion of dollar deposits into local currency experience a large contraction in intermediation (Savastano, 1996; Baliño et al., 1999).

supply of credit, interest rates and spreads. They find that banks tend to place as much as half of dollar deposits they receive off-shore, due to limits on safe and profitable foreign exchange lending in the local market, thus potentially limiting the supply of credit in the local market. They also find that net interest margins rise (i.e. efficiency is lower) with higher dollarization, potentially due to market power of dollarized banks in the system.

5.3 Measuring Dollarization and Financial Development

In this study we look at two different measures of partial dollarization – deposit and credit dollarization.[5] We define deposit dollarization as the ratio of dollar-denominated deposits to total broad money deposits, and credit dollarization as the ratio of dollar-denominated loans to total loans.[6]

Both deposit and credit dollarization have diminished over the sample period 1996 to 2015. (Figure 5.1). The Eastern European transition economies are generally more dollarized than the average country in the sample, and the jump in dollarization between 1996 and 1997 comes from the inclusion of the transition economies in the sample. The average level of deposit dollarization in our 77 country sample is also higher than the average credit dollarization level.

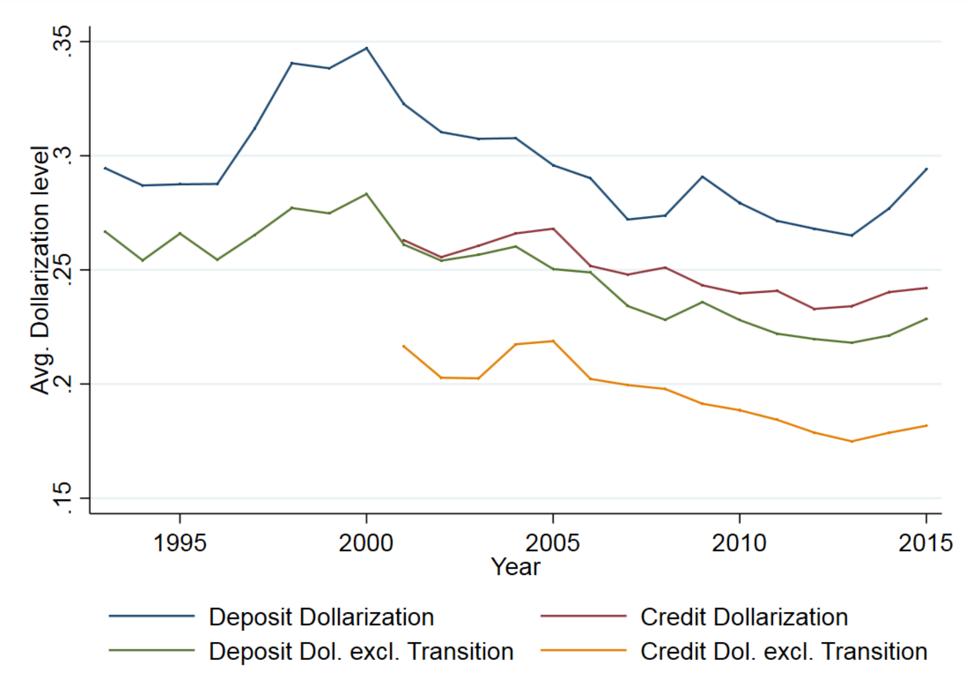

Figure 5.1: Deposit and Credit Dollarization

[5] A more complete measure of dollarization would also account for foreign currency cash holdings. However, owing to limited data availability for foreign cash holdings across countries, we focus on deposit and credit dollarization.

[6] A full description of the data is provided in Appendix 5A.

There is also significant geographical dispersion. Dollarization, and in particular deposit dollarization, is a prominent phenomenon in the Latin American countries in addition to the European transition economies, and much less common in the MENA or African countries (Figures 5.2 and 5.3). Finally, although the correlation between deposit and credit dollarization in our sample is fairly high at 82 %, there is still a lot of variation in the difference across countries (Figure 5.4).

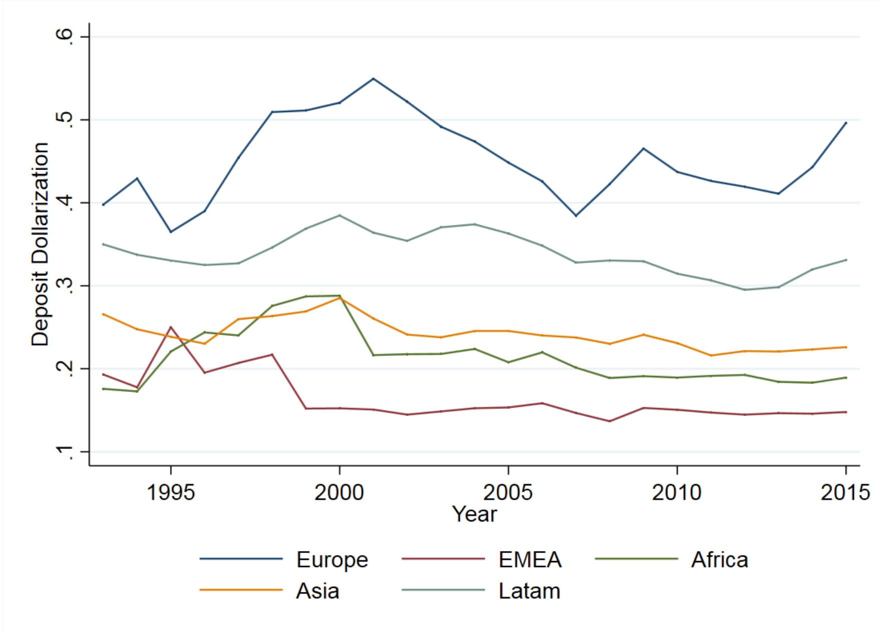

Figure 5.2: Average regional deposit dollarization

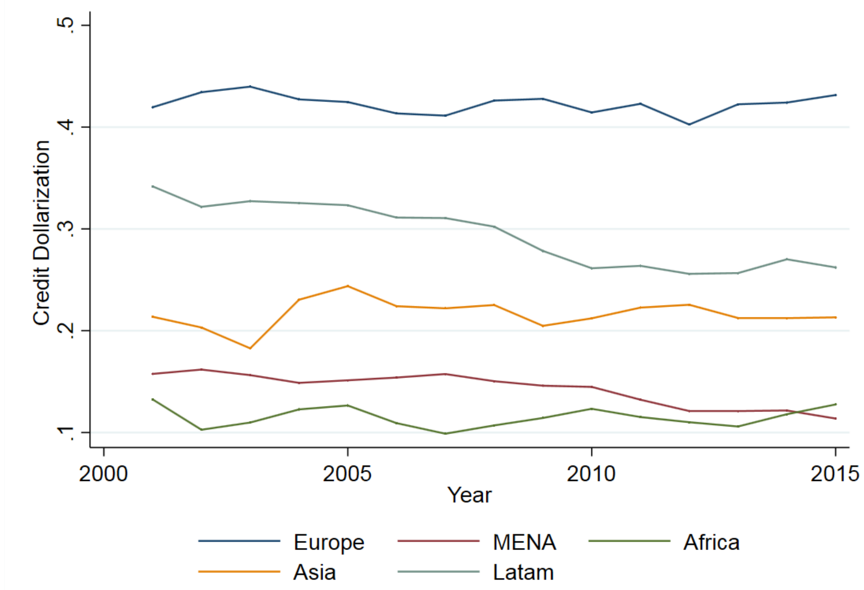

Figure 5.3: Average regional credit dollarization

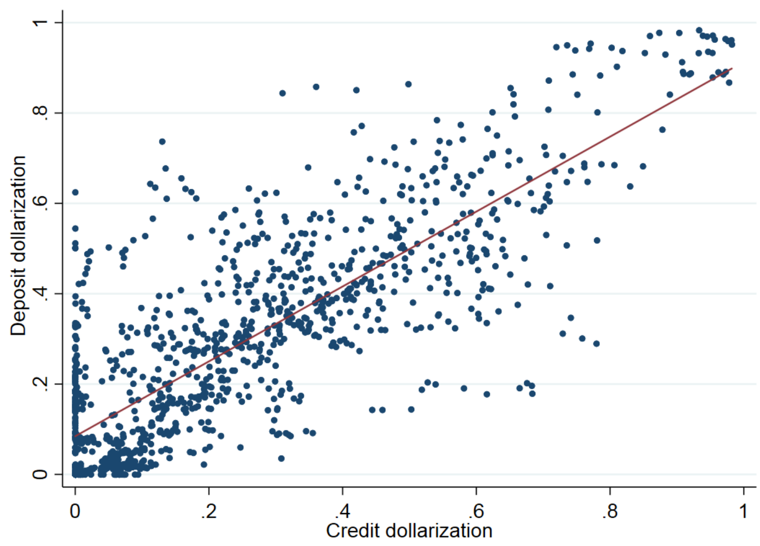

Figure 5.4: Deposit vs. Credit Dollarization

Financial development is a broad concept. In line with the emerging consensus in the recent literature that financial development is a multidimensional concept (see e.g. Sahay et al., 2015) we focus on three dimensions: financial depth, access and efficiency. The log of private credit to GDP is used to measure financial depth. While higher credit to GDP is usually consistent with a larger and more developed financial sector, financial depth in itself does not guarantee financial access or efficiency. We consequently also look at the impact of dollarization on access to financial services and financial efficiency. Financial access is represented by the log of bank accounts per 1000 adults, where a higher number of accounts in the adult population reflects better access to financial services. The bank net interest margin, defined as the accounting value of bank's net interest revenue as a share of its average interest-bearing assets, reflects how efficient the financial sector is in providing financial intermediation to the economy. Net interest margins tend to be substantially higher in developing countries than in developed countries. High interest margins often reflect market frictions, institutional and regulatory inefficiencies, information asymmetries, high fixed costs, imperfect banking sector competition and entry barriers, or a large vulnerability to macroeconomic variables such exchange rate, interest rate and real economic fluctuations (Stiglitz and Weiss, 1981; Beck and Hesse, 2009). Although a higher net interest margin is desirable from an individual bank's point of view, a lower net interest margin signals that the financial sector is more efficient in offering financial services to the society. Binned scatterplots of dollarization and the different dimensions of financial development suggest that a higher level of dollarization, particularly deposit dollarization, and a positive difference between aggregate deposit and credit dollarization, is associated with lower levels of financial depth, access and efficiency (Figures 5.5 to 5.7).

