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REMITTANCES, REGIONS AND RISK SHARING

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To my family

Preface

This report is a result of a research project carried out at the Economics Centre at the Economic Research Institute at the Stockholm School of Economics.

This volume is submitted as a doctor's thesis at the Stockholm School of Economics. As usual at the Economic Research Institute, the author has been entirely free to conduct and present her research in her own ways as an expression of her own ideas.

The institute is grateful for the financial support which has made it possible to fulfill the project.

Filip Wijkström
Director of the Economic Research Institute
at the Stockholm School of Economics

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Economics Centre
Stockholm School of Economics

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Washington, D.C. April 2010

Kristin Magnusson Bernard

Summary of Thesis

Introduction

The theme of this thesis is the importance of economic fluctuations within and between countries for capital flows and risk sharing inside and across national borders. Absent restrictions on international capital flows, macroeconomic theory tells us that trade in financial assets should be motivated by insurance motives (Backus, Kehoe and Kydland, 1992). Increased financial integration should then allow for improved risk sharing or consumption smoothing both across and within countries, and especially so for entities where fluctuations in local production are dissimilar. Moreover, countries experiencing high productivity shocks should experience net capital inflows (Backus, Kehoe and Kydland, 1994).

The increasing financial and real integration over the last decades both within and across countries provides us with many interesting examples against which we can contrast the above claims. First, of the two production factors capital and labor we typically only model the first one as mobile in the international business cycle literature. However, the rapidly increasing international labor migration of the last decades has also given rise to a dramatically larger role for a type of capital flow, workers' remittances, which due to their special nature of transfers between family members potentially behave very differently than predicted by standard international business cycle models (Fajnzylber et al, 2006). Second, there has been a renewed interest in the importance of sub-national economic fluctuations following the finding that while increased international financial integration has lead to more highly correlated output fluctuations across countries, business cycle heterogeneity within countries has actually increased (Artis and Zhang, 1999, Patridge and Rickman, 2005).

The first two papers of the thesis investigate the implications of having workers' remittances, flow between regions such as the United States and South America that opposed to the standard model's predictions instead display highly correlated output fluctuations. The decision to remit has often been justified on altruistic grounds and hence it has been argued that remittances should increase following drops in recipients' income. At the macroeconomic level, remittances should then be countercyclical with respect to output in the migrant's country of origin, thus potentially stabilizing its business cycle. We instead study the importance of local economic conditions such as the

regional business cycle, immigrant density and occupational patterns across economic sectors. After finding empirical support for the importance of host country economic conditions, we build a general equilibrium model and investigate the quantitative importance of remittances for the volatility of macroeconomic aggregates in the recipient country and the associated welfare consequences.

The third paper investigates how the claims of the international business cycle model fare depending on the economic entity studies, i.e. countries versus regions. Regions or states within countries or federations in many ways constitute ideal testing grounds for neoclassical models as their capital markets are typically thought to be well-integrated and barriers to financial flows low. Previous research on the matter is however scarce and concentrated on the United States. We study whether the so called "Quantity Puzzle", i.e. that consumption plans in the data are less correlated than output across geographical entities while theory spells out the opposite, and the predicted relationship between financial integration and output fluctuations hold for European regions and countries. As a second step, we also identify channels for inter-regional risk sharing at the multilateral level, following the methodology in Asdrubali et al, 1996.

Summary of Papers

Paper 1:

Workers' remittances today constitute a very important type of capital inflow for many developing countries. Being transfers between family members, it has often been argued that remittances should increase following a drop in recipients' income, thus potentially stabilizing the business cycles of the migrants' home countries. We instead show that remittances flows are mainly determined by the business cycle in the countries where migrants work. We build a general equilibrium model and calibrate it to the U.S., Mexico and El Salvador and show that remittances measurably increase the volatility of key macroeconomic variables in the recipient economy. The welfare losses stemming from the increased volatility are considerable when the share of remittances to GDP is large, and suggest that remittances might have more in common with other types of capital flows than previously thought.

Paper 2:

The recent recession in the United States and the falls or decelerating growth rates of remittances to some Latin American countries have intensified the interest in the relationship between these variables. We investigate whether host country conditions affect remittance outflows to Latin America, focusing on the roles of regional U.S. business cycles, geographical variation in immigrant density and sectoral factors. Using quarterly data for 1995-2008, we find that remittance flows are strongly influenced by economic conditions in the specific regions of the U.S. where migrants are clustered, as well as in the sectors especially important for immigrants' employment opportunities. The results are in sharp contrast to previous research suggesting that remittance flows are relatively insensitive to fluctuations in the aggregate U.S. business cycle. Precise estimation of these linkages is also shown to matter for gauging the sensitivity of remittances to economic conditions in the home country, and hence the extent to which remittances might buffer domestic shocks as well as transmitting external ones.

Paper 3:

The "Quantity Puzzle" presents a challenge for international RBC models, as does the positive relationship between countries' degree of financial integration and their bilateral output correlations. We study whether both phenomena obtain for European countries and regions. We confirm previous findings for U.S. and international data that they do for countries but not for regions. The latter result is driven by bilateral risk sharing being more dispersed within the regional sample than between countries and regions. Regions in well-integrated European economies where barriers to intra-country capital flows are low show patterns very similar to U.S. states, while those of less financially advanced countries replicate the pattern found between countries. We also identify channels for interregional risk sharing at the multilateral level by decomposing the cross-sectional variance of regional GDP into fractions smoothed in turn on capital markets and by migration, through fiscal policy and on credit markets. We find that the fraction of shocks not smoothed is higher for European regions than U.S. states, and even more so for regions in the new member states.

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Papers

PAPER 1

Business Cycle Properties of Remittance Flows and Macroeconomic Volatility

Kristin Magnusson Bernard

Abstract. Workers' remittances today constitute a very important type of capital inflow for many developing countries. Being transfers between family members, it has often been argued that remittances should increase following a drop in recipients' income, thus potentially stabilizing the business cycles of the migrants' home countries. We instead show that remittances flows are mainly determined by the business cycle in the countries where migrants work. We build a general equilibrium model and calibrate it to the U.S., Mexico and El Salvador and show that remittances measurably increase the volatility of key macroeconomic variables in the recipient economy. The welfare losses stemming from the increased volatility are considerable when the share of remittances to GDP is large, and suggest that remittances might have more in common with other types of capital flows than previously thought.

1. Introduction

Following the rapid growth of workers' remittances over the last decades, they have become an increasingly important source of external financing for developing countries. Remittances today represent one third of financial flows to the developing world, and outpace other private capital flows, FDI and official development assistance (ODA) by far in many cases. For the top 20 recipient economies, remittances also amount to more than 10% of GDP and for a few outliers up to a third of the economy (Fajnzylber et al, 2006).

Apart from their size, remittances have been argued to have other positive macroeconomic features. Like aid, remittances create no future liabilities. Moreover, since the decision to remit has often been justified on altruistic grounds, it has been argued that remittances should fluctuate countercyclically with GDP in the recipient countries. If this is the case, remittances could serve as a "free" stabilizer helping to smooth large fluctuations in national income and consumption in the home country over the business cycle by allowing households to use the transfers as insurance against adverse shocks (Buch et al, 2002).

The assumed countercyclical pattern of remittances has found limited empirical support, as shown by Sayan (2004, 2006) who often instead find a procyclical pattern. It has therefore been suggested that rather than being altruistic, migrants might instead remit to take advantage of favorable investment opportunities in the home countries. This would then result in procyclical remittance receipts, which is often also found in the data.

The decline or decelerating growth in remittances following the recent recession in most industrial countries has brought forward an alternative driver and transmission channel. Since remittances are usually defined as the portion of migrant workers' earnings sent back to the country of origin, it is natural to think that the size of earnings, or the labor market prospects of immigrants in the host country, could be an important factor for the remitters' decision on how much to transfer. Recent empirical evidence in favor of this hypothesis is provided in Magnusson Bernard (2009) and Vargas-Silva and Huang (2006) for the U.S. and remittance-recipient countries in Latin America, and in Lueth and Ruiz-Arranz (2006) for other parts of the world.

If remittances indeed respond positively to economic developments in the host country, it could potentially result in markedly different implications for the smoothing or destabilizing effects of remittances on the recipient economies. Consider for example Mexico and the remittance-receiving economies in Central America, for which 95% of transfers originate in the U.S.. Following a deterioration of the U.S. economy, remittances are then likely to fall. This will however most probably also coincide with a downturn in the recipient economies, given the very high correlation between aggregate business cycles for migrant and host countries in the region. Thus, instead of stabilizing the business cycle, remittances might exacerbate the downturn.

Whether remittances reduce or raise the volatility of macroeconomic aggregates has important welfare implications since most of the recipient economies are developing countries where macroeconomic fluctuations are often much stronger than in industrial countries. High output volatility has in general been shown to have adverse effects on economic growth and poverty (Ramey and Ramey 1995). Accordingly, while the welfare gains of eliminating consumption fluctuations in the U.S. are modest according to the classic works by Lucas (1977, 2003), the corresponding estimates for developing countries are often larger than the gains from an additional percentage point of consumption growth forever (Pallage and Robe, 2003).

This paper aims to fill the gap in the existing literature by quantifying the relative importance of the "host" and "home" country channels of remittances and the subsequent effects on volatility of the macroeconomic aggregates of economies receiving such inflows. To this end, we augment a standard small open economy model along the lines

of Schmitt-Grohé and Uribe (2003) with remittances and calibrate it to Mexico and El Salvador for the recipient economies and the U.S. for the host country. The reasons for investigating these two recipient countries are their close economic ties with their dominant host country the U.S., the availability of data and the importance of remittances for their economies. In absolute terms, Mexico is one of the world's largest recipients of remittances, currently receiving some 25 billion dollars annually. As a percentage of GDP, remittances however stand at about 3% of GDP in Mexico compared to almost 20% in El Salvador, which is also the second largest recipient of remittances in the Western Hemisphere in absolute numbers. We retrieve the relationship between the shocks to home and host country GDP and remittances by means of a VAR analysis and then feed these shocks to the domestic and foreign economy into the model to study the importance of spillovers through remittance transfers.

Turning to our results, we find positive, large and strongly significant spillovers from U.S. variables to Mexican and Salvadoran remittances and GDP. In line with previous literature, we find remittances to Mexico to react mainly to economic conditions in the U.S. southwestern border states and Salvadoran flows to the aggregate U.S. cycle. We find no significant evidence of a "home country" channel for either country but a small negative spillover from Mexican GDP to remittances, ceteris paribus possibly suggesting a weakly countercyclical pattern of remittances to Mexican GDP.

When simulating the model, we find that remittances exacerbate volatilities of macroeconomic aggregates in the recipient economy. The long-run quantitative effects approximated by the stochastic steady state are non-neglible already when remittances' share of GDP is modest. For larger remittance-to-GDP ratios, the effects are naturally much more pronounced, especially for consumption and the external variables, although effects increase less than proportionally. The results suggest that the ability of remittances to smooth an economic downturn in the recipient economy is limited due to them mainly responding to host country conditions, which at least in our sample are highly correlated with those in the recipient economies. We also find the welfare losses associated with the increase in volatility to be considerable when the share of remittances-to-GDP is large. Indeed, if the share of remittances-to-GDP is 20% and households are very risk-averse, they would be willing to give up a fifth of these transfers to avoid the increase in volatility they bring.

The relative importance of the "host" and "home" country channels has not previously been addressed in a general equilibrium context, but there is a nascent literature using general equilibrium models to study the effects of remittances on the recipient countries. Jansen et al. (2008) study the importance of the forms in which remittances enter the economy, i.e. as cash used directly for consumption or as bank deposits.

More closely related to our study, Bora Durdu and Sayan (2008) analyze the implications of remittance fluctuations for various macroeconomic variables and sudden stops, using a two-sector general equilibrium endowment economy calibrated to the Mexican and Turkish economies. Thus they study two cases where remittances show opposite cyclical characteristics with respect to the business cycle in the country of origin (host country factors are not taken into account). The quantitative effects on the long-run steady state are found to be small, but if the economy is borrowing-constrained, remittances amplify fluctuations in the short run.

Chami, Cosimano and Gapen (2006) investigate the effects of remittances on optimal fiscal and monetary policy in the recipient countries, with remittances exogenously specified as countercyclical transfers using parameters from the U.S. bequest literature. Using a monetary general equilibrium model with flexible labor supply, they find that already modest levels of remittances increase both the level and volatility of consumption and income, despite remittances increasing when adverse shocks occur. This is due to remittances raising the correlation of income and labor: facing a positive productivity shock, agents increase labor supply so as to take advantage of temporarily higher wages. As remittances also fall, the associated negative income effect further serves to increase labor supply.

That this strand of literature comes to different conclusions regarding the stabilizing effects of remittances could in part depend on different model specifications, or more exactly the household utility function. In the literature on small open economies, it is customary to use preference specifications that do not take into account the wealth effects for labor decisions, e.g. quasilinear preferences in the spirit of Greenwood, Hercowitz and Huffman (1988, GHH henceforth). GHH preferences are also used by Bora Durdu and Sayan while Chami et al, who model a closed economy apart from the remittance transfer, choose Cobb-Douglas preferences that preserve the income effect. We use both types of preferences as a robustness check and find that results hold up.

The rest of the paper is organized as follows. Section 2 provides empirical evidence regarding the dynamic relationship between the different variables of interest. Section 3 introduces the model. Section 4 discusses calibration and parametrization of the parameters not retrieved by the empirical analysis in section 2. Section 5 presents results and section 6 welfare calculations. Section 7 concludes.

2. Remittances, home and host country variables: Empirics

To obtain parameters for the persistence and spillovers of our stochastic variables, we study the empirical relationship between three series: remittances, income or production in the recipient economy, and remitters' income in the host country. As shown

in Magnusson Bernard (2009), remittances depend on the location of immigrants in the host country as well as the industries in which they are employed. Mexican remitters are concentrated in the southwestern border states of the U.S. while Salvadorans are more evenly spread across the country. This results in remittances to Mexico being highly affected by economic conditions in the border areas as opposed to the aggregate U.S. cycle while Salvadoran remittances are more sensitive to the latter.

Given immigrants' differences in location, the considerable state-level business cycle heterogeneity in the U.S. as documented by Artis and Zhang, 1999, Owyang, Rapach and Wall, 2007, Partridge and Rickman, 2005, then give rise to distinct business cycle profiles of remittances. We follow the tradition in the literature on regional business cycles in the U.S. and proxy regional income by total payroll employment from the Bureau of Labor Statistics Current Employment Survey, covering about 400 000 work sites each month. Estimates of U.S. state level output are available but subject to a higher degree of uncertainty than at the aggregate level. Moreover, state-level price indices needed to deflate the nominal data are not available. Remittance and recipient country GDP data was taken from national central banks and deflated using U.S. CPI for remittances (as they are measured in dollars at current prices) and the corresponding GDP deflator for recipient country output series. We use quarterly data for the period 1994-2008.

The importance of non-aggregate U.S. variables and the focus on emerging market recipient economies also have ramifications for our choice of methodology for retrieving the empirical relationship between these variables. For instance, we cannot perform a Solow decomposition since it requires data at business cycle frequencies on capital stocks and labor which is unfortunately not available for the regional U.S. variables, Mexico and El Salvador. This problem is shared by previous literature on emerging market business cycles and has been addressed in different ways.

To pin down the magnitude of the shocks we feed into the model, we partly follow the methodology in Neumeyer and Perri's (2005) study on business cycles in Argentina in assuming that percentage deviations from the trend of total factor productivity follow an AR(1) process. To assess the persistences and spillovers of the stochastic variables, output in the recipient and origin countries, border employment in the U.S. and remittances, we make use of quarterly data for the period 1994-2008 and estimate VARs, thus following the procedure in Bora Durdu and Sayan (2007).[1] For the results of the VAR analysis to be valid the data needs to be stationary (Hamilton, 1994). This was not the case for our level series according to the Augmented Dickey-Fuller and

[1] Neumeyer and Perri assume that the persistence of their stochastic output process is equal to the value of the same process estimated for the United States.

Phillips-Perrron tests which is why we transform the data using logs and first differences before estimating the VAR systems below. Data was also seasonally adjusted.

The VAR system takes the following form:

$$\xi_t = \Psi(L)\xi_t + \varepsilon_t \tag{2.1}$$

where ξ_t is a vector of stationary U.S. and home country variables. $\Psi(L)$ is a matrix polynomial in the lag operator, with $\Psi(L) = \Psi_1 L + \Psi_2 L^2 + ... + \Psi_p L^p$. ε_t is an idiosyncratic error.

The order of the variables in a VAR is important, as residuals must be orthogonalized in order to compute correct variance decompositions and impulse response functions. It is customary to use a recursive ordering in the orthogonalization of the residuals. The assumption behind this method is that series earlier in the system impact the following series immediately, while those listed later impact the earlier only with a lag.

In our case, the U.S. variables should clearly be placed before the Mexican or Salvadoran ones in the VAR system as there is ample evidence in previous literature of the impact of U.S. cycles on Latin American countries but practically no effects in the opposite direction. It is not clear whether e.g. Salvadoran remittances or Salvadoran GDP is the most affected by U.S. GDP, given the close ties between U.S. factors and both these variables. But since remitters work in the U.S., the resources they transfer can be argued to react faster to changes in U.S. economic conditions than e.g. trade or financial linkages between the U.S. and the remitters' country or origin, that in turn affect home country GDP. If remittances are affected by home country GDP, it is also plausible that this happens with a lag. Hence we use the following ordering: $[U.S._{GDP}, SLV_{REM}, SLV_{GDP}]$ for El Salvador and $[U.S._{GDP}, U.S._{borderemp}, MX_{REM}, MX_{GDP}]$ for Mexico.[2]

2.1. Mexico. As mentioned earlier, previous literature has found that remittances to Mexico are affected mainly by economic conditions in the southwestern border states. The aggregate Mexican cycle is however also affected by the aggregate U.S. economy. Hence we estimate a four-variable VAR of U.S. GDP, U.S. border state employment, Mexican remittances and Mexican GDP.

[2] We also changed the respective ordering of the Mexican and Salvadoran variables and results were not much affected.

Table 1 Estimation of shocks processes, Mexico

Response of	Response to $U.S._{GDP,t-1}$	$U.S._{borderemp,t-1}$	$MX_{rem,t-1}$	$MX_{GDP,t-1}$
$U.S._{GDP,t}$	0.33 (0.12)*	0.89 (0.46)	-0.00 (0.01)	-0.23 (0.15)
$U.S._{borderemp,t}$	0.17 (0.08)**	0.79 (0.19)***	-0.01 (0.00)	0.03 (0.06)
$MX_{rem,t}$	-2.07 (-2.51)	2.11 (0.18)***	0.84 (0.18)***	-0.06 (1.97)
$MX_{GDP,t}$	0.39 (0.18)*	1.24 (0.44)**	-0.04 (0.01)	0. 37 (0.15)*

Note: Standard errors adjusted for heteroskedasticity in parentheses. Results show coefficients of regressing row variables on column variables after taking logs and first differences. ***,** and * denotes significance at the 1%, 5 % and 10 % level, respectively. Quarterly data for 1994:1 to 2008:2.

