International risk sharing: methodological issues and an empirical assessment

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Abstract

Consumption insurance tests have become increasingly popular in the last decades, to gauge the extent of risk pooling across countries, or within a given country. We try to contribute to this literature by proposing some innovations to the standard methodology, and show that these may indeed be relevant, in the sense of producing different, and hopefully more accurate results. We apply the proposed methodology to a pool of OECD countries, to evaluate their performance in terms of risk sharing. A simple method to disentangle and evaluate the impact of idiosyncratic vs. aggregate risk is also proposed.

1.Introduction

The aim of this paper is to assess the international risk sharing problem from a methodological and empirical point of view on a sample that includes 26 OECD countries.

Risk sharing among countries is something desirable because it enables countries, and people residing therein, to smooth consumption across time and states of nature, limiting or even eliminating the impact of shocks on consumption choices. But several issues can hamper this mechanism, such as limited access to international financial markets, the non separabilities between tradable and non tradable consumption goods and, not less importantly, taste shocks or limited saving opportunities.

The main issues we will investigate in this work are essentially four. First of all we cope with the problem on hand from a methodological point of view. In particular, we believe that the way which is commonly used to isolate the idiosyncratic part of gdp introduces a prime source of coefficients

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bias, due to lack of orthogonality between the idiosyncratic part of gdp (a crucial regressor, as will be made clear in the sequel) and the disturbance. In this respect we show a different way to filter the idiosyncratic component of GDP that can guarantee this assumption of orthogonality. Secondly, we propose a revised specification of standard test regressions. The main point is the inclusion of idiosyncratic shock variables discriminating on the sign of the shocks (so we propose to split the "shock variable" into two: positive and negative shocks). In doing that, we will prove that including the Gdp growth rate as a proxy of idiosyncratic shocks, but without distinguishing between negative and positive shocks, could yield misleading results. Moreover, this discrimination between positive and negative shocks gives much more information about the evolution and the history of risk sharing behaviour within a country, and highlights some interesting features of that dynamics. Third, we will compare the pattern of the coefficients of risk pooling emerging from our regressions to those obtained by more standard tests, à la Asdrubali, Sorensen and Yosha (1996), Hess and Shin (1998) and Crucini (1999), just to cite a few recent and relevant contributions in the area. In fact, this is a crucial part of the (empirical) analysis, which will highlight the relevance of the approach presented in this work. Last, but not least, we will try to address two more issues which seem to bear some relevance on the assessment of risk sharing opportunities, namely the identification of a way to distinguish international risk sharing from alternative, observationally equivalent, situations, and of a way to assess the relative magnitude of a country's exposure to idiosyncratic as opposed to aggregate risk.

The rest of the paper is organized as follows: section 2 is a theoretical reminder, illustrating the rationale of consumption insurance tests. Section 3 features a short review of the recent literature on the subject. In section 4 we discuss the methodological issues anticipated in the introduction, whereas section 5 applies both the "new" and the more standard methodology to a set of 26 OECD countries, commenting the results and drawing some comparison between them.

Section 6 concludes, with a summary of the results and an eye to future developments.

2.Risk sharing tests: theoretical specification

Let us consider an abstract economy with a single good and a set of countries, each having a (finitely lived) macro-agent taking decisions in a context of risk, represented by a set of mutually exclusive and exhaustive states of the world. At a given date-event pair s_t=(s,t) the representative individual *i* receives an endowment of this (composite) good, e_{st}^{j}, possibly varying across date-event pairs. Agent *i* maximizes, under standard, state by state budget constraints, an intertemporal utility function of the form:

$$U^i(c_0)+\sum_t^T \rho^t \sum_{s_t} \pi_{s_t} U^i(c_{s_t}),$$

where T is the terminal date of the time horizon, ρ the time preference coefficient, which for simplicity we assume equal across economies, π_{st} the (objective) probability assigned to date event s_t, and $U^i(\cdot)$ the bernoullian utility index for consumption (the superscript indicating countries has been omitted, for brevity).

As we need to explore the testable implications of complete markets, let us suppose countries can engage in trading a complete set of Arrow Debreu securities. The price of the Arrow security paying off in state s_t will be denoted by q_{st}. The derived (indirect) expected utility function of country *i* as a function of its portfolio of assets, y^i , takes the form:

$$U^i(e_0-\sum_{s_t} q_{s_t} y_{s_t})+\sum_t \rho^t \sum_{s_t} \pi_{s_t} U^i(c_{s_t}),$$

Maximization of the indirect utility function yields, for every country *i*, the following first order condition with respect to y_{st}:

$$U^{i'}(c_0)q_{s_t}=\rho^t \pi_{s_t} U^{i'}(e_{s_t}+y_{s_t}),$$

which can also be expressed, via a simple normalization, as:

$$q_{s_t}=\rho^t \pi_{s_t} U^{i'}(e_{s_t}+y_{s_t}).$$

Representative agent *i*'s marginal rate of substitution between consumption at any two date event pairs, s_t and $s'_{\hat{t}}$, will be equal to:

$$\rho^{t-\hat{t}} \frac{\pi_{s_t}}{\pi_{s'_{\hat{t}}}} \frac{U^{j'}(e_{s_t}+y_{s_t})}{U^{j'}(e_{s'_{\hat{t}}}+y_{s'_{\hat{t}}})}=\rho^{t-\hat{t}} \frac{\pi_{s_t}}{\pi_{s'_{\hat{t}}}} \frac{U^{j'}(c_{s_t})}{U^{j'}(c_{s'_{\hat{t}}})}=\frac{q_{s_t}}{q_{s'_{\hat{t}}}}, \tag{1}$$

which clearly implies that rates of growth of marginal utility are perfectly correlated across countries.

To make this condition more operational, let us consider a specific date-event utility function of the CRRA type:

$$U^i(c_{s_t})=\frac{c_{s_t}^{1-\mu^i}}{1-\mu^i} \tag{2}$$

where μ^i represents the degree of relative risk aversion of country *i*. Substituting into (1), we obtain:

$$\rho^{t-\hat{t}} \frac{\pi_{s_t}}{\pi_{s'_{\hat{t}}}}\left(\frac{c_{s_t}}{c_{s'_{\hat{t}}}}\right)^{-\mu^i}=\frac{q_{s_t}}{q_{s'_{\hat{t}}}}, \tag{3}$$

indicating, in the case of $\mu^i = \mu \ \forall i$, a perfect correlation, across individuals, of rates of growth of consumption; even when $\mu^i \neq \mu$, the correlations between individual rates of growth in consumption should be positive, though not perfect.

The intuition underlying this interesting result is that countries, in a complete market world, can fully offset the idiosyncratic shocks hitting their resources, though they will not be able to offset aggregate risk. Needless to say, when markets are incomplete expression (1) does no longer hold. Agents' marginal rates of substitution from one date event to another will generically depend on the stochastic process followed by the idiosyncratic shocks.

We can therefore exploit the implications of equation (3) to build up a test of complete insurance, by estimating an equation of the form:

$$\Delta \log c_{it} = \beta_0 + \beta_1 IS_{it} + \beta_2 \Delta \log(c_{at}) + \varepsilon_{it} \tag{4}$$

where the left hand side is the logarithmic difference of national per capita (non durable) consumption, $\Delta \log(c_{at})$ is the logarithmic difference of per capita aggregate consumption, and IS_i is any variable capturing an idiosyncratic shock to income of country *i*.
A different specification would obtain if instantaneous utility were negative exponential (belonging to the family of CARA utility functions): in this case we would no longer obtain rates of growth of consumption, but rather absolute changes in consumption from one date event pair to another.

