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Income and Consumption Smoothing and Welfare Gains Across Pacific Island Countries: The Role of Remittances and Foreign Aid*

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Abstract

We examine the potential welfare gains and channels of income smoothing for Pacific Island Countries (PICs) and find that, under full risk sharing overall welfare gains across all PICs (particularly, Kiribati, Palau, and Papua New Guinea) are at desirable levels. However, for Australia, the potential welfare gain from risk sharing is almost similar to the gain it obtains if Australia attains full risk sharing with the rest of the OECD countries or with New Zealand alone. We also break down output using the framework of Sørensen and Yosha (1998) to quantify the extent and channels of risk sharing across PICs. For PICs, income-smoothing channels (net factor income and current transfers) play a significant role in buffering the output shock compared to the performance of those channels on smoothing the output shock for OECD countries. Domestic savings also smooth a fair portion of shocks to output, but the extent is much lower compared to that of OECD countries. Further, we analyze the effect of remittances and foreign aid on income smoothing for the PICs excluding Australia and New Zealand. Income smoothing via remittances is highly volatile and significant in recent years, while foreign aid seems to be a stronger and more stable channel for smoothing domestic output shocks for PICs.

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1 Introduction

Throughout the world, economic unions are becoming more important in promoting economic growth and welfare. Following the European Union (EU), the emerging markets of Eastern Asia, the oil-rich Middle East economies and others have formed (or aiming to form) economic (and monetary) unions to promote economic growth and welfare gains from each other.[1] The economic (and monetary) unions are often motivated to be formed by both developed and emerging economies -expansion of the EU to include Central and Eastern Europe is a good example- even though emerging market economies with a history of relatively high macroeconomic volatility may raise concerns for economic integration.

Pacific Island Countries (PICs) have so far only created a forum rather than an economic union. They are debating whether to harmonize and unify social, fiscal, and monetary policies -i.e. to form an economic union- in the future.[2] Several researchers suggested that the PICs region should move beyond the initiatives already in place by adopting a common currency, emphasizing its potential to enhance macroeconomic stability and further to increase trade flows between member countries. However, PICs have faced considerable challenges arising from the small size of their economies, and therefore vulnerability to shocks, as well as from limited policy flexibility, and variable economic performance. In a detailed study, Browne and Orsmond (2006) indicated that the adopting a common currency among PICs would require a substantial strengthening of domestic and regional policies that would take time to achieve. There is also no consensus that PICs should adopt a currency union. For example, De Brouwer (2000) and Duncan (2002) supported the idea that PICs should form a monetary union adopting the Australian dollar; on the other hand, Hughes (2003) and Fichera (2006) advised against any form of monetary union in the Pacific prior to unifying fiscal and monetary policies. A number of studies, including Bunyaratavej and Jayaraman (2005), and Bowman (2005) maintained that it is still too early for PICs to form a currency union, given the dissimilarities in their macroeconomic policies and key measures such as inflation and exchange rates, but the asymmetries of the output shocks encourage the policy holders to support the currency union.

We contribute to the existing literature first estimating the potential gains from economic integration for the countries in the PICs region. Particularly we define integration as the degree to which a country's consumption is independent from country-specific output shocks (risk sharing). Full risk sharing is defined as the case in which all country-specific output shocks (changes in terms of trade, fluctuations in production, policy reforms, natural disasters etc.) are completely diversified and the output volatility of an individual country is not reflected on its consumption. We measure each country's potential welfare gains in the case of full risk sharing, compared to the autarky position and show that when the PICs move towards full risk sharing, all (or some) of them will gain from diversifying country-specific risks. The advantages of integration are often questioned because of the recent financial crises and instability in a number of the emerging markets (see Rodrik (1998) and Stiglitz (2002)). While excessive output volatility is undesirable for any economy, the inability of individual members of an economic union to reduce the impact of adverse output shocks by monetary and exchange rate policy instruments is a major concern for the members. Even though the adverse supply shocks among members in the union lead to difficulties in having stable instruments, the full capital mobility version of the optimum currency area concept by Mundell (1973) states that

[1] Central and West African Monetary unions are also followers of the EU. The East African Community, the Caribbean Single Market and Economy, and the Union of South American Nations are other economic unions, that are scheduled to be formed in the near future.

[2] The Pacific Islands Forum, founded in 1971, is a political grouping of 16 independent and self-governing states which aims to enhance cooperation between the member countries and represent their interests. The forum includes Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

macroeconomic asymmetry does not preclude countries from forming economic and currency unions as long as they effectively share their output risks.[3] Clearly, policy makers should take into account the risk sharing opportunities that integration brings.

As we pointed out earlier, full risk sharing between countries in an economic (monetary) union can increase welfare.[4] However, even among the European Monetary Union (EMU) members, the total risk sharing is well below the full risk sharing.[5] At this stage, policy makers may consider taking various actions such as promoting trade in international goods, financial assets, labor movements, and foreign aid to attain full risk sharing among countries. There are different ways that countries can achieve risk sharing, which we refer to as the channels of risk sharing. The main channels are cross-border ownership of assets which "smooth" income (making income growth in a country less sensitive to output growth), international transfers (remittances and foreign aid) which smooth disposable income for a given income, and borrowing and lending which smooth consumption for a given level of disposable income. Asdrubali et al. (1996) (ASY) derived a simple way of quantifying the relative contributions of various channels of income and consumption smoothing within a common framework. They find that both capital and credit market institutions provide the bulk of risk sharing through income smoothing across the states in the US. Sørensen and Yosha (1998) and Balli and Sørensen (2007) used similar methods to evaluate channels of risk sharing among countries in the Organization for Economic Cooperation and Development (OECD).[6]

Second, we estimate various risk sharing channels for PICs to reveal the current state of risk sharing employing the methodologies of ASY and Sørensen and Yosha (1998). In addition to the typical channels of risk sharing, we decompose the magnitude of income smoothing via international transfers as remittance inflows and foreign aid, and find that the magnitudes of these channels are significant in smoothing some portion of the domestic output shocks. To the best of our knowledge, our approach of measuring income smoothing via remittance inflows and foreign aid is the first in the literature.