All variables show significant persistence. Moreover, we find considerable and significant spillovers from U.S. border employment to Mexican remittances, U.S. GDP to U.S. border employment, and from U.S. GDP and U.S. border employment to Mexican GDP. This is in line with previous literature, e.g. Magnusson Bernard (2009) and Vargas-Silva and Huang (2006) for the "host country effects", and Roache (2008) for the cyclical linkages between GDP in the two countries. Notice the much larger spillovers from U.S. border employment to Mexican remittances than for U.S. border employment or aggregate GDP to Mexican output, with respective coefficients of 2.11, 0.39 and 1.24. This supports our hypothesis that remittances might be an important transmission channel of shocks from the U.S. to countries further south.

We find no significant evidence of spillovers from Mexican GDP, but the coefficient is small and negative, ceteris paribus possibly suggesting a weakly countercyclical pattern. The size of this coefficient is very close to that found by Bora Durdu and Sayan (2007). Compared to Bora Durdu and Sayan, we also find much higher persistence of remittances to Mexico. This is most likely due to different length of the time series used, as they include data back to the early 1980s while we start our sample in 1994. The reason for our shorter sample is that we are concerned about the effects of the evident breaks and changes in measurement in the earlier parts of the remittance time series. Notice also that U.S. GDP depends only on its own lag, strongly suggesting that it is the variable in the system the least affected by the others included. To sum up, we find relatively strong evidence of links between U.S. variables and Mexican remittances but not between Mexican remittances and Mexican GDP.

2.2. El Salvador. Remittances to El Salvador are according to previous literature mainly sensitive to the aggregate U.S. cycle (Magnusson Bernard, 2009). Hence we estimate a VAR system of U.S. GDP, Salvadoran remittances and Salvadoran GDP.

Table 2 Estimation of shocks processes, El Salvador

	Response to		
Response of	$U.S._{GDP,t-1}$	$SLV_{rem,t-1}$	$SLV_{GDP,t-1}$
$U.S._{GDP,t}$	0.33 (0.12)*	0.05 (0.02)*	0.09 (0.12)
$SLV_{rem,t}$	2.89 (0.17)***	0.89 (0.17)**	0.05 (0.93)
$SLV_{GDP,t}$	0.64 (0.25)**	0.03 (0.03)	0.24 (0.17)

Note: Standard errors adjusted for heteroskedasticity in parentheses. Results show coefficients of regressing row variables on column variables after taking logs and first differences. ***,** and * denotes significance at the 1%, 5 % and 10 % level, respectively. Quarterly data for 1998:1 to 2008:2.

Again, we find significant persistence of all variables except for Salvadoran GDP. We also find large and significant positive spillovers from U.S. GDP to Salvadoran remittances and Salvadoran GDP, with coefficients 2.89 and 0.64 respectively, again confirming the close links between remittances and host country variables. We find no evidence of spillovers from Salvadoran GDP to remittances. This further supports our hypothesis of the "host country" channel while we find no evidence of "home country" effects in either direction, i.e. neither that remittances should respond to a drop in home GDP supporting an altruistic motive nor that they behave like investment flows.

3. Model

We model the recipient country as a small open economy following Mendoza (1991) and Schmitt-Grohé and Uribe (2003), but extend it with a stochastic remittance transfer from migrants' host country, augmenting their relatives' budget constraint in the country of origin.

3.1. Remitters. The empirical evidence in section 2 above suggests that we can consider law-of-motions for remittances of the following type:

$$REM_t = \psi_t^r REM_{t-1} + \psi_{i,t}^H y_{i,t-1}^H + \varepsilon_t \tag{3.1}$$

where ψ_t^r is the remittance persistence parameter and $\psi_{i,t}^H$ is the spillover parameter for the respective home and host country variables $y_{i,t-1}^H$ estimated in section 2 above.

3.2. The recipient economy. For simplicity, we assume all agents in the migrant's country of origin receive remittances. Moreover, we do not take into account the loss of labor force due to migration, but focus on an economy that already has a sizable fraction of the population abroad. The time period is taken to be a quarter.

Consider a small open economy populated by a large number of identical households described by the following utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, h_t) \tag{3.2}$$

where $\beta \in (0,1)$ is a constant parameter. The evolution of net foreign debt is given by

$$d_t = (1 + r_t) d_{t-1} - y_t - REM_t + c_t + i_t + \phi(k_{t+1} - k_t) \tag{3.3}$$

where r_t denotes the interest rate at which domestic residents can borrow in international markets in period t, and y_t denotes domestic output. REM_t denotes remittances that are perceived as an exogenous transfer by the recipient households. c_t denotes consumption, i_t gross investment, and k_t physical capital.

The function $\phi(\cdot)$ is meant to capture capital adjustment costs and is assumed to satisfy $\phi(0) = \phi'(0) = 0$. Convex adjustment costs are usually included in small open economy models to avoid excessive investment volatility in response to variations in the domestic-foreign interest rate differential. The chosen form for the adjustment cost function is standard in the literature and ensures that adjustment costs are zero in the non-stochastic steady state and that the domestic interest rate equals the marginal product of capital net of depreciation. Recent research has shown that this type of adjustment costs are quite successful in matching aggregate investment, although they fare worse at predicting turning points and investment at the plant level (Cooper and Haltiwanger, 2006).

It is well known that the steady state of small open economy models with incomplete asset markets depends on initial conditions and has equilibrium dynamics featuring random walks (Schmitt-Grohé and Uribe, 2003). A number of remedies to induce stationarity have been proposed, with virtually identical outcomes for model behavior.[3] We choose one of them and assume that the interest rate faced by domestic agents r_t is increasing in the aggregate level of foreign debt, denoted by $\tilde{d}_t$:

$$r_t = r + p(\tilde{d}_t) \tag{3.4}$$

where r denotes the world interest rate and $p(\cdot)$ is a strictly increasing, country-specific risk premium.

[3] See Schmitt-Grohé and Uribe (2003), for an extensive analysis of this matter.

Output is produced with a linearly homogeneous production technology that takes capital and labor services as inputs

$$y_t = \psi_t^H F(k_t, h_t) \tag{3.5}$$

where ψ_t^H is an exogenous stochastic productivity shock, as estimated in section 2.

The evolution of capital is given by

$$k_{t+1} = i_t + (1-\delta)k_t \tag{3.6}$$

where $\delta \in (0,1)$ is the depreciation of capital.

Households choose processes $\{c_t, h_t, y_t, i_t, k_{t+1}, d_t\}_t^\infty$ to maximize the utility function (3) subject to equations (2), (4)-(7) and a no-Ponzi game condition:

$$\lim_{j\to\infty} E_t \frac{d_{t+j}}{\prod_{s=1}^{j}(1+r_s)} \leq 0 \tag{3.7}$$

Let λ_t denote the Lagrange multiplier on the household budget constraint. The representative agent's first order conditions are then

$$\lambda_t = E_t \beta (1+r_t)\lambda_{t+1} \tag{3.8}$$

$$U_c(c_t, h_t) = \lambda_t \tag{3.9}$$

$$-U_h(c_t, h_t) = \lambda_t \psi_t^y F_h(k_t, h_t) \tag{3.10}$$

$$\lambda_t \left[1 + \phi'(k_{t+1} - k_t)\right] = \beta E_t \lambda_{t+1} \left[\begin{array}{c} \psi_{t+1}^y F_k(k_{t+1}, h_{t+1}) + \\ 1 - \delta + \phi'(k_{t+2} - k_{t+1}) \end{array} \right] \tag{3.11}$$

Due to all agents being identical, aggregate per capita debt will equal individual debt in equilibrium:

$$\tilde{d}_t = d_t \tag{3.12}$$

A competitive equilibrium is a set of processes $\left\{REM_t, c_t, h_t, y_t, y_t^H, i_t, k_{t+1}, d_t, \tilde{d}_t, r_t, \lambda_t\right\}_t^{\infty}$ satisfying eqs. (3.3)-(3.6) and (3.8)-(3.12) holding with equality, given eq. (2.1), and the initial values REM_0, Ψ_0,d_{-1},and k_0.

4. Calibration and Parameterization

4.1. Functional forms. In the baseline specification, we follow Schmitt-Grohé and Uribe (2003), Mendoza (1991) and Greenwood et al (1988) in using the following forms for preferences, technology, adjustment costs and the risk premium:

$$U(c,h) = \frac{[c - \omega^{-1}h^{\omega}]^{1-\gamma} - 1}{1-\gamma} \tag{4.1}$$

As is well known, the labor supply response in this class of preferences is unmitigated by consumption. Hours worked therefore display stronger cyclicality compared to e.g. Cobb-Douglas preferences where the income effect is present. The ease of substitution between leisure and consumption results in a procyclicality in consumption as well. That is, the incentive to forgo some consumption in response to a positive transitory shock is minimized by the sharper drop in leisure.

4.1.1. *Parameters from previous literature.* A time preferences rate β of 0.96 is a standard estimate at the quarterly frequency in the business cycle literature. Estimates of the risk aversion parameter γ vary from 2 (Schmitt-Grohé and Uribe, 2003, and Aguiar and Gopinath, 2007) over 5 (Reinhart and Vegh, 1995) to 10 as the upper bound of values (Mehra and Prescott, 1985). We choose 2 as it is the most commonly used in the literature as our benchmark value and discuss the effects of varying this parameter in our sensitivity analysis. The curvature of labor in the utility function determines the labor supply elasticity which is given by $\frac{1}{1-\omega}$. Estimates range from 1.2 in Neumeyer and Perri (2005) to 1.7 in Correia et al (1995). In absence of a consensus on the value to use, we set the benchmark value to 1.455, which is the value in Mendoza (1991).

Regarding the labor and capital exponents in the Cobb-Douglas production function, Gollin (2002) found the values of labor income shares α to be in the range of 0.65-0.80 for a wide range of developing and industrial countries despite the wide-held belief that capital shares are much higher in the former. As is traditional in the real business cycle literature, the capital share is therefore set to 0.32. We set the values of the steady-state value of debt $\bar{d}$ equal to 0.7442 and the elasticity of the risk premium with respect to the level of outstanding debt ψ_2 to 0.001, which equal the values in

Schmitt-Grohé and Uribe (2003), Neumeyer and Perri (2005) and Aguiar and Gopinath (2007).

4.1.2. *Calibrated parameters.* We set the size of the standard deviations of the shocks to border employment, Mexican GDP, Salvadoran GDP and the two countries' remittance series to match the volatility of these variables in our sample. For the aggregate U.S. shocks, we rely on standard estimates frequently used in earlier literature.

Previously used estimates of the capital adjustment cost ϕ are often calibrated to match some stylized facts of data and thus range from e.g. 0.028 (Schmitt-Grohé and Uribe 2003) to 4 (Aguiar and Gopinath 2007), depending on the size of shocks and their impact on investment volatility through variations in the domestic-foreign interest rate differential. We set capital adjustment costs so as to match the volatility of investment found in the data for Mexico as closely as possible, resulting in a value of 0.025.

4.1.3. *Model parameters.* We summarize the model parameters used in Table 3 below.

Table 3. Model parameterization

Steady-state remittances	REM_0	$[0.03; 0.20]$
Time preference rate	β	0.96
Risk aversion	γ	2
Depreciation rate	δ	0.05
Coefficient on interest rate premium	ψ	0.001
Coefficient on labor in utility function	ω	1.455
Labor exponent in production	1-α	0.68
Steady-state foreign debt	$\bar{d}$	[0.7442]
Capital adjustment costs	ϕ	0.025
Shock to MX GDP, st dev	$\varepsilon_{MX,GDP}$	0.0136
Shock to MX remittances, st dev	$\varepsilon_{MX,REM}$	0.0879
Shock to SLV GDP, st dev	$\varepsilon_{SLV,GDP}$	0.0119
Shock to SLV remittances, st dev	$\varepsilon_{SLV,REM}$	0.063
Shock to border employment, st dev	ε_{border}	0.0112
Shock to U.S. GDP, st dev	$\varepsilon_{U.S.}$	0.0129

Note: Refers to the quarterly frequency.

To the above parameters we add those estimated in Section 2, see Table 4 below.

Table 4. Persistence and spillover parameters of stochastic parameters

Estimation for	Persistence of		
	U.S. GDP	U.S. border employment	Home GDP
Mexico	0.33	0. 79	0.37
El Salvador	0.33	-	0.24
Spillover to	U.S. GDP	U.S. border employment	MX GDP
Remittances, Mexico	-	2.11	-0.06
GDP, Mexico	0.39/0.33	1.24	-
Remittances, El Salvador	2.89/0.05	-	-
GDP, El Salvador	0.64	-	-

Note: Refers to means.

5. Quantitative analysis

As a first stab at analyzing the performance of our models, we compare the equilibrium dynamics for economies with remittances and calibrated to Mexico and El Salvador, respectively. To retrieve the results, we solve a log-linear approximation of the set of equilibrium conditions.

5.1. Baseline models with remittances. Regarding the empirical regularities we would like to match, many emerging markets are characterized by strongly countercyclical trade balances and marked current account reversals, so called "sudden stops" (Aguiar and Gopinath, 2007, and others). Moreover, consumption is typically more volatile than output while the opposite holds for industrial countries. General equilibrium models featuring transitory shocks, representative agents and GHH preferences typically only match one of these features. A comparison of the volatility of some key variables produced by the benchmark model calibrated to Mexico and Mexican data (from Aguiar and Gopinath, 2007) is found in Table 5 below.

As seen from the table, our model matches the volatility of consumption rather well but underpredicts the volatilities of investment and the trade balance. Turning to contemporaneous correlations of the different macroeconomic aggregates with output, the model overpredicts the autocorrelation of output and the correlation of the trade balance with output. It however by far underpredicts the correlation of investment and output. The signs of the correlations produced by our model are consistent with that found in the data, in the sense that all variables apart from the trade balance are found to be procyclical. For El Salvador, we unfortunately only have quarterly data for output and cannot asses how well our model replicates other macroeconomic aggregates and moments of interest. Results for the benchmark model calibrated to El Salvador are found in Table 11 of the Appendix.

Table 5. Mexico: Baseline model and data

Moment	Model	Data	Moment	Model	Data
$std(y_t)$	2.48	2.48	$corr(y_t, y_{t-1})$	0.92	0.82
$std(c_t)$	2.95	3.07	$corr(y_t, c_t)$	0.86	0.92
$std(i_t)$	9.42	10.44	$corr(y_t, i_t)$	0.16	0.91
$std(h_t)$	1.88	not available	$corr(y_t.h_t)$	0.92	not available
$std(tb_t)$	3.55	5.43	$corr(y_t, \frac{tb_t}{y_t})$	-0.94	-0.74
$std(ca_t)$	2.43	not available	$corr(y_t, \frac{ca_t}{y_t})$	0.13	not available

Note: Estimates in "Data" column taken from Aguiar and Gopinath (2007).

5.2. Mexico. We now turn to investigating the importance of receiving remittances for the model when calibrated to Mexico. We do so in two ways. First, we study the impulse response to a negative shock to border employment, an exercise intended to mimic the current crisis. Second, we look at the difference in unconditional second moments between economies that receive remittances calibrated to Mexico and hypothetical ones that do not, holding all parameters constant. As seen from Figure 1, when the remittance-to-GDP ratio is modest, the simulated time series for economies receiving remittances compared to the ones for those that do not are quite similar apart from the external variables. A shock to border employment triggers recessions in both economies.

(Figure 1 about here: Impulse responses of macroeconomic aggregates in Mexico in response to a one-standard deviation shock to border employment)

Table 6 below presents differences in unconditional second moments between a model including remittances and one that does not. A volatility measure with a positive sign corresponds to a destabilizing effect of remittances, i.e. a higher standard deviation of that macroeconomic aggregate.

Table 6. Differences in unconditional second moments due to remittances

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	0.81	$corr(y_t, y_{t-1})$	-0.08		0
$std(c_t)$	1.01	$corr(c_t, c_{t-1})$	-0.03	$corr(y_t, c_t)$	-0.02
$std(i_t)$	3.16	$corr(i_t, i_{t-1})$	-0.12	$corr(y_t, i_t)$	0.09
$std(h_t)$	0.52	$corr(h_t, h_{t-1})$	-0.08	$corr(y_t, h_t)$	0
$std(\frac{tb_t}{y_t})$	4.37	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	0.17	$corr(y_t, \frac{tb_t}{y_t})$	0.72
$std(\frac{ca_t}{y_t})$	1.23	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	-0.08	$corr(y_t, \frac{ca_t}{y_t})$	-0.31

Note: Model calibrated to Mexico.

Standard deviations are measured in percentage points per quarter;

differences are hence measured in percentage points.

We find that the presence of remittances increases the volatility of macroeconomic aggregates. The standard deviations of output, consumption, investment and labor supply all increase with a half to three percentage points per quarter. The trade balance, or net exports, becomes more volatile when remittances are included due to there now being two types of capital flows, bonds and remittances. Remittances decrease resulting in a much more volatile trade balance, and markedly increased correlation of the trade balance as share of GDP and GDP. The current account deficit, or change in indebtedness vis-à-vis the rest of the world, also becomes more volatile, but relatively less so. Remittances decrease the persistence of all variables apart from the trade balance as share of GDP. The effects on the correlation of different macroeconomic aggregates with output are modest, the exceptions being the trade balance and to a lesser extent net exports.

It has been argued in policy discussions that remittances can help smooth the often large current account reversals following an economic crisis, including in cases when exclusions from international borrowing are effective. It should however be noted that this discussion has been based on the assumption of remittances being countercyclical with respect to home country GDP. Using our empirically estimated parameters which show that the host country effect dominates, we do not find support for such a claim.

Our estimated results are larger and of the opposite signs to those of Bora Durdu and Sayan (2007), due to the importance of host country shocks in our model. They conclude that the inclusion of countercyclical remittances lowers the volatility of consumption by 0.22 percentage points while we estimate the effect to be an increase of 1 percentage point. Model differences aside, we think that this underscores the importance of the host country channel. Bora Durdu and Sayan also find the effects to be smaller with more frequently binding borrowing constraints due to agents building up precautionary wealth to insure against states where the borrowing constraints bind, along the lines of Aiyagari (1994). Thus we do not think that including more stringent borrowing constraints in our model than the current risk premium function would lead to larger effects of remittances on the recipient economies.

From a welfare perspective we are mainly interested in the quantitative importance of the 1% increase in consumption volatility; we will get back to this issue in section 6 below. We first proceed to investigate the case of El Salvador where remittance inflows are large compared to the size of the economy.

5.3. El Salvador. We again perform two exercises; impulse responses to a negative shock to U.S. GDP and differences in unconditional moments due to remittances. Spillover parameters to remittances and GDP are now of course different and calibrated to the estimated values for El Salvador. Figure 2 below displays the differences between

an economy receiving 20% of remittance transfers and one that does not. A shock to aggregate U.S. GDP triggers a recession in both economies. Output, consumption, investment and hours worked fall. The differences between the dashed and solid lines also show that this deterioration of economic conditions is much more marked for economies receiving remittances. The reversals of the current account and trade balance are also larger.

(Figure 2 about here: Impulse responses of key macroeconomic aggregates in El Salvador in response to a one-standard deviation shock to aggregate U.S. GDP)

Differences in unconditional volatilities, serial correlations and correlations with output between an economy receiving remittances of 20% of GDP and one that does not receive such transfers are presented in table 7 below.

Table 7. Differences in unconditional second moments due to remittances

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	0.65	$corr(y_t, y_{t-1})$	-0.04		0
$std(c_t)$	3.71	$corr(c_t, c)$	-0.16	$corr(y_t, c_t)$	-0.24
$std(i_t)$	4.63	$corr(i_t, i)$	-0.01	$corr(y_t, i_t)$	0.05
$std(h_t)$	2.18	$corr(h_t, h)$	-0.04	$corr(y_t, h_t)$	0
$std(\frac{tb_t}{y_t})$	14.91	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	-0.69	$corr(y_t, \frac{tb_t}{y_t})$	0.36
$std(\frac{ca_t}{y_t})$	6.33	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.47	$corr(y_t, \frac{ca_t}{y_t})$	-0.18

Note: Model calibrated to El Salvador.