3. A bird's eye review of the literature on risk sharing tests.

On the basis of the considerations illustrated above, various tests of (full) risk sharing have to date been presented in the literature. The pioneering contributions to such tests can be found in Cochrane (1991) and Mace (1991) that using micro level data and a panel of 10,695 households managed to prove existence of full insurance, when the utility function is of the CARA type (exponential), running a regression of the difference of household's consumption on the difference of household's income and on the difference of the aggregate consumption. Only two rejections were registered: when non durables and clothing items were used as consumption variables.
In practice, the specification for exponential utility took the form:

$$\Delta C_{it} = \beta_0 + \beta_1 \Delta Y_{it} + \beta_2 \Delta C_{at} + \varepsilon_{it} \tag{5}$$

and the idea was that in the case of full insurance the coefficient on aggregate consumption should be statistically significant and equal to 1, while the coefficient on household's income should not be significantly different from zero, as it represents the sensitivity of consumption to the idiosyncratic risk.

The author, moreover, also used a specification that considered as the idiosyncratic risk variable the changes in employment status.

By implementing this test she could accept the hypothesis of full insurance, while using power utility (CRRA) she ran the following regression:

$$\Delta \log c_{it} = \beta_0 + \beta_1 \Delta \log y_{it} + \beta_2 \Delta \log(c_{at}) + \varepsilon_{it} \tag{6}$$

whereby she could not accept the hypothesis of full insurance.

The author also proposed a solution for potential bias in the estimation results. Unbiased estimations require no correlation between right-hand variables (first difference of aggregate consumption and of household income) and errors. To avoid such a bias, the author proposed to adopt a modified version of the test, as follows:

$$\Delta C_{it} - \Delta C_{at} = \beta_0 + \beta_1 \Delta Y_{it} + \varepsilon_{it} \tag{7}$$

The unit coefficient on aggregate consumption in this case is imposed and not estimated. With this modification the (null) hypothesis of full insurance still holds.

Similar tests have been conducted using macro data by Obstfeld (1995) and Lewis (1996[a], 1996[b]). Lewis (1996[a]), assuming the existence of a single tradable good and including a dummy variable as an indicator of capital market restrictions, employs a regression of the form:

$$\Delta \log c_{it} = \theta_0(t) + \beta^r D(j,t) X_{it} + \beta^u \left[1 - D(j,t) X_{it}\right] X_{it} + \varepsilon_{it} \tag{8}$$

where X_{it} is any idiosyncratic variable to country *i* and at time *t*; more precisely she uses domestic output growth from which she subtracts aggregate of world output in each period.

In order to account for the failures of standard consumption insurance tests to reveal full insurance, the author took into account the problem of non-separabilities in consumption, but this turned out not to be sufficient to provide an explanation for the rejection of international risk sharing. However, when both the problems of non-separabilities and of capital market restriction were taken into account (Lewis 1996[a]) some cases were found where the hypothesis could not be rejected; this was the case, in particular, when durables and bilateral payment restrictions were computed and included in the regression. Lewis(1996[b]) goes more deeply in exploring the importance of capital market restrictions. Six different measures of restrictions were identified and used. The main conclusion was that countries facing these kinds of restrictions have higher income sensitivity than countries that do not have to face capital market restriction. Furthermore, the difference in income sensitivity between “restricted” and “unrestricted” countries is more pronounced when restrictions affecting a smaller proportion of the world’s countries are considered. Some alternative explanations are proposed, such as habit persistence and expenditure shares on tradable and non tradable goods, when they are complementary in utility functions.

Alternative estimation procedure taking contributions by Lewis (1997), Crucini (1999), Crucini and Hess (2000) and Kim et al. (2005) were of the following type:

$$\Delta \log c_{it} = \alpha + \lambda \Delta \log c_{at} + (1-\lambda) \Delta \log y_{it}^{id} + \varepsilon_{it} \tag{9}$$

This specification takes into account the possibility that countries are allowed to pool just a fraction of aggregated risk.

A few analyses have also been conducted to gauge the extent of risk sharing and the channels through which it is achieved. This is the case of Asdrubali, Sorensen and Yosha (1996), Sorensen and Yosha (1998), Sorensen Yosha, and Wu and Zhu (2006).
In most of those contributions, the authors run an equation of the following type:

$$\Delta \log c_{it} = \beta_0 + \beta_1 (\Delta \log(GDP_{it}) - \Delta \log(GDP_{at})) + \beta_2 \Delta \log(c_{at}) + \varepsilon_{it} \tag{10}$$

which can be also expressed as:

$$\Delta \log c_{it} - \Delta \log(c_{at}) = \beta_0 + \beta_1 (\Delta \log(GDP_{it}) - \Delta \log(GDP_{at})) + \varepsilon_{it} \tag{11}$$

if one is ready to assume that $\beta_2 = 1$.

Another interesting debate on the same topic is whether there has been an increase in international risk sharing over a given time period; for instance, Giannone and Reichlin (2006) using an Asdrubali, Sorensen and Yosha regression specification show that during 90's, when markets integration in Europe experienced a strong acceleration, the ability of the euro area countries to share risk among themselves went up.
Giannone and Reichlin (2006) use a very similar regression to (11), i.e.:

$$\Delta_h (\log c_{it} - \log(c_{at})) = \beta_0 + \beta_1 \Delta_h (\log(GDP_{it}) - \log(GDP_{at})) + \varepsilon_{it} \tag{12}$$

where Δ_h denotes the h-th differences (1-L^h) and the coefficient β_1 is interpreted as the amount of risk not insured.

On this line but with different results Bai and Zhang (2005). In the empirical part of the paper they conduct a regression analysis similar to that of Mace (both panel and cross section) dividing the sample (1973-1998) in two sub-samples (1973-1985; 1986-1998) and conducting the tests separately for 19 developed countries, for 21 developing and for the joint of the two groups. Their study shows that, although the degree of financial integration doubles from the first to the second sub-period, there is no substantial improvement in international risk sharing. Moreover, they find that the share of nations in default also increase greatly over time, and conclude by claiming that even if cost of borrowing and financial integration have increased, given the magnitude of capital flows, international risk sharing did not turn out to be sensitive to this increase in financial integration. To get an improvement in international risk sharing more financial integration is not enough, but capital flows among country need to be very large. Artis and Hoffmann (2006), starting from an Asdrubali, Sorensen and Yosha (1996) type of equation, propose to apply this specification in log levels instead of log differences. They conduct the analysis using two samples: one with 23 OECD countries and one for US states. They identify two sub-periods: 1960-1990 and 1990-2000. The second sub-period is one in which financial markets liberalization has increased substantially. Their analysis is based on non-stationary panel regression in the sense of Phillips and Moon (1999).The main findings can be summarized as follows: countries' consumption risks turn out to be more diversified than in the past, but improvements in international risk sharing are a long term phenomenon, which is why they suggest a specification in levels and a panel cointegrated approach. They claim that specification in differences induces stationarity and stresses the high frequencies of the series involved in the analyses, thus generating a greater business cycle link between consumption and output volatility. On those grounds they conclude that using growth rates it is not possible to find out an increase in the extent of international risk sharing over the time span they considered.