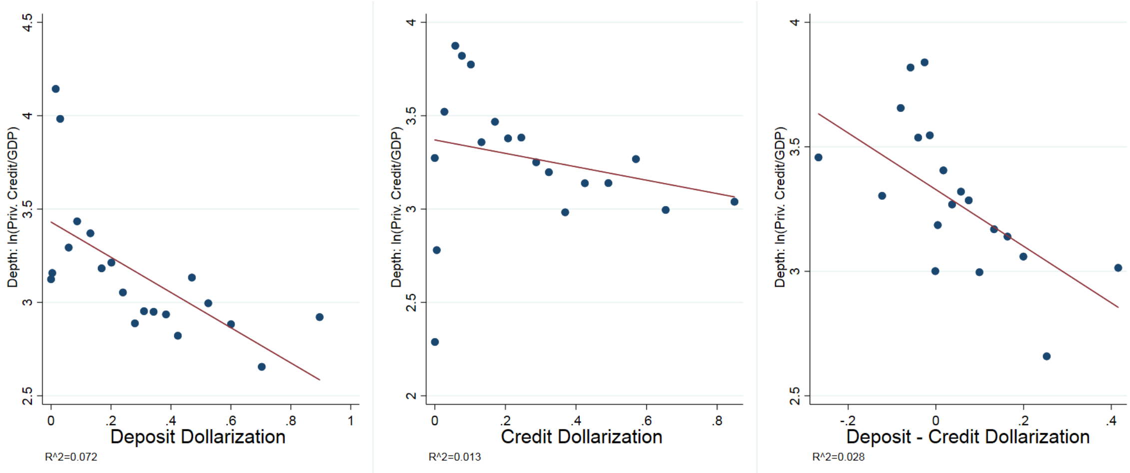

Figure 5.5: Financial Depth and Dollarization

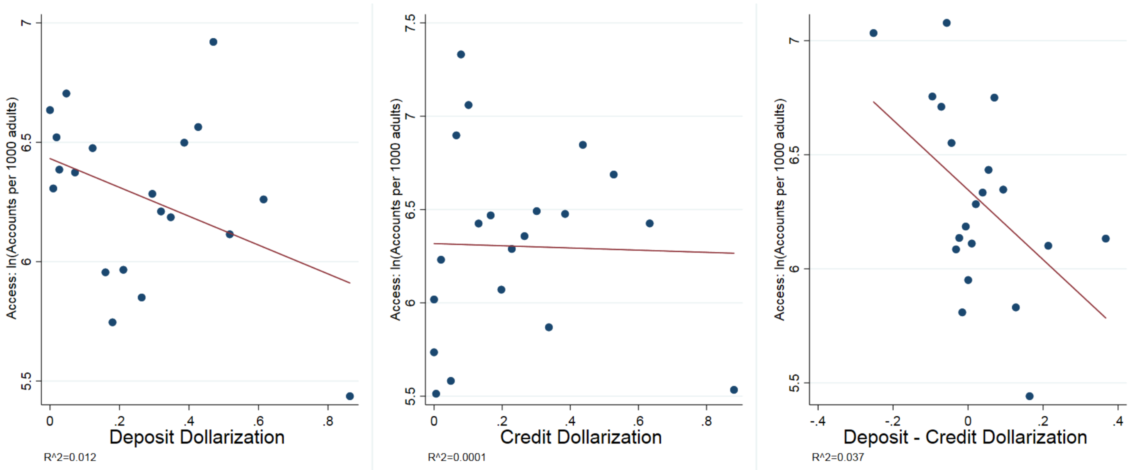

Figure 5.6: Financial Access and Dollarization

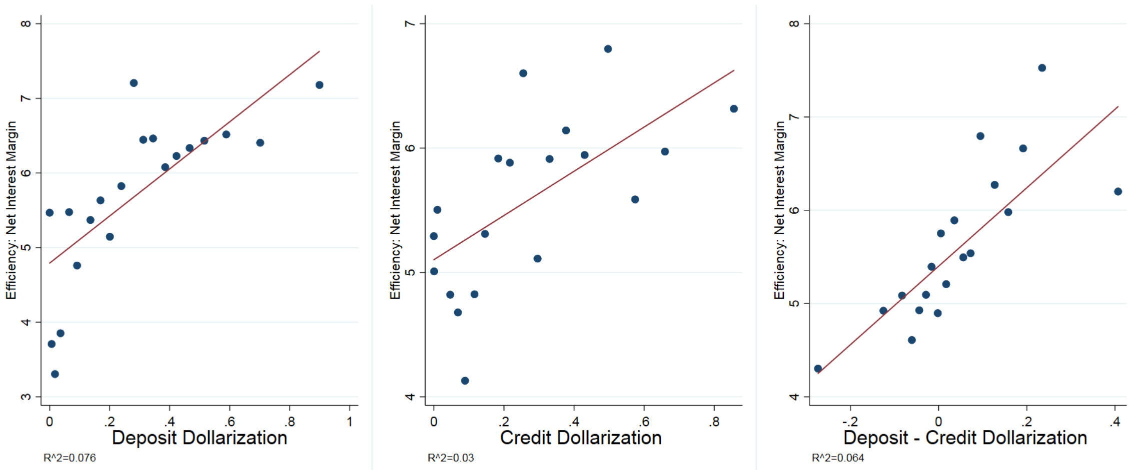

Figure 5.7: Financial Efficiency and Dollarization

5.4 Method

We use panel data analysis on our sample of 77 countries over the time period 1996–2015 to investigate the relationship between dollarization and financial development. The baseline panel models that we use aim to identify the impact of both credit and deposit dollarization on financial depth (*PrivCred*), access (*Accounts*) and efficiency (*NetIntMarg*).

The literature has identified several factors that have an impact on financial development. To ensure that we properly identify the impact of dollarization on financial development, we include both structural and macroeconomic policy variables as controls. Moreover, to make sure that we capture the underlying causes of dollarization that might be related to our financial development indicators, we also include variables from the literature associated with dollarization. The baseline equation which identifies the relationship between dollarization and the financial development indicator $FD_{i,t}$ in country i in year t is therefore specified as:

$$FD_{i,t} = \alpha FD_{i,t-1} + \beta Dol_{i,t} + \mathbf{P}'_{i,t}\gamma + \mathbf{S}'_{i,t}\theta + \mathbf{D}'_{i,t}\rho + \mu_i + \delta_t + \varepsilon_{i,t} \tag{5.1}$$

where $Dol_{i,t}$ is a measure of either deposit dollarization (*DepDol*) or credit dollarization (*CredDol*), **P** is a vector of policy variables that reflect the policy environment influencing financial development, **S** is a vector of structural variables that have an impact on financial development, **D** is a vector of variables that have an impact on dollarization, β, γ and θ contain the estimated coefficients, μ_i represents the country fixed effect, δ_t the time varying global component and ε the stochastic error term. As financial development is persistent, the lag of the dependent variable is also included. The coefficient of interest is β, which measures the impact of dollarization on financial development.

Policy variables in P

A wide range of policy variables have been found to impact financial development.[7] The policy variables in **P** can be divided into variables measuring macroeconomic developments, institutional quality and financial market regulation and structure. The macroeconomic variables used are the log change of real GDP per capita ($GDP\ growth$), CPI inflation ($Inflation$), and a banking crisis dummy ($Banking\ Crisis$). The market share of the three largest financial institutions in the country (3 $Bank\ Conc.$), is used as a proxy for financial market structure, an index of capital account openness ($KaOpen$) is used to control for capital market regulations, and external debt to gross national

[7] See e.g. Almarzoqi et al. (2015), Barajas et al. (2013), Court et al. (2012), de la Torre et al. (2013) and Trabelsi and Cherif (2017).

income (GNI) (*External Debt*), is used as a measure of debt sustainability and external vulnerability. The institutional quality measure used is the composite Worldwide Governance Indicators (*WGI*), which is a simple average of the subcomponents Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption.

Structural variables in S

Financial development is also affected by several structural variables such as income level, market size and demographics. Following Beck et al. (2008) and Barajas et al. (2013) we include the log of real GDP per capita (*GDP pc*), the log of population (*Pop*), and the log of the age dependency ratio (*Age Dep. ratio*) to control for the respective income level, market size and demographics, respectively.

Dollarization variables in D

The level of *Inflation* is already included in **P** and captures the currency substitution motivation for dollar investment. Following the portfolio approach, the dollar share of the minimum variance portfolio (*MVP*) is included to take into account that resident investors may select the currency composition of their asset portfolio to minimize the effect of volatility of the exchange rate and inflation.[8] The correlation between real GDP growth and the real exchange rate changes (*REER Cycl*) is used to capture the real income effects of exchange rate volatility. The share of foreign banks among total banks (*Foreign Banks*) is included as credit dollarization is found to be higher and deposit dollarization is found to be lower in markets where foreign banks are present (Basso et al., 2011). The log of the nominal effective exchange rate (*NEER*) takes into account that de-dollarization is generally associated with an exchange rate appreciation (as shown in García-Escribano and Sosa (2011) and Catão and Terrones (2016)). Finally, a dummy variable for Eastern European transition economies (*Transition*) is included to control for the fact that dollarization generally is higher in transition economies than in the rest of the sample. In the robustness tests we also include imports to GDP (*Imports*) to control for trade openness, a measure for remittances to GDP (*Remittances*), and the short term (three month) nominal interest rate differential between the domestic economy and the US (*i Diff*).

5.4.1 Estimation strategy

The presence of fixed effects in equation (1) gives rise to an endogeneity issue if estimated with OLS, as the lagged dependent variable is correlated with the error

[8] The dollar share of the minimum-variance portfolio (MVP) is defined as: MVP=[Var(π)+Cov(π,s)]/[Var(π)+Var(s)+2Cov(π,s)], where π denotes inflation and s is the change in the real exchange rate. The inflation and real effective exchange rate variances and the covariance are the respective values from the past five years.

term through the fixed effects. In panels where the time series dimension is relatively small like ours, this endogeneity creates biased coefficients, usually referred to as the Nickell bias (Nickell, 1981). To avoid the bias, we use the system and difference General Method of Moments (GMM) estimators.

The difference GMM estimator removes the fixed effect through differencing, and uses higher order lags of the endogenous regressors as instruments. However, if the dependent variable is highly persistent, the difference GMM estimator performs poorly as past changes in the variable contain little information about future changes. If that is the case, the system GMM estimator is considered a superior alternative. The system GMM exploits the fact that if a variable is highly persistent, past changes are more useful in predicting current levels than past levels are in predicting current changes (see Roodman, 2009a). The system GMM estimator thereby uses the same moment conditions as the difference GMM, but in addition employs an additional set of level moment conditions. That is, the system GMM estimator includes also a level equation, where the levels are instrumented by their first differences.

As financial development, and especially financial depth, is a persistent phenomenon, the system GMM model is our preferred model. We also estimate difference GMM and fixed effects models to test the robustness of our results to the model specification (see Appendix 5B).

An additional benefit of the GMM estimators is that they allow us to relax the assumption of exogeneity of the regressors in the model. As dollarization, financial development and some of the macroeconomic, policy and institutional variables might be endogenously determined, we consider the impact of dollarization both when it and its determinants are assumed to be endogenous and predetermined. The log changes in GDP are considered endogenous to all dimensions of financial development, as there is reason to believe that output growth is endogenously affected by financial development. Inflation is also allowed to be endogenously determined by financial depth, as an increase in private credit to GDP could have simultaneous effects on the price level and on dollarization. The institutional, regulation and market structure policy variables are considered predetermined along with the banking crisis dummy, whereas the structural variables are assumed exogenous. To avoid simultaneity issues, the beginning of period values (i.e. one year lags) of the variables are used for all the predetermined and exogenous structural variables.

The system GMM estimator aims to deal with endogeneity between dollarization and financial development, and we also try to control for all the underlying reasons for dollarizing that might affect financial development as well. Bellemare et al. (2017) however argue that using lags to deal with reversed causality could lead to inconsistent and biased results if there are still some unobserved time varying sources of heterogeneity (although the GMM estimator does a better job than a model that relies only on lags for identification). The existence of some dynamic latent sources of heterogeneity could thus lead to biased results and increase the risk of making Type 1 errors, which is a pitfall of this empirical approach that we recognize.

Both the system and difference GMM estimators are designed for panels with a relatively short time dimension. As the number of instruments grows quadratically with the time dimension, instrument proliferation risks overfitting the endogenous variables (Roodman, 2009b). In order to reduce the instrument count, we "collapse" our instruments by combining the instruments through addition into smaller sets. Despite collapsing the instruments we still have a fairly large instrument count when we allow dollarization along with its determinants to be endogenous. For that reason, we confirm that our results hold also when we use fewer instruments in the robustness section (see Appendix 5B).

5.5 Results

In this section we present the results for estimating the impact of dollarization on financial development. We first focus on the impact of dollarization on financial depth (*PrivCred*), and in the latter part of this section we present the results on the impact of dollarization on financial access (*Accounts*) and financial efficiency (*NetIntMarg*).[9]

The results using our preferred system GMM methodology are presented below.[10] For the baseline model for financial depth we report results both from estimations where dollarization and its determinants are considered predetermined and endogenous in the main text. For the rest of the analysis we only report the results from estimations where dollarization and its determinants are endogenous, and refer the reader to Appendix 5B for the predetermined cases.

5.5.1 Financial Depth

The baseline results measuring the impact of dollarization on financial sector depth, as measured by log of credit to GDP, are presented in Table 5.1. The results show that deposit dollarization has a statistically significant negative impact on financial

[9] We have also explored an alternative approach based on financial possibility frontiers. Beck et al. (2008) posit that there is a constrained optimum of financial development in an economy, which builds on the notion that there is a maximal sustainable level of financial depth in an economy at any given time. This maximal sustainable level, referred to as the financial possibility frontier, depends on structural and long term policy variables that impact the access to financial services in an economy. We look at how dollarization affects the gap between the structural financial depth (as implied by the financial possibility frontier) and actual financial depth, and find only insignificant or non-robust results. These results are not presented for the sake of space but are available upon request.

[10] Results using difference GMM and the fixed effects (FE) models can be found in Table 5.8 in Appendix 5B. The difference GMM estimator generally performs poorly when the dependent variable is highly persistent (Roodman, 2009b), so more weight should be given to the results from the system GMM estimations. Moreover, due to the Nickell bias in the FE model, the FE results should only be regarded as a check on the sign of the coefficients.

development (see columns 1 and 2). This result holds regardless of whether dollarization is considered endogenous or predetermined. The results suggest that a 1 percentage point increase in deposit dollarization reduces credit to GDP by around 0.4 percent in the short run, and 2–2.5 percent in the long run. Our results would therefore imply that, for the sample as a whole, the observed 5 percentage point reduction in dollarization since its peak has contributed to an increase in credit to GDP by about 10 percent in the past 15 years.[11] For highly dollarized economies the gains from de-dollarization can be large – cutting the level of dollarization by half (e.g. from about 90 percent to 45 percent) would potentially increase financial depth by close to 20 percent in the short run. Furthermore, the results suggest that in the long run halving dollarization could theoretically double financial depth in countries with near complete dollarization. The impact of credit dollarization is however much smaller and not statistically significant.[12]

The lagged dependent variable is statistically significant in all models, thus validating our choice of a dynamic specification. The difference in magnitude of the estimated coefficients on dollarization between the models where dollarization and its determinants are considered predetermined versus endogenous is small. The results on financial depth are also robust to alternative specifications and estimation methods. For example, the same conclusion can also be drawn from a more parsimonious model with less instruments (Table 5.7 in Appendix 5B), from a model with only the significant control variables (Table 5.5 in Appendix 5B) and results produced using the difference GMM estimator (Table 5.8 in Appendix 5B).[13]

To confirm the suitability of the model and instruments, a number of diagnostic tests are performed. As can be seen from Table 5.1, the Arellano-Bond tests for order 2 serial correlation in the residuals, AB-AR(2), confirm that the models do not suffer from autocorrelation.[14] The Hansen J-test of over-identifying restrictions furthermore confirms the joint validity of the instruments.