.Standard deviations are measured in percentage points per quarter;

differences are hence measured in percentage points.

Relative to the size of the economy, remittances are about seven times larger in this experiment compared to the previous ones calibrated to Mexico. As evident from table 7, for an economy where remittances make up a large share of GDP the effects on volatility are considerable for all macroeconomic aggregates, albeit not increasing by a factor seven from the previous experiment. Notice e.g. how the volatility of consumption increases by 3.71 percentage points compared to a scenario without remittances. To a large extent, this is due to the relevant U.S. macroeconomic variable, GDP, displaying much lower persistence than the relevant one, border state employment, for the exercise calibrated to Mexican data in the previous section.

Again, the most dramatic effects are found for the trade balance and current account as share of GDP due to the two types of capital inflows in the remittance-receiving economies. The persistence of macroeconomic aggregates and their relationship to GDP also change, as shown in columns two and three of Table 7. The effects are not necessarily larger but qualitatively similar to the previous experiments calibrated to Mexico.

One should keep in mind, though, that remittances constitute an additional resource for a country and even if they fall with busts in the host country, leading to rather large increases in volatility of the recipient economy, they in general increase the scope for consumption for the household. In section 6 we will thus relate the welfare losses of the 3.71 percentage point increase in consumption volatility to the associated expansion of the household budget.

5.4. Sensitivity analysis.

5.4.1. *The importance of income effects for labor supply decisions.* As discussed earlier, the above analysis follows most previous studies in the SOE literature in that it makes use of the so-called GHH utility function instead of standard Cobb-Douglas preferences (Greenwood et al, 1988). The key distinction between GHH and Cobb-Douglas preferences is the importance of the income effect for labor supply decisions in response to a productivity shock. A household has Cobb-Douglas preferences if

$$u(c_t, l_t) = \frac{(c_t^{\sigma}(1-h_t)^{1-\sigma})^{1-\gamma}}{1-\gamma} \tag{5.1}$$

with $0 < \sigma < 1$. The first order condition for labor can be written as

$$u_l(c_t, h_t) + u_c(c_t, h_t)\frac{\delta y_t}{\delta h_t} = 0 \tag{5.2}$$

In the case of GHH preferences, this reduces to

$$\omega h_t^{\omega-1} = \alpha \frac{y_t}{h_t} \tag{5.3}$$

In contrast, in the case of Cobb-Douglas preferences, the income effect mitigates labor's response to productivity shocks:

$$\frac{(1-\sigma)c_t}{\sigma(1-h_t)} = \alpha \frac{y_t}{h_t} \tag{5.4}$$

Labor supply now varies with consumption, with a higher level of consumption reducing the incentive to work. Moreover, compared to the case of GHH preferences, leisure and consumption are less easily substituted. Both effects preserve the incentive to smooth consumption over the business cycle in response to a positive shock. Existing data suggests that the correlation of hours worked with output is much lower

in emerging markets (e.g. 0.52 for Argentina and 0.57 for Mexico compared to 0.86 for Canada as shown in Aguiar and Gopinath 2007), which measurement issues aside suggest room for a stronger income effect on labor supply over the cycle. On the other hand, the income effect implicit in Cobb-Douglas preferences may be too strong, potentially generating an initial decline in labor supply in response to a transitory positive shock (or a shock to trend growth in the model of Aguiar and Gopinath, 2007). With GHH preferences the initial response of labor supply is always positive.

We set the parameters in the Cobb-Douglas utility function so that agents work one third of their time in the initial steady state. The benchmark model calibrated to Mexico is found in Table 12 in the Appendix. It is found to match the data rather well but fails to reproduce the higher relative volatility of consumption than output as well as the countercyclicality of the trade balance as share of GDP. As shown in tables 13-15 in the Appendix, the main results of the two benchmark experiments hold up both for Mexico and El Salvador, i.e. unconditional volatilities increase for economies receiving remittances. The effects are in general of comparable magnitudes. Effects are also very similar regarding the persistence of variables.

There is however one marked difference, regarding the correlations of output with other macroeconomic aggregates. In accordance with Chami et al, we find that remittances change the correlation of output and labor when the share of remittances is large. The wealth effect on labor supply dominates, leading to a countercyclical labor supply, which also decreases the volatility of output when the remittance-to-GDP ratio is large.

5.4.2. *Risk aversion, and speed of convergence.* For expositional clarity, this section again uses the baseline model with GHH preferences. We begin by varying the intertemporal elasticity of substitution in the interval discussed in the parameters' section, i.e. from 2 to 1.5-10. A higher value of γ increases the volatility of production, consumption, investment and hours worked. That the volatility of consumption increases with the level of risk aversion might seem counterintuitive. This is however due to the GHH preference specification, and the associated effect on the labor supply discussed above. This suggests to us to study the effects of higher risk aversion on consumption and leisure jointly. The volatility of this aggregate declines with higher risk aversion.

The exponent ω on labor in the utility function determines the marginal rate of substitution between leisure and consumption. A lower ω as e.g. 1.2 in Neumeyer and Perri (2005) translates into a higher labor supply elasticity $\frac{1}{1-\omega}$ and makes households' labor supply more volatile, thus inducing relatively smoother paths for the trade balance and current account as share of GDP as households to a larger extent vary labor

than bond holdings in response to shocks. Higher values of ω as in Correia et al (1995) push results in the opposite direction. The volatilities of the trade balance and the current account as share of GDP do not change much. Higher depreciation δ increases the volatilities of all variables.

The results are insensitive to the level of steady-state debt. Lastly, higher adjustment costs for capital slow down the dynamics towards the new steady state, and mainly affect the volatility of investment compared to the other variables for all experiments.

6. Welfare analysis

We have found that remittances increase the volatility of the recipient economy. This holds for different parameter values and utility functions. It is however also important to translate these results into welfare losses and gains as perceived by risk-averse households, and relate them to the extra resources for consumption remittances bring. As mentioned in the introduction, numerous attempts have been made to compute the welfare costs of business cycles in the U.S., with results varying widely depending on model assumptions, e.g. regarding market completeness, agents' preferences and the stochastic processes governing consumption. This strand of the literature originated with Lucas (1977), who proposed that to understand the welfare costs of income fluctuations, we should ask a representative consumer to evaluate her lifetime utility under two different scenarios. More specifically, compare the lifetime utility of a perfectly smooth consumption path to one that fluctuates over the business cycle but maintains the same average level of consumption over time. Consumers who are risk averse, i.e. care about smoothing consumption over time, will then rank the smooth stream higher than the risky one. Lucas then asked what it would cost to compensate all households with extra consumption so they would be indifferent between the risky and smooth consumption plans. The answer turns out to be

$$\lambda = \frac{1}{2}\gamma\mu^2 \tag{6.1}$$

where λ is the compensation parameter measured in percentage of average consumption, γ is the coefficient of risk aversion and μ is the standard deviation of consumption. As one would intuit, the compensation required increases with the level of risk aversion of the consumer and the volatility of consumption. Lucas finds that the benefits of eliminating business cycles are very small, or around two tenths of a percentage point of consumption. The first attempt in the literature at quantifying the relative

magnitude of costs for developing countries compared to the U.S. by Pallage and Robe (2003) however found that not only is the average cost tenfold that of the U.S. regardless of model specification, eliminating it would also bring larger welfare gains than a permanent extra 1% of yearly consumption growth for moderate levels of risk aversion.

It is not obvious how to generalize Lucas measure to a context where instead of comparing a volatile consumption profile to a completely flat one, we compare two volatile series. If we use the difference in the welfare losses generated by the respective consumption profiles as the relevant estimate, we implicitly assume that the welfare cost of volatility is convex in the level of volatility of the two consumption profiles. For instance, with standard values of risk aversion, a 2 percentage point increase in consumption volatility would entail a welfare cost that is twenty times larger if starting from a consumption plan that has a standard deviation of 19% compared to one with a volatility of 1%. While evidence exists of high volatility per se being negative for welfare (Ramey and Ramey, 1995), we are not aware of previous literature supporting the welfare loss rising so dramatically in the level of volatility of the two consumption series. We therefore prefer to err on the side of caution and assume that volatility increases of a certain percentage point size have similar welfare effects regardless of the volatilities of the consumption series.

6.1. Mexico. The welfare effects of remittances to Mexico are summarized in table 8 below.

Table 8. Welfare effects of remittances in Mexico

Increase consumption volatility, %	Risk aversion	Welfare loss %	As % of added consumption scope
0.94	1.5	0.01	0.28
1.01	2	0.01	0.43
1.08	2.5	0.02	0.61
1.41	5	0.05	2.07
1.83	10	0.17	6.98

Note: Volatilities are measured in percentage points per quarter

Increases in consumption volatility ranges from just below one to almost two percent. To relate this to the added scope for consumption they bring, remember that these transfers constitute about 3% of GDP in Mexico. Moreover, about 80% of remittances are consumed with our model specification, resulting in an average 2.4% increase of consumption.[4] Notice however that not even very risk-averse households would be willing to give up more than around 7% of this space to avoid the extra volatility brought about by these transfers. For lower estimates of risk aversion, effects

[4] The exact share of consumption in GDP ranges from 80.7% for the lowest level of risk aversion to 79.5 % for the highest.

are naturally even more modest. This suggests that from a welfare perspective, the loss stemming from the increased volatility through remittances is modest compared to the added resources for consumption they constitute.

6.2. El Salvador. When remittances constitute a large share of the economy as in the case of El Salvador, the volatility of consumption is found to increase with three to over eight percent. Average consumption increases with about 16% in economies that receive remittances compared to those that do not. The last column of table 9 below relates the welfare losses of the increased volatility due to remittance transfers to this expansion of the household's resources. The welfare losses in terms of added consumption scope are measurable already for lower levels of risk aversion and quite marked for high-end estimates. Indeed, they are also tenfold those of the original Lucas' estimates. Households would be willing to give up to a fifth of the extra consumption scope to avoid the extra volatility they bring for high values of the risk aversion parameter.

Table 9. Welfare effects of remittances in El Salvador

Increase consumption volatility, %	Risk aversion	Welfare loss %	As % of added consumption scope
3.42	1.5	0.09	0.55
3.71	2	0.14	0.86
4.01	2.5	0.20	1.26
5.72	5	0.82	5.11
8.22	10	3.38	21.12

Note: Volatilities are measured in percentage points per quarter.

7. Conclusions

Workers' remittances today constitute one of the quantitatively most important types of capital inflows for many developing countries. Moreover, it has often been argued that remittances through their nature of transfers between family members could work as an insurance mechanism during times of economic hardship in the remitters' country of origin. We suggest that remittances might instead have more in common with other types of capital inflows to developing countries in that they lead to increased volatility of macroeconomic aggregates, especially external ones.

The driving force is our finding of a close and positive relationship between remittances and economic conditions in the countries where remitters work, and the similar association between the aggregate business cycles of the two countries. Thus, when the host country enters a recession, so does the migrants' country of origin, where the decline is exacerbated by a fall in remittance receipts. We find strong and significant

procyclical relationships between remittances to Mexico and El Salvador and U.S. variables and weakly countercyclical but not significant linkages between remittances and GDP in Mexico.

When feeding these shocks into our model, the results suggest the presence of remittances increases volatility in economies receiving remittances compared to those that do not, already when remittances constitute a modest share of GDP. Although remittances expand the household budget, we find the welfare losses resulting from the increased volatility of consumption to be a tenfold larger than the classical Lucas (1977) gain of eliminating business cycle fluctuations in the U.S. when the share of remittances-to-GDP is large and risk aversion is modest to high.

Future research as well as the current recession in industrial countries and consequent decline in remittance receipts will shed further light on the validity of the mechanisms suggested in this paper. While we present new evidence on the importance of host country factors for remittances, the decision to migrate in the first place most likely comes from a combination of home and host country developments (i.e. the "push" and "pull" factors for immigration in the terminology of previous literature). A very interesting extension would hence be to endogenize the migration decision so as to not only capture the change in capital flows over the business cycle but also the differing size of the labor force.

Appendix

Unconditional moments

Table 10 Second moments for the benchmark model, Mexico

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	2.48	$corr(y_t, y_{t-1)}$	0.92		1
$std(c_t)$	2.95	$corr(c_t, c_{t-1)}$	0.96	$corr(y_t, c_t)$	0.86
$std(i_t)$	9.42	$corr(i_t, i_{t-1)}$	0.55	$corr(y_t, i_t)$	0.16
$std(h_t)$	1.88	$corr(h_t, h_{t-1)}$	0.92	$corr(y_t, h_t)$	1
$std(\frac{tb_t}{y_t})$	3.55	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	0.93	$corr(y_t, \frac{tb_t}{y_t})$	-0.94
$std(\frac{ca_t}{y_t})$	2.43	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.57	$corr(y_t, \frac{ca_t}{y_t})$	0.13

Note: Standard deviations are measured in percentage points per quarter.

Table 11 Second moments for the benchmark model, El Salvador

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	1.98	$corr(y_t, y_{t-1})$	0.75		1
$std(c_t)$	3.85	$corr(c_t, c_{t-1})$	0.94	$corr(y_t, c_t)$	0.82
$std(i_t)$	6.93	$corr(i_t, i)$	0.48	$corr(y_t, i_t)$	0.19
$std(h_t)$	1.28	$corr(h_t, h)$	0.75	$corr(y_t, h_t)$	1
$std(\frac{tb_t}{y_t})$	6.75	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	0.83	$corr(y_t, \frac{tb_t}{y_t})$	-0.73
$std(\frac{ca_t}{y_t})$	3.51	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.62	$corr(y_t, \frac{ca_t}{y_t})$	0.18

Note: Standard deviations are measured in percentage points per quarter.

Robustness checks: Cobb-Douglas preferences

Table 12. Second moments of baseline model and data, Mexico

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	2.67	$corr(y_t, y_{t-1})$	0.77		1
$std(c_t)$	1.91	$corr(c_t, c_{t-1})$	0.82	$corr(y_t, c_t)$	0.52
$std(i_t)$	9.63	$corr(i_t, i_{t-1})$	0.60	$corr(y_t, i_t)$	0.14
$std(h_t)$	1.58	$corr(h_t, h_{t-1})$	0.74	$corr(y_t, h_t)$	-0.27
$std(\frac{tb_t}{y_t})$	2.73	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	0.36	$corr(y_t, \frac{tb_t}{y_t})$	0.51
$std(\frac{ca_t}{y_t})$	2.55	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.45	$corr(y_t, \frac{ca_t}{y_t})$	0.38

Note: Standard deviations are measured in percentage points per quarter.

Estimates in "Data" column are taken from Aguiar and Gopinath (2007).

Table 13. Second moments of baseline model and data, El Salvador

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	2.21	$corr(y_t, y_{t-1})$	0.80		1
$std(c_t)$	1.73	$corr(c_t, c_{t-1})$	0.76	$corr(y_t, c_t)$	-0.43
$std(i_t)$	7.22	$corr(i_t, i_{t-1})$	0.52	$corr(y_t, i_t)$	0.27
$std(h_t)$	1.87	$corr(h_t, h_{t-1})$	0.63	$corr(y_t, h_t)$	0.34
$std(\frac{tb_t}{y_t})$	5.40	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	0.44	$corr(y_t, \frac{tb_t}{y_t})$	0.20
$std(\frac{ca_t}{y_t})$	3.65	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.57	$corr(y_t, \frac{ca_t}{y_t})$	0.18

Note: Standard deviations are measured in percentage points per quarter.

Table 14. Differences in second moments, Mexico

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	1.04	$corr(y_t, y_{t-1})$	0.01		0
$std(c_t)$	1.12	$corr(c_t, c_{t-1})$	0	$corr(y_t, c_t)$	-0.06
$std(i_t)$	3.29	$corr(i_t, i_{t-1})$	0.05	$corr(y_t, i_t)$	0.07
$std(h_t)$	1.44	$corr(h_t, h_{t-1})$	0.01	$corr(y_t, h_t)$	0.04
$std(\frac{tb_t}{y_t})$	-2.68	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	-0.24	$corr(y_t, \frac{tb_t}{y_t})$	-0.52
$std(\frac{ca_t}{y_t})$	-0.37	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.07	$corr(y_t, \frac{ca_t}{y_t})$	-0.09

Note: Standard deviations are measured in percentage points per quarter; differences are hence measured in percentage points.

Table 15. Differences in second moments, El Salvador

Standard deviations		Serial Correlations		Correlations with output	
$std(y_t)$	-0.24	$corr(y_t, y_{t-1})$	0.02		0
$std(c_t)$	1.32	$corr(c_t, c_{t-1})$	0.06	$corr(y_t, c_t)$	-0.11
$std(i_t)$	-0.88	$corr(i_t, i_{t-1})$	0.001	$corr(y_t, i_t)$	-0.05
$std(h_t)$	1.04	$corr(h_t, h_{t-1})$	0.25	$corr(y_t, h_t)$	0.26
$std(\frac{tb_t}{y_t})$	9.35	$corr(\frac{tb_t}{y_t}, \frac{tb_{t-1}}{y_{t-1}})$	0.69	$corr(y_t, \frac{tb_t}{y_t})$	-0.09
$std(\frac{ca_t}{y_t})$	1.71	$corr(\frac{ca_t}{y_t}, \frac{ca_{t-1}}{y_{t-1}})$	0.14	$corr(y_t, \frac{ca_t}{y_t})$	0.17

Note: Standard deviations are measured in percentage points per quarter; differences are hence measured in percentage points.

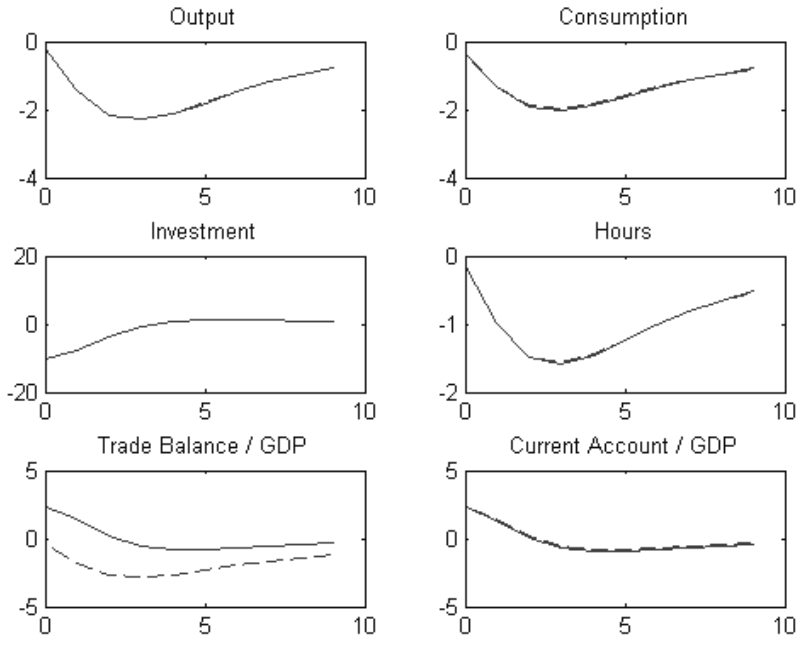

FIGURE 1. Impulse responses of macroeconomic aggregates in Mexico in response to a one-standard deviation shock to border employment. Note: Dashed lines refer to economies with remittances, solid lines to economies without remittances.