4. Methodological issues

Let us now sketch the main methodological points we want to make in this contribution. For this, let us look back at equation (4), which constitutes the basis for our test of consumption insurance.
The dependent variable in the equation is the log difference of country *i*'s aggregate consumption growth, and the two regressors are, respectively, the innovation to the log difference of GDP, and the log difference of a given (reference) set of countries' aggregate per capita consumption.
First of all, let us stress how important it is to use *innovations*[3] to the log difference of GDP, instead of (log-differenced) GDP itself, if one wants to evaluate the impact of idiosyncratic risks onto consumption. To understand why, suppose we did not decompose the variable $\Delta \log(GDP_{it})$ in these two components; then, if risk pooling were indeed at work, and if the aggregate component of $\Delta \log(GDP_{it})$ did not play any role on idiosyncratic consumption growth, the estimated coefficient of this aggregate GDP growth variable would most likely be downward biased, as the weight of the small (or zero) effect of the aggregate component might possibly overcome the weight of the idiosyncratic one.
For reasons which will be made clearer below, the idiosyncratic component of GDP growth will be computed as the (estimated) residual in the following equation:

$$\Delta \log(GDP_{it}) = \beta \Delta \log(GDP_{at}) + \eta_{it}, \tag{13}$$

where the variable on the r.h.s. is the log difference of total GDP of the same set of countries as in equation (4).
The rate of growth of a given country's GDP will therefore be decomposed in two orthogonal components: in fact,

$$\Delta \log(GDP_{it}) = \hat{\beta} \Delta \log(GDP_{at}) + e_{it}, \qquad \hat{\beta} \Delta \log(GDP_{at}) \perp e_{it}. \tag{14}$$

[3] We define innovations to (log-differenced) GDP as the difference between the variable itself, and an aggregate component, more precisely defined in the paper.

This decomposition serves several purposes: first and foremost, it accounts for the fact that in equation (4) we had better not include the aggregate component of GDP growth[4], due to potentially severe multicollinearity problems with aggregate per capita consumption growth, and that the omitted variable should be orthogonal to the included, idiosyncratic component, to avoid a potentially serious omitted variable bias on β_1. On the other hand, it is quite likely, always in view of the collinearity hinted at above, that any effect of the aggregate component of national income growth on idiosyncratic consumption shocks might be captured by the aggregate consumption term. Secondly, decomposing $\Delta \log(GDP_{it})$ as in (14) might also prove fruitful to remove the endogeneity affecting innovations in income as an explanatory variable (one might easily argue, in fact, that aggregate income growth of the reference pool of countries is not that likely to be correlated with innovations affecting any single country's income growth).

The more standard practice (see, for a few examples, the contributions by Obstfeld and Rogoff (2004), Sorensen and Yosha (1998), and the more recent ones by Sorenson et al. (2006) and Artis and Hoffman (2006)), consisting in decomposing income innovations in the two components (idiosyncratic vs. aggregate) by simply subtracting the average (across countries in a wide economic area) rate of GDP growth from individual countries' rates leads to the following specification:

$$\Delta \log c_{it} = \beta_0 + \beta_1 (\Delta \log(GDP_{it}) - \Delta \log(GDP_{at})) + \beta_2 \Delta \log(c_{at}) + \varepsilon_{it} \qquad (15)$$

which does not guarantee, per se, this orthogonality property. On the other hand, subtracting $\Delta \log(GDP_{at})$ from $\Delta \log(GDP_{it})$ may strongly (and positively) bias the estimation of β_2, possibly inducing into the false belief that international risk pooling is indeed the case. In fact, if the subtracted term, $\Delta \log(GDP_{at})$, keeps some explanatory power, once the effect of $\Delta \log(c_{at})$ has been accounted for, and if β_1 is nonzero, we end up in a case of omitted variable. As the term $\Delta \log(GDP_{at})$ is usually correlated with $\Delta \log(c_{at})$, the coefficient of the latter will incorporate part or all of the effect of the omitted variable onto the dependent variable, bringing about the bias.

In the next section it will be shown that these two procedures may indeed yield quite different results.

[4] In principle, though, we would be interested in estimating the differential impact of aggregate income shocks, as well as average consumption. On this, read more below.

Remarkably, the formulation of the consumption insurance test adopted in this work is also different from a more common methodology (cfr. Kose et al. (2006) and references therein), consisting in estimating the equation:

$$\Delta \log c_{it} - \Delta \log(c_{at}) = \beta_0 + \beta_1 (\Delta \log(GDP_{it}) - \Delta \log(GDP_{at})) + \varepsilon_{it} \tag{16}$$

both for the different decomposition of GDP growth, as clarified above, and because in (16) the coefficient on aggregate consumption growth, $\Delta \log(c_{at})$, has been constrained to 1. Unfortunately, as can easily be understood from using actual data, this can by no means be taken for granted; moreover, this implicitly assumes that the researcher has correctly identified the set of countries sharing risks together.

To obtain a formulation of the test equation compatible with (16) we can apply the same decomposition illustrated in (14) to $\Delta \log c_{it}$, which splits it in an idiosyncratic and in an aggregate component, just like for income growth. The resulting equation will be of the form:

$$\Delta \log c_{it}^{id} = \beta_0 + \beta_1 \Delta \log GDP_{it}^{id} + \varepsilon_{it} \tag{17}$$

Equations (16) and (17), the way they are specified, imply that we expect positive and negative realization of the idiosyncratic shocks variable to have the same relevance, i.e. no systematic impact at all, on consumption growth, as a given country will be allowed to average out consumption across states of the world, implying that consumption growth will roughly be equal to aggregate consumption growth, regardless of the nature of the shock (in other words, consumption growth would be constant across all states of the world). A fortiori, coefficient β_1 should not turn out to be significant, even if we regressed equation (17) on separate sub samples, for example (but not necessarily) consisting only of positive, or negative, realizations of the shock variable.

We realize, however, that this should be the case only if all the variables involved were stationary, as it might happen if we considered many realizations of the shock variable to the same country in the same situation (for example, exactly at the same moment in time). In practice, available data refer to the same country over different periods of time (as in time series analyses), or to different countries at given points in time, as in cross section analyses, or combinations of the two, as in panel estimations. For example, in the case of time series estimations, although we may reasonably suppose (and test) that rates of income growth (and consumption) be stationary over long periods of time, it might equally be possible that non-stationarity be found over shorter time spans. Developing countries, for example, might experience growing rates of growth for a relatively long period. If that were the case, even with perfect insurance we might reasonably expect growth rates in consumption to co-vary more strongly with income growth in case of positive innovations (which partly embody an increase in permanent per capita consumption), and more moderately in the case of negative innovations (which would be largely offset by insurance mechanisms). Consequently, on average we might detect lack of insurance (i.e., a statistically significant coefficient β_1 in equation (17)) even when insurance is in fact complete, particularly when positive shocks prevailed over negative ones. Likewise, lack of stationarity might be induced by taste shifts, entailing similar consequences. When insurance is severely restricted, on the other hand, the opposite (i.e., detecting more insurance than it is in fact the case) might also realize, as consumption growth would strongly co-vary with negative income innovations, and would be less sensitive to positive ones.

That is why it might be sensible to split the shock variable in two variables, reflecting negative and positive income innovations, and focus on the estimate of coefficient β_1^-, attached to the former.

To sum up, by restricting the coefficients of the two sub-variables to be equal (i.e., if we did not split the shock variable), we might fail to detect full insurance (when present), or make the opposite mistake, of detecting more insurance than it is in fact the case. On the other hand, by splitting the shock variable in any sensible way, nothing would change in the standard, full insurance and stationary case, corresponding to using equation (17): both coefficients should turn out to be statistically non significant. Put another way, the procedure followed in the rest of the paper will be without loss of generality, with respect to the maintained theory.

Hence, we will carry out our consumption insurance test by explicitly distinguishing between "negative" and "positive" realization of the shock variable, where the terms "negative" and "positive" will be better clarified below, and the equation to be estimated will take the form:

$$\Delta \log c_{it} = \beta_0 + \beta_1 IS_{it}^{+} + \beta_2 IS_{it}^{-} + \beta_3 \Delta \log(c_{at}) + \varepsilon_{it} \,. \tag{18}$$

Based on all this, in the sequel we are implementing a test based on equation (4), partially modified to account separately for negative and positive shocks.