[11] Based on the long-run coefficient. Credit to GDP in our sample has increased by around 50 percent since 1996 while deposit dollarization has declined by around 5–8 percentage points since its peak in 2000.

[12] Note that the sample for columns 3–4 is much smaller than for columns 1–2. When the regressions in columns 1–2 are estimated with the same sample as in columns 3–4, we still find that deposit dollarization has a significantly negative impact on financial depth. Thus, the difference in results is not coming from the difference in sample but rather from the different measure of dollarization.

[13] In addition to deposit dollarization, we see that external debt, inflation, foreign banks, banking crises, the nominal effective exchange rate ($NEER$), low institutional quality and a high concentration of bank market power (3 *Bank Conc*) have a negative, although not always very significant, impact on financial sector depth.

[14] The null hypothesis for the Arrelano-Bond AR(p) test is no p order autocorrelation. Order one serial correlation is expected through the construction of the model. As we are unable to reject the null hypothesis of no second order autocorrelation, it justifies the use of second order lags as instruments for the lagged dependent variable.

Private Credit /GDP

	Predet.	Endog.	Predet.	Endog.	Endog.
DepDol	-0.392**	-0.393**			
	(0.164)	(0.182)			
CredDol			-0.096	0.049	
			(0.088)	(0.127)	
$DepDol - CredDol$					-0.239**
					(0.109)
$PrivCred_{-1}$	0.845***	0.818***	0.899***	0.861***	0.864***
	(0.072)	(0.052)	(0.066)	(0.042)	(0.036)
GDPgrowth	-0.104	-0.016	0.344	0.078	-0.018
	(0.271)	(0.299)	(0.341)	(0.213)	(0.232)
Inflation	-0.047	-0.168	-0.101	-0.338**	-0.211
	(0.159)	(0.203)	(0.110)	(0.164)	(0.164)
MVP	-0.003	0.001	0.010	0.002	0.008
	(0.008)	(0.006)	(0.007)	(0.010)	(0.011)
REER Cycl.	0.026	0.022*	0.021	0.015	0.016
	(0.016)	(0.012)	(0.013)	(0.011)	(0.012)
NEER	0.095*	0.070	0.116**	0.115**	0.197**
	(0.052)	(0.051)	(0.048)	(0.053)	(0.083)
Institutions	-0.022	0.090	0.043	0.085**	0.096**
	(0.102)	(0.059)	(0.060)	(0.039)	(0.044)
Foreign Banks	-0.001	-0.003**	-0.002	-0.002***	-0.003***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
3 Bank Conc.	-0.410*	-0.216	-0.257	-0.145	-0.132
	(0.223)	(0.155)	(0.197)	(0.150)	(0.166)
KaOpen	0.051	0.057	-0.038	-0.086*	-0.050
	(0.098)	(0.070)	(0.050)	(0.052)	(0.048)
External Debt	-0.163**	-0.060	-0.148***	-0.021	-0.144***
	(0.076)	(0.062)	(0.053)	(0.056)	(0.048)
Banking Crisis	-0.044	-0.064	-0.075	-0.134***	-0.103**
	(0.045)	(0.041)	(0.046)	(0.051)	(0.047)
GDP pc	-0.145*	-0.050	-0.014	-0.008	-0.005
	(0.081)	(0.057)	(0.066)	(0.024)	(0.023)
Population	-0.145*	-0.066	-0.084	-0.039	-0.039
	(0.077)	(0.050)	(0.053)	(0.043)	(0.049)
Age Dep. Ratio	-0.895	-0.102	0.003	0.006	0.129
	(0.621)	(0.483)	(0.655)	(0.197)	(0.212)
Transition	-0.010	0.358	0.177	0.191*	0.251**
	(0.256)	(0.248)	(0.286)	(0.114)	(0.119)
Obs	1 216	1 243	963	967	963
Countries	77	77	74	74	74
Max T	19	19	14	14	14
Avg T	16	16	13	13	13
Instruments	83	206	83	185	189
AB-AR(1) p-val	0.000	0.000	0.000	0.002	0.002
AB-AR(2) p-val	0.713	0.575	0.356	0.391	0.395
Hansen p-val	0.169	1.000	0.135	1.000	1.000

Note: Dependent variable: ln(Private Credit / GDP). System GMM estimations where dollarization and its determinants are either considered predetermined (Predet.) or endogenous (Endog.). Robust SE in parentheses, symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Models include time dummies and a constant.

Table 5.1: The impact of dollarization on financial depth

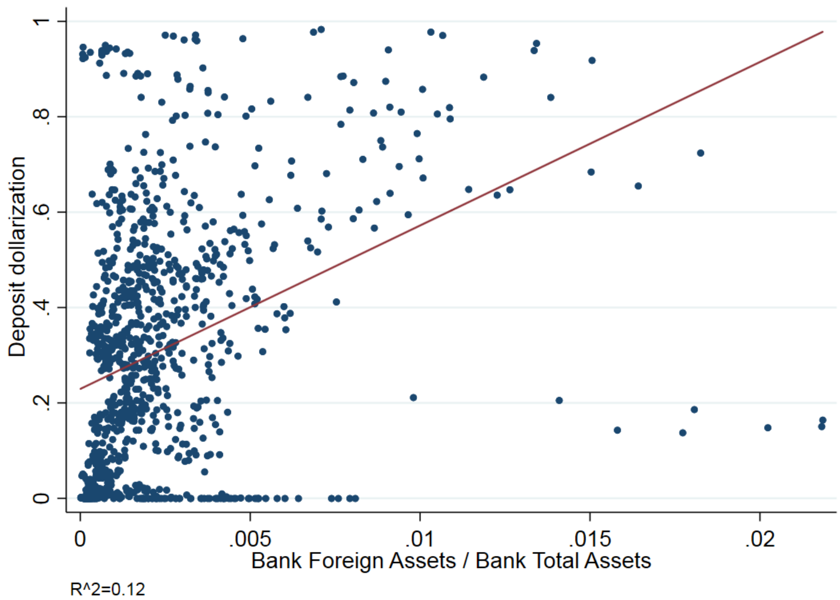

Figure 5.8: Deposit dollarization and foreign asset ratios of deposit taking banks

Deposit dollarization thus seems to have a significant and negative impact on financial deepening of the financial system, whereas credit dollarization does not. One possible explanation for these results is the hypothesis put forward by De Nicolo et al. (2005) that part of foreign currency deposits are exported rather than returned to the domestic economy in the form of private credit, which in turn leads to a shallower domestic financial sector. A simple correlation plot suggests a positive correlation between deposit dollarization and the share of assets that banks hold abroad (see Figure 5.8), suggesting that deposit dollarization may hamper financial depth as banks export part of the foreign currency deposits instead of extending new loans.[15] Additionally, the existence of financial assets and liabilities in two or more currencies might create additional frictions and costs in the credit markets that inhibit further financial deepening.

The baseline results shown in Table 5.1 suggest that there is a difference in how deposit and credit dollarization affects financial development. We explore these results further by examining first, the impact of the mismatch between deposit and credit dollarization on financial development and, second, the importance of high inflation episodes in explaining the impact of dollarization. [16]

If the negative impact of dollarization on financial development arises because the banking sector invests the foreign currency assets abroad rather than extending for-

[15]For some economies, this could also reflect a form of carry-trade, i.e. foreign investment in relatively high-yielding and stable foreign currency deposits in developing economies during periods of low global interest rates.

[16]We have also explored whether there are other sources of impact heterogeneity, such as income level, level of dollarization, financial market access, institutional quality, capital account openness, exchange rate regime or foreign bank presence. We do not find any robust results suggesting that the impact of dollarization is different across these characteristics.

eign currency loans to resident investors, the negative impact should be larger when the difference (or mismatch) between deposit and credit dollarization is larger. We therefore look at whether the aggregate difference in deposit and credit dollarization ratios (*DepDol-CredDol*) has an impact on financial depth. Re-estimating the system GMM estimations including this mismatch suggests that it does indeed have a negative effect on financial depth (see column 5, Table 5.1).[17] These results are in line with the Honohan and Shi (2001) hypothesis that if banks receive more foreign currency deposits than they can return to the domestic financial market as foreign currency loans, they will invest the foreign currency deposits abroad. This result continues to hold if we use the difference between foreign currency deposits and credit scaled by GDP (not shown).

Second, the previous literature has found that the relationship between dollarization and financial development is somewhat different in high inflation economies compared to countries with stable price developments. De Nicolo et al. (2005) establish that deposit dollarization is associated with a deeper private financial sector in economies with high inflation. Court et al. (2012) find that dollarization reduces financial depth except in high-inflation economies. We extend our analysis to test whether financial development is supported by dollarization in countries with a history of high inflation. We add an interaction term between dollarization and a dummy variable that takes the value 1 if the country has experienced an annual inflation rate higher than 250 percent between 1980 and 1997,[18] and zero otherwise. Alternatively, we add an interaction term of dollarization and the natural logarithm of the country's maximum historical inflation during 1980-1996.[19] The results show some evidence that deposit dollarization has a less negative or even positive impact on financial depth in economies with a history of very high inflation (see Table 5.2). This suggests that deposit dollarization can be used by investors as a tool to circumvent some of the risks related to a history of macroeconomic instability. In some country cases, and in particular those hampered with high inflation and macroeconomic instability, dollarization could therefore facilitate financial deepening. This result also highlights the need to consider country specific circumstances in interpreting the average results obtained for the full sample. The results in Table 5.2 also confirm the previous finding that credit dollarization does not have a statistically significant impact on financial deepening.

[17] Here we present the results where the gap between deposit and credit dollarization is endogenous, but the same conclusions hold if we consider the gap predetermined.

[18] For the Eastern European transition economies this period is 1995-1998.

[19] We only consider historical inflation to reduce endogeneity concerns, but we reach the same conclusions when we consider the maximum inflation over the full sample period.

	Private Credit / GDP			
$DepDol$	-1.006***	-0.575***		
	(0.258)	(0.158)		
$DepDol * D^{HighInfl}$	1.049***			
	(0.400)			
$DepDol * MaxInfl$		0.104*		
		(0.056)		
$CredDol$			0.142	0.084
			(0.159)	(0.161)
$CredDol * D^{HighInfl}$			-0.097	
			(0.177)	
$CredDol * MaxInfl$				-0.021
				(0.047)
$D^{HighInfl}$	-0.202		-0.084	
	(0.161)		(0.122)	
$MaxInfl$		-0.024		-0.022
		(0.024)		(0.029)
$PrivCredit_{-1}$	0.798***	0.810***	0.848***	0.830***
	(0.050)	(0.050)	(0.043)	(0.044)
GDP growth	-0.096	-0.111	-0.019	0.034
	(0.261)	(0.265)	(0.206)	(0.207)
External Debt	-0.106*	-0.101**	-0.022	-0.030
	(0.054)	(0.050)	(0.050)	(0.056)
$Inflation$	-0.282	-0.227	-0.363**	-0.326*
	(0.198)	(0.187)	(0.183)	(0.175)
MVP	0.007	0.002	0.001	0.004
	(0.008)	(0.006)	(0.010)	(0.010)
REER Cycl.	0.032**	0.030**	0.018	0.021
	(0.015)	(0.013)	(0.012)	(0.013)
$NEER$	0.093	0.095*	0.117**	0.120*
	(0.063)	(0.049)	(0.059)	(0.068)
Foreign Banks	-0.003*	-0.003***	-0.003***	-0.003***
	(0.002)	(0.001)	(0.001)	(0.001)
Institutions	0.064	0.045	0.082**	0.086**
	(0.062)	(0.049)	(0.039)	(0.040)
3 *Bank Conc.*	-0.288*	-0.324**	-0.158	-0.210
	(0.154)	(0.138)	(0.137)	(0.138)
KaOpen	0.155**	0.077	-0.112**	-0.087
	(0.078)	(0.064)	(0.055)	(0.063)
Banking Crisis	-0.044	-0.051	-0.133***	-0.112**
	(0.045)	(0.041)	(0.049)	(0.055)
GDP pc	-0.106**	-0.083*	0.017	0.021
	(0.054)	(0.049)	(0.034)	(0.039)
Population	-0.109**	-0.110***	-0.039	-0.052
	(0.043)	(0.039)	(0.041)	(0.043)
Age Dep. Ratio	-0.423	-0.352	0.114	0.140
	(0.447)	(0.399)	(0.242)	(0.258)
Obs	1 243	1 243	967	967
Countries	77	77	74	74
Max T	19	19	14	14
Instruments	241	241	199	199
AB-AR(1) p-val	0.000	0.000	0.002	0.002
AB-AR(2) p-val	0.484	0.540	0.420	0.383
Hansen p-val	1.000	1.000	1.000	1.000

Note: Dependent variable ln(Private Credit/GDP). System GMM estimations with dollarization and its determinants endogenous. Robust SE in parentheses, symbols ***, ** and * denote significance at 1%, 5% and 10 % levels, respectively. Models include time dummies, a transition country dummy and a constant.