Our results can be summarized as follows: for the less developed PICs (i.e. PICs not including Australia and New Zealand), the potential welfare gains from full risk sharing are higher than those achieved by OECD members under full risk sharing. For New Zealand, the welfare gains are higher compared to the welfare gains New Zealand obtains by attaining full risk sharing with the OECD members or attaining full risk sharing with Australia only. For Australia, the gains from full risk sharing with other PICs is at the same level as the potential gains of full risk sharing if Australia attains full risk sharing with the OECD members.

Considering the channels of risk sharing, smoothing via net factor income flows plays a significant role in risk sharing among less developed PICs. This channel is mostly driven by the short term labor income inflows; i.e. net compensation of employees from the rest of the world.[7] International transfers, particularly remittance inflows in recent years and foreign aid, smooth significant percentage of output shocks across the less developed PICs. This channel is not strong enough among OECD members to buffer the output shocks. The reason might be

[3]The OCA concept by Mundell (1961) and McKinnon (1963) suggest that the lack of independent monetary policy may lead to a significant loss of welfare and even breakdown of monetary union and the union members may exhibit non-synchronized (or asymmetric) output fluctuations if international capital mobility is limited.

[4]Specifically, full risk sharing is the situation where consumption grows at identical rates in all countries. We refer to the growth rate of a country-level variable minus the union-wide counterpart as the "idiosyncratic" growth rate. We consider risk sharing to be higher the less idiosyncratic consumption growth co-varies with idiosyncratic income growth.

[5]Asdrubali et al. (1996) find that total risk sharing is around 70-80% for the US. Basher et al. (2009) also find a similar magnitude of total risk sharing for Canada while for the EU, Balli and Sørensen (2007) calculate it to be below 50%.

[6]Soyoung et al. (2006) and Kim and Sheen (2007) employ the same methodology and measure the channels of risk sharing for Eastern Asian countries, Australia, and New Zealand, respectively.

[7]Compensation of employees -what the IMF's Balance of Payments termed labor income until 1995- are funds transferred to countries of origin by nationals who have been abroad for fewer than 12 months.

that the amount of the remittance inflows and foreign aid to the OECD region is much lower compared to PICs or other low income countries. Lastly, because of the ineffectiveness of the credit markets, the savings channel -although this corresponds to a fair portion of the total risk sharing for PICs- is able to smooth a smaller amount of domestic output shocks compared to OECD countries.

2 Data and Descriptive Statistics

We employ a broad annual dataset to measure the channels of risk sharing and to calculate the potential welfare gains from risk sharing for PICs for the years 1981 to 2007.[8] National accounts data, i.e. gross domestic product (GDP), gross national income (GNI), net national income (NNI), disposable national income (DNI), and government (G) and private consumptions (C), are all obtained from the United Nations (UN) National Accounts Statistics: Main Aggregates and Detailed Tables. Population and exchange rates are also obtained from the UN National Accounts Database. The consumer price index (CPI) of each country is obtained from the IMF's International Financial Statistics Database. For OECD members, the national accounts data are taken from the OECD National Accounts, Main Aggregates (Volume I) and Detailed Tables (Volume II). The OECD countries in our sample consist of all OECD members except Luxembourg, Iceland, the Czech Republic, Hungary, Korea, Mexico, Poland, Slovakia, and Turkey.[9] Remittances (in US dollars) are obtained from the World Bank's Migration and Development Brief, prepared by the Migration and Remittances Team and Development Prospects Group. Foreign aid data is obtained from World Bank's Development Indicators Database (WDI). By dividing each national account unit (e.g. GDP) by the country's population, and by deflating with each country's CPI, we transform the series into real per capita terms.

Table 1 reports the summary statistics for real GDP and real consumption per capita growth rates of individual countries for the 1981–2007 period. The first two columns report the mean and standard deviation of real GDP per capita growth rates. Overall, the annual growth rate for PICs averages 0.36%. The rate drops to 0.26% when we exclude Australia and New Zealand. The standard deviation of real GDP per capita growth for PICs is 3.84% and it is at a similar level when we exclude Australia and New Zealand. The third and fourth columns show the mean and standard deviation of real consumption per capita growth rates. Consumption growth rates are higher than GDP growth rates for PICs. The average consumption per capita growth rate is 0.85%, which is 2.5 times that of the GDP per capita growth rate. When we exclude Australia and New Zealand, the consumption growth rate is still very high and at 0.83%. It is more likely that international transfers (remittances and foreign aid) are injected to the less developed PICs, promoting more consumption growth than the GDP growth for the less developed PICs. The last two columns report the correlations of each country's output and consumption growth rate with the aggregate PICs output and consumption growth rates. The correlations of output are larger than those of consumption, which is consistent with the international consumption correlation puzzle documented by Backus et al. (1992).

[8] PICs include Australia, Fiji, French Polynesia, Kiribati, Marshall Islands, Micronesia, New Caledonia, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu. Cook Islands and Talau are excluded because of insufficient data. In analyzing the channels of risk sharing, a few more countries are excluded because of missing observations.

[9] We exclude these countries due to various reasons. Luxembourg is very small and atypical, Iceland has incomplete data and the rest of the excluded countries are less developed part of all members.

3 Potential Welfare Gains From Risk Sharing

Welfare gains are indeed achieved when countries perfectly diversify their idiosyncratic output shocks and smooth out their consumption. Economists have attempted to measure the potential welfare gains from consumption risk sharing by comparing the level of welfare gains of a complete market economy (full risk sharing) with the incomplete market (autarky) economy. In this section, we follow Kalemli-Ozcan et al. (2001) to estimate the potential welfare gains of each PICs member if they attain full risk sharing with other countries in the region.