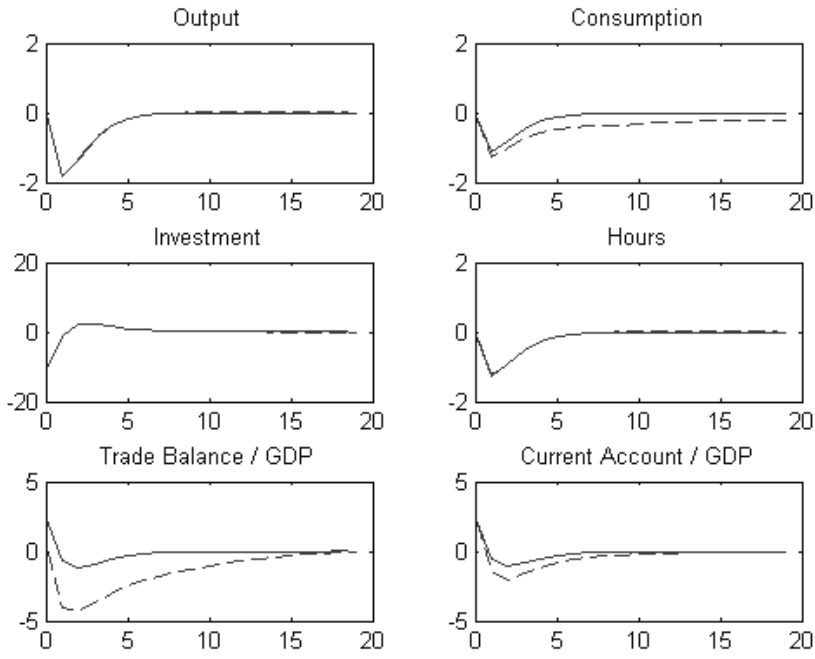

FIGURE 2. Impulse responses of macroeconomic aggregates in El Salvador in response to a one-standard deviation shock to U.S. GDP. Note: Dashed lines refer to economies with remittances, solid lines to economies without remittances.

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PAPER 2

The Impact of U.S. Regional Business Cycles on Remittances to Latin America

Kristin Magnusson Bernard

Abstract. The recent recession in the United States and the falls or decelerating growth rates of remittances to some Latin American countries have intensified the interest in the relationship between these variables. We investigate whether host country conditions affect remittance outflows to Latin America, focusing on the roles of regional U.S. business cycles, geographical variation in immigrant density and sectoral factors. Using quarterly data for 1995-2008, we find that remittance flows are strongly influenced by economic conditions in the specific regions of the U.S. where migrants are clustered, as well as in the sectors especially important for immigrants' employment opportunities. The results are in sharp contrast to previous research suggesting that remittance flows are relatively insensitive to fluctuations in the aggregate U.S. business cycle. Precise estimation of these linkages is also shown to matter for gauging the sensitivity of remittances to economic conditions in the home country, and hence the extent to which remittances might buffer domestic shocks as well as transmitting external ones.

1. Introduction

Following the rapid growth of workers' remittances over the last decades, they have become a very important source of external financing for many developing countries. In some Central American countries remittances now account for up to 25 percent of GDP and by far outpace e.g. FDI, other capital inflows and aid. Hence it is not surprising that policymakers and researchers have tried to understand the effects of remittances on the recipient economies. Remittances have been argued to possess several attractive features; as unrequited transfers, they create no future obligations, and compared to other types of financial inflows they have appeared more stable. But to properly investigate for example the destabilizing or insurance properties of remittance flows for the receiving countries, or to forecast them, we first need to understand their drivers. This subject has received much less attention so far, and produced very few conclusions.

(Figure 1 about here: Remittances to Central America and Mexico)

Remittances are usually defined as the portion of migrant workers' earnings sent back to the country of origin. From this it is natural to think that the size of current earnings, or the labor market prospects of immigrants in the host country, could matter for the size of transfers. Indeed recently it often has been suspected that the recent recession in the U.S. is behind the drop or deceleration in remittances to Mexico and a lesser extent El Salvador. It has however been hard to establish linkages between U.S. economic factors and remittances to Latin America at business cycle frequencies (Roache & Gradzka 2007).

Our contribution is to demonstrate econometrically that U.S. economic conditions indeed matter for remittances to Latin America, but that the aggregate business cycle previously studied is not the relevant determinant. Focusing on the U.S. aggregate economy can be seriously misleading because (i) Hispanic immigrants are not uniformly distributed across the U.S. but instead concentrated in a limited number of states, and (ii) as we demonstrate, regional and state-level business cycles within the U.S. are quite heterogeneous (indeed as different as between EMU countries).

These two key stylized facts help us identify linkages between U.S. state-level and regional economic variables and remittances to Latin America, both through looking at correlation coefficients between cyclical components of series and polynomial lag estimation. We find that remittance flows to Latin American countries are strongly influenced by economic conditions in the specific regions of the U.S. where migrants are clustered, as well as the sectors especially important for immigrants' employment opportunities. We also find evidence of remittances responding positively to negative macroeconomic conditions at home. Hence remittances can potentially both absorb domestic shocks and transmit external ones. To our knowledge, this paper is the first to study the importance of disaggregate U.S. indicators in this context, and our results are in sharp contrast to the failure to detect strong effects of U.S. variables in previous literature.

By establishing linkages at business cycle frequencies we are able to provide some simple "rules of thumb" for forecasting the effects of U.S. economic conditions on remittances to Latin America. But secondly, and maybe more important, the empirical findings here also suggest that we should not only think about whether remittances can smooth income declines in the remitters' country of origin but also that shocks in immigrants' host countries could be transmitted via remittances. As we show in our theoretical companion paper (Magnusson Bernard, 2010), featuring a two-country general equilibrium model, host country shocks to remittances have substantial implications for the volatility of key macroeconomic variables in the recipient economies. Even if remittances are (weakly) countercyclical to home country GDP, remittances

cannot substantially smoothen the home business cycle if aggregate shocks to home and host country output are positively correlated, as is the case for e.g. Mexico, El Salvador and the U.S.

While remittances are sent by most Hispanic subgroups in the U.S., this paper concentrates on those from the Mexican and Salvadoran populations. In absolute terms, Mexico is one of the globally largest recipients of remittances, currently receiving some 25 billion U.S. dollars annually. As a percentage of GDP, remittances however stand at about 3% of GDP in Mexico compared to almost 20% in El Salvador, the second largest recipient of remittances in the hemisphere. Not only are remittances important for these economies, but reliable information on where their remitters work and sufficiently long time series of the data needed are also available. While sharing the U.S. as the most important destination for migrants, Mexico and El Salvador also have some interesting differences in emigrants' location and occupation that will be found important for their ability to diversify the effects of U.S. regional shocks on remittance receipts.

Section 2 of this paper reviews two distinct strands of earlier literature related to our analysis: the first studying the importance of cyclical economic conditions for remittances and the second concerning U.S. state and regional business cycles. Section 3 describes the data used and discusses measurement issues. Section 4 documents the geographic concentration of Hispanic immigrants and state-level business cycle heterogeneity in the U.S. Section 5 presents our econometric procedures and results. Section 6 concludes and draws policy implications.

2. Literature

Most of the remittances literature falls into three broad areas: (i) the microeconomic motives for remitting and the sociodemographic profile of remitters and recipients, (ii) institutional features of the remittance market such as the effects of declining transaction costs, and (iii) the effects of remittances on the recipient economies and the importance of conditions in the same countries such as natural disasters, wars, political and macroeconomic factors for the decision to remit. As earlier mentioned, less attention has been paid to the role of "host country" conditions.

The results from the literature on the importance of home country conditions are mixed, finding both negative and positive effects on remittances. This has been justified by remittances having two possible functions: compensatory transfers seeking to alleviate recipients' economic distress or opportunistic flows allowing remitters to take advantage of favorable investment opportunities in the home country, thus resulting in

either a negative or positive coefficient on home country conditions. The view of remittances as compensatory transfers currently seems to have the most support (Chami et al, 2008, Sayan, 2006). Part of the differences in results may also be due to studies failing to take into account the importance of host country factors.

In the most thorough examination to date of host country conditions in the Western Hemisphere, Roache and Gradzka (2007) conclude after using a range of methods that no clear linkages between remittances and U.S. macroeconomic factors can be established. On the other hand, Vargas-Silva and Huang (2006) look at flows from the U.S. to several countries including Mexico and find evidence of linkages using a vector error-correction model. A range of aggregate U.S. indicators are found to Granger-cause remittances to Mexico, although imprecise estimation makes the results somewhat difficult to interpret.

For other regions of the world and with methodologies differing from ours, a few studies have also found positive host country effects. Lueth and Ruiz-Arranz (2006) use a gravity model and per capita income growth as a measure of the host country business stance, and find positive effects on bilateral remittances to the Middle East, Europe and Asia. Positive host country effects have also been found for remittances to Greece and Egypt (Lianos 1997, El-Sakka and McNabb 1999). Studies on the Germany-Turkey remittance corridor from a business cycle perspective have yielded mixed results. Sayan (2004) find no statistically significant linkages while Aydas, Metin-Ozcan and Neyapti (2005) do. Host country conditions have also be used as (valid) instruments for remittances in several studies (Aggarwal and Martinez Peria, 2006, Bugamelli and Paternò, 2008).

Studies on regional business cycles in the U.S. date back to the early works of McLaughlin (1930), Vining (1949), Borts (1960) and Syron (1978). There has recently been a renewed interest in the topic following the finding that business cycles across countries have become more synchronized with increased international economic and financial integration over the last decades. However, and importantly for our analysis, the U.S. is displaying more heterogeneity in regional and local business cycles since the 1990s compared to earlier decades. In fact, the results in Artis and Zhang (1999) imply that most EMU economies became more synchronized with Germany during the ERM period than U.S. state economies were with each other by the late 1980s and onwards.

The sources of business cycle heterogeneity within the U.S. still seem to be an open question, but most authors favor differences in industry mix as an explanation. Regional and spatial effects (e.g. neighbors' industry mix) seem to be weaker, but most studies find the Midwest to be the region most synchronized with the aggregate U.S. cycle (Owyang, Rapach and Wall, 2007, Partridge and Rickman, 2005). Of special

interest to our project, Cañas and Phillips (2008) have noted that the region bordering Mexico in the southwest has become significantly more aligned with the Mexican cycle since the introduction of NAFTA in 1994, but that the effects within this U.S. region again differ depending on industry mix.

3. Data

A major complicating factor in our analysis is that high-frequency remittance data disaggregated by origin in the U.S. is currently not available. There is some state-by-state-evidence on remittances to Latin America from three annual surveys conducted by the Inter-American Development Bank (IDB henceforth). The nature of the information unfortunately makes it unsuitable for time-series analysis as these surveys cover different states in different years. It is however noteworthy that the states highlighted by the IDB surveys as major origins of remittances are well aligned with the "Hispanic" states that we will identify in the next section. We will instead use data from national central banks on total remittance inflows, measured at the quarterly frequency and starting in 1995 for Mexico and 1998 for El Salvador. We will deal with this aggregate nature of remittances data in various ways in our estimations. Since about 95% of remittances to these countries reportedly come from the U.S. we are rather confident about not picking up large effects of other host countries.

There is an ongoing discussion about whether the available remittance data accurately captures the actual amounts transferred, and how variation in caption over time has affected data. While earlier remittance data from the region mainly included transfers made through official channels, efforts have been made during the latest decade also to include informal remittances e.g. though surveys of returning migrants at the border. This improved capture clearly has contributed to the high growth rates of remittances, but the extent of this effect is not well known.

There are some indications supporting the accuracy of Mexican data. Remittance inflows to a certain area within Mexico are positively correlated with the number of emigrants from the same region, suggesting that remittance patterns can be reconciled with demographic factors. The credibility of high-frequency movements in remittances is supported by data showing seasonal spikes coinciding with important events in the recipient countries such as religious holidays, Mother's Day and the start of the school year (Cañas, Coronado and Orrenius, 2007, IMF, 2006, INEGI, 2008).

Concerning U.S. variables, it is customary to date state recessions from developments in payroll employment. We follow this literature and make use of state-level employment data from the Bureau of Labor Statistics Current Employment statistics. This survey covers about 400,000 work sites each month. Alternatives could have been

state-level output or personal income. Estimates of U.S. output at the state level are available but are subject to a higher degree of uncertainty than at the national level. Personal income on the other hand also includes regional transfers and capital income payments, which makes it less appropriate for business cycle analysis. In addition, state-level price indices required to obtain real income or output are not available (Owyang, Rapach and Wall, 2007, Orrenius, Saving and Caputo, 2005, Partridge and Rickman, 2005, Phillips and Cañas, 2007). Lastly, and most relevant for our topic, we suspect that remitters' income in the U.S. derives far more from their labor than from profits on capital, so a focus on labor market conditions seems appropriate.

We also study two sub-components of total employment per state: employment in the construction and leisure services sectors. The construction sector is often claimed to be of special importance for Mexican immigrants' employment opportunities, although it makes up only 5% of U.S. total employment. The same goes for the service sector and Salvadoran immigrants. While we ideally would have liked to include all service employment this was not available for all states. We however have reasons to believe that our results can be generalized to the broader service sector as employment in the leisure service sector was highly correlated with total service sector employment for the states where both measures were available. Agriculture is also a very important sector, especially for Mexican short-term migrants, but sufficiently long time series of agricultural employment at the state level were unfortunately not available.

Remittance data and recipient country GDP were adjusted for seasonal effects using the U.S. Census Bureau X12 program. Data was deflated using U.S. CPI for remittances and the corresponding GDP deflator for recipient country output series. For most methods employed in this paper the data need to be stationary. This was not the case for any log-level series according to the common Augmented Dickey-Fuller and Phillips-Peron tests, which failed to reject non-stationarity.

Data on the number and state-level location of Hispanic immigrants were taken from the U.S. Censuses for the years 1995, 2000 and 2005. Up to half of the immigrants are however thought unauthorized and the extent to which their activities are captured by official statistics remains an open question (Orrenius, 2008, Chiswick and Hurst 2000, Miller and Neo, 2003). To compare Hispanic immigrants' residency with that for illegal immigrants we used data on the location of issuance of Mexican matricula consular identity cards during 2004-2007. These identity cards are used for identification by many illegal Mexicans and can be obtained by the applicant only from the geographically closest of the 47 Mexican consulates in the U.S. As shown in tables 4 and 6 in the appendix, the percentage of issuance of identity cards in a certain state

is well aligned with the census data on the Hispanic fraction of population [1]. Hence, we feel rather confident about using the official statistics (Ministry of Foreign Affairs of Mexico, 2008).

4. Hispanics' location and state-level business cycle heterogeneity

The first stylized fact we establish is the striking geographical bias in the distribution of Hispanics across states. Almost 35% of individuals of Hispanic origin resided in California in 2005, as shown in table 4 in the appendix. The four border states Arizona, California, New Mexico and Texas were home to almost 60% according to U.S. Census data. In contrast, the 40 least "Hispanic" of the 51 U.S. states only hosted 15% of the population group. Only looking at number of Hispanic individuals also masks some important trends, where traditional "Hispanic" states such as Texas and New York have seen much smaller, and according to some sources negative Hispanic population gains, and instead e.g. Colorado and Georgia that traditionally have had low number of Hispanic immigrants have seen their share rise considerably. Most of geographic transitions by Hispanics however seem to be within states (U.S. Census Bureau 1995, 2000, 2005).

The U.S. census data does not contain state-level information about different subnationalities within the Hispanic category. As two-thirds of the Hispanic population in the U.S. is of Mexican origin, the census data may give a reasonably good approximation of Mexicans' distribution across states. For Salvadorans, surveys have found that the majority resides in a dozen states: Arizona, California, Colorado, Florida, Georgia, Illinois, Maryland, New Jersey, New Mexico, New York, Texas and Virginia, but the distribution across these states is unknown. As earlier mentioned, both Mexican and Salvadoran immigrants tend to work mainly in the construction and services sector, with the former being relatively more important for Mexicans and the latter for Salvadorans (Gammage, 2007, Garcia and Palacios, 2008).

We now turn to state the second of our stylized facts, demonstrating business cycle heterogeneity among U.S. states and regions, as measured by correlation coefficients between the cyclical components of HP-filtered data. Figure 2 below illustrates the point with correlations of California—which is the economically largest of the U.S. states, as well as the most "Hispanic"—with each of the other states, and with the aggregate U.S. employment cycle. (Note that California is in a sense more Hispanic than it is economically dominant, with 35% of the U.S. Hispanic population compared to 10% of total employment.)

[1] Given the Mexicans' dominant share of the Hispanic population, data on people of Hispanic origin is likely to be a good proxy for the Mexican population.

(Figure 2 about here: Distribution of correlations between the employment cycle in California and the rest of the U.S.)

It is clear that there exists considerable business cycle heterogeneity among U.S. states. For more than half of the U.S. states, the correlations are less than 0.3, and some of those are negative. On the other hand, 17 states show correlations of + 0.6 or more. Among these are some states geographically close to California such as Colorado but also other further away. Reflecting this diversity, California's correlation with the aggregate U.S., marked in red, is in between or about + 0.5. The correlations between service employment in California, the other states and the aggregate U.S. look very similar, while the construction sector shows less heterogeneity in cycles across states. The magnitude and patterns of correlation coefficients are broadly in line with estimates in previous literature (Partridge and Rickman, 2005).

Regarding the importance of different industry mix across states, we can only infer differences in relative weights of the services and construction sectors from our data. We find that the construction sector has a larger share of employment in most of the "Hispanic" states outlined above, the exceptions being Illinois and New York. The same is true but to a lesser extent of our service sector measure. There is also as much variation in correlations between the three different employment measures within a certain state as for the same sector between states discussed in the previous paragraph. We find no evidence of Hispanic states having especially strong or weak within-state correlations of the three employment variables compared to states with low fractions of Hispanic population.

5. Estimating linkages

Our main hypothesis is that remittances to Mexico and El Salvador should be more positively affected by U.S. economic conditions in regions and sectors where the majority of remitters work. To test this, we first look at correlation coefficients and then proceed to a multivariate analysis, controlling for other variables, using distributed lag models.

5.1. Correlation coefficients. To assess the links between remittances and U.S. regional indicators, we calculated correlation coefficients between remittances and the three employment measures for the U.S. 48 contiguous states.[2] We also present correlation coefficients for the aggregate of all state-level variables to put these state-level

[2] According to the literature on state-level business cycles in the U.S., Alaska and Hawaii display very different characteristics from the 48 contiguous states, and are therefore usually not investigated. We follow this convention. The District of Columbia was not included due to lack of data.

results in perspective. To make data stationary two separate methods were used, HP-filtering and first-differences. Qualitatively the same pattern was obtained with the two techniques but with first-differenced data correlations were in general lower as were t-statistics.[3] To account for time effects, we calculated contemporaneous correlation coefficients as well as correlations with 1 to 4 quarter lags of the U.S. indicators. Results were quite similar for one and two quarter lags while correlations decreased for further lags. For clarity of the presentation, Figure 3 on the next page shows results only for states where correlation coefficients were high and significant.[4]

From Figure 3, a number of interesting observations can be made. First, the states where high and significant correlations are found match well the "Mexican" or "Salvadoran" states outlined in the previous section. Of the states with significant Mexican and Salvadoran populations, Illinois is the only one where no employment indicator is significantly related to remittances to either country. One possible explanation for this is the relative geographic isolation and different regional business cycle of Illinois from e.g. California and the other "Hispanic" states shown earlier.