Table 5.2: Dollarization and financial depth in countries with a history of high inflation

5.5.2 Financial Access and Efficiency

While financial depth is a useful summary indicator, it does not capture the multidimensional nature of financial development. We therefore look at the impact of dollarization on financial access, which is represented by the number of bank accounts per adult, and on financial efficiency, approximated by the aggregate net interest margin.

Our results show no evidence of a link between dollarization and financial access (columns 1 and 2 in Table 5.3). The results from the preferred system GMM estimation show that both deposit and credit dollarization have no significant impact on financial access.[20]

In contrast, there is some evidence that deposit dollarization increases the net interest margin charged by firms (see columns 3 and 4 in Table 5.3). As a higher net interest margin is a signal of lower financial sector efficiency, these results suggest that deposit dollarization may also have a negative influence on banking sector efficiency. As Honohan and Shi (2001) point out, this result may be related to the contraction in the supply of credit when banks shift their assets abroad (as there are strong economies of scale in banking). The higher spreads could also be related to higher concentration and monopoly power in the banking system in dollarized economies, as supported by the significance of the positive coefficient on the bank concentration variable (3 *Bank Conc.*). However, these results should be interpreted with care, as they rely on the model where dollarization is considered endogenous (thus including multiple instruments) and vary somewhat across alternative specifications. The negative impact on efficiency is statistically significant in the more parsimonious models (see Table 5.5 in Appendix 5B), but the magnitude of the coefficients varies depending on the model specification. When we reduce the number of instruments, the deposit dollarization coefficient is no longer significant (see Table 5.7 in Appendix 5B). In addition, few control variables are statistically significant, suggesting that the model may not be good at explaining drivers of financial efficiency.[21]

5.5.3 Robustness

Finally, we conduct a number of robustness checks to ensure that our conclusions still hold even if we reduce the number of instruments, use more parsimonious models, use alternative estimators, and if we exclude countries with low levels of dollarization.[22] These results are presented in Appendix 5B. First, we confirm that our results

[20] When the same models are re-estimated using difference GMM (shown in Table 5.8 in Appendix 5B), we find that both deposit and credit dollarization have a statistically significant negative impact on financial access. However, as the difference GMM estimator tends to perform poorly when the dependent variable is highly persistent, we give more weight to the system GMM results.

[21] When we look at the impact of the spread between the deposit and lending rate instead of the Net Interest Margin we find similarly inconclusive results.

[22] To confirm that we have properly controlled for the reasons why economies become dollarized in the first place, we have also created a proxy for dollarization which is by construction exogenous to the known or observed determinants of dollarization. We do this by estimating dollarization using a very

	Accounts		Net Interest Margin	
DepDol	0.367		4.539**	
	(0.261)		(2.299)	
CredDol		-0.037		-0.869
		(0.192)		(1.654)
Accounts_{-1}	0.758***	0.765***		
	(0.070)	(0.071)		
NetIntMarg_{-1}			0.387***	0.401***
			(0.073)	(0.081)
GDP growth	0.588	0.727	0.714	3.392*
	(0.461)	(0.453)	(2.179)	(1.842)
Inflation	0.790**	0.812**	1.799	1.651
	(0.389)	(0.402)	(1.537)	(1.504)
NEER	-0.122	-0.143	-0.558	-1.418
	(0.153)	(0.160)	(0.832)	(1.016)
Institutions	0.158**	0.074	-0.517	-0.255
	(0.075)	(0.074)	(0.602)	(0.762)
3 *Bank Conc.*	-0.003**	-0.004*	0.029*	0.031*
	(0.002)	(0.002)	(0.017)	(0.017)
Foreign Banks	-0.327	-0.440*	-0.150	3.241
	(0.258)	(0.260)	(1.630)	(2.028)
KaOpen	-0.041	0.024	-1.101	1.501**
	(0.075)	(0.073)	(0.924)	(0.756)
MVP	-0.239*	-0.242*	0.062	0.012
	(0.122)	(0.125)	(0.078)	(0.110)
REER Cycl.	0.003	-0.001	-0.310**	-0.074
	(0.029)	(0.031)	(0.140)	(0.176)
Banking Crisis	0.164**	0.176*	-0.388	-0.416
	(0.080)	(0.098)	(0.403)	(0.459)
GDP pc	0.091**	0.113***	0.066	-0.034
	(0.043)	(0.042)	(0.655)	(0.332)
Population	-0.048	-0.110*	-0.055	0.898
	(0.066)	(0.065)	(0.480)	(0.557)
Age Dep. ratio	-0.161	0.003	0.089	2.261
	(0.354)	(0.298)	(5.138)	(2.675)
Transition Econ	0.101	0.203	-2.681	1.516
	(0.214)	(0.174)	(2.625)	(1.847)
Obs	487	481	1 131	876
Countries	58	57	75	72
Max T	10	10	18	13
Avg T	8	8	15	12
Instruments	225	204	237	216
AB-AR(1) p-val	0.017	0.014	0.000	0.003
AB-AR(2) p-val	0.743	0.803	0.518	0.434
Hansen p-val	1.000	1.000	1.000	1.000

Note: Dependent variables: ln(Accounts per 1000 adults) and Net Interest Margin. System GMM estimations where dollarization and its determinants are endogenous. Robust SE in parentheses, and symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Models include time dummies and a constant.

Table 5.3: Dollarization and Financial Access and Efficiency

are not driven by instrument proliferation. One drawback with the system (and difference) GMM is that the number of instruments grows rapidly in the time dimension, especially in the models where we allow dollarization and its determinants to be endogenous. The number of instruments is reduced if 1) we restrict dollarization and its determinants to be predetermined instead of endogenous (Appendix 5B, Table 5.6) allow only the lagged dependent variable, GDP growth, inflation and dollarization to be endogenous and restrict the dollarization determinants to be exogenous or predetermined.

As can be seen from Appendix 5B, Table 5.7, reducing the instrument count does not change our main conclusions, and instead we find that when we restrict the dollarization determinants and inflation to be predetermined rather than endogenous, the impact of deposit dollarization on financial depth is larger and more negative.

Second, we confirm that our results hold even if we exclude the insignificant control variables from the models (Appendix 5B, Table 5.5). Third, we also find that the difference GMM estimations (Appendix 5B, Table 5.8) yield results similar to the preferred system GMM. The results from fixed effects (FE) estimations also support our general conclusions.[23]

Finally, we confirm that we reach the same conclusions when we exclude countries that have very low levels of dollarization, possibly owing to foreign exchange regulations (Appendix 5B, Table 5.9). In practice, we exclude all countries with either deposit or credit dollarization below 1 % on average over the sample period, which leaves us with a sample of 63 countries.

5.6 Conclusion

Despite significant strides in financial development, financial dollarization remains common in developing economies. Consistent with past studies, our results using a large sample of emerging and developing economies show that financial dollarization can dampen financial development, and as a result, slow down economic development. In particular, our panel regression estimates show that deposit dollarization has a negative impact on financial deepening. We argue that this negative impact may reflect the fact that a share of foreign currency deposits are transferred overseas rather than returned to the domestic economy as private credit. We also find that the negative impact of dollarization on financial development is dampened some-

rich set of dollarization determinants, and the resulting residuals can be seen as a proxy for the part of dollarization which is not related to the underlying reasons for dollarizing. The same conclusions as in the main analysis are reached when we use this by construction exogenous dollarization measure. These results are not reported but available upon request.

[23]We have also estimated the model with dollarization and financial depth in first differences, and these results also indicate that a reduction in deposit dollarization has a positive effect on financial depth in the following year. These results are however not reported for the sake of space.

what in countries with past experiences of high inflation. Therefore, while the results from the full sample suggest potentially large gains from de-dollarization on average, policy recommendations drawn from the results need to carefully consider country-specific circumstances. The results suggest that there may be country cases where dollarization helps mitigate the negative impact of high inflation and macroeconomic instability on financial development. Our estimates also provide some evidence of a negative relationship between dollarization and financial efficiency. It is possible that deposit dollarization contributes to shallower domestic credit markets and therefore limits opportunities to take advantage of economies of scale. We do not find evidence that dollarization has a statistically significant effect on financial inclusion in our data.

Our results are driven by deposit dollarization and we do not find consistent evidence that credit dollarization as such has an impact on financial development. Consistent with our results for deposit dollarization, however, we find that an aggregate level measure of mismatch (i.e. the difference between deposit and credit dollarization) is associated with lower levels of financial development. This is in line with evidence on currency mismatch as a source of financial sector instability. Further research, perhaps using data at a more granular (sectoral, firm or individual) level is needed to better understand how currency mismatch impacts financial development. We also note that while we have gone through significant effort to obtain robust empirical results, our system GMM estimation is only a partial solution to concerns about identification. Further research is therefore needed to explore strategies that could help better establish causality from dollarization to financial development. An alternative empirical approach would be to examine significant de-dollarization events for evidence of their impact on financial development.

Overall, our results suggest that, in addition to concerns related to lower monetary policy effectiveness, limits to flexibility of fiscal policy and heightened financial stability risks, there are additional costs from dollarization related to lower financial depth and banking sector efficiency. The results therefore justify policy efforts to increase the use of the domestic currency in financial transactions. This is particularly the case for countries with a high degree of financial dollarization, where the gains from de-dollarization in terms of the development of local financial markets could be substantial. Studies of de-dollarization strategies suggest that dollarization is often a persistent phenomena and that de-dollarization therefore requires sustained policy efforts on multiple fronts. Kokenyne et al. (2010), García-Escribano and Sosa (2011) and Catão and Terrones (2016) argue that credible macroeconomic stabilization policies to lower inflation and stabilize the exchange rate have been a key component of successful de-dollarization strategies in Europe and Latin America. Strengthening economic institutions, and particularly monetary policy frameworks that enhance the credibility of monetary policy in the face of external shocks, is a first step. Additional efforts are also needed to lower the incentives for financial institutions and economic agents to transact in foreign currencies. Prudential policies that have been successfully pursued include raising provisions for foreign currency loans, tighter capital requirements against open foreign exchange positions, differentiated reserve requirements and remuneration on foreign currency deposits, among others. Finally, the development of local currency financial markets can provide alternate vehicles for longer term investment and savings.

5.7 Appendix

Appendix 5A: Data

The dataset contains annual data for a sample of 77 emerging market and developing countries over the period 1996–2015. The sample is limited by data availability, and the countries included in the sample have dollarization levels ranging between 0 and 98 percent (for both credit and deposit dollarization). As we are interested in the impact of partial dollarization on financial development, fully dollarized countries are excluded from the study along with countries with currencies whose currencies are pegged to the USD (i.e. show close to zero exchange rate volatility) over the sample period. The data panel is unbalanced, as not all of the series are available at the starting date for all the countries. The Eastern European transition economies are included in the sample from 1997 onwards.

Dollarization

Deposit dollarization (*DepDol*) is defined as total foreign currency deposits in broad money over total broad money deposits. Credit dollarization (*CredDol*) is defined as foreign currency loans over total loans. The dollarization data is collected from a number of sources. Deposit and credit dollarization data from 2001 onward is obtained from the IMF's Standardized Report Form (SRF) for 70 of the countries in our sample. Deposit dollarization data for the time prior to 2001 is supplemented by data from Levy Yeyati's (2009) dollarization database.[24] As not all countries report their foreign currency deposits and loans via the SRF, the missing dollarization data for these countries were supplemented by data from IMF staff reports and Levy Yeyati (2006). The deposit dollarization data is thus available from 1996 onward for some of the countries, whereas the credit dollarization data starts only in 2001.

[24] For the countries where the Levy-Yeyati and IMF deposit dollarization data for the overlapping period of 2001-2009 is different, we used the backward growth rates of the dollarization ratios to extrapolate the SRF deposit dollarization data series.

Financial development

The financial development data are retrieved from the Global Financial Development Database (GFDD) compiled by Čihák et al. (2012). Financial depth (*PrivCred*) is defined as Private credit by deposit money banks and other financial institutions to GDP (percent). This data is collected from the International Financial Statistics (IFS). Financial access (*Accounts*) is proxied by the number of bank accounts with commercial banks per 1,000 adults, originally published in the IMF's Financial Access Survey (FAS). Financial efficiency (*NetIntMarg*), represented by bank net interest margin (percent), is defined as the accounting value of bank's net interest revenue as a share of its average interest-bearing (total earning) assets (originally sourced from Bankscope, Bureau van Dijk (BvD)). Another measure of efficiency is the bank lending-deposit spread, defined as the difference between lending rate and deposit rate, originally published in the IMF's International Financial Statistics (IFS, 2017).

Data for GDP per capita in 2010 USD (*GDP pc*), Population (*Population*), Population density (*PopDens*) proxied by millions of people per square kilometer, Age dependency ratio (percent) (*AgeDepRatio*) and dummies for Eastern European transition country (*Transition*), fuel exporter, offshore financial center status are collected from the FinStats database by Feyen and Sourrouille (2017). Control and additional variables The control variables are collected from a number of sources. The change in the Consumer Price index (CPI) from IFS is used as a measure of inflation ($Inflation$). Nominal and real effective exchange rates based on CPI ($NEER$ and $REER$) are collected from the World Economic Outlook (WEO, 2017) database.