The main assumption of Kalemli-Ozcan et al. (2001) is a closed form expression that can be derived for the welfare gains that are achieved by moving from financial autarky to full risk sharing. To calculate the potential welfare gains from risk sharing, Kalemli-Ozcan et al. (2001) compare the expected utility of consuming each country's own per capita output (autarky) with that of consuming the country-specific portion of aggregate output under full risk sharing within a groups of economies. The difference between the utilities is called the potential welfare gain from risk sharing. The gains are expressed as the permanent increase in the level of each country's consumption.[10]

Kalemli-Ozcan et al. (2001) formulate the gains for logarithmic utility (a special case for CRRA utility) as:[11]

$$G^i = 100 * \frac{1}{\delta} \left(\frac{1}{2}\sigma^2 + \frac{1}{2}(\sigma^i)^2 - cov^i\right). \tag{1}$$

We use G^i as Kalemli-Ozcan et al. (2001)'s measure of the potential gains from risk sharing for country i. δ is the intertemporal discount rate.[12] σ^2 is the variance of the group-wide per capita GDP growth rate, $(\sigma^i)^2$ is the variance of country i's per capita GDP growth rate, and cov^i is the covariance of the country i's GDP per capita with the group-wide GDP per capita. The equation can be interpreted as follows: higher gains are attained with a lower covariance since countries with asymmetric output growth are certainly being compensated in the risk sharing agreement to provide insurance for other countries by stabilizing aggregate output growth. Similarly, a country with a higher variance of output will benefit more from sharing risk with other countries. The higher the variance of the aggregate group-wide output, the more other countries would be willing to "pay" to country i for joining the risk sharing arrangement because it provides additional diversification opportunities for all.

Table 2 reports the potential welfare gains that each PIC member is able to attain if full risk sharing exists within the region. The potential gains for smaller PICs economies (Kiribati, Palau, French Polynesia, New Caledonia, and Vanuatu) are in higher percentages. Even relatively bigger PIC economies (Fiji and Papua New Guinea) have higher potential welfare gains compared to the potential gains of OECD countries. Kalemli-Ozcan et al. (2001) estimated that, on average, OECD members' gains from risk sharing are less than 1% when OECD members attain full risk sharing with each other.[13] Relatively large welfare gains for the PICs are primarily driven by the high volatility of output and consumption (see Table 1), particularly for Kiribati, Palau, and Papua New Guinea. Countries with the highest level variance and a counter-cyclical pattern of output growth would contribute most greatly towards stabilizing aggregate consumption in the region.[14] We also find that for New Zealand, the welfare gain from

[10] Kalemli-Ozcan et al. (2001) derived utility gain measurement from the general Constant Relative Risk Aversion (CRRA) utility function of $U(c) = \frac{c^{(1-\gamma)}}{(1-\gamma)}$, $(\gamma \neq 1)$ where γ is the coefficient of relative risk aversion.

[11] The derivation of the formula can be found in Kalemli-Ozcan et al. (2001) pages 130–135.

[12] Generally, previous studies including Kalemli-Ozcan et al. (2001), employed δ in the range of 0.02 to 0.04.

[13] Recently, Demyank and Volosovych (2008), by employing the same methodology, find that EU members gain 0.69% on average from full risk sharing for the period of 1994–2005, whereas new EU members (members accepted after 2004) gain around 3% from full risk sharing over the same period.

[14] The higher correlation of GDP growth rates of each OECD country with OECD-wide GDP growth rates(see Demyank and Volosovych (2008)) forces the potential of welfare gains across OECD to be relatively smaller.

full risk sharing with other PICs is in a higher percentage than OECD averages. Our finding for New Zealand is similar to the findings of Kim and Sheen (2007) who indicate that the welfare gain is higher when Australia and New Zealand have full risk sharing with each other than when Australia and New Zealand have full risk sharing with other OECD members. For Australia, the welfare gains from full risk sharing with other PICs members is relatively lower and it is similar to the percentage of welfare gain Australia obtains when it has full risk sharing with the rest of the OECD members or with New Zealand alone.[15] These findings would not motivate Australia, unlike New Zealand, to seek full risk sharing with the other PICs.

4 Full Risk Sharing and Perfect Consumption Smoothing

The basic theory of international risk sharing is well known—see Obstfeld and Rogoff (1996)—and we only outline the basic ideas for endowment economies with one homogeneous tradable good. Period t per capita output of country i is an exogenous random variable with a commonly known probability distribution. The representative consumer of each country is a risk averse expected utility maximizer.[16] Consumers within each country are identical with Constant Relative Risk Aversion (CRRA) utility functions and perfect Arrow-Debreu markets for contingent claims. Optimal consumption then satisfies the full risk sharing relation when the consumption of a country co-moves with world consumption but not with country specific shocks.

A testable implication is that consumption growth rates are identical for all countries, i.e. $\Delta \log c_t^i = \alpha + \beta \Delta \log c_t^w + \epsilon_t^i$, where α is a constant and ϵ_t^i is an error term—due to either taste shocks or noise. After controlling for aggregate consumption growth ($\Delta \log c_t^w$), the consumption growth rate of a country ($\Delta \log c_t^i$) should not be a function of the output growth of that country. Regression-based tests for full risk sharing at the country level are conducted by Obstfeld (1994), Canova and Ravn (1996), and Lewis (1996)(see Lewis (1995) for a comprehensive survey of these literature).[17]

It is of more interest to quantify the extent of risk sharing between countries rather than to test the abstract ideal of perfect risk sharing. It is also interesting to identify the exact channels through which risk is shared and to quantify the amount of risk sharing obtained via each channel. ASY and Sørensen and Yosha (1998) developed a method for answering these questions. In the next section, we explain their methodology in detail.

4.1 Channels of income and consumption smoothing

There are several mechanisms for sharing risk. The most straightforward way of sharing risk internationally is through international income diversification; i.e. through cross-border ownership of productive assets. Net income from cross-border ownership of productive assets (net factor income) is reflected in the National Accounts data as the difference between GDP and GNI. If risk is not fully shared through net factor income flows, other channels for smoothing consumption are possible. The second channel, depreciation, is the difference between GNI and NNI. When depreciation does not vary one-to-one with GDP, then there is a room for income smoothing via depreciation. This channel of risk sharing is not very interesting but it needs to be included if we want to consider all "wedges" between GDP and consumption. NNI can be

[15] See Kim and Sheen (2007) for calculations of welfare gains of Australia obtains when it has full risk sharing with the rest of the OECD members or with New Zealand alone.

[16] We do not consider non-separabilities in the utility function between consumption and leisure or non-tradable output. See Canova and Ravn (1996) and Lewis (1996) for a treatment of these issues in the context of international risk sharing.