The pattern of correlation coefficients also seems to pick up some of the differences in geographic location and sectoral occupation between Mexicans and Salvadorans discussed earlier. For remittances to Mexico, results are especially strong for the states along the southwestern border, while Salvadoran remittances seem related to a larger number of states. In fact, given the large number of states with significant coefficients for remittances to El Salvador, one would almost expect remittances to that country also to be responsive to aggregate U.S. indicators, a point that is discussed further below.

(Figure 3 Significant cyclical correlations between remittances and U.S. variables, and geographic location of Mexican and Salvadoran immigrants)

Correlations between remittances to El Salvador and various U.S. indicators were in general higher than the corresponding ones for Mexico, as shown in table 7 in the Appendix. Mexicans' often claimed higher dependence on the construction sector also seems reflected in the higher number of significant coefficients compared to services employment.

[3] This is in line with the different features of the HP-filter and first differences where the former keep more high-frequency variation which results in higher correlations (Baxter and King, 1999).

[4] For Mexico, very few coefficients were significant for other states. For El Salvador, coefficients were significant for some more states, but their magnitude was smaller than the ones shown in table 7 in the appendix.

For comparison, we also calculated correlations with aggregate U.S. total employment, service and construction employment as well as with GDP of the recipient countries. As seen from table 8 in the appendix, remittances to Mexico only show a significant correlation with U.S. aggregate employment in construction, and the coefficient is considerably lower than most found for individual states. Remittances to El Salvador on the other hand seem to be responsive at high significance levels also to aggregate U.S variables, although again the coefficients are lower than for disaggregate U.S. data.

Home country GDP was significantly and negatively correlated with remittances, consistent with the "remittances as compensatory transfers" hypothesis discussed in the literature review. Coefficients were remarkably similar in magnitude for Mexico and El Salvador and significant at the 10% level. The home country GDP coefficients are considerably lower than the ones we obtain for the U.S. indicators.

To sum up the results from this section, correlations between remittances and U.S. variables are especially strong for the "Mexican" and "Salvadoran" states, suggesting our proposed research strategy might be fruitful. Moreover, and as to be expected given the earlier discussed state-level business cycle heterogeneity in the U.S., the pattern found in correlation coefficients at the aggregate level does not hold up at the state level.

Notice however that these are simple unconditional correlation coefficients not controlling for other variables possibly affecting remittances. This includes possible bias from spillovers between U.S. variables. There is a risk of "over-fitting" total remittances to individual U.S. state-level variables in the sense that e.g. the coefficient on employment in Arizona is not picking up the effects on remittances from that particular state but in fact e.g. spillovers from California. A different, but related problem is that we can only hope to account for a fraction of the variation in remittances with any single state-level variable, given that total remittance flows emanate from many different locations in the U.S. We will address these issues in the next section.

5.2. Multivariate distributed lag models. To assess whether the above preliminary evidence holds up in a more formal econometric framework, we proceed to distributed lag estimation. The hypothesis to be investigated is whether remittances are affected by contemporaneous and lagged values of exogenous U.S. variables.

In the most general form, the model can be written as

$$r_{it} = \alpha_i + \sum_{s=0}^{p} \beta_s x_{t-s} + \sum_{s=0}^{R} \gamma_s z_{t-s} + e_{it} \tag{5.1}$$

where r_{it} is the quarterly percentage change in remittance flows to country i in period t, α_i is a constant, β_s is a sensitivity parameter to be estimated, and x_{t-s} is a stationary state-level U.S. employment variable in period t-s. z_{t-s} denotes a set of control variables.

In many cases, the high collinearity of current and lagged values of the x's and z's defeats direct estimation. The number of parameters to be estimated is instead reduced by using polynomial distributed lags which imposes a smoothness condition on the lag coefficients. Smoothness is expressed as requiring that the coefficients lie on a polynomial of relatively low degree. A polynomial distributed lag model with order q restricts the β coefficients to lie on a q-order polynomial of the form:

$$\beta_s = \varphi_1 + \varphi_2(s - \bar{c}) + \varphi_3(s - \bar{c})^2 + ... + \varphi_{q+1}(s - \bar{c})^q \tag{5.2}$$

for $s = 1, 2, ...P$ where $\bar{c}$ is a pre-specified constant given by

$$\bar{c} = \left\{ \frac{P}{2}, \frac{P-1}{2} \right\} \text{ for } P = \{even, odd\} \tag{5.3}$$

This specification allows us to estimate a model with P lags using only q parameters.

Regarding the choice of control variables, there is as earlier mentioned an ongoing discussion about to what extent remittances respond to macroeconomic conditions in the home countries, and whether remittances can act as a stabilizing factor of their business cycles. Including GDP in the recipient countries as an explanatory variable is therefore important to assess and control for the effect of e.g. a shock to recipients' income. There are also other, pure econometric, reasons to include home country GDP. If business cycle or economic growth indicators are highly correlated across countries, omission of origin country regressors would be a serious specification error. High correlations indeed seem to be the case both for aggregate and state-level variables in the case of Mexico, Central America and the U.S. (Phillips and Cañas, 2007, Roache, 2008, Sosa, 2008).

Moreover, the Mexican (real) peso/dollar exchange rate could be an important factor to take into account for the decision of sending remittances in currency or kind. The sign of the exchange rate coefficient is a priori not clear. If families target a certain consumption level in domestic currency, a depreciation would result in a negative sign through falling remittances. But if the consumption basket also contains a considerable

share of imported goods, a depreciated peso would be associated with an increase in remittances so as to preserve recipients' purchasing power. El Salvador has been dollarized though most of the period under study why the exchange rate was not included in the regressions for that country.

Lacking a theoretical model of how long it should take for a shock to the exogenous variables to affect remittance outflows, we rely upon measures of fit. After estimating equations with various lag and polynomial orders, we report below the ones with the lowest Akaike information criteria. In most specifications, this was achieved for 4-6 quarter lags of the explanatory variables, with polynomials of degree two to three. In polynomial lag estimation, the sum of the coefficients on the explanatory variable can be interpreted as the elasticity of the dependent variable to an innovation in the former over the estimation period. The coefficients should be interpreted as an upper bound on estimated effects as they measure accumulated effects over time assuming immigrants do not change geographical residence or sectoral occupation, arguably a strict assumption.

We estimated two sets of regressions: first on state-by-state and second on regional and re-weighted variables, to address the problems with state-level analysis outlined earlier. Regarding the first problem of "over-fitting" remittances to individual state-level variables and to ensure that results from state-level indicators are not instead picking up an aggregate U.S. factor, we estimate regressions with and without the aggregate U.S. total employment, employment in services and construction respectively. This way, we make sure that in the state-by-state regressions we only pick up the effect of a certain state over and above the impact of the aggregate U.S. cycle. The results from state-level regressions, reported in tables 9 and 10 in the appendix, confirmed the evidence obtained from looking at correlation coefficients. For Mexico, remittances were again significantly affected by especially construction sector employment in the "Mexican" states and the Southwestern border states outlined before. Salvadoran remittances were again sensitive to a large number of states or a broad U.S. cycle compared to Mexico's remittance inflows.

5.2.1. *Which aggregate U.S. cycle matters for total remittances?* The second problem with state-level analysis outlined earlier is that any individual state can explain at best a fraction of total remittances. At the same time, discarding information from other states (beyond the U.S. aggregate control variable) that may have largely orthogonal business cycles reduces our ability to explain total remittances. What we would like is instead to get a picture of the economic conditions facing the larger majority of Mexican and El Salvadoran immigrants in the U.S. In this way, we can hope to capture

more of the variation in total flows of remittances. This also makes the magnitude of the effects we find more comparable with previous studies using aggregate data.

To this end, we aggregate the state-level data in such as fashion that we give higher weights to the states that matter most for immigrant employment opportunities. We do so in two ways: first, by constructing weighted aggregate "Mexican" and "Salvadoran" variables for total employment, employment in the services and construction sector, and second by looking at the Southwestern border states separately. At least 60% of Mexican immigrants are thought to reside in the four border states; for Salvadoran immigrants we have no reason to believe this region to be of special importance.

We begin by stating the results for aggregate U.S. variables for comparison. In the below regressions, the control variables were the respective home country's GDP, and in the case of Mexico also the real peso/dollar exchange rate.

Table 1 Remittances and aggregate U.S. variables

Mexico				
	U.S. variable	MX GDP	XR	R-sq
U.S. total employment	2.80 (0.79)	1.61 (0.86)	2.21 (1.19)	0.35
U.S. construction	6.06 (1.12)	4.33 (0.54)	1.06 (0.34)	0.36
U.S. services	-1.12(-0.14)	0.75 (0.76)	1.20 (0.45)	0.28
El Salvador				
	U.S. variable	SLV GDP		R-sq
U.S. total employment	1.13*(1.54)	-3.03 (-1.18)		0.49
U.S. construction		5.03** (-1.72)		0.48
U.S. services	6.89** (1.77)	-4.61** (-1.97)		0.35

Distributed Lag Estimation. *, **, *** denotes significance at the 10, 5 and 1 %level respectively. T-statistics in parenthesis.

The above table confirms the results from simple correlation coefficients; remittances to Mexico are not significantly affected neither by total U.S. employment, nor U.S. employment in the construction and services sectors. Neither do remittances to Mexico seem to be affected by domestic developments. Remittances to El Salvador, on the other hand, show sensitivity both to aggregate U.S. employment and employment in the services sector. Coefficients on Salvadoran GDP were negative and significant in two out of three regressions, and of about the same magnitude as the coefficients on the U.S. variables. This suggests a bad income shock in El Salvador could affect remittances positively even after controlling for host country factors.

We keep these results, or lack thereof in the Mexican case, in mind when continuing to estimations for remittances to Mexico, El Salvador and weighted U.S. variables. For the "Mexican" variables we aggregate the state-level variables using as weights

the percentage of Hispanics living in each state using the U.S. 2000 Census.[5] Given the dominant share of Mexicans in the Hispanic population, the Hispanic shares of population are good proxies for where Mexicans reside. For the "Salvadoran" variables we simply add up states where there is evidence of significant populations residing, and control for the aggregate U.S. variables.[6]

Table 2 Remittances and U.S. "Mexican" and "Salvadoran" variables

Mexico				
	U.S. variable	MX GDP	XR	R-sq
U.S. "Mexican" employment	2.02*** (1.60)	-2.20* (-1.49)	2.49** (1.76)	0.58
U.S. "Mexican" construction	11.24** (2.67)	-7.88**(-2.69)	1.47* (1.60)	0.58
U.S. "Mexican" services	6.94 (0.22)	-1.11 (0.57)	1.53 (1.22)	0.33
El Salvador				
	U.S. variable	SLV GDP		R-sq
U.S. "Salvadoran" employment	1.67* (1.44)	-4.09 (-1.02)		0.76
U.S. "Salvadoran" construction	4.14* (1.35)	-3.25* (-1.34)		0.60
U.S. "Salvadoran" services	9.27** (1.88)	-3.64* (-1.50)		0.48

Distributed Lag Estimation. *, **, *** denotes significance at the 10, 5 and 1 % level respectively. T-statistics in parenthesis.

The striking differences in the above table compared to the results for the un-weighted aggregate variables in Table 1 concern Mexico. Remittances to Mexico show strongly significant relationships with our constructed "Mexican" variables for both total employment and employment in the construction sector as opposed to the lack of results for un-weighted variables. This again lends support to the idea that certain states are of major importance for Mexican immigrant employment opportunities and hence also ability to remit.

Interpreting the estimated coefficients as elasticities suggests that as a "rule of thumb," remittances to Mexico can be expected to fall by about 2% over six quarters following a 1% initial decline in the U.S. "Hispanic" employment situation, or by 11% following a similar decline in the "Hispanic" construction sector. While not exactly comparable due to differences in methodology, the magnitude of the 2% coefficient is similar and the 11% somewhat larger than those found in Lueth and Ruiz-Arranz (2006) for other parts of the world. Interestingly, when we try to estimate the effects on the aggregate U.S. economy especially relevant for Mexicans we also find stronger effects for the Mexican control variables. This suggests that remittances might increase

[5] We also tried using the 1995 and 2005 weights as well as an average and results did not change.

[6] These states are Arizona, California, Colorado, Florida, Georgia, Illinois, Maryland, New Jersey, New Mexico, New York, Texas and Virginia.

either in response to a positive shock in the host country or a negative one in remitters' country of origin.

For El Salvador, results are also stronger in terms of significance levels for the constructed "Salvadoran" variables compared to the un-weighted ones. Coefficients are however remarkably similar for the un-weighted and weighted variables, again confirming the more general sensitivity of Salvadoran remittances to U.S. variables both at the aggregate and state level, as well as the larger importance of the service sector. As a "rule of thumb", a 1% fall in "Salvadoran" employment would lead to almost a 2% decline in remittances, or a 1% fall in services employment to an almost ten-fold effect. This is again in the ballpark of the estimated effects in Lueth and Ruiz-Arranz (2006). Again, the Salvadoran control variables are also significant, with a negative sign, suggesting remittances' dual response to conditions in both countries.

5.2.2. *Border states.* A possibility mostly relevant for Mexico is that the four states on the U.S. southwest border are especially important for remittances. Recall that about 60 percent of Hispanics in the U.S. reside in those states, and about 65 percent of the identity cards issued by Mexican consulates are issued there. Moreover, the region has a long history of two-way migration and the transaction costs of remitting are possibly lower due to the smaller geographical distances between home and host countries. To investigate this hypothesis, we aggregate respectively state-level total employment, employment in the services and construction sectors for the border states California, Arizona, New Mexico and Texas.

Again, we control for the U.S. aggregate respective employment variable, home country GDP and in Mexico's case the exchange rate. Here, we view El Salvador as something of a control case. If we obtain equally strong results for "border" variables for El Salvador and Mexico, we are probably not picking up the effects of distance to the border per se as these ought to be weaker for El Salvador than Mexico (since the former do not share a border with the U.S). Luckily for our hypothesis, results were not significant for any "border" variable for El Salvador after controlling for the aggregate U.S. variables. Hence, we only report results for Mexico in Table 3 below.

Table 3 U.S."border" variables and Mexican remittances

	U.S. variable	MX GDP	Peso/dollar XR	R-sq
U.S. "border" construction employment	9.37** (2.67)	-3.46 (-0.80)	0.28 (0.43)	0.72
U.S. "border" total employment	13.23** (1.72)	-2.04 (-0.45)	0.86 (0.78)	0.77
U.S. "border" services employment	13.54** (1.66)	-4.58 (-0.79)	0.11 (0.05)	0.62

Distributed Lag Estimation. *, **, *** denotes significance at the 10, 5 and 1 % level respectively. T-statistics in parenthesis.

The above table indicates that the border states indeed seem to play an especially important role for remittances to Mexico for all three different employment measures, and even more so than the "Mexican" employment variables investigated before. Coefficients are high and significant and R-squares are considerable. However, while the Mexican GDP control variables still had the expected signs in most cases, they were no longer statistically significant. This is probably due to the very high correlation of the U.S. border state variables with the Mexican GDP variable. It is possible that what we are picking up is not only the effect of the economic conditions in the border states but also other factors such as increased immigration control which is possibly correlated with economic variables (see below).

5.2.3. *Robustness checks.* We conducted a number of tests to assess the plausibility of our results. First, we estimated all regressions using only the sample up to 2006:1, so as to control for the possible effects of the commonly perceived tightened security along the U.S.-Mexico border during the last two years. Early 2006 was also the period when growth in remittances to Mexico began to decline—and when the series for U.S. "housing construction starts" began to turn downward. Using this shorter sample only affected the results for the constructed "Mexican" and border state construction sector employment variables, where coefficients were smaller (but still significant) for the shorter sample period. This provides some indirect evidence that U.S. border security developments and the construction sector have played a role for the recent developments in remittances to Mexico.

Second, we estimated an AR (1) specification, that is included a lagged term for the change in remittances among the explanatory variables. This did not change the results. As regards endogeneity concerns, it is possible that remittances may affect growth and exchange rates in the recipient countries. (This is perhaps more a concern for the analysis of El Salvador, where remittance inflows are much larger in relation to the domestic economy than in Mexico.) We believe our estimation method with its

included lags should help diminish the contemporaneous effects on these variables, and hence the bias their interaction might produce.

6. Conclusions

While it seems plausible that workers' remittances could depend positively on economic conditions in the host country, such linkages to the U.S. economy have been hard to establish formally for recipient countries in the Western Hemisphere. Our starting point in this paper was that this may partly be due to earlier studies concentrating on the stance of the overall U.S. economy. After documenting significant variation in immigrant density across U.S. states and heterogeneity in business cycles at the U.S. state level, we provided new evidence that remittances to El Salvador and Mexico are in the short run significantly and positively affected by the economic conditions where their remitters work, as well as the sectors especially important for their employment opportunities.

The pattern we obtained is consistent with demographic information showing the Salvadorans to be more spread across the U.S. compared to the Mexicans who cluster in California and the other Southwestern border states. Remittances to El Salvador seem related to so many—and diverse— U.S. states that a relationship to remittances also shows up in the results using aggregate U.S. data, so one could as well argue these flows are in fact responding to a broader U.S. cycle. Remittances to Mexico on the other hand show some quite dramatic and interesting differences between the aggregate and state level: while strongly related to employment in a limited number of states, we find no significant relationships to total U.S. employment.

To assess the picture facing the "average" Mexican or Salvadoran immigrant, we constructed aggregate variables weighted by the share of Hispanic population in each state. Again, we obtained strongly significant results in contrast to the aggregate variables un-weighted by Hispanic population. We also found the four border states to be of special importance for remittances to Mexico, which is not surprising given that around 60% of its immigrants reside there. We also found macroeconomic conditions in remitter' home countries to matter, suggesting that remittances could increase both in response to a negative shock at home or a positive one abroad.

Future research using remittance data surrounded by less uncertainty will be able to estimate the links between remittances and local or regional host country economic activity more precisely. A major step forward would be to better match origins and destinations of remittances by using data disaggregated by U.S. source states, possibly from market intermediaries.

Our analysis has important policy implications. Once we know more about which host country conditions matter for remittances, we are much better equipped to e.g. forecast remittance flows. Given the considerable social and macroeconomic importance of remittances in many recipient economies, this is highly desirable and timely task.

We however think our most important policy contribution is to suggest new links for how remittances affect the macroeconomic performance of the recipient economies. This paper, although purely empirical, has suggested that remittances might not only smooth home country shocks due to their possibly countercyclical features but also transmit shocks originating in the host countries. As shown in our theoretical companion paper, Magnusson Bernard (2010), this mechanism is quantitatively important for the volatility of e.g. consumption in the recipient economies. For recipient countries whose aggregate economic cycles are highly correlated with those of the countries where their remitters work, this also means remittances will fall simultaneously with negative shocks to domestic output. Future research, as well as the recent recession facing the U.S. and the remittances-receiving economies in Latin America, will shed further light on this matter.