The dollar share of the minimum-variance portfolio (MVP) is defined as: MVP=[Var(π)+Cov(π, s)]/[Var(π)+Var(s)+2Cov(π, s)], where π denotes inflation and s is the change in the real exchange rate. The inflation and real effective exchange rate variances and the covariance are the respective values from the past five years. (This expression could also be simplified to $MVP =$Var(π)/Cov(π, e), where e denotes the nominal rate of devaluation.)

The Three Bank Concentration ratio (3 *Bank Conc*) from GFDD is defined as the assets of the three largest commercial banks as a share of total commercial banking assets in the country. The share of foreign banks among total banks (*Foreign Banks*) is defined by Claessens and van Horen (2015) as the share of the number of foreign owned banks to the number of the total banks in a country. A bank is defined as foreign if 50 percent or more of its shares are owned by foreigners. The banking crisis variable (*Banking Crisis*), constructed by Laeven and Valencia (2013), is a dummy variable taking on value one if the country is in a systemic banking crisis, and zero otherwise. Chinn and Ito's 2006 measure of capital account openness (*KaOpen*) is used as a de jure measure of financial openness. Remittance inflows to GDP, reported in the GFDD, measures current transfers by migrant workers as well as wages and salaries earned by nonresident workers, as a fraction of GDP. Trade openness ($Imports$) is proxied by the ratio of imports to GDP (and we also use exports to GDP for robustness), with the data taken from WDI. The interest rate difference, ($i\ Diff$), is the three month nominal deposit interest rate difference between the domestic economy and the US, collected from IFS. External debt per GNI ($External\ Debt$) is collected from the World Bank's International Debt Statistics and Quarterly External Debt Statistics.[25]

There are several different measures of institutional quality available that measure somewhat different institutional dimensions. In this study we use the composite Worldwide Governance Indicators (WGI) from Kaufmann et al. (2010) as our measure of institutional quality. The composite WGI indicator is the simple average of the six different measures of institutional quality; Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption.

Bank Foreign Assets consists of foreign portfolio investment and other foreign assets by deposit-taking corporations, except the central bank, as reported in the IMF's Balance of Payment statistics, International Investment Position. Bank Total Assets is from the GFDD and is defined as total assets held by deposit money banks.

Country coverage

The countries included in the sample are Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Benin, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Burundi, Cambodia, Chile, China, Colombia, Costa Rica, Croatia, Dominican Republic, Egypt, Georgia, Ghana, Guatemala, Haiti, Honduras, Hungary, India, Indonesia, Israel, Jamaica, Kazakhstan, Kenya, Republic of Korea, Kuwait, Kyrgyz Republic, FYR Macedonia, Madagascar, Malawi, Malaysia, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Nicaragua, Nigeria, Pakistan, Paraguay, Peru, Philippines, Poland, Romania, Russia, Rwanda, Senegal, South Africa, Sri Lanka, Sudan, Swaziland, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, Uruguay, Venezuela, Vietnam, Yemen and Zambia.

[25]The external debt data for Kuwait, Namibia and Trinidad & Tobago are collected from IMF staff reports, and the external debt to GNI data for Trinidad & Tobago includes only external government debt.

	Mean	Std. Dev	Min	Max	Obs
Deposit Dollarization	0.291	0.245	0	0.984	1427
Credit Dollarization	0.252	0.24	0	0.982	1070
Private Credit to GDP	34.82	28.09	1.61	165.7	1427
Net Interest Margin	5.755	2.931	0.17	25.49	1406
Accounts per 1000 adults	942.4	915.7	2.39	5342	605
GDP p.c. (USD)	4739.1	6266.4	160.3	49015.9	1427
Inflation	0.134	1.146	-0.09	41.45	1425
Foreign Banks (%)	38.84	25.66	0	100	1357
3 Bank concentration ratio	0.626	0.189	0.146	1	1398
NEER	405.7	8200	33.2	304944	1427
KaOpen	0.476	0.33	0	1	1426
WGI	-0.324	0.567	-1.67	1.25	1427
REER Cyclicality	0.104	0.544	-0.99	1	1383
External Debt/GNI	0.502	0.335	0.03	2.26	1394
MVP	0.045	0.934	-2.69	9.59	1338
Population (mil.)	51.0	157.7	0.47	1371.2	1427
Age Dependency Ratio	4.101	0.288	3.47	4.73	1427
Transition Economy dummy	0.222	0.416	0	1	1427
Banking Crisis Dummy	0.056	0.229	0	1	1423

Table 5.4: Summary Statistics

Appendix 5B. Additional results

	Private Credit / GDP		Accounts		Net Interest Margin	
DepDol	-0.451**		-0.444		5.496***	
	(0.183)		(0.433)		(1.330)	
CredDol		0.194		-0.804**		0.632
		(0.122)		(0.400)		(1.420)
$PrivCredit_{-1}$	0.896***	0.890***				
	(0.040)	(0.042)				
$Accounts_{-1}$			0.545***	0.478***		
			(0.087)	(0.080)		
$NetIntMarg_{-1}$					0.401***	0.349***
					(0.077)	(0.096)
GDP growth	0.076	0.191	0.558	0.419		
	(0.209)	(0.211)	(0.518)	(0.511)		
External Debt	-0.047	-0.134***				
	(0.054)	(0.037)				
Inflation	-0.249***	-0.194	0.284	-0.022	0.187	2.477
	(0.044)	(0.230)	(0.329)	(0.401)	(0.331)	(1.843)
MVP			-0.057	-0.050		
			(0.054)	(0.067)		
NEER					-0.166	-0.752
					(0.812)	(1.375)
Foreign Banks	-0.001	-0.002***			0.002	0.043***
	(0.001)	(0.001)			(0.010)	(0.016)
Institutions	0.013	0.065*	0.146	0.210		
	(0.056)	(0.039)	(0.112)	(0.138)		
KaOpen					-0.831	0.375
					(0.510)	(0.481)
Banking Crisis	-0.101***	-0.126***	0.200	0.481	-0.677**	-0.336
	(0.032)	(0.042)	(0.259)	(0.296)	(0.288)	(0.423)
GDP pc			0.257***	0.311***	-0.331**	-0.492***
			(0.079)	(0.099)	(0.155)	(0.154)
Transition	0.401***	0.186**	0.248	-0.100		
	(0.129)	(0.079)	(0.348)	(0.453)		
Obs	1 298	974	556	550	1 298	896
Countries	77	74	61	60	75	72
Max T	19	14	11	11	21	13
Avg T	17	13	9	9	17	12
Instruments	146	125	150	129	146	125
AB-AR(1) p-val	0.000	0.001	0.046	0.077	0.000	0.001
AB-AR(2) p-val	0.708	0.647	0.489	0.789	0.489	0.789
Hansen p-val	1.000	1.000	1.000	1.000	1.000	0.996

Note: Dependent variables: ln(Private Credit/GDP), ln(Accounts per 1000 adults) and Net Interest Margin. System GMM estimations where dollarization and its determinants are endogenous. Robust SE in parentheses, symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Models include time dummies and a constant.

Table 5.5: Dollarization and Financial Development using more parsimonious models

	Private Credit / GDP					Accounts		Net Interest Margin	
$DepDol$	-0.502***	-0.434***				0.030		0.065	
	(0.172)	(0.160)				(0.328)		(1.939)	
$CredDol$			-0.065	-0.156*			0.017		-0.017
			(0.155)	(0.093)			(0.149)		(1.247)
$DepDol - CredDol$					-0.249***				
					(0.096)				
$DepDol * D^{HighInfl}$	0.342								
	(0.346)								
$DepDol * MaxInfl$		0.076							
		(0.059)							
$CredDol * D^{HighInfl}$			-0.465						
			(0.505)						
$CredDol * MaxInfl$				-0.055					
				(0.067)					
$PrivCredit_{-1}$	0.830***	0.832***	0.804***	0.817***	0.817***				
	(0.053)	(0.055)	(0.058)	(0.051)	(0.047)				
$Accounts_{-1}$						0.577***	0.550***		
						(0.079)	(0.084)		
$NetIntMarg_{-1}$								0.358***	0.218**
								(0.108)	(0.104)
$D^{HighInfl}$	-0.060		0.334						
	(0.213)		(0.304)						
$MaxInfl$		-0.013		0.050					
		(0.035)		(0.043)					
GDP growth	-0.105	-0.103	0.094	0.078	-0.006	0.338	0.293	2.578	2.112
	(0.270)	(0.267)	(0.251)	(0.240)	(0.246)	(0.579)	(0.580)	(2.527)	(2.791)
External Debt	-0.179***	-0.190***	-0.133*	-0.115	-0.150***	-0.195	-0.168	-0.472	-0.629
	(0.062)	(0.064)	(0.077)	(0.071)	(0.053)	(0.179)	(0.214)	(0.758)	(0.923)
$Inflation$	-0.119	-0.117	-0.437**	-0.402**	-0.342	0.265	0.147	-1.315	1.937
	(0.204)	(0.207)	(0.189)	(0.193)	(0.262)	(0.312)	(0.318)	(1.676)	(2.288)
MVP	-0.003	-0.005	0.021	0.017	0.011	-0.186**	-0.151**	0.079	-0.045
	(0.007)	(0.007)	(0.014)	(0.012)	(0.008)	(0.081)	(0.073)	(0.103)	(0.134)
REER Cycl.	0.026*	0.027*	0.020	0.016	0.024**	-0.003	-0.010	0.078	-0.071
	(0.014)	(0.015)	(0.016)	(0.016)	(0.012)	(0.024)	(0.030)	(0.163)	(0.179)
$NEER$	0.074	0.081	0.139**	0.119*	0.117*	0.049	0.053	1.137	-1.939***
	(0.054)	(0.056)	(0.069)	(0.067)	(0.063)	(0.123)	(0.137)	(0.894)	(0.751)
Foreign Banks	-0.003**	-0.003**	-0.002*	-0.002**	-0.003**	-0.002	-0.003	-0.005	-0.014
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.020)	(0.021)
Institutions	0.074	0.063	0.078	0.083	0.092	0.178	0.279**	-0.341	0.616
	(0.067)	(0.066)	(0.058)	(0.053)	(0.056)	(0.123)	(0.142)	(0.666)	(1.033)
3 Bank Conc.	-0.354**	-0.352**	-0.468**	-0.372**	-0.260*	-0.426	-0.065	-0.726	1.837
	(0.160)	(0.156)	(0.194)	(0.155)	(0.138)	(0.406)	(0.329)	(2.772)	(2.872)
$KaOpen$	0.044	0.038	-0.086	-0.097	-0.069	0.097	0.180	0.412	1.382
	(0.067)	(0.066)	(0.068)	(0.066)	(0.049)	(0.118)	(0.157)	(1.016)	(0.893)
Banking Crisis	-0.027	-0.030	-0.056	-0.076	-0.087*	0.218	0.189	-0.321	-0.748
	(0.037)	(0.038)	(0.048)	(0.046)	(0.045)	(0.146)	(0.152)	(0.404)	(0.571)
GDP pc	-0.074	-0.079	-0.025	-0.026	-0.020	0.133**	0.162**	-0.190	0.233
	(0.077)	(0.073)	(0.041)	(0.038)	(0.040)	(0.066)	(0.078)	(0.887)	(0.656)
Obs	1 214	1 214	961	961	960	536	530	1 190	936
Countries	77	77	74	74	74	58	57	75	72
Max T	19	19	14	14	14	11	11	19	14
Avg T	16	16	13	13	13	9	9	16	13
Instruments	119	119	119	119	118	94	94	107	107
AB-AR(1) p-val	0.000	0.000	0.002	0.002	0.002	0.047	0.050	0.000	0.004
AB-AR(2) p-val	0.722	0.717	0.306	0.325	0.350	0.686	0.587	0.545	0.354
Hansen p-val	1.000	1.000	0.999	0.997	0.999	0.986	0.994	0.934	0.940

Note: Dependent variables: ln(Private Credit/GDP), ln(Accounts per 1000 adults) and Net Interest Margin. System GMM with dollarization and its determinants predetermined. Robust SE in (), ***, ** and * denote significance at 1%, 5% and 10 % levels. Models include time dummies, a transition economy dummy, population, age dependency ratios and a constant.