[17] Full risk sharing tests, using individual-level data are first performed by Cochrane (1991), Mace (1991) and Townsend (1994). International Real Business Cycle studies, most notably Backus et al. (1992), Baxter and Crucini (1995), and Stockman and Tesar (1995) examine the prediction that the correlation of consumption across countries should be equal to unity. The data are, however, far from confirming that prediction.

smoothed through international transfers which are the differences between NNI and Disposable National Income (DNI)). The last channel is saving which is the difference between DNI and consumption. Consumption can be smoothed through pro-cyclical saving behavior Individuals save and dis-save in order to smooth consumption inter-temporally.

The variance decomposition described below allows us to measure both the fraction of shocks to GDP that are smoothed through net factor income flows, depreciation, international transfers, and saving and the fraction of shocks that are not smoothed.

4.2 Decomposing the cross-sectional variance of shocks to GDP

Consider the identity, holding for any period t:

$$\text{GDP}^i = \frac{\text{GDP}^i}{\text{GNI}^i}\frac{\text{GNI}^i}{\text{NNI}^i}\frac{\text{NNI}^i}{\text{DNI}^i}\frac{\text{DNI}^i}{(\text{C}^i + \text{G}^i)}(\text{C}^i + \text{G}^i), \tag{2}$$

where all the magnitudes are in per capita terms, and i is the country index. The time index is suppressed to stress the cross-sectional nature of the derivation.

Taking logs and differences on both sides of (2), multiply both sides by $\Delta \log \text{GDP}^i$ (minus its mean) and taking the cross-sectional average, we obtain the variance decomposition:

$$\begin{aligned}
\text{var}\{\Delta \log \text{GDP}^i\} \;=\; & \text{cov}\{\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} \\
& + \text{cov}\{\Delta \log \text{GNI}^i - \Delta \log \text{NNI}^i, \Delta \log \text{GDP}^i\} \\
& + \text{cov}\{\Delta \log \text{NNI}^i - \Delta \log \text{DNI}^i, \Delta \log \text{GDP}^i\} \\
& + \text{cov}\{\Delta \log \text{DNI}^i - \Delta \log(\text{C}^i + \text{G}^i), \Delta \log \text{GDP}^i\} \\
& + \text{cov}\{\Delta \log(\text{C}^i + \text{G}^i), \Delta \log \text{GDP}^i\} \; .
\end{aligned}$$

In this equation, "var { X }" and "cov { X,Y }" denote the statistics $\frac{1}{N}\sum_{i=1}^{N}(\text{X}^i - \bar{\text{X}})^2$ and $\frac{1}{N}\sum_{i=1}^{N}(\text{X}^i - \bar{\text{X}})(\text{Y}^i - \bar{\text{Y}})$, respectively, where N is the number of countries in the sample. Dividing by $\text{var}\{\Delta \log \text{GDP}^i\}$, we get $1 = \beta_f + \beta_d + \beta_\tau + \beta_s + \beta_u$, where, for example:

$$\beta_f = \frac{\text{cov}\{\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\}}{\text{var}\{\Delta \log \text{GDP}^i\}} \tag{3}$$

is the ordinary least squares estimate of the slope in the cross-sectional regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, and similarly for β_d, β_τ, and β_s. The coefficients β_f, β_d, β_τ, and β_s are interpreted as the fraction of shocks absorbed through factor income flows, depreciation, international transfers, and saving, respectively. The last coefficient in the decomposition is given by:

$$\beta_u = \frac{\text{cov}\{\Delta \log(\text{C}^i + \text{G}^i), \Delta \log \text{GDP}^i\}}{\text{var}\{\Delta \log \text{GDP}^i\}}, \tag{4}$$

which is the ordinary least squares estimate of the slope in the cross-sectional regression of $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$. β_u is the fraction of shocks to GDP that are not smoothed.

If there is full risk sharing, then $\text{cov}\{\Delta \log(\text{C}^i + \text{G}^i), \Delta \log \text{GDP}^i\} = 0$ and hence $\beta_u = 0$. If full risk sharing is not achieved, then consumption in country i varies positively with idiosyncratic shocks to country i's output, and $\beta_u > 0$. A cross-sectional regression of consumption on output, controlling for fluctuations in world consumption, is therefore a test of full risk sharing.[18]

If full risk sharing is achieved through income smoothing via factor income flows, then $\text{cov}\{\Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} = 0$ and $\text{cov}\{\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} = \text{var}\{\Delta \log \text{GDP}^i\}$,

[18] This is the test suggested by Mace (1991) and Townsend (1994), who tested for full risk sharing by running cross-sectional (or panel) regressions of consumption on income, controlling for aggregate movements in income and consumption.

implying $\beta_f = 1$.[19] Moreover, in this case, since consumers in each country consume their GNI, $\text{C}^i + \text{G}^i = \text{GNI}^i$, implying that $\beta_u = 0$.

Suppose that full risk sharing is achieved through the combination of factor income flows, depreciation, and international transfers, then by similar reasoning, $\beta_f + \beta_d + \beta_\tau = 1$ and since consumers in each country will consume their DNI, $\beta_u = 0$. Similarly, if full risk sharing is achieved through factor income flows, depreciation, international transfers, and saving, then $\beta_f + \beta_d + \beta_\tau + \beta_s = 1$ and $\beta_u = 0$. If consumption is perfectly smoothed, β_f, β_d, β_τ, and β_s sum to unity and $\beta_u = 0$. Otherwise, they sum to less than unity. In either case, these coefficients reflect the incremental amount of smoothing achieved through these various channels.

We do not impose any restrictions on the sign of the β-coefficients. If a country is hit by a positive shock and say, capital consumption increased more than the increase in the output, then the estimated coefficient, β_d, is negative i.e, depreciation channel provides dis-smoothing.