By considering innovations to GDP growth as our shock variable, the final estimated equation will take the following shape:

$$\Delta \log c_{it} = \beta_0 + \beta_1^{+} \Delta \log GDP_{it}^{id+} + \beta_1^{-} \Delta \log GDP_{it}^{id-} + \beta_3 \Delta \log(c_{at}) + \varepsilon_{it} \tag{19}$$

or, by only considering the idiosyncratic component of consumption growth as the dependent variable, as in (17):

$$\Delta \log c_{it}^{id} = \beta_0 + \beta_1^{+} \Delta \log GDP_{it}^{id+} + \beta_1^{-} \Delta \log GDP_{it}^{id-} + \varepsilon_{it} \tag{20}$$

where the variable $\Delta \log(GDP_{it}^{id})$ has been split in two separate variables, containing respectively the "positive" and the "negative" realizations of the original variables, and zero elsewhere.

To distinguish between positive and negative realizations of the variable $\Delta \log(GDP_{it})$, we are going to make use of a concept of output gap, as follows. Assuming that the trend output (as measured, for example, by real GDP filtered according to the Hodrick and Prescott (1997) method) is the level of output that a country wishes to secure, we define as "negative" components of the variable $\Delta \log(GDP_{it})$ those corresponding to periods of negative output gap (when actual GDP is below its trend level), and "positive" components those corresponding to periods of positive output gap. This, let us notice, does not imply that those components be actually negative or positive, as the opposite might well be the case.
This method will allow us to capture unfavourable and favourable shocks even when $\Delta \log(GDP_{it})$ is positive at all times, which is almost always the case for developed countries and for many developing countries, as well.
However, it is maybe worth stressing once more, this or alternative specifications of negative and positive shocks will not fail to reveal "standard" consumption insurance, if that is indeed the case (i.e., there is no loss of generality with respect to the full insurance case).
For a robustness check, we will also identify negative and positive components of innovations to GDP by using alternative filters, namely a linear and/or quadratic trend, and a band pass filter à la Baxter and King (1999).

Finally, starting from the econometric analysis outlined above, one last step of this research will aim at evaluating one important feature related to country insurance, which fundamentally consists in answering the following question: what is the comparative relevance of idiosyncratic vs. aggregate risk ?

This question seems to be quite relevant, as it pertinent to the interpretation of the results of consumption insurance tests, that we are going to carry out in the sequel.
In fact, we cannot possibly assess this relevance by simply looking at the significance and/or magnitude of the coefficient β_1 (or β_1^-, in case we split negative from positive realizations of the shock variable) . In other words, we might obtain a large and significant estimate for β_1, but the corresponding variable might possibly explain a very tiny portion of consumption variability, in which case we should conclude that the country in question would be little affected by idiosyncratic risk. Hence, the idea is to measure the relevance of idiosyncratic and aggregate shocks by computing the share in R^2 which can be attributed to, respectively, the idiosyncratic component and the aggregate component of domestic income growth.
Starting from the regression model:

$$\Delta \log c_{it} = \beta_0 + \beta_1 \Delta \log GDP_{it}^{id} + \beta_2 \Delta \log GDP_{it}^{a} + \varepsilon_{it}$$

where the regressors are the idiosyncratic and, respectively, the aggregate components of output growth (computed as explained in section 3), we may compute the share of the coefficient of multiple correlation imputable to $\Delta \log GDP^{id}$ and $\Delta \log GDP^{a}$.
To do so, let us recall that the coefficient of multiple correlation with two explanatory variables (plus intercept), is:

$$R_{0.12}^2 = \frac{b_1 \sum x_1 y + b_2 \sum x_2 y}{\sum y^2},$$

which can be reformulated as:

$$R_{0.12}^2 = \frac{n\sigma_y (b_1 \rho_{x_1 y} \sigma_{x_1} + b_2 \rho_{x_2 y} \sigma_{x_2})}{n\sigma_y^2} = \frac{(b_1 \rho_{x_1 y} \sigma_{x_1} + b_2 \rho_{x_2 y} \sigma_{x_2})}{\sigma_y} = b_1 \rho_{x_1 y} \frac{\sigma_{x_1}}{\sigma_y} + b_2 \rho_{x_2 y} \frac{\sigma_{x_2}}{\sigma_y}.$$

with $X_1 = \Delta \log GDP^{id}$, and $X_2 = \Delta \log GDP^{a}$.
Introducing the following definitions:

Vulnerability to idiosyncratic shocks: $V_1 = \hat{b}_1 \rho_{x_1, y}$

Vulnerability to aggregate shocks: $V_2 = \hat{b}_2 \rho_{x_2, y}$

Relative exposure to idiosyncratic shocks: $RE_1 = \frac{\sigma_{x_1}}{\sigma_y}$

and

Relative exposure to aggregate shocks: $RE_2 = \frac{\sigma_{x_2}}{\sigma_y}$,

we obtain: $REL_j = V_j \times RE_j \qquad j = 1, 2..$

When only idiosyncratic risk is present, the formula holds only with respect to the appropriate term.

5. OECD Countries and consumption insurance tests: some empirical evidence

In this section we present some (preliminary) results obtained by applying our test methodology to data concerning 26 OECD countries, obtained from the World Bank "World Development Indicators" database, for the time period 1970-2003. Estimations have been performed by using total final consumption (including public expenditures) or household final consumption (excluding public expenditures).

To provide a general view of the risk pooling situation for our set of countries, Table 1 contains the results of estimating equation (20), by using the three different techniques to split the shock variable described in the previous section, i.e. the HP filter, the linear or quadratic trend, and a Band Pass (BP) filter.
As one can promptly notice by looking at Table 1, for almost all countries can we detect some lack of insurance, although the magnitude of the coefficient attached to negative shocks (in which we are particularly interested) varies widely (from a relatively modest 0.34 for UK to a value of 1.06 for Iceland, if we look at the HP decomposition). Two countries appear to behave quite differently, in terms of risk sharing, namely Luxembourg and Spain. Both feature statistically non significant coefficients for the negative idiosyncratic shock variable, the coefficient of Luxembourg being even negative. It is also worth noticing from Table 1 that the coefficients for positive and negative shocks are often broadly different, which further confirms the need to operate a distinction between the two.

Insert Table 1

The case of Luxembourg is quite telling in this respect. The coefficient on the variable representing positive shocks is positive and statistically significant, whereas that on negative shocks is negative and non significant. If the shock variable was not split in its two components, we might possible fail to detect full insurance, if the weight of the first coefficient overcame that of the second. In general, we can reasonably assert that the pattern of insurance would be quite different, in the absence of a distinction between the two types of shocks.

In Table 2 we present the results of regression the more standard, equation (16), where the explanatory variable has also been divided into positive and negative components, according to the proposed methodologies.

Insert Table 2

One can easily spot some differences between the results of the two sets of regressions, confirming that going from (16) to (17) is not a trivial step, but certainly more impressive is the comparison we may obtain by looking at figure 1, which contains the plots of recursive estimations (i.e. estimated coefficients obtained by adding, in sequence, one more observation, starting with the first 20 observations, from 1992 to 2003) for both specifications (16) (right) and (17) (left), and accounting for negative and positive shocks. In fact, the graphs only represent the coefficients on negative shocks, following the three alternative filters (HP, linear or quadratic, and BP).

From a cursory look at those graphs, we can get some interesting insights. First of all, what is pretty striking is that one cannot find real signs of an increase in consumption smoothing in the last years of the sample, despite the increase in financial flows. In other words, financial globalization doesn't seem to have affected the amount of risk smoothing enjoyed by the various economies surveyed.

Secondly, the dynamics of recursive estimates are fairly robust to a change in the method used to decompose shocks in a negative and a positive component.