Table 5.6: Financial development with dollarization and its determinants predetermined

	Private Credit / GDP		Accounts		Net Interest Margin	
DepDol	-0.604**		-0.818		6.336	
	(0.258)		(0.818)		(9.368)	
CredDol		-0.150		-0.686		1.520
		(0.204)		(0.500)		(2.895)
$PrivCredit_{-1}$	0.729***	0.700***				
	(0.101)	(0.082)				
$Accounts_{-1}$			0.627***	0.583***		
			(0.120)	(0.113)		
$NetIntMarg_{-1}$					0.288*	0.173
					(0.147)	(0.131)
GDP growth	-0.217	-0.134	-0.068	0.041	-0.498	1.530
	(0.401)	(0.314)	(0.585)	(0.572)	(1.954)	(1.667)
External Debt	-0.237**	-0.121	-0.047	-0.040	-0.498	1.530
	(0.098)	(0.081)	(0.244)	(0.247)	(1.954)	(1.667)
Inflation	0.020	-0.226	0.823*	0.611	-2.040	-0.289
	(0.129)	(0.145)	(0.450)	(0.381)	(3.557)	(3.682)
MVP	0.011	0.007	-0.322***	-0.235*	0.219*	0.139
	(0.014)	(0.014)	(0.122)	(0.126)	(0.124)	(0.276)
REER Cycl.	0.020	0.037	-0.034	-0.032	0.675*	-0.123
	(0.037)	(0.028)	(0.034)	(0.041)	(0.371)	(0.327)
NEER	-0.028	0.119	-0.593*	-0.568*	-0.198	-1.441
	(0.110)	(0.098)	(0.320)	(0.293)	(2.877)	(2.151)
Foreign Banks	0.004	0.009**	-0.002	0.001	-0.035	-0.063**
	(0.005)	(0.004)	(0.004)	(0.005)	(0.046)	(0.031)
Institutions	0.371	0.015	0.319	0.282	-2.726	-1.214
	(0.283)	(0.162)	(0.380)	(0.335)	(2.254)	(2.155)
3 *Bank Conc.*	-0.841***	-0.493*	-0.528	-0.578	4.123	2.367
	(0.256)	(0.266)	(0.427)	(0.503)	(4.493)	(2.948)
KaOpen	0.091	-0.005	0.081	0.441	-4.544	-0.287
	(0.231)	(0.157)	(0.247)	(0.291)	(3.808)	(2.768)
Banking Crisis	-0.072	-0.210**	0.349	0.400	-0.568	-0.454
	(0.092)	(0.103)	(0.225)	(0.262)	(1.588)	(0.922)
GDP pc	-0.347	-0.117	-0.014	-0.023	7.373**	1.381
	(0.230)	(0.138)	(0.228)	(0.265)	(3.756)	(2.209)
Population	-0.148	0.090	-0.358*	-0.228	-4.164	-1.761
	(0.137)	(0.148)	(0.198)	(0.139)	(3.378)	(2.511)
Age Dep. Ratio	-0.406	-0.669*	-0.396	-0.192	8.377	5.599
	(1.103)	(0.377)	(0.824)	(0.863)	(28.730)	(8.447)
Transition	0.106	-0.109	-0.338	0.101	-11.681	-0.546
	(0.367)	(0.257)	(0.654)	(0.569)	(18.285)	(7.203)
Obs	1 239	966	536	530	1 194	940
Countries	77	74	58	57	75	72
Max T	19	14	11	11	19	14
Avg T	16	13	9	9	16	13
Instruments	107	107	111	111	97	97
AB-AR(1) p-val	0.000	0.001	0.035	0.049	0.000	0.003
AB-AR(2) p-val	0.359	0.209	0.477	0.769	0.477	0.769
Hansen p-val	0.991	0.972	1.000	1.000	0.988	0.652

Note: Dependent variables: ln(Private Credit/GDP), ln(Accounts per 1000 adults) and Net Interest Margin. System GMM estimations where the lagged dependent variable, GDP growth, inflation and dollarization are assumed endogenous. Robust SE in parentheses, and symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Models include time dummies and a constant.

Table 5.7: Dollarization & Financial Development relationship estimated with fewer instruments

	Private credit / GDP		Accounts		Net Interest Margin	
	FE	Diff GMM	FE	Diff GMM	FE	Diff GMM
DepDol	-0.155**	-0.441**	-0.430*	-0.614*	0.630	3.479*
	(0.070)	(0.203)	(0.234)	(0.356)	(0.818)	(2.027)
$PrivCred_{-1}$	0.817***	0.730***				
	(0.022)	(0.056)				
$Accounts_{-1}$			0.694***	0.494***		
			(0.058)	(0.094)		
$NetIntMarg_{-1}$					0.397***	0.342***
					(0.057)	(0.075)
GDP growth	0.190	-0.132	0.391	0.690	1.099	3.214
	(0.192)	(0.313)	(0.333)	(0.578)	(1.331)	(3.789)
Inflation	-0.222***	-0.365***	0.061*	0.224**	-0.695***	-0.466
	(0.069)	(0.130)	(0.036)	(0.104)	(0.254)	(0.379)
MVP	0.004	0.002	-0.135*	-0.133*	0.016	0.119
	(0.006)	(0.007)	(0.081)	(0.071)	(0.063)	(0.094)
REER Cycl.	0.013	0.018*	0.006	-0.029	-0.037	-0.201
	(0.008)	(0.011)	(0.016)	(0.028)	(0.101)	(0.151)
NEER	0.058*	0.196***	-0.013	-0.015	-0.335	-0.547
	(0.031)	(0.057)	(0.073)	(0.134)	(0.355)	(0.746)
Foreign Banks	0.000	0.003*	-0.001	0.001	0.002	-0.008
	(0.001)	(0.002)	(0.001)	(0.003)	(0.007)	(0.021)
Institutions	0.088**	0.205***	0.132	0.166	-0.594	-1.171
	(0.040)	(0.065)	(0.113)	(0.199)	(0.387)	(0.827)
3 Bank Conc.	-0.102	-0.101	-0.066	0.060	0.792	3.007*
	(0.063)	(0.088)	(0.125)	(0.153)	(0.626)	(1.539)
KaOpen	0.034	0.074	-0.013	0.047	-0.298	0.316
	(0.042)	(0.062)	(0.093)	(0.096)	(0.440)	(0.683)
External Debt	-0.049**	0.005	-0.081	-0.122	0.089	-0.552
	(0.025)	(0.082)	(0.064)	(0.096)	(0.309)	(0.766)
Banking Crisis	-0.077***	-0.072*	0.061*	0.224**	-0.695***	-0.466
	(0.026)	(0.037)	(0.036)	(0.104)	(0.254)	(0.379)
GDP pc	0.042	-0.083	0.083	0.456	0.657	2.879
	(0.056)	(0.194)	(0.177)	(0.281)	(0.638)	(2.118)
Population	0.052	0.336	0.632	1.382*	0.782	-1.483
	(0.115)	(0.342)	(0.395)	(0.787)	(1.028)	(3.389)
Age Dep. Ratio	-0.125	-0.378	0.041	0.799	0.490	-0.747
	(0.128)	(0.573)	(0.303)	(0.751)	(1.165)	(5.778)
Obs	1,216	1,163	538	429	1,192	1,058
Countries	77	77	58	58	75	75
Max T	19	18	11	9	19	17
Avg T	16	15	9	7	16	14
$\bar{R}^2$	0.89		0.87		0.27	
Instruments		198		215		217
AB-AR(1) p-val		0.000		0.033		0.000
AB-AR(2) p-val		0.475		0.538		0.575
Hansen p-val		1.000		1.000		1.000

Note: Dependent variables: ln(Private Credit/GDP), ln(Accounts per 1000 adults) and Net Interest Margin. Fixed effects (FE) and Difference GMM (Diff GMM) estimations where dollarization and its determinants are endogenous.

Table 5.8: Deposit dollarization and Financial Depth, Access and Efficiency with FE and Difference GMM estimators

	Private Credit / GDP		Accounts		Net Interest Margin	
DepDol	-0.368**		0.223		5.285**	
	(0.185)		(0.305)		(2.634)	
CredDol		0.113		-0.106		-1.132
		(0.128)		(0.220)		(1.896)
$PrivCredit_{-1}$	0.828***	0.862***				
	(0.052)	(0.040)				
$Accounts_{-1}$			0.761***	0.760***		
			(0.070)	(0.075)		
$NetIntMarg_{-1}$					0.327***	0.307***
					(0.078)	(0.095)
GDP growth	0.059	0.021	0.772*	0.801*	-0.033	2.043
	(0.330)	(0.220)	(0.466)	(0.465)	(2.363)	(2.463)
External Debt	-0.033	-0.023	-0.227*	-0.187	-0.671	-1.280
	(0.063)	(0.071)	(0.116)	(0.129)	(0.813)	(0.829)
Inflation	-0.192	-0.327**	0.947*	1.011*	1.548	1.594
	(0.196)	(0.156)	(0.484)	(0.546)	(1.595)	(1.436)
MVP	0.002	0.006	-0.264**	-0.262**	0.041	-0.003
	(0.006)	(0.010)	(0.132)	(0.130)	(0.086)	(0.113)
REER Cycl.	0.022	0.010	-0.010	-0.027	-0.244	-0.078
	(0.013)	(0.012)	(0.031)	(0.031)	(0.163)	(0.170)
NEER	0.076	0.177***	-0.135	-0.116	-0.260	-1.770*
	(0.055)	(0.058)	(0.160)	(0.151)	(0.848)	(0.986)
Foreign Banks	-0.003**	-0.003***	-0.002	-0.002	0.033**	0.046**
	(0.001)	(0.001)	(0.002)	(0.003)	(0.017)	(0.022)
Institutions	0.065	0.106**	0.136	0.079	-0.175	-0.561
	(0.058)	(0.053)	(0.103)	(0.096)	(0.630)	(0.857)
3 *Bank Conc.*	-0.241*	-0.090	-0.578*	-0.637**	0.751	3.370
	(0.140)	(0.170)	(0.312)	(0.314)	(1.475)	(2.055)
KaOpen	0.014	-0.063	-0.079	-0.056	-1.080	1.438*
	(0.085)	(0.066)	(0.081)	(0.080)	(0.945)	(0.766)
Banking Crisis	-0.047	-0.096**	0.191*	0.210	-0.313	-0.127
	(0.037)	(0.038)	(0.116)	(0.137)	(0.459)	(0.465)
GDP pc	-0.042	-0.018	0.057	0.070	-0.205	-0.344
	(0.052)	(0.027)	(0.045)	(0.044)	(0.531)	(0.334)
Population	-0.089	-0.027	-0.129	-0.181**	0.062	0.875
	(0.057)	(0.053)	(0.079)	(0.082)	(0.584)	(0.700)
Age Dep. Ratio	-0.062	0.033	-0.352	-0.302	-0.535	0.203
	(0.430)	(0.250)	(0.335)	(0.281)	(4.534)	(2.356)
Transition	0.286	0.213	-0.092	-0.099	-2.488	0.594
	(0.205)	(0.145)	(0.204)	(0.195)	(2.446)	(1.698)
Obs	1 022	777	405	399	945	713
Countries	63	60	49	48	62	59
Max T	19	14	10	10	18	13
Avg T	16	13	8	8	15	12
Instruments	200	179	218	197	255	234
AB-AR(1) p-val	0.000	0.012	0.027	0.027	0.000	0.006
AB-AR(2) p-val	0.813	0.575	0.785	0.813	0.632	0.592
Hansen p-val	1.000	1.000	1.000	1.000	1.000	1.000

Note: Dependent variables: ln(Private Credit/GDP), ln(Accounts per 1000 adults) and Net Interest Margin. System GMM estimations where dollarization and its determinants are endogenous. Robust SE in parentheses, and symbols ***, ** and * denote significance at the 1%, 5% and 10 % levels, respectively. Models include time dummies and a constant.

Table 5.9: The relationship between dollarization and financial development in countries with deposit and credit dollarization above 1 %

6 Conclusion

This thesis consists of four empirical articles that look at the relationship between the financial market and the real economy. I study how different imbalances, either global or domestic, and financial integration, affect macrofinancial outcomes such as exchange rate sensitivity, consumption, international consumption risk sharing or financial sector development.

In Chapter 2 I show that the composition of net foreign assets matter for the exchange rate sensitivity to changes in financial market risk tolerance using a panel of 28 currencies over the period 1/1997-6/2016. I find that debt financing increases the exchange rate sensitivity to financial turbulence, whereas equity financing reduces it - currencies of countries with large negative net external portfolio debt are much more vulnerable to changes in financial market uncertainty than currencies with the equivalent net external equity. Ownership matters too, private net foreign debt heightens the exchange rate sensitivity much more than public. I also show that the relationship between banking sector risk intolerance, net external asset positions and exchange rates has moreover become stronger since the credit crisis.

Chapter 3 looks at the long run relationship between consumption and wealth. We show that financial integration, by relaxing liquidity constraints of consumers, has permanently increased the consumption-to-wealth ratio in the US over the sample period Q4/1951-Q4/2016. We do this using an unobserved component model, where the regression of consumption on assets and earnings is augmented with a non-stationary unobserved component. By explicitly estimating - and hence controlling for – such a component in the regression, valid long-run elasticity estimates of consumption to wealth can be obtained irrespective of whether consumption, assets and earnings are cointegrated. The results suggest that there is a non-stationary latent component present in the consumption equation, and we interpret this component as stemming from financial liberalization.

Chapter 4 looks empirically at international consumption risk sharing and its determinants in a panel of 120 countries from 1970 to 2014. Complete financial markets allow countries to share their consumption risks internationally, thereby creating welfare gains through lower volatility of aggregate consumption. International consumption risk sharing in especially emerging markets and developing countries is however far from complete, where the estimates of the degree of international risk sharing range around 30 %. Contrary to some previous studies, I show that financial liberalization and financial integration has a significantly positive impact on international consumption risk sharing in poorer developing countries, whereas in emerging market countries only capital account openness has an impact. Moreover, there is some evidence that high income inequality or a high share of low income individuals reduces consumption smoothing in less developed countries. Lack of financial reforms, a lower degree of financial integration and higher inequality can thus partly explain why the degree of risk sharing is lower in developing countries than in advanced economies.