Appendix

Table 4 Fraction of Hispanic population in the U.S., per state

	2000	2005		2000	2005
Alabama	0,21%	0,23%	Montana	0,05%	0,05%
Alaska	0,07%	0,08%	Nebraska	0,16%	0,27%
Arizona	3,69%	3,70%	Nevada	0,68%	1,12%
Arkansas	0,24%	0,29%	New Hampshire	0,05%	0,06%
California	31,08%	34,88%	New Jersey	3,20%	3,16%
Colorado	2,09%	2,02%	New Mexico	2,71%	2,16%
Connecticut	0,90%	0,84%	New York	9,41%	8,09%
Delaware	0,11%	0,11%	North Carolina	0,36%	1,07%
DC	0,13%	0,11%	North Dakota	0,02%	0,02%
Florida	7,61%	7,65%	Ohio	0,60%	0,61%
Georgia	1,23%	1,51%	Oklahoma	0,37%	0,51%
Hawaii	0,25%	0,22%	Oregon	0,53%	0,77%
Idaho	0,29%	0,29%	Pennsylvania	1,01%	1,11%
Illinois	4,32%	4,02%	Rhode Island	0,19%	0,26%
Indiana	0,60%	0,62%	South Carolina	0,14%	0,27%
Iowa	0,23%	0,24%	South Dakota	0,02%	0,03%
Kansas	0,53%	0,10%	Tennessee	0,15%	0,35%
Kentucky	0,17%	0,18%	Texas	19,96%	18,91%
Louisiana	0,30%	0,28%	Utah	0,41%	0,57%
Maine	0,03%	0,03%	Vermont	0,02%	0,02%
Maryland	0,64%	0,70%	Virginia	0,72%	0,94%
Massachusetts	1,22%	0,41%	Washington	1,00%	1,25%
Michigan	0,93%	0,85%	West Virginia	0,04%	0,04%
Minnesota	0,40%	0,41%	Wisconsin	0,41%	0,55%
Mississippi	0,11%	0,11%	Wyoming	0,11%	0,09%
Missouri	0,33%	0,35%			

Source: U.S. Census Bureau

Table 5 Salvadorans and Mexicans in the U.S.

	1995	1996	1997	1998	1999	2000
El Salvador	656	701	607	723	761	765
Mexico	6,668	6,679	7,017	7,119	7,197	7,841

	2001	2002	2003	2004	2005	2006
El Salvador	829	868	1,019	955	1,121	1,091
Mexico	8,259	9,659	9,967	10,453	10,805	10,900

Unit: Hundreds of thousands. Source: U.S. Census Bureau.

Table 6 Percentage of matricula consular identity cards issued in different U.S. states

	2004	2005	2006	2007
California	37,34%	38,60%	40,23%	42,52%
Texas	15,61%	15,58%	16,20%	15,78%
Illinois	12,68%	11,46%	9,76%	8,79%
Georgia	4,25%	3,91%	3,84%	3,28%
Arizona	3,74%	4,06%	4,07%	4,72%
Florida	3,32%	2,46%	2,74%	2,91%
North Carolina	2,45%	2,67%	2,55%	2,11%
Indiana	2,40%	2,10%	1,98%	1,45%
Oregon	2,40%	2,33%	2,10%	1,74%
New York	2,37%	2,28%	2,01%	3,33%
Colorado	2,19%	2,25%	2,13%	2,30%
Nevada	2,18%	2,93%	2,85%	2,33%
Washington	1,96%	1,79%	1,75%	1,07%
Pennsylvania	1,16%	0,74%	0,86%	0,53%
Utah	1,09%	1,64%	1,53%	1,45%
Nebraska	1,03%	0,83%	0,89%	0,73%
New Mexico	1,00%	1,00%	1,00%	1,00%
Missouri	0,89%	0,94%	0,84%	0,78%
DC	0,81%	1,06%	0,99%	1,17%
Michigan	0,77%	0,72%	0,57%	0,42%
Massachusetts	0,11%	0,11%	0,11%	0,11%
Arkansas	0,00%	0,00%	0,00%	0,71%
Minnesota	0,00%	0,56%	0,89%	0,90%

Source: Ministry of Foreign Affairs of Mexico

Table 7 Correlations between cyclical components of HP-filter, remittances and U.S. state-level variables

	Mexico		El Salvador	
	Coefficient	T-Stat	Coefficient	T-Stat
AZ Output	0.35	(2.67)	0.75	(7.94)
AZ Construction	0.68	(6.54)	0.72	(7.38)
AZ Services	0.31	(2.33)	0.70	(6.89)
CA Output			0.64	(5.89)
CA Construction	0.60	(5.24)	0.71	(7.13)
CA Services			0.63	(5.72)
CO Output			0.52	(4.28)
CO Construction			0.61	(5.40)
FL Output	0.42	(3.26)	0.83	(10.48)
FL Construction	0.78	(8.73)	0.70	(7.02)
FL Services	0.35	(2.62)	0.56	(4.77)
GA Output			0.62	(5.58)
GA Construction			0.55	(4.66)
GA Services			0.55	(4.71)
NV Output	0.53	(4.44)	0.74	(7.74)
NV Construction	0.78	(8.83)	0.58	(4.97)
NV Services			0.51	(4.21)
NJ Output			0.56	(4.82)
NJ Construction			0.45	(3.55)
NM Output	0.34	(2.58)	0.69	(6.72)
NM Construction	0.52	(4.33)	0.78	(8.84)
NY Output			0.62	(5.87)
TX Output			0.65	(6.27)
VA Output			0.72	(7.33)
VA Construction	0.60	(5.36)	0.79	(9.11)
VA Services			0.69	(6.78)

Note: All of the above correlation coefficients are significant at the 5% level.

Table 8 Correlations between cyclical components of HP-filtered data, remittances, host and home country aggregate variables

	Mexico		El Salvador	
	Coeff.	T-stat	Coeff.	T-Stat
U.S. total employment	-0.09	-0.5	0.64**	7.04
U.S. construction employment	0.35**	2.55	0.56***	4.61
U.S. Services employment	-0.05	-0.33	0.47***	3.59
MX GDP	-0.21*	-1.41		
SLV GDP			-0.21*	-1.35

Note: *, **, *** denotes significance at the 10, 5 and 1 % level respectively.

Table 9 Distributed Lag Estimation, Mexican remittances and state-level U.S. variables

With controls:

(a) U.S. aggregate employment, construction and services employment respectively

(b) Mexican GDP and peso/dollar exchange rate for all regressions

*, **, *** denotes significance at the 10, 5 and 1 % level respectively.

	Sum of coefficients U.S. variable	T-stat	R-sq
Arizona construction	3.43**	2.21	0.46
Arizona employment	7.94**	1.92	0.44
Arizona services	2.86*	1.36	0.52
California construction	2.13**	1.70	0.88
California employment	5.08**	2.60	0.81
Colorado construction	5.90**	1.83	0.49
Colorado services	10.54*	1.40	0.54
Florida construction	2.88**	2.40	0.51
Florida employment	4.74***	1.72	0.79
Florida services	8.07***	2.43	0.51
New Mexico construction	4.39***	2.68	0.59
New Mexico employment	4.38**	1.76	0.82
Nevada construction	1.18**	1.40	0.39
Nevada employment	8.12***	2.79	0.52
Nevada services	10.86***	3.43	0.62
New York construction	10.25**	1.97	0.70
New York employment	3.03*	1.38	0.37
Texas construction	7.11**	1.92	0.78

Table 10 Distributed Lag Estimation, Salvadoran remittances and state-level U.S. variables

With control variable: Salvadoran GDP. No exchange rate control, dollarized economy for most of period under study.

*, **, *** denotes significance at the 10, 5 and 1 % level respectively.

	Sum of coefficients on U.S. variables	T-stat	R-sq
Arizona construction	0.62**	2.13	0.22
Arizona employment	2.20**	2.11	0.29
Arizona services	4.44**	3.14	0.46
California construction	1.01*	1.32	0.17
California employment	3.53*	1.35	0.19
California services	3.27*	1.31	0.21
Colorado employment	2.54*	1.39	0.23
Florida construction	2.12**	1.96	0.17
Florida employment	3.16**	1.73	0.22
Florida services	4.22*	1.42	0.11
Georgia employment	3.55**	1.88	0.19
Georgia services	4.78**	1.96	0.23
New Mexico construction	1.21*	1.51	0.24
New Mexico employment	8.67**	1.81	0.22
Nevada construction	0.59*	1.51	0.27
Nevada employment	2.72**	1.89	0.28
Nevada services	1.51**	1.71	0.25
New York employment	1.74*	1.39	0.18
New York Services	7.61**	2.36	0.23
New Jersey employment	4.78**	1.77	0.19
New Jersey services	5.51*	1.41	0.13
Texas employment	3.07**	2.18	0.32
Virginia construction	1.917*	1.55	0.16
Virginia employment	4.22*	1.32	0.18
Virginia services	5.31**	1.74	0.11

FIGURE 1. Remittances to Central America and Mexico. X-axis: Billions of U.S. dollars, seasonally adjusted. Sources: Haver Analytics, national authorities, and IMF International Financial Statistics.

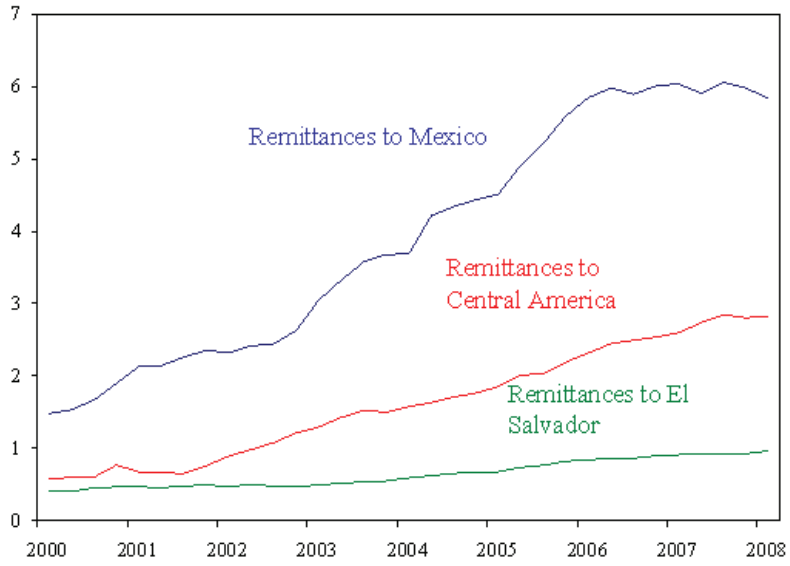


FIGURE 2 Distribution of correlations between the employment cycle in California and the rest of the U.S.

X-axis: Comovement between California, other U.S. states and total U.S. employment, ordered by magnitude. Y-axis: Size of correlation coefficient. Source: U.S. Bureau of Labor Statistics, Current Employment Survey. Note: Correlations are contemporaneous and between cyclical components of HP-filtered and logged data.

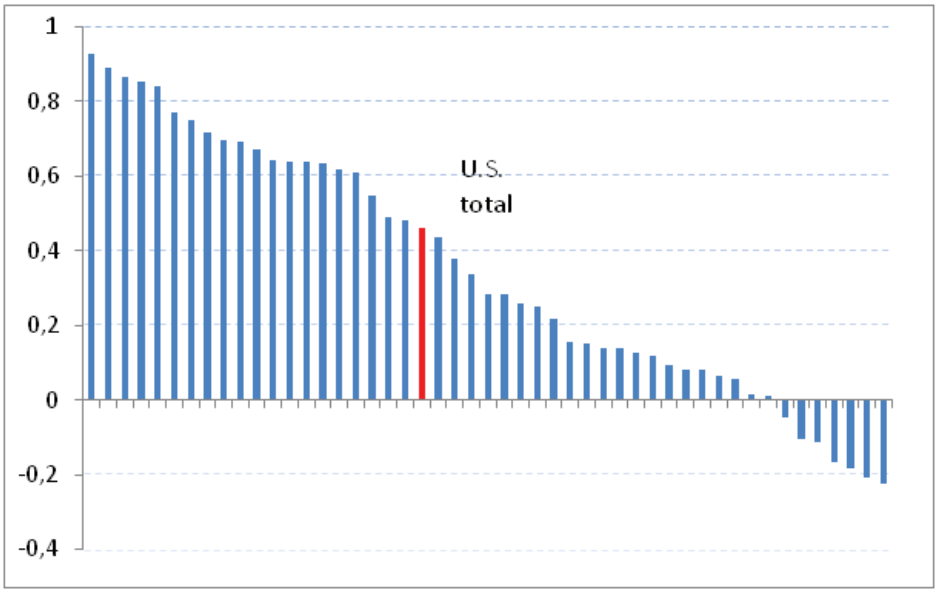
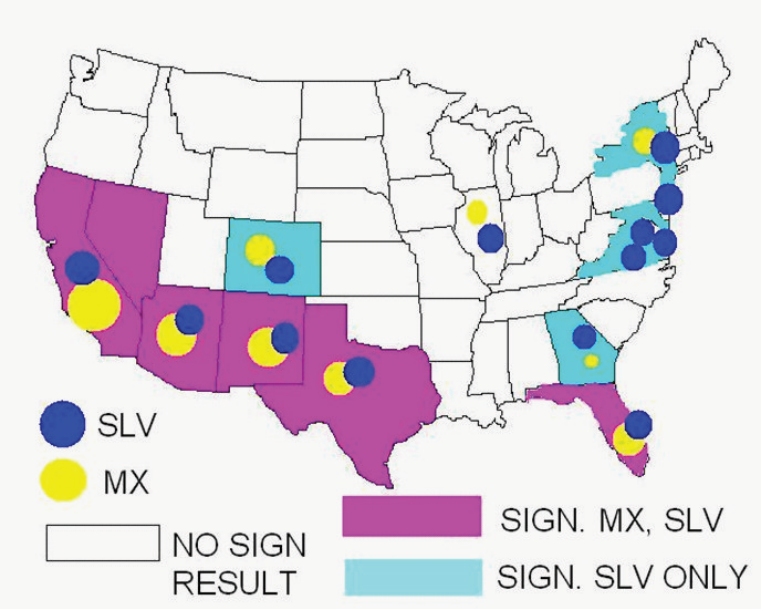


FIGURE 3 Significant cyclical correlations between remittances and U.S. variables, and geographic location of Mexican and Salvadoran immigrants

Sources: U.S. Census Bureau, Haver Analytics, author's calculations. Note: "Sign. Result" refers to a correlation coefficient between cyclical components of HP-filtered variables significant at the 5% or higher level. Circles refer to populations of Mexicans and Salvadorans. Their sizes are proportional to shares of population for Mexico, not for Salvadorans as the corresponding information is not available.



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PAPER 3

Quantity Puzzles and Risk Sharing Across Countries and Regions

Kristin Magnusson Bernard

ABSTRACT. The "Quantity Puzzle" presents a challenge for international RBC models, as does the positive relationship between countries' degree of financial integration and their bilateral output correlations. We study whether both phenomena obtain for European countries and regions. We confirm previous findings for U.S. and international data that they do for countries but not for regions. The latter result is driven by bilateral risk sharing being more dispersed within the regional sample than between countries and regions. Regions in well-integrated European economies where barriers to intra-country capital flows are low show patterns very similar to U.S. states, while those of less financially advanced countries replicate the pattern found between countries. We also identify channels for interregional risk sharing at the multilateral level by decomposing the cross-sectional variance of regional GDP into fractions smoothed in turn on capital markets and by migration, through fiscal policy and on credit markets. We find that the fraction of shocks not smoothed is higher for European regions than U.S. states, and even more so for regions in the new member states

1. Introduction

Absent restrictions on international capital flows, theory predicts that trade in financial assets should be motivated by insurance motives, and this in turn should be reflected in quantities. In other words, consumption plans should be highly correlated among countries where fluctuations in local production are dissimilar, since they provide especially good risk sharing opportunities to each other. In the data, cyclical fluctuations in consumption are less correlated than the corresponding component of output. This discrepancy between model predictions and data has been dubbed the "Quantity Puzzle" (Backus, Kehoe and Kydland, 1992. Moreover, most theoretical models predict that the relationship between financial integration and correlation of output fluctuations should be negative (Backus, Kehoe and Kydland 1994).[1] Additionally, countries experiencing high productivity shocks will have net capital inflows according to the model.

[1] Since countries are perfecly symmetric in this class of models, output correlations are a priori positive.

Stepping away from the complete markets assumption changes this result qualitatively but not quantitatively (Kehoe and Perri 2002). This prediction on the correlation between financial integration and output correlations, much like the Quantity Puzzle, has found little empirical support. The relationship usually seems the *opposite* - financial integration is found to be positively correlated with output fluctuations (Kose, Prasad and Terrones, 2003, Bordo and Helbling, 2003).

Little evidence exists on how international business cycle models fare on the sub-national level. Regions or states within countries or federations in many ways constitute ideal testing grounds for the neoclassical model as their capital markets are typically thought to be well-integrated and barriers to financial flows low. Indeed, using a simple neoclassical framework, Kalemli-Ozcan et al (2008) find that capital flows between U.S. states behave according to the model. It is however not clear how these results hold up outside the U.S., e.g. for European regions where financial integration is in general lower and also more heterogeneous than across countries (Ekinci et al, 2007). More closely related to our study is Imbs (2004) who finds no "Quantity Puzzle" for North American states, i.e. that pairwise correlations in consumption are on average higher than for output. Moreover, financial integration is found to be associated with lower correlations of output fluctuations. The author takes this as evidence that the key to the Quantity Puzzle lies in aggregate capital flows or frictions associated with national borders.

We think that Imbs' findings on the failings of the international business cycle model for international but not intra-national data require further investigation. Do regions within OECD countries behave in line with the neoclassical models? Is the difference between countries and regions within a country as marked if we confront it with more challenging data? For example, European countries that are more integrated than countries further apart, and a larger sample of regions displaying possibly more heterogeneous levels of financial integration?

As pointed out by Imbs, readily available measures of financial integration do not exist at the intra-national level. He extends the measure of risk sharing first suggested by Kalemli-Ozcan et al (2001, 2003) and Asdrubali et al (1996), i.e. the responsiveness of consumption to local production, to a bilateral context where the relationship between pairwise differences between the cyclical components of the just mentioned variables are investigated.[2] Full financial integration or risk sharing is achieved when differences in the cyclical components of consumption are not related to differences in shocks to output in the same regions. For regions in financial autarky, on the other hand, the relationship should be one-to-one. The validity of this approach cannot be

[2] Consumption is here typically proxied by local disposable income.

confirmed by regional data but is instead indirectly supported by showing that this risk sharing measure gives rise to very similar results as directly observable measures of financial integration when analyzing country-level data.

Most international business cycle models as well as Imbs focus on bilateral risk sharing. We extend the analysis to the multilateral level and investigate more in detail the different channels through which multilateral risk sharing is actually achieved, by drawing on the Asdrubali et al (1996) framework. They decompose the cross-sectional variance in U.S. gross state product into fractions smoothed on capital markets and through migration, through fiscal policy and on asset markets. The reasoning behind the smoothing channels goes as follows: A well-developed capital market allows for cross-region ownership of productive assets, thus facilitating risk sharing. Labor mobility or short-term migration facilitate adjustment to local temporary spikes or troughs in demand. The central government's tax-transfer system can alleviate idiosyncratic shocks to states. Finally, regions in a country or states in a federation can smooth their consumption ex-post by adjusting their asset portfolios.

Little is known about how European regions fare in this regard, and thus it is of interest to quantify the importance of both the different channels and the overall level of smoothing, as well as to make comparisons with U.S. states. Does the Economic and Monetary Union (EMU) succeed in providing the same level of consumption insurance to its regions as the U.S. federation of states? Do the relatively deeper capital markets in the U.S. make for a higher reliance on this channel? Does Europe's relatively larger public sector make it more or less efficient in smoothing the idiosyncratic shocks of its regions?