4.3 Estimation of channels of risk sharing

Empirically, the following (panel) equations are estimated:

$$\begin{aligned}
\Delta \log \text{GDP}_t^i - \Delta \log \text{GNI}_t^i &= \nu_{f,t} + \beta_f \;\; \Delta \log \text{GDP}_t^i + \epsilon_{f,t}^i \;, \\
\Delta \log \text{GNI}_t^i - \Delta \log \text{NNI}_t^i &= \nu_{d,t} + \beta_d \;\; \Delta \log \text{GDP}_t^i + \epsilon_{d,t}^i \;, \\
\Delta \log \text{NNI}_t^i - \Delta \log \text{DNI}_t^i &= \nu_{\tau,t} + \beta_\tau \;\; \Delta \log \text{GDP}_t^i + \epsilon_{\tau,t}^i \;, \\
\Delta \log \text{DNI}_t^i - \Delta \log(\text{C}_t^i + \text{G}_t^i) &= \nu_{s,t} + \beta_s \;\; \Delta \log \text{GDP}_t^i + \epsilon_{s,t}^i \;, \\
\Delta \log(\text{C}_t^i + \text{G}_t^i) &= \nu_{u,t} + \beta_u \;\; \Delta \log \text{GDP}_t^i + \epsilon_{u,t}^i \;,
\end{aligned} \tag{5}$$

where $\nu_{\cdot,t}$ are time fixed effects. The time fixed effects capture year-specific impacts on growth rates, most notably the impact of the growth on aggregate output. Furthermore, with time fixed effects, the β-coefficients captures the weighted averages of the year-by-year cross-sectional regressions. To account for autocorrelation in the residuals, we assume that the error terms in each equation and in each country follow an AR(1) process. We assume that the autocorrelation parameter is identical across countries and equations as the samples are short.[20]

Allowing for state-specific variances for the error terms, we estimate the simultaneous system (5) by a two-step Generalized Least Squares (GLS) procedure. First, we use least squares, then use the residuals to estimate the weights. Second, weighted least squares is performed using the estimated weights. The Prais-Winsten transformation is used to take care of the serial correlation of the variables. We use differenced data at annual frequency. Since our method is based on panel estimations with time fixed effects, it yields fully consistent estimates even if worldwide taste shocks occur.

4.4 Income and consumption smoothing

Table 3 displays the estimated percentages of GDP shocks smoothed through each channel for PICs. The upper panel contains estimations including Australia and New Zealand in the sample, and the lower panel contains the estimations excluding Australia and New Zealand in the sample.[21] In order to make comparisons, we also estimate the channels of income and consumption smoothing for OECD members, and present the results in Table 4. Conceptually, the coefficients add up to 100% but we choose not to impose this constraint.[22] The first rows in

[19] If not, $\text{cov}\{\Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} > 0$ and hence, $\beta_f < 1$.

[20] Following Pesaran (2004) we test cross-section dependence and show that cross-section independence occurs.

[21] Due to the large number of missing observations we dropped some Pacific Island Countries to pursue the estimations.

[22] Due to the heteroscedasticity and autocorrelation, the sum of the coefficients may not be equal to 100%. However our calculations show that even though we do not impose this restriction, the sum of the coefficients are pretty close to 100%.

both the upper and lower panels of Table 3 display the percentage of output shocks smoothed by the factor income inflows for PICs. In the lower panel, factor income flows have a positive and significant contribution of 6% to 8% to risk sharing. Net factor income is decomposed of net income from net financial assets (equity, bond, and Foreign Direct Investment (FDI) earnings), net compensation of employees from the rest of the world, and net tax on imports. It is known that the volume of the cross-border asset holdings of the less developed PICs is relatively lower compared to that of developed countries such as OECD members or EU members. Therefore, one can not expect that risk sharing via net factor income channel is driven by income from financial assets. However, income from non-resident (seasonal) laborers working abroad (net compensation of employees from rest of the world) is the crucial factor behind the positive and significant level of factor income smoothing. Indeed, net compensation of employees from the rest of the world is a remarkable inflow to the less developed PICs economies. According to the UN National Accounts Detailed Aggregates Database for the years between 1980–2007, Fiji's inflow of compensation of employees from the rest of the world is 3% of its GDP, on average. Similarly, Kiribati has 3%, Papua New Guinea 3%, Tonga 2.5%, and Vanuatu 2.5%. These amounts are highly remarkable compared to Australia and New Zealand, where the net compensation of employees from the rest of the world is only 0.2% and 0.4% of their GDP, respectively. For OECD members, the smoothing via factor income is very limited until 2000s according to Table 4. However because of the substantial decline in portfolio home bias, net factor income flow is, after all, able to smooth a portion of domestic output shocks. The estimated percentage of GDP shocks smoothed by factor income flow is positive and significant (6%) for the period 2001–2007 only.[23] Another component of net factor income flows, net compensation of employees from the rest of the world, is not a driven factor for the net factor income flows for OECD members. Because, at average between 1990 and 2007, the ratio of the net compensation of employees from the rest of the world to GDP is 0.1% for OECD members. Overall, in both tables, smoothing via net factor income channel is significant but the driving sub-channels are different.

The second rows in Tables 3 and 4 display the estimated percentages of GDP shocks smoothed via depreciation. The depreciation channel is not very interesting as it is a function of past investment and besides, it is mainly imputed. However, the negative sign can be relatively more intuitive as depreciation typically does not move with output and therefore a larger share of output is available for income and consumption. Unlike OECD members, for PICs without Australia and New Zealand, it is highly volatile in every decade. We may consider that massive ongoing construction works taking place in urban areas and the destruction of old buildings for the sake of having newer buildings might be a reason for high volatility in this channel.

The third rows in Tables 3 and 4 display the estimated percentages of GDP shocks smoothed via international transfers. International transfers include workers' remittances and official transfers, such as contributions to foreign aid. Table 3 shows that the international transfers channel is highly significant in the lower panel, which highlights the importance of international transfers for the less developed PICs in smoothing the output shocks. In average, years between 1981 and 2007, around 9% of output shocks has been buffered by international transfers. For OECD members, smoothing via international transfers is insignificant, which is not surprising since the level of remittance inflows and foreign aid inflows are smaller in magnitude and are not able to smooth the shocks across OECD sample. In the next section, we go one step further and decompose the international transfers channel by measuring the effects of the remittance transfers and foreign aid on smoothing domestic output shocks, one by one across PICs.