Finally, Chapter 5 looks at the impact of dollarization on financial development. While developing economies have made significant strides in financial development over the past decades, financial dollarization, as reflected in elevated shares of foreign currency deposits and credit in the banking system, remains common. Chapter 5 therefore studies the impact of financial dollarization, differentiating across foreign currency deposits and credit on financial depth, access and efficiency for a sample of 77 emerging market and developing countries over the past two decades. Panel regressions estimated using system GMM show that dollarization, and deposit dollarization in particular, has a negative impact on financial deepening. There is also some evidence that dollarization hampers improvements in financial inclusion. The results suggest that beyond standard concerns related to heightened financial stability risks, policy efforts to reduce dollarization can spur faster, safer and more inclusive financial development.

The main conclusion is that international and domestic imbalances, such as the reliance on foreign debt financing and foreign currency savings, can have adverse effects on both exchange rate vulnerability and the financial market depth and efficiency. Financial integration has both domestic and global effects. I find that it affects both the domestic consumption-to-wealth ratio and international consumption risk sharing in both advanced economies and poorer developing countries, but much less so in emerging markets. This finding could be explained by the observation that emerging market countries have experienced a lot of procyclical portfolio debt inflows, which are the ones that in Chapter 2 are found to also increase the exchange rate vulnerability. Another take away of this thesis, which is more empirical in nature, is the importance of controlling for potential unobserved factors. As is highlighted in Chapters 3 and 4, ignoring this can lead to significantly different inferences.

Nederlandse samenvatting (Summary in Dutch)

In dit proefschrift onderzoek ik de relatie tussen verschillende soorten mondiale en binnenlandse onevenwichtigheden en financiële integratie, en bestaat uit vier empirische hoofdstukken. In hoofdstuk 2 wordt onderzocht hoe de samenstelling van de netto buitenlandse vermogenspositie van invloed is op wisselkoersgevoeligheid voor wereldwijde onzekerheid op de financiële markten. De empirische resultaten laten zien dat schuldfinanciering de kwetsbaarheid van wisselkoersen voor financiële turbulentie verhoogt, terwijl aandelenfinanciering dit vermindert. Hoofdstuk 3 gebruikt een niet-geobserveerde componentbenadering om de langetermijnrelatie tussen consumptie en (woning)vermogen in de VS te bestuderen. De resultaten suggereren dat er een niet-stationaire latente component aanwezig is in de consumptievergelijking en dat het negeren ervan zorgt voor een overschatting van het effect van zowel financiële als woningvermogen op consumptie. Hoofdstuk 4 analyseert welke factoren die de internationale risicodeling van consumptie beïnvloeden. Financiële liberalisering en financiële integratie hebben een aanzienlijk positief effect op de internationale risicodeling in consumptie in armere ontwikkelingslanden. De resultaten suggereren ook dat een hoog aandeel van personen met een laag inkomen de spreiding van consumptie in zowel geavanceerde als minder ontwikkelde economieën vermindert. Hoofdstuk 5 gaat in op de relatie tussen dollarisatie en financiële ontwikkeling en laat zien dollarisatie van depoisto's, en ook de mismatch tussen dollarisatie van deposito's en kredieten, een negatief effect heeft op financiële ontwikkeling en financiële efficiëntie in minder ontwikkelde landen.

Bibliography

Abiad, A., E. Detragiache, and T. Tressel (2010, June). A New Database of Financial Reforms. *IMF Staff Papers 57*(2), 281–302.

Aizenman, J. and M. Binici (2015). Exchange market pressure in oecd and emerging economies: Domestic vs. external factors and capital flows in the old and new normal.

Alfaro, L., S. Kalemli-Ozcan, and V. Volosovych (2014). Sovereigns, upstream capital flows, and global imbalances. *Journal of the European Economic Association 12*(5), 1240–1284.

Almarzoqi, R., S. B. Naceur, and A. Kotak (2015). What matters for financial development and stability? Imf working paper 15/173, International Monetary Fund.

Alquist, R. and M. D. Chinn (2008). Conventional and unconventional approaches to exchange rate modelling and assessment. *International Journal of Finance and Economics, John Wiley & Sons, Ltd. 13*(1), 2–13.

Antonakakis, N. and J. Scharler (2012, 08). Has globalization improved international risk sharing? *International Finance 15*, 251–266.

Araujo, J. D., A. C. David, C. van Hombeeck, and C. Papageorgiou (2015, July). Joining the club? procyclicality of private capital inflows in low income developing countries. *IMF Working Paper No. 15/163.*

Artis, M. J. and M. Hoffmann (2008). Financial Globalization, International Business Cycles and Consumption Risk Sharing. *Scandinavian Journal of Economics 110*(3), 447–471.

Artis, M. J. and M. Hoffmann (2012). The home bias, capital income flows and improved long-term consumption risk sharing between industrialized countries. *International Finance 14*, 481–505.

Asdrubali, P., B. E. Sorensen, and O. Yosha (1996). Channels of Interstate Risk Sharing: United States 1963-1990. *The Quarterly Journal of Economics 111*(4), 1081–1110.

Backus, D., P. Kehoe, and F. Kydland (1992). International real business cycles. *Journal of Political Economy 100*(4), 745–75.

Bai, Y. and J. Zhang (2012). Financial integration and international risk sharing. *Journal of International Economics 86*(1), 17–32.

Baker, S. R., N. Bloom, and S. J. Davis (2018). Measuring economic policy uncertainty. Database, www.PolicyUncertainty.com.

Baliño, T., A. Bennett, and E. Borensztein (1999). Monetary policy in dollarized economies. Imf occasional papers no. 171, International Monetary Fund.

Balli, F. and F. Rana (2014). Determinants of risk sharing through remittances: cross-country evidence. CAMA Working Papers 2014-12, Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, The Australian National University.

Barajas, A. and R. Morales (2003). Dollarization of liabilities: Beyond the usual suspects. Imf working paper, no. 03/11, International Monetary Fund.

Barajas, A., E. D.-N. Thorsten Beck, and R. Yousefi (2013). Too cold, too hot, or just right? assessing financial sector development across the globe. Imf working paper, no. 13/81, International Monetary Fund.

Barro, R. J. (2000). Inequality and Growth in a Panel of Countries. *Journal of Economic Growth 5*(1), 5–32.

Basso, H. S., O. Calvo-Gonzalez, and M. Jurgilas (2011). Financial dollarization: The role of foreign-owned banks and interest rates. *Journal of Banking and Finance 35*, 794–806.

Bauwens, L., M. Lubrano, and J.-F. Richard (2000). *Bayesian inference in dynamic econometric models*. Oxford University Press.

Beck, T., E. Feyen, A. Ize, and F. Moizeszowicz (2008). Benchmarking financial development. Policy research working paper no. 4638, World Bank.

Beck, T. and H. Hesse (2009). Why are interest spreads so high in uganda? *Journal of Development Economics 88*, 192–204.

Becker, S. O. and M. Hoffmann (2006). Intra- and international risk-sharing in the short run and the long run. *European Economic Review 50*(3), 777 – 806.

Bellemare, M. F., T. Masaki, and T. B. Pepinsky (2017). Lagged explanatory variables and the estimation of causal effect. *The Journal of Politics 79*, 949–963.

Bianchi, F., M. Lettau, and S. Ludvigson (2017). Monetary policy and asset valuation. *Unpublished manuscript*.

Blalock, G. and P. J. Gertler (2008). Welfare gains from foreign direct investment through technology transfer to local suppliers. *Journal of International Economics 74*.

Bluedorn, J., R. Duttagupta, J. Guajardo, and P. Topalova (2013). Capital flows are fickle; anytime, anywhere. *IMF Working Papers 13/183*.

BoP-IIP (2016). Balance of payments and international investment position statistics. Database, International Monetary Fund.

Brunnermeier, M., D. Rodrik, J. D. Gregorio, B. Eichengreen, M. El-Erian, A. Fraga, T. Ito, P. R. L. J. Pisani-Ferry, E. Prasad, R. Rajan, M. Ramos, H. Rey, K. Rogoff, H. S. Shin, A. Velasco, B. W. di Mauro, and Y. Yu (2012). Banks and cross-border capital flows: Policy challenges and regulatory responses. Technical report, Brookings Committee on International Economic Policy and Reform.

Burnside, C., M. Eichenbaum, and S. Rebelo (2001). Hedging and financial fragility in fixed exchange rate regimes. *European Economic Review 45*, 1151–1193.

Calvo, G. A., L. Leiderman, and C. M. Reinhart (1993). Capital inflows and real exchange rate appreciation in latin america: The role of external factors. *IMF Staff Papers 40*, 108–151.

Campbell, J. and N. Mankiw (1989). Consumption, income, and interest rates: reinterpreting the time series evidence. *NBER Macroeconomics Annual 4*, 185–216.

Canarella, G., S. Pollard, and K. Lai (1990). Cointegration between exchange rates and relative prices: another view. *European Economic Review 34*(7), 1303–1322.

Canova, F. and M. Ravn (1996). International consumption risk sharing. *International Economic Review 37*(3), 573–601.

Carroll, C. D., M. Otsuka, and J. Slacalek (2011). How large are housing and financial wealth effects? *Journal of Money, Credit and Banking 43*(1), 55–79.

Carroll, C. D., J. Slacalek, and M. Sommer (2012). Dissecting saving dynamics: measuring wealth, precautionary, and credit effects. *IMF Working Paper WP/12/219*.

Carter, C. and R. Kohn (1994). On Gibbs sampling for state space models. *Biometrika 81*, 541–53.

Catão, L. and M. E. Terrones (2016). Financial de-dollarization: A global perspective and the peruvian experience. Imf working paper no. 16/97, International Monetary Fund.

Chang, Y., J. Miller, and J. Park (2009). Extracting a common stochastic trend: theory with some applications. *Journal of Econometrics 150*(2), 231–47.

Chinn, M. and H. Ito (2006). What matters for financial development? capital controls, institutions, and interactions. *Journal of Development Economics 81*(1), 163–192.

Chudik, A. and M. H. Pesaran (2013). Large Panel Data Models with Cross-Sectional Dependence: A Survey. CESifo Working Paper Series 4371, CESifo Group Munich.

Čihák, M., A. Demirgüç-Kunt, E. Feyen, and R. Levine (2012). Benchmarking financial systems around the world. Policy research working paper; no. 6175, World Bank, Washington, DC.

Claessens, S. and N. van Horen (2015). The impact of the global financial crisis on banking globalization. Dnb wp no. 459, The Dutch National Bank.

Coakley, J. and A.-M. Fuertes (2001). A non-linear analysis of excess foreign exchange returns. *Manchester School 69*.

Collin-Dufresn, P., R. S. Goldstein, and J. S. Martin (2001). The determinants of credit spread changes. *The Journal of Finance 56*.

Cooper, D. (2016). Wealth effects and macroeconomic dynamics. *Journal of Economic Surveys 30*(1), 34–55.

Corcoran, A. (2007). International financial integration and consumption risk sharing. Technical report, mimeo, Trinity College Dublin.

Court, Ozsoz, and Rengifo (2012). The impact of deposit dollarization on financial deepening. *Emerging Markets Finance and Trade 48*.

Davis, M. and M. Palumbo (2001). A primer on the economics and time series econometrics of wealth effects. *Finance and Economics Discussion Series Federal Reserve Board Washington 2001-09*.

de la Torre, A., E. Feyen, and A. Ize (2013). Financial development: Structure and dynamics. *Oxford University Press*.

De Nicolo, G., P. Honohan, and A. Ize (2005). Dollarization of bank deposits: Causes and consequences. *Journal of Banking and Finance 29*, 1697–1727.

Deaton, A. and A. Heston (2010). Understanding ppps and ppp-based national accounts. *American Economic Journal: Macroeconomics 2*(4), 1–35.

Della Corte, P., S. Riddiough, and L. Sarno (2016). Currency premia and global imbalances. *Review of Financial Studies 29*.

Della Corte, P., L. Sarno, and G. Sestieri (2012). The predictive information content of external imbalances for exchange rate returns: How much is it worth? *Review of Economics and Statistics 94*.

Durbin, J. and S. Koopman (2001). *Time series analysis by state space methods*. Oxford University Press.

Eichengreen, B. (2001). What problems can dollarization solve? *Journal of Policy Modeling 23*, 267–277.

Engle, R. and C. Granger (1987). Cointegration and error correction: representation, estimation and testing. *Econometrica 55*(2), 251–76.

Everaert, G. (2010). Estimation and inference in time series with omitted $I(1)$ variables. *Journal of Time Series Econometrics 2*(2), 1–25.

Feenstra, R. C., R. Inklaar, and M. Timmer (2015). The next generation of the penn world table. Working Paper 19255, National Bureau of Economic Research.

Fernández-Arias, E. (1996). The new wave of private capital flows: Push or pull? *Journal of Development Economics 48*, 389–418.