Thirdly, these dynamics do appear to reflect some major macroeconomic events. For instance, for many countries in Europe the first years of the sample (1992-1993) register an increase in the coefficient, i.e. a decrease in risk sharing, and this may reflect the currency turmoil experienced a the time. On the other hand, this does not seem the case for Germany, showing an upward trend during the whole period, and possibly reflecting its severe internal crisis in terms of unemployment rate and gdp growth, following reunification. The Mexican crisis can also been recognized in the corresponding graphs.

In terms of comparison between our specification of the test equation and the standard specification, equation (16), we may observe many differences in the magnitude of the corresponding coefficients, and sometimes even in the dynamics, as for example with Portugal, Spain and Norway. Recursive estimations also allow us to understand how important it is to split the shock variable in a positive and a negative component. In Table 3 we report, for both specifications (16) and (20), the first row of the correlation matrix between coefficients computed on a "total shock" variable (first column), positive shock (second column) and negative shock (third column).

Insert Table 3

It should be evident that in a few cases the "total shock" variable is driven by its positive component (as with Austria, Hungary, Luxembourg, the Netherlands, Spain, United Kingdom), and in other cases its behaviour rather reflect that of its negative components (as with Denmark, France, Germany, Iceland, Italy, Japan, Mexico, New Zealand). For both sets of countries, therefore, using a "total shock" variable might consequently be completely misleading,

Following the approach outlined at the end of the previous section, we also tried to gauge the extent of idiosyncratic and aggregate risk vulnerability, exposure and relevance for LAC countries. The results are reported in table (4). This table reports (complete) results only for those countries for which it was clear that a decomposition of income growth in an idiosyncratic and an aggregate component could be obtained. When this was not the case (as for Chile, Haiti, Jamaica, Nicaragua, Panama, El Salvador and Trinidad), we assumed that income dynamics was generated solely by idiosyncratic shocks.

Insert table (4) here

The results reported in table 4 are highly suggestive of the fact that most LAC countries are relatively more vulnerable to idiosyncratic than to aggregate shocks (except in the case of Bolivia, Brazil, Colombia and Paraguay, for which the reverse would appear to be true), and that in some cases the former do explain a large share of variability in consumption dynamics (as for Chile, Mexico, Argentina, El Salvador, Jamaica and Uruguay, in order of importance). The case of Chile is quite significant, as it is well known that the dynamics of world copper prices is a major determinant of its economic up and downturns. Not surprisingly, then, Chile is the first country in the list, in terms of relevance of idiosyncratic shocks.

Moreover, the table shows that relevance appears to be determined mostly by vulnerability, rather than (relative) exposure (this is particularly so with respect to idiosyncratic shocks), and in many cases an inverse correlation between vulnerability and exposure is observed. Secondly, one can see that LAC countries are, on average, more or less equally vulnerable to aggregate and idiosyncratic shocks, but they are significantly more exposed to the latter.

Per se, these indications could be important for policy purposes, if a policymaker wanted to identify the major sources of risk affecting a country or a group of countries, and in as much as instruments to buffer idiosyncratic variability in income (essentially, various types of insurance mechanisms) may be different from those required to counter aggregate risk (essentially, aggregate savings).

6. Concluding remarks

Consumption insurance tests have become increasingly popular in the last fifteen years, since the seminal papers by Cochrane (1991) and Mace (1991), and have been extensively used to gauge the risk sharing opportunities enjoyed by various pools of countries. Many contributions to the recent literature have highlighted the role that risk sharing plays on growth, which also explains the popularity of this type of analysis and tests.

In this work we have illustrated some innovations to an otherwise standard methodology to assess risk sharing opportunities in a pool of countries. The originality of the approach lies in allowing potentially asymmetric effects of positive and negative idiosyncratic components to innovations in GDP, and in the way of effecting a decomposition of GDP growth into an aggregate and a specific component. This methodology has been applied to a set of OECD countries, whose performance in terms of risk sharing has been analyzed, both in a static and in a dynamic framework (recursive estimations). The (preliminary) results we present show that, indeed, there may be some remarkable differences between the results obtained by following this methodology and the results obtained by employing more standard methodologies. In addition, a simple method to assess the relative impact of idiosyncratic vs. relative risk has also been proposed, which seems to be useful in interpreting the results of the consumption insurance test.

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Table 1. OECD countries – Estimation Results								
dependent variable $\Delta \log C_{it}^{id}$, explicative Rgdppc								
	I HP filter			II quadratic/linear filter		III BP filter		
	Const	resid +	resid -	resid+	resid-	Const	resid+	resid-
Aus	-	1.039	0.857	1.022	0.345		1.034	0.858
		[0.000]	[0.000]	[0.000]	[0.039]		[0.000]	[0.000]
Aut	-	1.005	0.866	0.957	0.885		1.063	0.819
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
Bel	-	0.306	0.633	0.275	0.844		0.329	0.579
		[0.069]*	[0.015]	[0.076]*	[0.004]		[0.055]	[0.027]
Can	-	0.519	0.582	0.342	0.701		0.443	0.661
		[0.000]	[0.000]	[0.021]	[0.000]		[0.003]	[0.000]
Dnk	-	0.77	0.586	0.811	0.537		0.848	0.434
		[0.000]	[0.002]	[0.000]	[0.005]		[0.000]	[0.037]
Fin	-	0.596	0.643	0.576	0.651		0.558	0.67
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
Fra	-	0.495	0.373	0.536	0.315		0.567	0.342
		[0.020]	[0.027]	[0.005]	[0.077]*		[0.011]	[0.059]
Deu	-	0.579	0.623	0.583	0.644		0.654	0.54
		[0.002]	[0.010]	[0.000]	[0.039]		[0.121]*	[0.001]
Jpn	-	0.815	0.672	0.67	0.783		0.786	0.646
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
Grc	-	0.208	0.389	0.441	0.266		0.572	0.239
		[0.259]*	[0.012]	[0.044]	[0.059]		[0.037]	[0.087]*
Irl	-	0.188	0.523	0.317	0.417		0.207	0.512
		[0.214]	[0.001]	[0.035]	[0.014]		[0.206]*	[0.001]
Isl	-	1.275	1.062	1.166	1.192		1.269	1.04
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.002]
Ita	-	0.741	0.628	0.741	0.628		0.644	0.885
		[0.000]	[0.005]	[0.000]	[0.005]		[0.000]	[0.001]
Kor	-	1.198	0.858	1.148	0.849		0.814	0.904
		[0.000]	[0.000]	[0.000]	[0.000]		[0.031]	[0.000]
Lux	-	0.532	−0.027	0.501	−0.047		0.387	0.001
		[0.000]	[0.811]*	[0.000]	[0.690]*		[0.006]	[0.990]*
Mex	-	1.06	0.97	1.019	0.98		1.005	0.997
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
Nor		0.813	0.612	0.813	0.612	−0.004	1.034	0.678

		[0.000]	[0.000]	[0.000]	[0.000]	[0.052]	[0.000]	[0.000]
Nzl	-	0.739	0.368	0.567	0.566		0.571	0.539
		[0.000]	[0.019]	[0.001]	[0.000]		[0.000]	[0.002]
Nld	-	0.611	0.916	0.708	0.788		0.697	0.898
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.003]
Prt	-	1.154	0.767	1.16	0.769		1.113	0.761
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]
Gbr	-	0.684	0.339	0.761	0.286		0.466	0.418
		[0.002]	[0.033]	[0.000]	[0.065]*		[0.038]	[0.015]
Esp	-	0.424	0.408	0.424	0.408		0.446	0.356
		[0.045]	[0.238]	[0.045]	[0.238]		[0.043]	[0.281]*
Swe	-	0.441	0.401	0.425	0.414		0.33	0.523
		[0.014]	[0.015]	[0.015]	[0.014]		[0.054]	[0.004]
Che	-	0.319	0.39	0.302	0.4		0.277	0.401
		[0.009]	[0.000]	[0.012]	[0.000]		[0.025]	[0.000]
Hun	-	0.919	0.451	0.7	0.59		0.685	0.489
		[0.000]	[0.010]	[0.002]	[0.000]		[0.001]	[0.005]
Usa	-	0.75	0.627	0.738	0.637		0.732	0.605
		[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]

This table reports the results of estimating equation (20). Stars denote coefficients statistically non significant.