To investigate the above questions on the "Quantity Puzzle", bilateral and multilateral risk sharing, we will mainly use an European regional data set for the period 1980-2007 from Cambridge Econometrics. Our maximum sample consists of 279 European regions at the NUTS 1 and 2 level, and the variables included are annual GDP, GVA, and different measures of household income and consumption[3]. The country-level data used is relatively standard. For comparison with previous studies that all concentrate on U.S. states, we will follow the methodology used in those papers closely and refer to earlier results whenever possible.

We find that the "Quantity Puzzle" indeed obtains for countries within the European Union, while regions of the same countries show correlations in accordance with

[3] NUTS refer to Nomenclatuture of Territorial Units for Statistics. The guidelines for the approximate size of NUTS regions are that a NUTS 1 region should have 3 to 7 million inhabitants, while the NUTS 2 regions encompass 800 000 to 3 million, although these limits are not strictly enforced so as not to interfere with geographical and institutional divisions already in place in the European Union member states.

the predictions of the international real business cycle model. Moreover, and in accordance with previous literature, we find that on average bilateral risk sharing is higher between regions than countries. This however masks some important heterogeneity in regional risk sharing: regions within some countries display lower levels of bilateral risk sharing than between countries. Therefore, we fail to show that financial integration translates into less correlated output fluctuations at the country level as well as for the whole sample of European regions.

When excluding the less financially integrated regions of Southern Europe, on the other hand, we find that financial integration is associated with less correlated output fluctuations, as the neoclassical model predicts and as found in Imbs (2004). This suggests that the obstacles to free capital flows that have been put forward as the main impediments to reconciling the predictions of this theoretical framework with data need not only be associated with national borders but also with intranational factors. Regarding the determinants of intra-country integration, we find risk sharing to be positively correlated to within-country trade flows as well as dissimilarities in sectoral structure, which suggests that room for improvement in the risk sharing abilities of European regions may lie in these linkages.

In a second step, we investigate channels of multilateral risk sharing among European regions and countries. We find that the fraction of shocks not smoothed is on average higher for European regions than for U.S. states, and especially so for the regions within the new member states in Eastern Europe. This aside, we find the relative importance of different channels to be the same for Europe and the U.S., i.e. that the largest fraction of shocks are smoothed on capital markets, followed by capital markets and fiscal policy. We also find that most of the smoothing of shocks occurs within the same country, i.e. that geographic proximity is very important. We find very little smoothing of shocks for countries, i.e. that international risk sharing is still very limited which is in accordance with previous studies.

The rest of the paper is organized as follows. Section 2 is concerned with the "Quantity Puzzle" and bilateral risk sharing and investigates determinants of output correlations. Section 3 studies channel of multilateral risk sharing for countries and regions. Section 4 concludes.

2. Quantity Puzzles and Bilateral Risk Sharing

For the methods used this section we need as long a time series as possible and hence end up with a sample consisting of the "old" EU countries Austria, Belgium, France, Germany, Greece, Italy, the Netherlands and Spain. Despite sufficiently long time

series being available, other countries such as Finland, Sweden, Switzerland, Portugal and Ireland were not included due to the number of regions in these countries being too small for investigating regional variation within countries in a meaningful way. An more detailed description of all data used is found in the Data appendix.

2.1. Methodology. Following Kalemli-Ozcan et al (2001, 2003) and Asdrubali et al (1996), financial integration can be proxied by the amount of risk shared. For a single region or state, risk sharing is measured as the responsiveness of cyclical fluctuations in output y_{it} to the same component of local consumption c_{it} as follows:

$$y_{it} - c_{it} = \alpha + \beta y_{it} + \varepsilon_{it} \tag{2.1}$$

where β is an index of overall risk sharing in region i; with perfect risk sharing, consumption is unhinged from local production, and β equals one. A β of zero on the other hand represents the other extreme of financial autarky where local consumption is fully determined by local income.

As pointed out by Imbs (2004), β cannot be used directly in a bilateral context. For example, the pairwise sum of two regions' β might be high even if they are in fact both mainly sharing risk with a third party as opposed to within the pair. Equation (1) is hence extended to a bilateral context in the following way:

$$\Delta y_{ijt} - \Delta c_{ijt} = \alpha + \beta \Delta y_{ijt} + \varepsilon_{it} \tag{2.2}$$

where Δx_{ijt} denotes differences in x_t between countries or regions i and j. The equation says that capital will flow from relatively richer to poorer regions or states if efficient risk sharing as measured by β is possible. Estimates of β will be low between regions that offer little insurance capacity to each other (i.e. output fluctuations move in lockstep), even when measured fluctuations in consumption are similar (e.g. because of risk sharing with third parties).

Previous literature on the U.S. (Kalemli-Ozcan et al 2001, 2003, Imbs 2004) proxies consumption with disposable income for lack of data on the former. We have access to region-level household expenditure and retail spending data, which are closer to common definitions of consumption as they do not include savings rates, but choose to present results using disposable income to enable comparisons with previous work.

Moreover, we did not find that results were qualitatively affected by the choice of consumption proxy.

That β is a valid measure of financial integration cannot be directly verified at the regional level but is instead indirectly supported by obtaining very similar results for international data using this measure and variables on direct financial integration. At the country level, we measure financial integration as the pairwise sum of bilateral asset holdings from the IMF Coordinated Portfolio Investment Survey for the years 2001-2007. For what follows, results did not change depending on whether time averages or initial values of this variable were used.

If consumption correlations are high and output correlations are low, the above estimate of β becomes uninformative due to insufficient variation in the difference of cyclical consumption correlations. But as argued earlier, the "Quantity Puzzle" mainly pertains to the opposite relation, i.e. that output correlations are high and consumption correlations low. Thus it seems safe to follow Imbs' approach and use the estimates of β to investigate the determinants of bilateral output correlations in the following way:

$$\rho_{ij}^{Y} = \alpha_0 + \alpha_1 \phi_{ij} + \alpha_2 T_{ij} + \alpha_3 S_{ij} + X_{ij} + \varepsilon_{ij}^{0} \tag{2.3}$$

$$T_{ij} = \gamma_0 + \gamma_1 \phi_{ij} + \gamma_2 I_{ij}^{1} + \varepsilon_{ij}^{1} \tag{2.4}$$

$$S_{ij} = \delta_0 + \delta_1 \phi_{ij} + \delta_2 I_{ij}^{2} + \varepsilon_{ij}^{2} \tag{2.5}$$

where ρ_{ij}^{Y} denotes the Pearson correlation coefficient between the cyclical component of GDP in regions i and j. Direct effects of financial integration are captured by ϕ_{ij} and will be measured by our risk sharing measure as estimated by β from equation 2.1 for both regions and countries as well as with the direct measures discussed earlier for the latter. When estimating the system of eqs. (2.3)-(2.5), we will also instrument the CPIS measure with institutional variables capturing the financial advancement of a country (La Porta et al 1998). X_{ij} is a vector of control variables, e.g. country dummies in the regional data set and an indicator of whether the pair of regions are NUTS 1 or 2.

To properly account for the full effect of financial integration on bilateral integration, we need to control for a host of factors and net out their possible respective correlation with financial integration. Starting with Frankel and Rose (1998), many

papers have found a significant effect of bilateral trade intensity on business cycle co-movements; T_{ij} captures this direct effect. In the international data set, trade flows will be measured using the IMF's Direction of Trade Database and computed in the intense form following Deardroff (1998), Clark and van Wincoop (1999), and Imbs (2004):

$$T_{ij} = \frac{1}{T} \sum_{t} \frac{(EX_{i,j,t} + IM_{i,j,t}) * NYW_t}{NY_{i,t} * NY_{j,t}}. \tag{2.6}$$

$EX_{i,j,t}$ ($IM_{i,j,t}$) denotes total merchandise imports from country i to country j in year t, NY_i nominal GDP in country i, year t, and NYW is world nominal output in year t (all variables measured in U.S. dollars). Trade flows cannot be measured directly at the regional level. Instead, we instrument them according to the gravity model of international trade with (arguably exogenous) geographical variables. For the regional level we use a binary variable indicating a common border, another indicating whether the region borders another country, and the product of populations.

S_{ij} is meant to capture the effect of specialization or similarity in sectoral structure on cycles following the works of Imbs (2001), Clark and van Wincoop (2001) and Kalemli-Ozcan, Sorensen and Yosha (2001). The main conclusion of this literature is that more dissimilar countries or states can insure production risk since they typically face relatively less synchronized shocks and thus lower output correlations. Sectoral real value added data is used to compute an index S of the similarity in sectoral structure:

$$S_{ij} = \frac{1}{T} \sum_{t} \sum_{n}^{N} |s_{n,i} - s_{n,j}| \tag{2.7}$$

where $s_{n,i}$ denotes the GDP share of industry n in country i at the one-digit level. S_{ij} is the time average of the discrepancies in economic structure of countries i and j and reaches its minimal value zero for identical countries or regions.

Determinants of output correlations aside, it is also possible that financial integration affects trade or specialization (Lane and Milesi-Ferretti, 2004, Kalemli-Ozcan et al, 2003). To allow for this, we need distinct instruments for T_{ij} and S_{ij}. For the former at the regional level we as earlier mentioned have no direct measures but use a binary variable indicating a common border, one indicating whether the region borders another country, and the product of populations. For the countries we instead of the external border variable use the distance between capitals. In instrumenting specialization we follow Imbs (2004) and use the pairwise sum and difference of per capita

output both at the regional and country level, with the argument that richer regions tend to be more diversified and thus probably more similar. We first estimate a version of the above system where γ_i and δ_i are set to zero and later generalize the estimation.

2.2. Results. Table 4 summarizes the statistics of interest from both the country-level and regional data sets: pairwise correlations of cyclical components of output and consumption as well as our measure of bilateral risk sharing β. We find that for European countries cyclical output fluctuations are more correlated than the same component of consumption, and that the opposite relation holds for regions within the same countries. This means we find no "Quantity Puzzle" for European regions which is in line with Imbs' findings for the U.S.

The difference between European countries and regions is however much smaller than between Imbs' larger sample of countries (indeed, larger than his state-level sample) and U.S. states, again pointing to the importance of the composition of the country sample we discussed in the introduction. This is also in accordance with Imbs' finding that international financial integration tends to push up both output and consumption correlations, as European countries are likely more similar along this dimension than a larger sample of countries showing more dispersion in geographical distance and levels of development. Comparing U.S. states and European regions, we also find that the spreads between the average output and consumption correlations are higher among the former. On the other hand, the dispersion of output and consumption correlations is very similar both in our sample and Imbs' data set.

Turning to our risk sharing measure, we find that β is on average higher between regions than countries, confirming the findings in Imbs (2004) and Kalemli-Ozcan et al (2003). Note though that the difference is much smaller between the relatively highly integrated countries in Europe and their regions than between the Imbs' country data set and U.S. states. We also find that risk sharing is on average higher between European regions than between U.S. states.

There are however interesting differences hidden behind the mean of regional risk sharing. Risk sharing between regions in Spain, Italy and Greece is on average *lower* than the average risk sharing between European countries. This corresponds well to the Kalemli-Ozcan et al (2007) findings that intra-country capital flows seem to be a lot smaller and even directed towards poorer (or catching-up) regions in Southern Europe while not so further north.

Notice that the standard deviations both for the European country-level and regional variables are such that the above suggested differences are not statistically significant, something that was also found by Imbs for his data set. This is what motivates the more formal statistical analysis we now proceed to.

We begin with simple OLS regression of the system of equations (2.3)-(2.5), hence ignoring all possible simultaneity problems between financial integration on the one hand and trade and specialization on the other. The results are presented in Table 5. For the international data we use the CPIS measure of bilateral asset holdings for financial integration ϕ in specifications (i) and (ii), while all other specifications use our measure of risk sharing β. Estimations (iii) and (v) also instrument trade and specialization (sectoral structure). The impact of trade and specialization is in line with earlier literature regardless of whether these differences are instrumented or not, i.e. more intense bilateral trade linkages are associated with more correlated business cycles. Moreover, economies that are more similar in terms of structure or specialization patterns (i.e. score low on this variable) are more correlated.

The most interesting result of Table 5 concerns the role of finance. Across countries, we find that more financially integrated countries have more correlated output fluctuations, although the estimate is not significant when we use the CPIS measure. We find this to be the case also for the full sample of European regions, at the highest significance levels and regardless of whether trade and structure are instrumented. This is in sharp contrast to Imbs (2004) who always finds the opposite for U.S. states, i.e. that financial integration within a country results in less correlated output fluctuations as suggested by theory.

We believe that the reason behind the differences in results for European regions and U.S. states lies in other characteristics not fully captured by the country dummies we use, rather than financial integration or capital flows to a larger extent being associated with national borders as spelled out in Imbs (2004). There are few formal barriers to capital flows within EU countries but remember that we still found risk-sharing to be lower between regions within Southern Europe than on average between European countries. Indeed, when we exclude regions in Greece, Italy and Spain from the data set (the lower right corner of Table 5) we get strikingly similar results for the remaining European regions to what Imbs obtains for U.S. states: financial integration is associated with lower correlations of output fluctuations and the effect is highly statistically significant.

Why is then risk sharing or financial integration lower in Southern Europe? Ekenci et al (2007), using an income-based measure of insurance, find that capital does not flow to poorer regions in Southern Europe and suggest that this is due to government subsidies and taxes being channelled to these relatively poorer regions. But as we measure risk sharing *after* these transfers have taken place and still find lower values, we are sceptical to the claim that government transfers substituting for private capital

flows are what drives the lower risk sharing between regions in Southern European countries.

We do not believe that differences in savings behavior can explain either the differences between the country-level and regional data sets, or those within the sample of European regions, despite the fact that consumption is proxied with disposable income for regions. First, we would need local savings rates to be negatively correlated with income for Southern European regions but not for those further north. In the literature, savings rates are usually found to be positively correlated with income. Second, we double-checked our results using risk sharing measures based on household expenditure or retail spending, which are net of savings, and the main results hold up.

Table 6 displays the results for the specification where finance is allowed to simultaneously be related to trade and specialization patterns. Our main results are unchanged. The full sample of European regions displays similar results as the analysis of country-level data: more financial integration is associated with higher output fluctuations. Again, the opposite holds when excluding Greece, Spain and Italy from the sample. This suggests that the driving force behind our results is not an endogeneity of financial variables at the regional level as the effects of finance clearly differ depending on the characteristics of the countries the regions under study belong to.

We find positive relationships between risk sharing on the one hand and a more specialized structure of the economy and trade intensity on the other. This is however not to be taken as a causal relationship (see Kalemli-Ozcan et al, 2003, for a further discussion of causality and this issue), i.e. it is not clear whether risk sharing drives specialization or trade or the other way around, but suggests that policy makers interested in improving the integration of their regions could benefit from looking further into this nexus.

2.3. Robustness and Extensions. The estimation results in able 7 include a measure of the size of the financial sector to try to control for that risk sharing is not only an outcome of different local regulations that in turn affect financial integration. Once we control for the size of the financial sector the effects of finance and structure becomes highly significant for the country sample while the signs of coefficients do not change.

While the effect of financial integration is still negative and significant for Northern Europe and positive and significant for the whole regional sample, we find that regions with more developed finance and real estate sectors tend to have significantly more correlated output fluctuations (regardless of where in Europe they are located), while the opposite is true for the country level. This is in line with the findings in Imbs (2004) although he did not obtain a significant result for the country level. It appears that it

is mainly the size of the banking sector of European regions that is driving the positive results while the U.S. ones are due to the real estate sectors. For countries, on the other hand, a large banking sector seems to result in low output correlations, suggesting that international risk sharing might indeed be achieved through that mechanism. These results that go against our evidence on the effects of financial integration at different levels of aggregation merit further future investigation.

We also try to take account of other possibly important differences between U.S. states and European regions. Our sample consists of both NUTS 1 and NUTS2 regions, where the latter are in general smaller than U.S. states. To investigate whether the size of regions matters for the results, we estimate the above regressions only for regions with a product of populations above the median, i.e. 5 million. Results do not change.

Finally, remember that we in all specifications perform a cross-section analysis based on the whole time period 1980-2007. It has been shown that risk sharing and financial integration have increased over time and thus it would have been interesting to split the sample into different subperiods. Unfortunately, the available regional European time series are too short for such an exercise. As pointed out by Hoffman and Shcherbakova (2008), risk sharing among U.S. states also differs considerably over the business cycle. Unfortunately, our methodology does not allow us to study boom versus bust years separately, since our risk sharing measure is computed over an extended time period.

3. Channels of Multilateral Risk Sharing

The previous section dealt with bilateral risk sharing and the role of financial integration for output correlations at the regional and country level. We now instead turn to investigating channels of multilateral risk sharing. The Asdrubali (1996) method we employ in this section relies on panel data, which is why we are able to make do with a shorter sample and are able to include a larger sample of both "old" and "new" European union members: Austria, Belgium, the Czech Republic, Germany (including former GDR regions), Greece, Spain, France, Ireland, Italy, the Netherlands, Poland, Portugal, Slovakia, Finland, Sweden, Slovakia, and the United Kingdom, for a total of 279 regions or 3070 observations.

3.1. Methodology. Following Asdrubali et al (1996), we do not distinguish between the citizens of a region and the government of a region, but take regional gross state product as given. With full risk sharing, consumption would be a fixed proportion of output irrespective of the stochastic process governing the latter. Denote (real) gross regional product, (real) regional primary income, (real) regional disposable income and (real) consumption by grp, ri, dri and c. All variables are henceforth expressed in per capita terms. According to the Eurostat definitions gross primary income includes

dividends, interest, and rents across borders. Primary income also include nonpersonal taxes. Moreover, with gross regional GDP being based on the place-of-work while regional primary income is based on the place-of-residene, the difference between them will also take into account labor commuting. Regional disposable income also takes into account the effects of personal taxes and transfers to individuals.

If there is full risk sharing after capital markets and labor commuting, ri should not comove with gri. If this is not the case, further smoothing can occur through the fiscal system. If this channel also achieves less than full risk sharing, further smoothing can be obtained on credit markets. Finally, if full risk sharing is achieved, local consumption will be completely unhinged from local production. The above outlined step-wise smoothing can be summarized in the following identity (suppressing time indices for the moment):

$$grp^i = \frac{grp^i}{ri^i}\frac{ri^i}{dri^i}\frac{dri^i}{c^i}c^i \tag{3.1}$$

where i is an index of regions. To obtain a measure of smoothing from the above identity, take logs and differences, multiply both sides by $\Delta \log grp^i$ and take expectations, to arrive at the following decomposition of the cross-sectional variance in grp :

$$\begin{aligned} var\left\{\Delta \log grp\right\} &= cov\left\{\Delta \log grp, \Delta \log grp - \Delta \log ri\right\} \\ &\quad + cov\left\{\Delta \log grp, \Delta \log ri - \Delta \log dri\right\} \\ &\quad + cov\left\{\Delta \log grp, \Delta \log dri - \Delta \log c\right\} \\ &\quad + cov\left\{\Delta \log grp, \Delta \log c\right\} \end{aligned} \tag{3.2}$$

Divide by the variance of $\Delta \log grp$ to get

$$1 = \beta_{K+M} + \beta_F + \beta_C + \beta_U \tag{3.3}$$

where e.g. β_{K+M} is the OLS estimate of the slope in the regression of $\Delta \log grp - \Delta \log ri$ on $\beta \Delta \log grp$ and the other coefficients are defined accordingly. Coefficients are not restricted to be positive; a negative coefficient implies dissmoothing through that channel.