Ferson, W., S. Sarkissian, and T. Simin (2003, August). Spurious regressions in financial economics? *Journal of Finance LVIII*(4), 1393–1413.

Feyen, E. and D. Sourrouille (2017). Finstats 2017: A ready-to-use tool to benchmark financial sectors across countries and time. World bank mimeo, World Bank, Washington, DC.

Flood, R. P., N. P. Marion, and A. Matsumoto (2012). International risk sharing during the globalization era. *Canadian Journal of Economics 45*(2), 394–416.

Forbes, K. J. and F. E. Warnock (2012). Capital flow waves: Surges, stops, flight, and retrenchment. *Journal of International Economics 88*(2), 235–251.

FRED (2018). Database, Board of Governors of the Federal Reserve System (US), FRED, Federal Reserve Bank of St. Louis;.

Frühwirth-Schnatter, S. and H. Wagner (2010). Stochastic model specification search for Gaussian and partial non-Gaussian state space models. *Journal of Econometrics 154*(1), 85–100.

Fuleky, P., L. Ventura, and Q. Zhao (2015). Common correlated effects and international risk sharing. Working papers, University of Hawaii Economic Research Organization, University of Hawaii at Manoa.

Gabaix, X. and M. Maggiori (2015). International liquidity and exchange rate dynamics. *Quarterly Journal of Economics 130*, 1369–1420.

García-Escribano, M. and S. Sosa (2011). What is driving financial de-dollarization in latin america? Imf working paper no 11/10, International Monetary Fund.

George, E. and R. McCulloch (1993). Variable selection via Gibbs sampling. *Journal of the American Statistical Association 88*, 881–889.

Geweke, J. (1992). Evaluating the accuracy of sampling-based approaches to the calculation of posterior moments. In J. Berger, J. Bernardo, A. Dawid, and A. Smith (Eds.), *Bayesian statistics*. Oxford University Press.

Ghosh, Atish R.and Qureshi, M. S., J. I. Kim, and J. Zalduendo (2014). Surges. *Journal of International Economics 92*, 266–285.

Gourinchas and Rey (2007). International financial adjustment. *Journal of Political Economy 115*, 665–703.

Granger, C. and P. Newbold (1974). Spurious regressions in econometrics. *Journal of Econometrics 35*, 143–159.

Groen, J., R. Paap, and F. Ravazzolo (2013). Real-time inflation forecasting in a changing world. *Journal of Business and Economic Statistics 31*(1), 29–44.

Gulde, A. M., D. S. Hoelscher, lain Ize, D. D. Marston, and G. D. Nicolo (2004). Financial stability in dollarized economies. Imf occasional papers 230, International Monetary Fund.

Habib, M. and L. Stracca (2012). Getting beyond carry trade: What makes a safe haven currency? *Journal of International Economics 87*, 50–64.

Hadzi-Vaskov, M. (2006). Workers? Remittances and International. Working Papers 06-19, Utrecht School of Economics.

Hamilton, J. (1994). *Time series analysis*. Princeton.

Harvey, A. (1989). *Forecasting structural time series models and the Kalman filter*. Cambridge University Press.

Harvey, A., S. Henry, S. Peters, and S. Wren-Lewis (1986). Stochastic trends in dynamic regression models: an application to the employment-output equation. *Economic Journal 96*, 975–985.

Hausmann, R. (1999). Should there be five currencies or one hundred and five? *Foreign Policy 116*, 65–79.

Hevia, C. and L. Serven (2013). Partial consumption insurance and financial openness across the world. Policy Research Working Paper Series 6479, The World Bank.

Honohan, P. and A. Shi (2001). Deposit dollarization and the financial sector in emerging economies. Policy research working paper; no. 2748, World Bank, Washington, DC.

Hossfeld, O. and R. MacDonald (2015). Carry funding and safe haven currencies: A threshold regression approach. *Journal of International Money and Finance 59*, 185–202.

IFS (2017). International financial statistics. Database, International Monetary Fund.

Imbs, J. (2006). The real effects of financial integration. *Journal of International Economics 68*(2), 296–324.

Ize, A. and E. L. Yeyati (2003). Financial dollarization. *Journal of International Economics 59*, 323–347.

Ize, A. and E. L. Yeyati (2005). Financial de-dollarization: Is it for real? Imf working paper no. 05/187, International Monetary Fund.

Jeanne, O. (2000). Foreign currency debt and the global financial architecture. *European Economic Review 44*, 719–727.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control 12*(2-3), 231–254.

Johansen, S. (1991, November). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica 59*(6), 1551–1580.

Jorda, O. and A. M. Taylor (2012). The carry trade and fundamentals: Nothing to fear but feer itself. *Journal of International Economics 88*, 74–90.

Kaminsky, G. L., C. M. Reinhart, and C. A. Vegh (2004). When it rains, it pours: Procyclical capital flows and macroeconomic policies. Nber working papers 10780, National Bureau of Economic Research.

Kaufmann, D., A. Kraay, and M. Mastruzzi (2010). The worldwide governance indicators: A summary of methodology, data and analytical issues. World bank policy research, working paper no. 5430., World Bank, Washington DC.

Kim, C.-J. and C. Nelson (1999). *State-space models with regime switching. Classical and Gibbs-sampling approaches with applications*. Cambridge: MIT Press.

Kim, S., N. Shephard, and S. Chib (1998, July). Stochastic volatility: likelihood inference and comparison with ARCH Models. *Review of Economic Studies 65*(3), 361–93.

Kim, Y. and C.-J. Kim (2011). Dealing with endogeneity in a time-varying parameter model: joint estimation and two-step estimation procedures. *Econometrics Journal 14*, 487–497.

Kokenyne, A., J. Levy, and R. Veyrune (2010). Dedollarization. Imf working paper, no. 10/188, International Monetary Fund.

Kose, A. M., E. S. Prasad, and A. D. Taylor (2011). Thresholds in the process of international financial integration. *Journal of International Money and Finance 30*(1), 147–179.

Kose, M. A., E. S. Prasad, and M. E. Terrones (2009). Does financial globalization promote risk sharing? *Journal of Development Economics 89*(2), 258–270.

Krueger, D. (2004). Consumption and saving: Theory and evidence. Teaching manuscript, University of Pennsylvania.

Laeven, L. and F. Valencia (2013). Systemic banking crises database: An update. Imf working paper 12/163, International Monetary Fund.

Lane, P. R. and G. M. Milesi-Ferretti (2007). The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970-2004. *Journal of International Economics 73*(2), 223–250.

Lettau, M. and S. Ludvigson (2001). Consumption, aggregate wealth, and expected stock returns. *Journal of Finance LVI*(3), 815–849.

Lettau, M. and S. Ludvigson (2004). Understanding trend and cycle in asset values: re-evaluating the wealth effect on consumption. *American Economic Review 94*(1), 276–299.

Lettau, M. and S. Ludvigson (2015). Changes in the measurement of consumption in cay. *Report*.

Levchenko, A. and P. Mauro (2007). Do some forms of financial flows help protect against "sudden stops"? *The World Bank Economic Review 21*, 389–411.

Levine, R. (2005). Finance and growth: Theory and evidence. In *in Aghion, P. and Durlauf, S. (eds.): Handbook of Economic Growth*. Elsevier.

Levy Yeyati, E. . (2006). Financial dollarization: Evaluating the consequences. *Economic Policy 21*, 61–118.

Lewis, K. K. (1996). What Can Explain the Apparent Lack of International Consumption Risk Sharing? *Journal of Political Economy 104*(2), 267–97.

Lustig, H., N. Roussanov, and A. Verdelhan (2011). Common risk factors in currency markets. *Review of Financial Studies*.

Mace, B. J. (1991). Full Insurance in the Presence of Aggregate Uncertainty. *Journal of Political Economy 99*(5), 928–56.

MacKinnon, J. (2010). Critical values for cointegration tests. *Working Paper Economics Department Queen's University 1227*.

Martin, A. D. and L. J. Mauer (2003). Exchange rate exposures of us banks: A cash flow-based methodology. *Journal of Banking and Finance 27*.

McCulloch, R. E. and R. S. Tsay (1993). Bayesian inference and prediction for mean and variance shifts in autoregressive time series. *Journal of the American Statistical Association 88*(423), 968–978.

Menkhoff, L., L. Sarno, M. Schmeling, and A. Schrimpf (2012). Carry trades and global foreign exchange volatility. *The Journal of Finance 67*, 681–718.

Modigliani, F. and M. Miller (1958). The cost of capital, corporation finance and the theory of investment. *American Economic Review 48*, 261–297.

Moser, G., W. Pointner, and J. Scharler (2005). Financial globalization, capital account liberalization and international consumption risk-sharing. *National Bank of Austria, Focus 1*, 05.

Newey, W. and K. West (1987). A simple positive semi-definite heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica 55*, 703–708.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica 49*.

Obstfeld, M. (1993). Are Industrial-Country Consumption Risks Globally Diversified? NBER Working Papers 4308, National Bureau of Economic Research, Inc.

Ogaki, M. and J. Y. Park (1997). A cointegration approach to estimating preference parameters. *Journal of Econometrics 82*(1), 107–134.

Park, J. Y. (1990). Testing for unit roots and cointegration by variable addition. *Advances in econometrics 8*(2), 107–133.

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. CESifo Working Paper Series 1229, CESifo Group Munich.

Pesaran, M. H. (2006). Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure. *Econometrica 74*(4), 967–1012.

Phillips, P. (1986). Understanding spurious regressions in econometrics. *Journal of Econometrics 33*, 311–340.

Phillips, P. C. B. and S. Ouliaris (1990). Asymptotic properties of residual based tests for cointegration. *Econometrica 58*(1), 165–193.

Planas, C., W. Roeger, and A. Rossi (2007). How much has labor taxation contributed to European structural unemployment? *Journal of Economic Dynamics and Control 31*(4).

Povcalnet (2017). Database, the World Bank.

Reinhart, C. M., K. S. Rogoff, and M. A. Savastano (2014). Addicted to dollars. *Annals of Economics and Finance 15*, 1–50.

Ricci, L. A., G. M. Milesi-Ferretti, and J. Lee (2013). Real exchange rates and fundamentals: A cross-country perspective. *Journal of Money, Credit and Banking 45*, 845–865.

Roodman, D. (2009a). How to do xtabond2: An introduction to difference and system gmm in stata. *Stata Journal 9*, 86–136.

Roodman, D. (2009b). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics 71*, 135–158.

Rossi, B. (2013). Exchange rate predictability. *Journal of Economic Literature 51*(4), 1063–1119.

Rudd, J. and K. Whelan (2006). Empirical proxies for the consumption-wealth ratio. *Review of Economic Dynamics 9*, 34–51.

Sahay, R., A. Kyobe, L. Nguyen, M. Cihk, A. Barajas, D. A. Pena, and R. Bi (2015). Rethinking financial deepening: Stability and growth in emerging markets. Imf staff discussion note 15/08., International Monetary Fund.

Sarantis, N. and C. Stewart (2001). Unobserved components in an error-correction model of consumption for Southern European countries. *Empirical Economics 26*, 391–405.

Savastano, M. A. (1996). Dollarization in latin america: Recent evidence and some policy issues. In *P. Mizen and E. Pentecost (eds.), The Macroeconomics of International Currencies*. Brookfield Vt., Edward Elgar.

Slacalek, J. (2004). International evidence on cointegration between consumption, income and wealth. *Unpublished manuscript*.

Solt, F. (2016). The standardized world income inequality database. *Social Science Quarterly 97*(5), 1267–1281. SWIID Version 6.2, March 2018.

Sorensen, B. E. and O. Yosha (1998). International risk sharing and European monetary unification. *Journal of International Economics 45*(2), 211–238.

Stiglitz, J. E. and A. Weiss (1981). Credit rationing in markets with imperfect information. *The American Economic Review 71*, 393–410.

Stockman, A. C. and L. L. Tesar (1995). Tastes and Technology in a Two-Country Model of the Business Cycle: Explaining International Comovements. *American Economic Review 85*(1), 168–85.

Tai, C.-S. (2005). Asymmetric currency exposure of us bank stock returns. *Journal of Multinational Financial Management 15*.

Terrones, M., E. Prasad, and A. Kose (2003). Financial integration and macroeconomic volatility. Imf working paper no. 03/50, International Monetary Fund.

Trabelsi, M. and M. Cherif (2017). Capital account liberalization and financial deepening: Does the private sector matter? *The Quarterly Review of Economics and Finance 64*, 141–151.

Ventura, L. (2008). Risk sharing opportunities and macroeconomic factors in Latin American and Caribbean countries : A consumption insurance assessment. Policy Research Working Paper Series 4490, The World Bank.

Volosovych, V. (2013). Risk sharing from international factor income: explaining cross-country differences. *Applied Economics 45*(11), 1435–1459.

WDI (2017). World development indicators. Database, The World Bank.

WEO (2017). World economic outlook. Database, International Monetary Fund.

Zeldes, S. P. (1989). Consumption and Liquidity Constraints: An Empirical Investigation. *Journal of Political Economy 97*(2), 305–346.

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