The fourth rows in Tables 3 and 4 report the percentages of output shocks smoothed via savings. Both panels indicate that bulk of total smoothing is achieved via savings. However,

[23] Sørensen et al. (2007) and Balli and Sørensen (2007) find that the capital market integration among high income OECD members allowed significant magnitudes of income smoothing to be via net factor income flows.

in the upper panel of Table 3, we show that the percentage of domestic output smoothed by savings is 40% on average, whereas it is 26% for the less developed PICs. Since Australia and New Zealand have well developed credit markets, there is a remarkable difference in smoothing output shocks via savings. For the OECD members, the output shocks smoothed via savings is 58% on average for the period of 1981–2007. Comparing percentage of domestic shocks via savings for OECD members with the PICs counterpart, policy makers are able to observe the importance of the credit markets in consumption smoothing, even other income channels-factor income flow or international transfers- are not"strong enough."

Even though for PICs, the total smoothing is mostly driven by the savings channel, the magnitude of this channel is lower compared to OECD. Unlike the OECD countries, the factor income and international transfers channels are significant and smooth a greater percentage of shocks for the less developed PICs. Relatively higher amounts of remittance transfers (and net compensation of employees from abroad) from immigrants and foreign aid inflows are the main reasons for this finding.

4.5 Income Smoothing Via Remittance Inflows and Foreign Aid

Many studies have investigated the effects of foreign aid and remittance transfers on economic growth for the PICS, including Knapman (1986), Gounder (2001), Jayaraman and Choong (2006), Pavlov and Craig (2006), Rao and Takuria (2006), and Rao et al. (2007). However, these studies are silent on measuring the extent to which remittances and foreign aid smooth domestic output shocks and stabilize per capita consumption.[24] The less developed PICs have been growing faster than the world average, and the real GDP per capita levels of these countries are still behind those of Australia and New Zealand. Both transfers through non-immigrants and immigrants living abroad and foreign aid from international institutions and governments are important injections into these economies. Indeed, an analysis of how much of domestic shocks are smoothed via these injections is important for policy makers.

Regarding on the amount of remittances in the PICs, Ratha et al. (2009) document that the remittance inflows to the less developed PICs were around 2 billion US dollars in 2008. For instance, in 2008, while Tonga has a remittance inflows of 37% of its GDP, Samoa has 26%. Considering the larger economies, such as Fiji and Papua New Guinea, the remittance inflows are 7% and 3% of their GDP, respectively. Australia has remittance inflows of only 0.4% of its GDP, whereas New Zealand has 0.5%.[25]

According to World Development Indicators (WDI), the foreign aid inflows are at remarkable levels for the less developed PICs as well. Between the years 1980 and 2007, Fiji has a foreign aid inflows of 24% of its GDP on average whereas Papua New Guinea has 10%. For smaller economies, foreign aid inflows is much higher. For example, Kiribati has foreign aid inflows of 50% of its GDP; whereas Palau has 47%, Samoa has 21%, Tonga has 20%, and Vanuatu has 17%.

Remittances smooth domestic output shocks when remittances and domestic economy move counter-cyclically. In other words, remittances are able to buffer domestic shocks when migrants send more money back home when the domestic economy is in recession and vice-versa. In order to measure the percentage of output shock smoothed via remittance inflows, we estimate the following equation:

$$\Delta \log \text{GDP}_t^i - \Delta \log(\text{GDP}_t^i + \text{NET} \quad \text{REMITTANCES}_t^i) = \nu_{r,t} + \beta_r \, \Delta \log \text{GDP}_t^i + \epsilon_{r,t}^i \ , \tag{6}$$

[24]Not many studies address the effect of remittances and financial aid on smoothing domestic output shocks. Sayan (2006) studied whether or not remittances have a tendency to move counter-cyclical with GDP in recipient countries.

[25]High income OECD countries has a remittance inflows of 0.2% of their GDP on average for 2008.

where "NET REMITTANCES$_t^i$" is remittance inflows for country i at time t and $\nu_{r,t}$ is a time fixed effect. As we noted earlier, the time fixed effects capture year-specific impacts on growth rates, most notably the impact of the growth on aggregate output. The regression examines if output plus remittance inflows (which can be considered as "income" available before other channels of risk sharing) varies less (more) than one-to-one with output. If that is the case, positive (negative or dis-smoothing) risk sharing from remittance inflows is achieved. The estimated coefficient, β_r, is our measure of such risk sharing via remittance inflows.

Similarly, we obtain income smoothing via foreign aids from the rest of the world with the following equation:

$$\Delta \log \text{GDP}_t^i - \Delta \log(\text{GDP}_t^i + \text{FOREIGN AID}_t^i) = \nu_{a,t} + \beta_a \, \Delta \log \text{GDP}_t^i + \epsilon_{a,t}^i \ , \tag{7}$$

where "FOREIGN AID$_t^i$" is foreign aid inflows from abroad for country i at time t and $\nu_{a,t}$ is a time fixed effect. Similarly, the regression examines if output plus foreign aid (which can be considered as "income" available before other channels of risk sharing) varies less (or more) than one-to-one with output. If that is the case, positive (negative or dis-smoothing) risk sharing from foreign aid inflows is achieved. The estimated coefficient, β_a, is our measure of such risk sharing via foreign aid inflows.

Table 5 displays the percentage of shocks smoothed via remittance inflows and foreign aid from other governments and foreign institutions. The last columns contain the regression components for the entire sample. We observe that for the entire period, the foreign aid channel smooths domestic output shocks to some extent, whereas income smoothing via remittances is insignificant. By looking at sub-samples, we realize that smoothing via remittances is highly volatile. Between 1987 and 2000, income smoothing via remittance inflows was negative and significant, whereas, from 2000 onwards, 19% of domestic shocks were absorbed by the remittances. On the other hand, the results for the entire sample demonstrate that the percentage of shocks smoothed via foreign aid is 13% and significant. Even though smoothing via foreign aid is higher and at significant levels before 2000, it decreases over the recent years.

In Figure 1, we illustrate the results discussed so far in a graphical form. The dotted line corresponds to the income smoothing via remittances and the solid line corresponds to smoothing via foreign aid. We observe that smoothing via remittances is highly volatile. Until 2000, it is negative then it becomes positive meaning after 2000 remittances starts to play a role in smoothing output shocks. Unlike remittances, smoothing via foreign aid is less volatile and it declines in recent years.