Table 2. OECD countries – Estimation results									
dependent variable dlog(country_conspc)-dlog(tconspc), explicative (dlog(country_gdppc)-dlog(tgdppc))									
	I HP filter			II quadratic/linear filter			III BP filter		
	C	shock +	shock -	C	shock +	shock -	C	shock +	shock -
Aus	-	1.038	0.864		1.02	0.379		1.029	0.872
		[0.000]	[0.000]		[0.000]	[0.029]		[0.000]	[0.000]
Aut	-	0.809	0.965		0.829	1.001		0.869	0.894
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Bel	-	0.287	0.605		0.251	0.819		0.331	0.513
		[0.094]	[0.014]		[0.106]**	[0.003]		[0.064]*	[0.036]
Can	−0.003	0.537	0.561	−0.003	0.348	0.696	−0.003	0.47	0.628
	[0.035]	[0.000]	[0.000]	[0.034]	[0.023]	[0.000]	[0.039]	[0.003]	[0.000]
Dnk	-	0.847	0.61		0.847	0.59		0.895	0.52
		[0.000]	[0.001]		[0.000]	[0.006]		[0.000]	[0.016]
Fin	-	0.661	0.632		0.622	0.648		0.619	0.653
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Fra	-	0.385	0.554		0.396	0.554		0.419	0.524
		[0.008]	[0.000]		[0.005]	[0.000]		[0.006]	[0.001]
Deu	-	0.558	0.653		0.569	0.67		0.637	0.536
		[0.003]	[0.004]		[0.001]	[0.016]		[0.093]*	[0.001]
Jpn	-	0.934	0.64		0.75	0.777		0.895	0.607
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Grc	-	0.27	0.36		0.467	0.266		0.658	0.22
		[0.155]*	[0.021]		[0.036]	[0.061]		[0.017]	[0.111]*
Irl	-	0.37	0.465		0.395	0.442		0.354	0.481
		[0.010]	[0.001]		[0.006]	[0.003]		[0.029]	[0.001]
Isl	-	1.293	1.049		1.183	1.178		1.296	1.001
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.002]
Ita	-	0.745	0.586		0.745	0.586		0.664	0.758
		[0.000]	[0.008]		[0.000]	[0.008]		[0.000]	[0.004]
Kor	-	0.799	0.833		0.787	0.845		0.716	0.876
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Lux	-	0.444	−0.035		0.439	−0.034		0.34	−0.000
		[0.000]	[0.756]		[0.000]	[0.770]**		[0.006]	[0.999]*
Mex	-	1.035	0.979		1.036	0.961		0.934	1.017
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]

Nor	-	0.824	0.611		0.824	0.611		0.873	0.625
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Nzl	-	0.75	0.402		0.599	0.517		0.595	0.526
		[0.000]	[0.003]		[0.000]	[0.000]		[0.000]	[0.000]
Nld	-	0.504	1.003		0.626	0.929		0.626	1.039
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Prt	-	0.945	0.738		1.002	0.717		0.925	0.74
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.001]
Gbr	-	0.775	0.323		0.831	0.279		0.557	0.39
		[0.000]	[0.042]		[0.000]	[0.074]*		[0.017]	[0.025]
Esp	-	0.805	0.972		0.805	0.972		0.9	0.826
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
Swe	−0.005	0.38	0.458	−0.005	0.366	0.468	−0.005	0.335	0.508
	[0.014]	[0.023]	[0.003]	[0.016]	[0.032]	[0.002]	[0.034]	[0.048]	[0.002]
Che	−0.005	0.385	0.386	−0.005	0.367	0.398	−0.004	0.329	0.423
	[0.002]	[0.001]	[0.000]	[0.003]	[0.001]	[0.000]	[0.014]	[0.007]	[0.000]
Hun	-	0.899	0.443		0.71	0.565		0.635	0.499
		[0.000]	[0.013]		[0.003]	[0.003]		[0.004]	[0.005]
Usa	-	0.78	0.588		0.771	0.599		0.701	0.588
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]

This table reports the results of estimating equation (16), also accounting for negative and positive components of the shock variable. Stars denote coefficients statistically non significant.

Table 3. Correlations between recursive coefficients of “total”, “positive” and “negative” shock variables.

	Differences			Residuals		
	Tot	+	-	Tot	+	-
Australia	1	0.999	0.877	1	0.998	0.878
Austria	1	0.984	-0.524	1	0.852	0.034
Belgium	1	0.265	0.497	1	0.649	0.598
Canada	1	0.905	0.932	1	0.867	0.885
Denmark	1	0.600	0.925	1	0.071	0.933
Finland	1	0.789	0.595	1	0.832	0.625
France	1	0.749	0.931	1	0.480	0.943
Germany	1	-0.478	0.944	1	-0.248	0.776
Greece	1	0.637	0.672	1	0.601	0.609
Hungary	1	0.989	0.630	1	0.984	0.698
Iceland	1	0.386	0.882	1	0.540	0.906
Ireland	1	0.882	0.827	1	0.903	-0.313
Italy	1	0.575	0.891	1	0.594	0.872
Japan	1	0.268	0.839	1	0.802	0.974
Korea	1	0.784	0.981	1	0.392	0.991
Luxembourg	1	0.670	-0.429	1	0.789	-0.598
Mexico	1	0.050	0.998	1	0.317	0.995
Netherlands	1	0.938	-0.196	1	0.974	-0.571
New Zeland	1	0.615	0.923	1	0.562	0.762
Norway	1	0.549	0.776	1	0.612	0.722
Portugal	1	-0.270	0.986	1	0.424	0.993
Spain	1	0.981	0.627	1	0.970	0.786
Sweden	1	0.741	0.986	1	0.318	0.952
Switzerland	1	0.216	0.689	1	0.412	0.965
United Kingdom	1	0.963	0.526	1	0.941	0.230
Usa	1	0.327	0.150	1	0.762	0.110

This table contains the first row of the correlation matrices between recursive coefficients computed on “total”, “positive” and “negative” shock variables. The labels “differences” and “residuals” refer to the way we split variables.

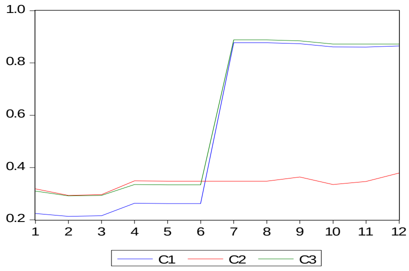
Table 4. Risk Pooling and Risk Relevance

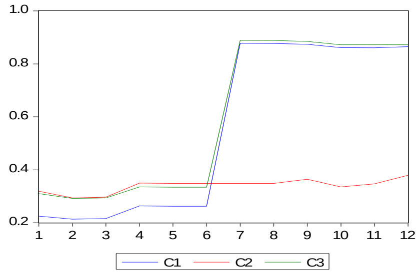
This table contains an assessment of the relative impact of idiosyncratic and aggregate risk for a number of LAC countries, following the methodology outlined in section 4. In particular, *V. Agg.* and *V. Id.* stand, respectively, for Vulnerability to aggregate and idiosyncratic risk, *Rex. Agg.* and *Rex. Id.* for Relative Exposure to aggregate and idiosyncratic risk, and *Rel. Agg.* and *Rel. Id.* for Relevance of aggregate and idiosyncratic risk. These measures have been computed with reference to total consumption, but similar results would hold with respect to household final consumption.