More specifically, the β-coefficients are obtained by running the following panel regressions:

$$\Delta \log grp_t^i - \Delta \log ri_t^i = \nu_{K+M,t} + \beta \Delta \log grp_t^i + u_{K+M,t}^i, \tag{3.4}$$

$$\Delta \log ri_t^i - \Delta \log dri_t^i = \nu_{F,t} + \beta \Delta \log grp_t^i + u_{F,t}^i, \tag{3.5}$$

$$\Delta \log dri_t^i - \Delta \log c_t^i = \nu_{C,t} + \beta \Delta \log grp_t^i + u_{C,t}^i, \tag{3.6}$$

$$\Delta \log c_t^i = \nu_{U,t} + \beta \Delta \log grp_t^i + u_{U,t}^i, \tag{3.7}$$

where $\nu_{.,t}$ are time fixed effects. The β coefficients will then be weighted averages over the time period under study. The time fixed effects capture year-specific impacts on the growth rates, most notably to aggregate variables in the respective countries that affect all regions in them in a similar way.

3.2. Data. All data is taken from the Cambridge Econometrics Regional European Database; a full description is found in the data appendix. All income variables are for the years 1995-2005.

In contrast to Asdrubali et al who use BEA data on state-level GDP that is corrected for the income flows caused by commuting workers, the Eurostat regional GDP definition keeps this component. Since primary income is defined in similar ways for U.S. states and European regions, the fraction of the cross-sectional variance of GDP attributed to this channel will refer only to capital market smoothing for U.S. states while it will be the combination of this and labor commuting or migration for European regions. Moreover, and unlike Asdrubali et al, we are not able to take public consumption into account but instead our consumption variable refers only to private consumption. Asdrubali et al proxy consumption by scaling aggregate U.S. retail sales with each state's economic weight. We instead have access to both region-specific household retail spending and total household expenditure, and use both these measures to proxy consumption. Results do not change.

3.3. Econometric Issues. Region-level data might be measured less precisely than aggregate variables, and this problem is especially likely to arise for small regions. As is well known, measurement errors in the regressor bias the estimates towards zero while measurement errors in the dependent variable only lead to increased standard errors. We try to alleviate the problem by weighting the regressions with the region-specific variance. Any remaining measurement errors would as pointed out by

Asdrubali et al most likely overstate the amount of capital market smoothing and understate the amount not smoothed. This is due to the fact that Eurostat uses retail sales data for construction of the gross regional product variables, thus giving rise to a positive bias in the first smoothing channel. The possible biases in the fiscal policy and credit market coefficients are less clear.

3.4. Results. Table 1 below displays the results for the whole regional sample.

Table 1 Estimates of Income and Consumption Smoothing, percent

1995-2005 Europe		1981-1990 U.S.
Capital Markets and Migration (β_{K+M})	40 (0.03)	48 (0.04)
Fiscal Policy (β_F)	9 (0.02)	14 (0.01)
Credit Markets (βc)	17 (0.05)	19 (0.09)
Not Smoothed (β_U)	34 (0.04)	19 (0.08)

Percentages of shocks to gross regional/state product absorbed at each level of smoothing. Standard errors in parentheses. Regressions weighted with region-specific variance and including time-fixed effects. The U.S. estimates are taken from Asdrubali et al (1996) p. 1094.

All coefficients for Europe are clearly significant at the 1% level. We find that almost twice the fraction of shocks, 34% versus 19 %, remains in Europe compared to the U.S. after smoothing has taken place through our three channels. Although we cannot verify it, we believe that only a fraction of this result could be driven by us not being able to take public consumption into account. Similar to the U.S., the largest fraction of shocks are smoothed on capital markets, followed by credit markets and fiscal policy. Despite that the coefficient β_{K+M} captures both smoothing through capital markets and migration for European regions as opposed to capital markets alone for the U.S. states, European regions achieve less risk sharing through this channel. This suggests that the often made claim of deeper capital markets in U.S. seems to have real effects. It would have been interesting to also see results for a later period in the U.S. since the breakdown of results for different decades in Asdrubali et all shows a continuously larger smoothing through capital markets toward the end of their sample in 1990. Thus it is possible that the difference between Europe and the U.S. might be even larger today than what the results reported here indicate.

That less smoothing occurs through the fiscal policy channel in Europe compared to the U.S. is surprising given the much larger size of the public sector in Europe compared to the U.S., and that the fiscal policy smoothing channel refers both to the fiscal system's so called automatic stabilizers, the capacity of which is usually thought to increase with the size of government, and any thereto added discretionary fiscal policy.

The smoothing effect of discretionary fiscal policy is typically estimated to be small (see e.g. Fátas and Mihov, 2001, Mountford and Uhlig (2002), Blanchard and Perrotti, 2002, and Galí, López-Salido and Vallés, 2007). We cannot decompose the different components of fiscal policy neither into discretionary and non-discretionary parts, nor into different components of fiscal policy such as taxes, unemployment benefits and Social Security contributions. Asdrubali et al show for the U.S. that different components of fiscal policy actually have both smoothing and dismoothing effects, although they find the net effect to be positive. It is hence possible that different components of European fiscal policy cancel out, although we have no possibility to investigate this hypothesis. It is also possible that the rules in the Maastricht treaty on cyclical deficits together with the large actual deficits experienced by many of the countries in the sample during the period under study have limited their ability to smooth shocks through fiscal policy but it is not clear if the principles of the treaty have had such stringent effects.

Finally, the fraction of shocks smoothed on credit markets is very similar for Europe and the U.S., 17 versus 19 percent.

3.5. Robustness and Extensions. We now turn to breaking down results for different subsamples.

New member states and EMU countries Given the lower degree of financial development in the new member states, it is possible that they make less use of capital and credit markets for smoothing shocks, On the other hand, quite extensive migration took place from e.g. Poland to Western Europe during the period under study, possibly resulting in a larger contribution from this β_{K+M} channel. Hence, we first perform the above panel regression exercise only for the new member states Czech Republic, Poland and Slovakia. It has also been suggested (Ekinci et al, 2007) that the closer the economic and cultural ties between a group of countries, the more risk sharing can be expected. We hence study whether risk sharing is more efficient among the EMU countries, where integration can be thought to be especially close due to e.g. a common monetary policy, than in the European sample at large.

Table 2 Estimates of Income and Consumption Smoothing, percent

New Member States		EMU Countries
Capital Markets and Migration (β_{K+M})	33 (0.09)	36 (0.03)
Fiscal Policy (β_F)	6 (0.02)	7 (0.01)
Credit Markets (βc)	21 (0.06)	21 (0.04)
Not Smoothed (β_U)	39 (0.14)	36 (0.08)

Percentages of shocks to gross regional/state product absorbed at each level of smoothing. Standard errors in parentheses. Regressions weighted with region-specific variance and including time-fixed effects.

We find a somewhat lower fraction of shocks smoothed on capital markets or by labor in regions of the new member states compared to the full European sample, but the difference is within one standard deviation. There are no clear differences concerning fiscal policy or credit markets. As a consequence, a somewhat higher fraction of shocks remains unsmoothed for regions in the new member states but the effects are again within one standard error. Interestingly, we also do not find the regions in EMU countries to have a lesser fraction of shocks unsmoothed than the European sample as a whole. This is most likely due to the exclusion from the EMU sample of the UK, where regions due to e.g. its well-developed financial markets have especially good opportunities for risk sharing compared to many other European countries.

Given the lower risk sharing found for Southern Europe in the previous section on bilateral risk sharing, we also investigated this sample separately. We find that while smoothing through capital markets and migration is identical for Southern Europe and the sample as a whole, less smoothing takes place through fiscal policy (4% versus 6 %) and on credit markets (12% versus 17%). Hence, about 5 percentage points more of shocks remain unsmoothed in Southern Europe versus the sample at large.

Geographical proximity To assess the importance of geographical proximity for sharing risk, we follow Asdrubali et al and regress $\Delta \log c$ on $\Delta \log grp$ and $\Delta \log gdp$, where the latter refer to the aggregate GDP of the country a certain region belongs to. The coefficients are 0.11 (0.03) and 0.79 (0.04) showing that regional consumption comove with regional GDP but much more so with GDP at the country level. These results are in line with Asdrubali et al and suggests that consumption smoothing is to a large extent done at the country level as opposed to between regions.

Specialization, region size and level of income Asdrubali et al find that "farm states", i.e. states that are in the top third of the sample when it comes to agriculture's share of GDP, rely relatively more on credit markets while the six top

"mineral extraction " states instead rely on capital markets. European regions are on average less specialized than U.S. states, which is why we do not think classification into these specific categories would be fruitful. As argued in the section on bilateral risk sharing, larger regions can however be thought to be more diversified in general and hence have better ability to smooth shocks within the region. We hence code regions according to whether their population is above or below the median.[4] We do not find that larger regions in general have a larger fraction of shocks unsmoothed or rely on the respective channels to different extents. We repeat the exercise with instead splitting the sample according to the median level of regional GDP per capita. This neither affect the results.

Comparison with country-level data We run the corresponding panel regressions with aggregate data for the same sample of countries we consider in the regional sample. Table 3 below presents the results of this exercise and the corresponding ones for the U.S. from Asdrubali et al.

Table 3 Estimates of Income and Consumption Smoothing, percent

1995-2005 Europe		1981-1990 U.S.
Capital Markets and Migration (β_{K+M})	9 (0.06)	11 (0.09)
Fiscal Policy (β_F)	6 (0.07)	15 (0.09)
Credit Markets (βc)	3 (0.10)	7 (0.10)
Not Smoothed (β_U)	83 (0.07)	66 (0.06)

Percentages of shocks to gross regional/state product absorbed at each level of smoothing. Standard errors in parentheses. Regressions weighted with country-specific variance and including time-fixed effects. The U.S. estimates are taken from Asdrubali et al (1996) p. 1103.

The standard deviations are such that neither for the U.S. nor our sample is there any significant evidence of international risk sharing through capital markets and migration, fiscal policy or credit markets. To properly address the issue of international risk sharing one should however also take into account shocks to e.g. world output and use longer time series for the European sample, something we leave for future research.

As pointed out by Asdrubali et al., an important difference between smoothing on credit and capital markets is that the latter can be thought of as ex ante arrangements or insurance prior to shocks, but the latter takes place ex post. In case of persistent or permanent shocks, credit constraints most likely become more binding and the risk

[4] This variable was highly skewed with a few very large regions as outliers, so splitting the sample according to the mean did not seem to be an advisable approach.

sharing obtained on asset or credit markets less efficient. Previous research has also shown that the degree of aggregate smoothing obtained varies considerably over the business cycle, with marked increases in booms and declines in busts (Hoffman and Shcherbakova 2008). While we are not able to address the importance of the persistence of shocks or business cycle issues due to the limited length of our data set, we think it is important to keep these issues in mind.

4. Conclusions

We investigate whether the so called "Quantity Puzzle" and the negative relation between financial integration and correlation coefficients of cyclical components of output proposed by international business cycle models hold for a sample of European countries and regions. Previous research on U.S. states and a large sample of countries (Imbs, 2004) finds that U.S. states display relationships as prescribed by the model while the opposite signs of coefficients are obtained for countries. We find that the degree of bilateral risk sharing among European regions is crucial for the results. Well-integrated European regions where bilateral risk sharing is high confirm the predictions of the model and the results obtained for U.S. states. This suggests that the key to the "Quantity Puzzle" does not only lie in frictions associated with national borders but also in risk sharing within a country.

We also find evidence that increased trade and sectoral specialization are positively related to risk sharing, suggesting that improving regions' performance along these dimensions could be an important policy priority. Since our results suggest that regions with larger financial sectors on average have more correlated output fluctuations, we believe further research into the determinants of intra-country risk sharing, financial integration and the importance of a large financial sector is warranted. This also points to the "younger" generations of international RBC models where markets are endogenously incomplete as the more promising way forward compared to assuming that financial frictions are mainly associated with national borders.

We also study the importance of different channels of multilateral risk sharing or shock smoothing for European regions relative to U.S. states. We find that on average, a larger fraction of shocks remains unsmoothed after risk sharing through capital markets, migration, fiscal policy and credit markets in Europe compared to the U.S. This especially holds for the new member states in Eastern Europe.

While previous research on the U.S. indicates that risk sharing varies over the business cycles and different channels of smoothing change in relative importance over time, we were not able to address such issues due to limited sample length but leave it for future research.

Appendix

Table 4 Summary Statistics Bilateral Risk Sharing

	Country data			Regional data		
	Mean	Min/max	Obs.	Mean	Min/max	Obs
Output corr.	0.37 (0.32)	-0.67/0.91	136	0.25 (0.13)	-0.23/0.46	1978
Consumption corr.	0.26 (0.39)	-0.74/0.87	136	0.32 (0.35)	-0.79/0.99	1978
Risk sharing index	0.46 (0.15)	0./0.88	136	0.54 (0.13)	0/0.93	1978

Notes: All variables computed using the cyclical components of the Baxter-King filter with parameters for annual data. Real variables expressed in prices as of year 2000. Consumption here refers to disposable income as defined by Eurostat. Standard errors for mean of variables within parentheses.

Mean of subgroups, risk sharing: ES, GR, IT: 0.35, rest of sample: 0.60

Table 5 Determinants of Output Correlations

	Countries		
	(i) OLS	(ii) IV	(iii) IV
Structure	-0.13 (-0.58)	-0.11 (-0.83)	-0.26 (-0.42)
Trade	0.03 (4.56)	0.07 (1.98)	0.06 (1.83)
Finance	0.18 (0.5)	0.81 (0.97)	0.90 (0.39)
Obs.	136	136	136

	Regions (full sample)		Regions (not ES, GR, IT)	
	(iv) OLS	(v) IV	(vi) OLS	(vii) IV
Structure	-0.52 (-12.98)	-1.02 (-5.30)	-0.33 (-9.53)	-0.88 (-2.27)
Trade	0.075 (6.34)	0.18 (5.55)	0.075 (6.59)	0.04 (2.26)
Finance	0.33 (10.28)	0.28 (6.84)	-0.15 (-2.57)	-0.68 (-3.27)
Obs.	1546	1546	1257	1257

Notes: Dependent variable: Pearson correlation coefficient of cyclical components of output. (i) and (iii) use the CPIS data for the Finance measure and sums bilateral asset holdings. Specifications (iii) - (vii) use the computed proxy on risk sharing constructed on the basis of cyclical components of output and consumption (disposable income). Controls include country dummies. Series detrended using the Baxter-King filter. T-statistics in parentheses.

Instruments

Trade (Countries) Distance, presence of common border, product of populations, (Regions) Common border, external border, product of populations

Structure (Countries and Regions) Pairwise sum and difference of per capita output

Finance (when directly observed) Institutional variables from La Porta et al.

Table 6 Simultaneous equations

	Country data	
	(i) 3SLS	(ii) 3SLS
Correlation Equation		
Trade	0.11 (3.39)	0.09 (2.63)
Structure	-0.08 (0.12)	-0.37 (-0.67)
Finance	0.15 (0.47)	0.52 (2.06)
Trade Equation		
Finance	0.071 (2.19)	2.47 (1.57)
Specialization Equation		
Finance	-0.131 (4.33)	-0.14 (-1.68)
Obs.	136	136

	Regions (full)		Regions (not ES, GR, IT)	
	(iii) 3SLS		(iv) 3SLS	
Correlation equation				
Trade	0.07 (2.55)		0.20 (4.30)	
Structure	-1.08 (-5.63)		-0.65 (-1.16)	
Finance	0.28 (7.54)		-2.93 (-5.85)	
Trade equation				
Finance	0.06 (1.15)		0.20 (2.00)	
Specialization equation				
Finance	-0.07 (-2.56)		-0.21 (-6.34)	
Obs.	1978	1978	1257	1257

Notes: Specification (i) use directly observed measures of asset holdings from the IMF CPIS survey, the other specifications our risk sharing measure. Instruments, detrending and control variables as in table 5.

Table 7 Simultaneous equations - FIRE

	Country data			
	(i) 3SLS	(ii) 3SLS	(iia) 3SLS	(iib) 3SLS
Correlation Equation				
Trade	0.03 (0.09)	0.01 (0.02)	0.01 (0.77)	0.02 (0.6)
Structure	-1.30 (-2.77)	-1.99 (-3.27)	-0.93 (-1.97)	-1.28 (-2.26)
Finance	0.25 (3.08)	0.52 (2.06)	0.10 (2.57)	0.38 (1.66)
FIRE	-1.37 (-3.41)	-0.768 (-2.96)		
Banks			0.01 (0.31)	0.01 (0.79)
Real Estate			-1.58 (-2.82)	-1.10 (-2.14)
Trade Equation				
Finance	0.07 (2.13)	2.47 (1.56)		
Specialization Equation				
Finance	-0.027 (4.25)	-0.14 (-1.73)		
Obs.	136	136	136	136

	Regions (full)		Regions (not ES, GR, IT)	
	(iii a) 3SLS	(iii b) 3SLS	(iv a) 3SLS	(iv b)
Correlation equation				
Trade	0.07 (1.62)	0.36 (3.62)	0.08 (0.82)	0.01 (0.90)
Structure	-0.25 (-1.61)	-0.37 (-1.61)	-0.32 (-2.19)	-0.34 (-3.05)
Finance	0.33 (9.47)	0.34 (10.17)	-0.21 (-2.92)	-0.20 (-3.08)
FIRE	0.017 (5.27)		0.02 (3.60)	
Banks		0.01 (1.39)		0.028 (1.56)
Real Estate		-0.001 (-0.62)		0.015 (1.01)
Trade equation				
Finance	0.06 (1.15)	0.06 (1.15)	0.29 (6.34)	0.29 (6.34)
Specialization equation				
Finance	-0.07 (-2.90)	-0.07 (-2.90)	-0.21 (-2.00)	-0.21 (-2.00)
Obs.	1978	1978	1257	1257

Notes: Specification (i) use directly observed measures of asset holdings from the IMF CPIS survey, the other specifications our risk sharing measure. FIRE denotes the pairwise sum of the share of the Finance and Real Estate sector (as defined by Eurostat) of total GDP. Banks and Real Estate denote pairwise sum of respective sector. The other instruments, detrending and control variables as in table 5.

Data
Section 2 Bilateral Risk Sharing
Trade flows (direct estimation)
IMF, Direction of Trade Database, 1980-2007
Bilateral Asset Holdings
IMF, CPIS survey, 2001-2007
Financial Development
Institutional variables, La Porta et al (1998), various periods
GDP, countries and regions
Cambridge Econometrics, 1980-2007
Primary Income
Countries and NUTS 1-2 regions, Cambridge Econometrics, 1980-2007
Disposable Income
Countries and NUTS 1-2 regions, Cambridge Econometrics, 1980-2007
Household expenditure
Countries and NUTS 1-2 regions, Cambridge Econometrics, 1980-2007
Retail spending
Countries and NUTS 1-2 regions, Cambridge Econometrics, 1980-2007
Sectoral GVA
Countries and NUTS 1-2 regions, Cambridge Econometrics, 1980-2007
Population
Countries and NUTS 1-2 regions, Cambridge Econometrics, 1980-2007
Countries: Distance, borders, Google Maps
Regions: Internal and external borders, Eurostat

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