5 Concluding Remarks

In this paper, we examine the potential welfare gains and channels of income smoothing for PICs. We find that the overall welfare gains across all PICs (particularly Kiribati, Palau, and Papua New Guinea) are higher than the potential gains for OECD countries under the full risk sharing. For the developed PICs, New Zealand would have a higher gain from full risk sharing with the rest of the PICs, compared to the potential welfare gains if New Zealand attained full risk sharing with other OECD members. However, for Australia, the potential welfare gains from full risk sharing with other PICs are almost similar to the gains obtained if Australia attained full risk sharing with the rest of the OECD countries or with New Zealand alone. Given that Australia is the biggest country (both economically and demographically) in the region, and the motivation of Australia for achieving full risk sharing is not as strong as that of other countries in the region, the possibility of attaining perfect market integration does not seem plausible in the near future.

In quantifying the extent and channels of risk sharing across the PICs, we find that net factor income flows and net transfers channels smooth an important portion of the output shocks, compared to OECD members. We indicate that the net factor income channel of PICs

is driven by the net compensation of employees from the rest of the world. For OECD members, significant smoothing via net factor income is driven by income flows from the foreign financial asset holdings. Domestic savings smooth the bulk of output shocks for PICs, but the percentage of the shocks absorbed via savings is lower -much lower for the less developed PICs- compared to the OECD counterpart. Further, we analyze the effect of remittances and foreign aid on income smoothing for the less developed PICs. We find that smoothing via remittances is highly volatile and significant in recent years, whereas foreign aid seems to be a stronger and more stable channel for smoothing the domestic output shocks for PICs.

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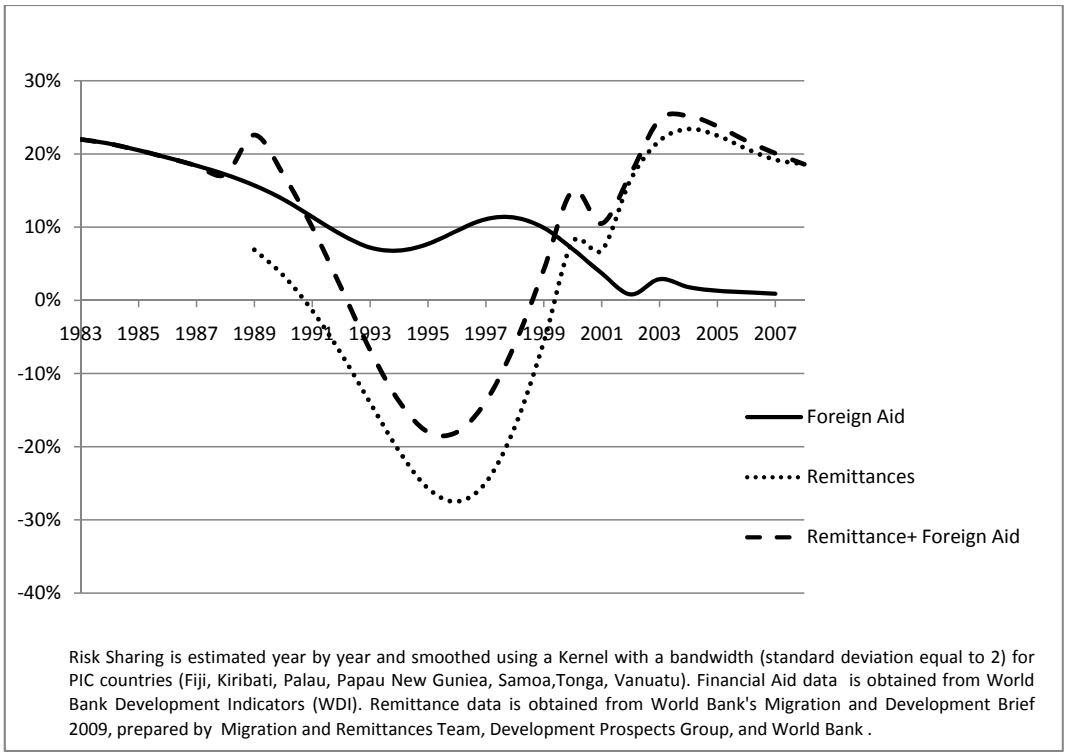
Figure 1: Income Smoothing via Foreign Aid and Net Remittances for PICs without A&NZ



Risk Sharing is estimated year by year and smoothed using a Kernel with a bandwidth (standard deviation equal to 2) for PIC countries (Fiji, Kiribati, Palau, Papau New Guniea, Samoa,Tonga, Vanuatu). Financial Aid data is obtained from World Bank Development Indicators (WDI). Remittance data is obtained from World Bank's Migration and Development Brief 2009, prepared by Migration and Remittances Team, Development Prospects Group, and World Bank .

Table 1: **Descriptive Statistics for Pacific Island Countries**

	ΔGDP		ΔC		ΔGDP	ΔC
	Mean	StD	Mean	StD	Correlation	Correlation
Australia	0.77	3.77	0.79	3.83	0.99	0.99
Fiji	0.31	4.80	1.29	7.69	0.80	0.78
French Polynesia	0.79	4.05	2.28	5.48	0.64	0.51
Kiribati	0.41	6.02	1.28	7.13	0.71	0.70
Marshall Islands	0.05	1.97	–0.08	2.24	0.46	0.42
Micronesia	0.31	1.55	0.15	1.55	0.27	0.19
New Caledonia	0.48	4.24	0.84	5.21	0.69	0.55
New Zealand	1.20	5.19	1.22	5.24	0.94	0.91
Palau	0.20	6.02	–0.17	10.60	0.67	0.41
Papua New Guinea	–0.35	6.86	-0.11	7.56	0.76	0.71
Samoa	0.28	3.13	0.52	5.04	0.84	0.53
Solomon Islands	–0.21	4.47	0.11	5.26	0.63	0.79
Tonga	0.24	3.22	0.43	4.57	0.86	0.58
Vanuatu	0.95	3.45	1.04	4.12	0.76	0.79
Average	0.36	3.84	0.85	5.40	0.72	0.62
Average w/o A&NZ	0.26	3.71	0.83	5.45	0.67	0.56

Notes: Sample: 1981–2007. ΔGDP and ΔC are the real GDP per capita growth and the real consumption per capita growth, respectively. Correlations of ΔGDP and ΔC are calculated with respect to the 14 country aggregates. For example, the row related to Vanuatu represents the correlation of ΔGDP and ΔC growth of Vanuatu with the aggregate ΔGDP and ΔC. Means and standard deviations (StD) are multiplied by 100. A&NZ stands for Australia and New Zealand.