	V. Agg.	Rex.Agg.	Rel.Agg.	V. Id.	Rex.Id.	Rel.Id.
ARG	0.671	0.392	0.263	0.936	0.756	0.708
BLZ	-0.010	0.178	-0.002	0.818	0.551	0.450
BOL	0.900	0.448	0.403	0.251	1.098	0.275
BRA	0.235	0.818	0.192	0.186	0.826	0.154
CHL				1.177	0.712	0.838
COL	0.487	0.402	0.196	0.283	0.940	0.266
CRI	0.041	0.644	0.026	0.013	1.029	0.014
DOM	0.507	0.204	0.104	0.506	0.609	0.308
ECU	0.318	0.358	0.114	0.368	0.652	0.240
GTM	0.332	0.599	0.199	0.622	0.771	0.479
GUY	0.411	0.188	0.077	0.383	0.382	0.146
HND	0.428	0.407	0.174	0.179	0.838	0.150
HTI				0.686	0.507	0.347
JAM				0.418	0.588	0.246
MEX	0.371	0.526	0.195	0.894	0.773	0.691
NIC				0.089	0.332	0.030
PAN				0.248	0.564	0.140
PER	0.384	0.314	0.121	0.561	0.785	0.440
PRY	1.226	0.370	0.454	-0.006	0.491	-0.003
SLV				1.090	0.450	0.490
TTO				0.534	0.468	0.250
URY	1.065	0.388	0.413	1.102	0.479	0.528
VEN	0.252	0.323	0.081	0.652	1.014	0.661

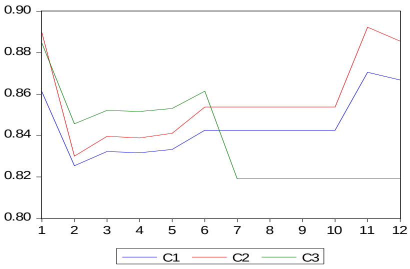
Figure 1. Recursive estimations.

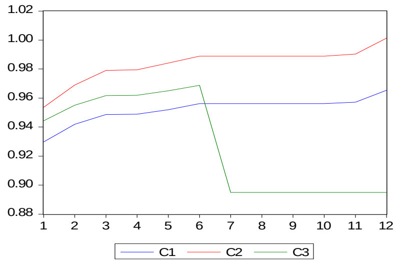
AUSTRALIA





AUSTRIA





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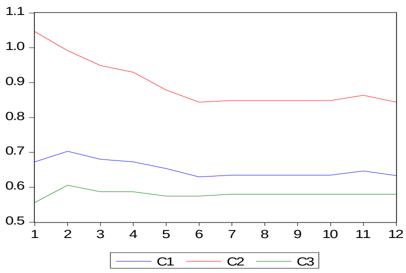

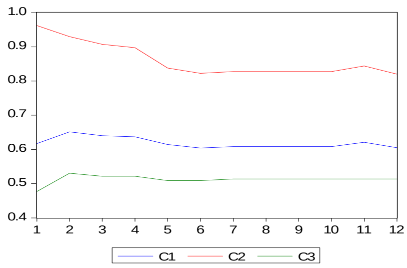

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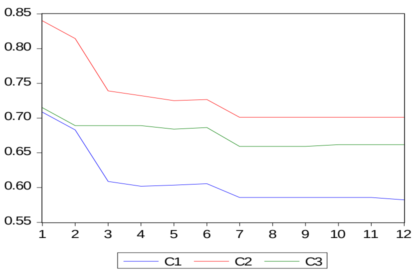

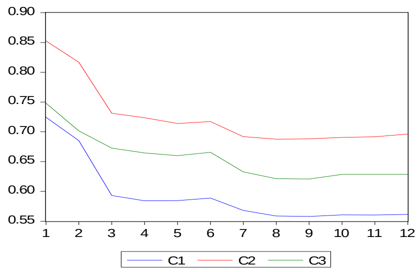

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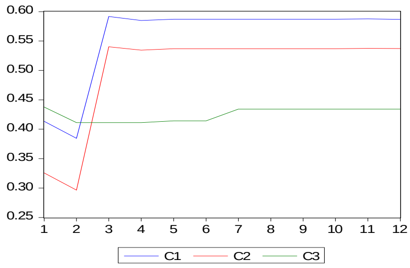

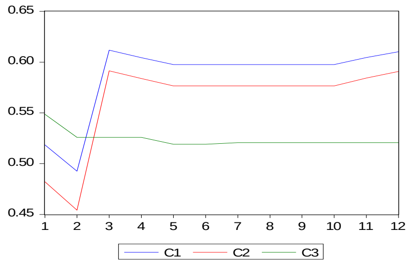

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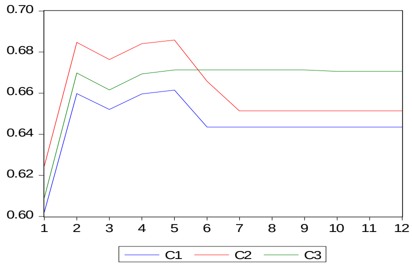

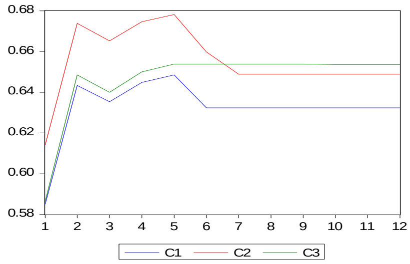

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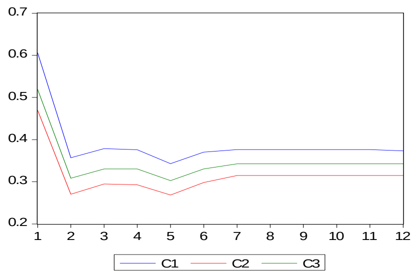

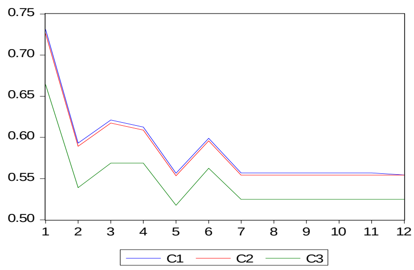

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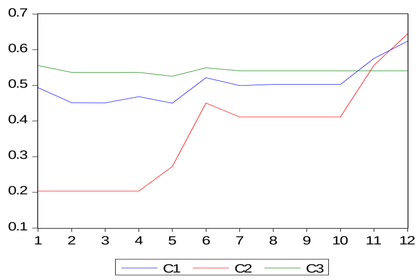

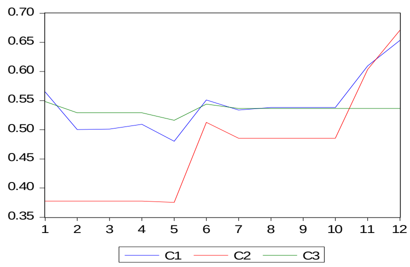

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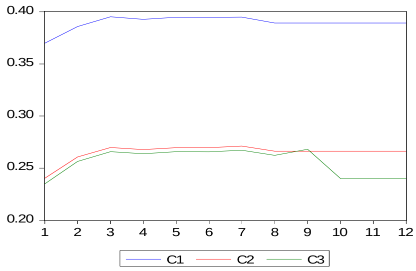