Table 2: **Potential Welfare Gains from Risk Sharing among PICs**

	Welfare Gains
Australia	0.51
Fiji	4.32
French Polynesia	7.94
Kirbati	11.22
Marshall Islands	5.69
Micronesia	5.82
New Caledonia	8.95
New Zealand	1.31
Palau	13.02
Papua New Guinea	5.37
Samoa	4.05
Solomon Islands	5.48
Tongo	2.60
Vanuatu	6.14

Notes: Sample: 1981–2007. Table represents welfare gains in utility when each country moves from financial autarky (each member consumes its own GDP) to perfect risk sharing (where the consumption growth does not depend on GDP growth). The gain can be interpreted as a permanent percentage increase in the country's per capita consumption relative to its initial consumption autarky.

Table 3: **Income and Consumption Smoothing by National Accounts Categories for PICs**

	PICs with A&NZ			
	1981–1990	1991–2000	2001–2007	1981–2007
Factor Income (β_f)	0	5	1	4
	(2)	(6)	(8)	(2)
Depreciation (β_d)	–7	1	–1	–1
	(2)	(4)	(6)	(5)
Transfers (β_τ)	–2	–4	4	3
	(3)	(3)	(2)	(1)
Saving (β_s)	28	48	31	40
	(12)	(12)	(11)	(11)
Not Smoothed (β_u)	80	52	65	57
	(11)	(17)	(17)	(10)
	PICs without A&NZ			
	1981–1990	1991–2000	2001–2007	1981–2007
Factor Income (β_f)	7	7	8	6
	(3)	(4)	(2)	(4)
Depreciation (β_d)	–12	8	6	–1
	(1)	(8)	(6)	(7)
Transfers (β_τ)	9	8	11	9
	(3)	(4)	(4)	(4)
Saving (β_s)	23	18	30	26
	(13)	(11)	(15)	(11)
Not Smoothed (β_u)	73	59	49	60
	(14)	(18)	(11)	(18)

Notes: PICs includes Australia, Fiji, Papua New Guinea, New Zealand, Samoa, Tonga, and Vanuatu. The rest of PICs are not included due to missing observations. A&NZ stands for Australia and New Zealand. Two Step GLS method is used to solve the system of simultaneous equations. First, we perform the OLS, then use the residuals to estimate the weights. Second, weighted least squares is estimated using the estimated weights. The Prais-Winsten transformation is used to take care of the serial correlation of the variables. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, β_d is the slope in the regression of $\Delta \log \text{GNI}^i - \Delta \log \text{NNI}^i$ on $\Delta \log \text{GDP}^i$, β_τ is the slope in the regression of $\Delta \log \text{NNI}^i - \Delta \log \text{DNI}^i$ on $\Delta \log \text{GDP}^i$ and β_s is the slope in the regression of $\Delta \log \text{DNI}^i - \Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$. β_u is the coefficient in the regression of $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$ and it is the percentage of shocks not smoothed. We interpret the rest of β-coefficients as the incremental percentage amounts of income smoothing achieved at each level. Standard errors are in brackets.

Table 4: **Income and Consumption Smoothing by National Accounts Categories for OECD members**

	1981–1990	1991–2000	2001–2007	1981–2007
Factor Income (β_f)	−1	0	6	2
	(1)	(1)	(3)	(1)
Depreciation (β_d)	−9	−11	−7	−9
	(1)	(1)	(1)	(1)
Transfers (β_τ)	1	1	1	0
	(1)	(1)	(1)	(1)
Saving (β_s)	56	58	64	58
	(4)	(5)	(7)	(4)
Not Smoothed (β_u)	45	48	33	43
	(2)	(3)	(4)	(5)

Notes: OECD: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the UK, and the US. Two Step GLS method is used to solve the system of simultaneous equations. First, we perform the OLS, then use the residuals to estimate the weights. Second, weighted least squares is estimated using the estimated weights. The Prais-Winsten transformation is used to take care of the serial correlation of the variables. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, β_d is the slope in the regression of $\Delta \log \text{GNI}^i - \Delta \log \text{NNI}^i$ on $\Delta \log \text{GDP}^i$, β_τ is the slope in the regression of $\Delta \log \text{NNI}^i - \Delta \log \text{DNI}^i$ on $\Delta \log \text{GDP}^i$ and β_s is the slope in the regression of $\Delta \log \text{DNI}^i - \Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$. β_u is the coefficient in the regression of $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$ and it is the percentage of shocks not smoothed. We interpret the rest of β-coefficients as the incremental percentage amounts of income smoothing achieved at each level. Standard errors are in brackets.

Table 5: **Income Smoothing via Remittance Inflows and Foreign Aid for PICs without A&NZ**

	1987–1990	1991–2000	2001–2007	1987–2007
NET REMITTANCES (β_r)	2	–13	19	–2
	(2)	(5)	(5)	(3)
	1987–1990	1991–2000	2001–2007	1987–2007
FOREIGN AID (β_a)	16	18	3	13
	(7)	(6)	(2)	(5)

Notes: PICs includes Fiji, Kiribati, New Caledonia, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu. The rest of PICs are not included due to lack of data. Two Step GLS method is used. First, we perform the OLS, then use the residuals to estimate the weights. Second, weighted least squares is estimated using the estimated weights. The Prais-Winsten transformation is used to take care of the serial correlation of the variables. β_r is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP} + \text{NET REMITTANCES})^i$ on $\Delta \log \text{GDP}^i$ and it is the percentage of shocks smoothed via remittance inflows. β_a is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP} + \text{FOREIGN AID})^i$ on $\Delta \log \text{GDP}^i$ and it is the percentage of shocks smoothed via foreign aid inflows. These two panel regressions are solved separately. Standard errors are in brackets.