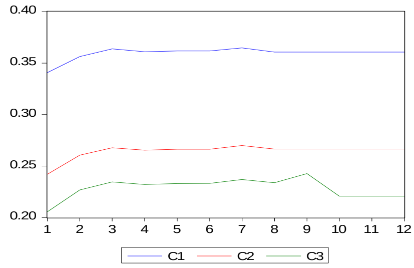

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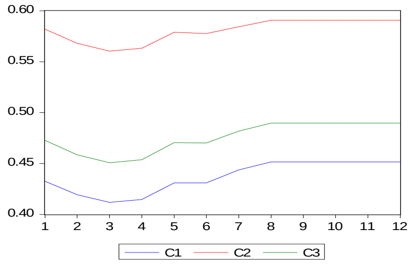

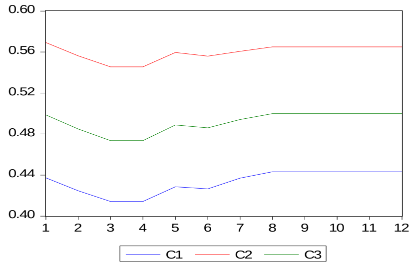

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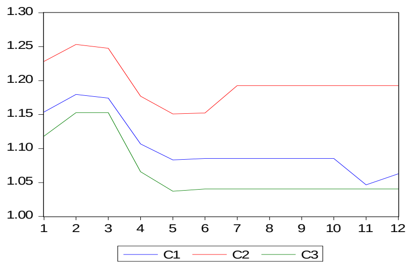

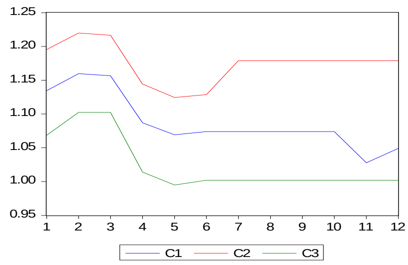

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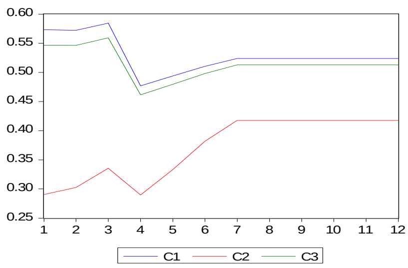

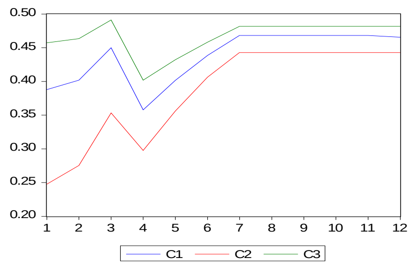

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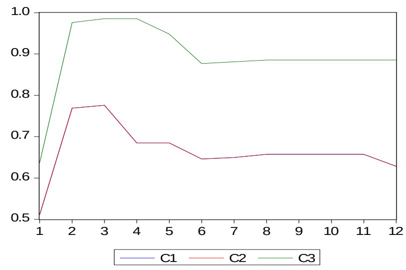

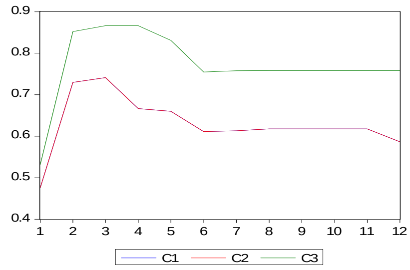

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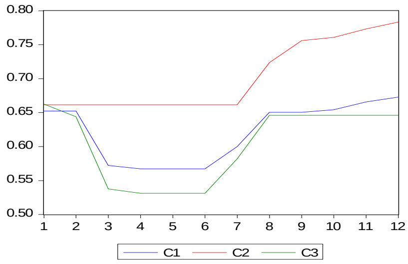

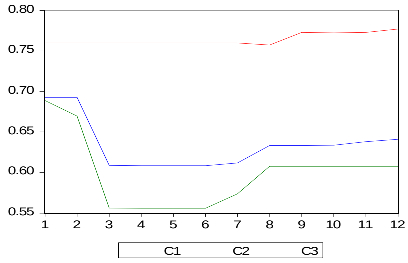

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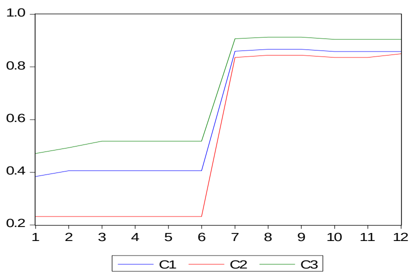

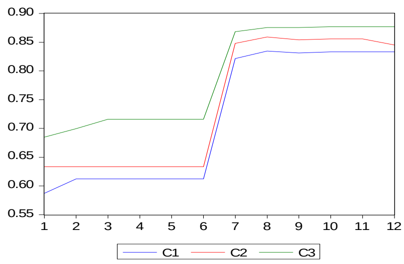

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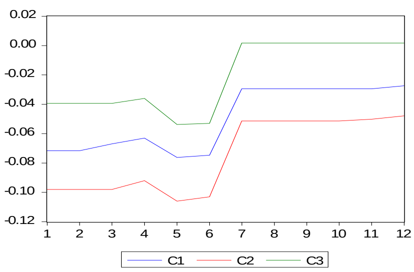

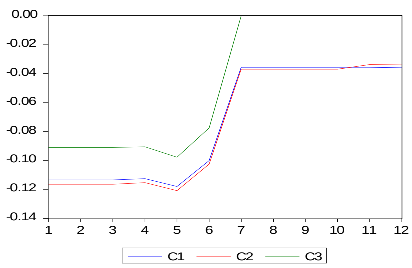

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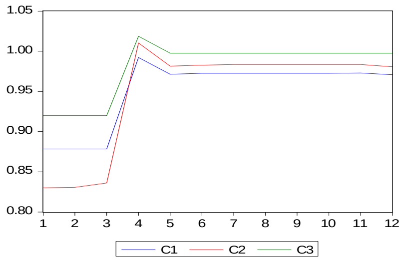

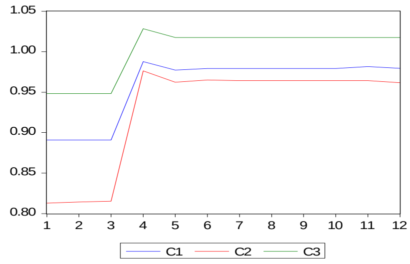

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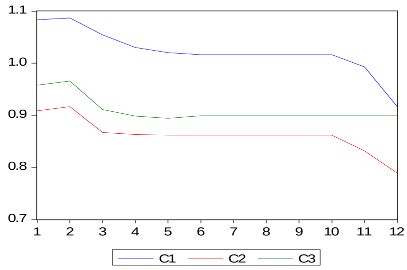

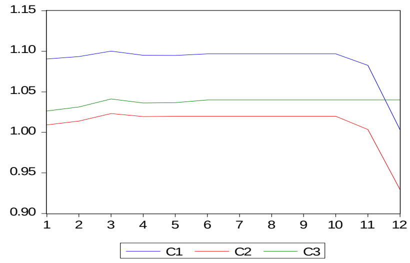

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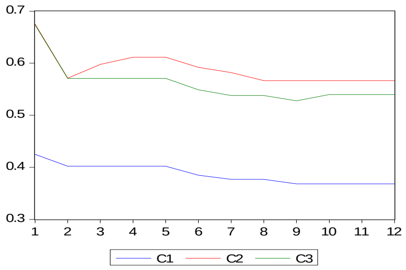

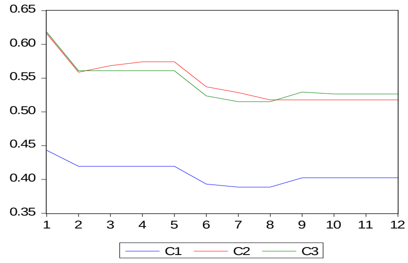

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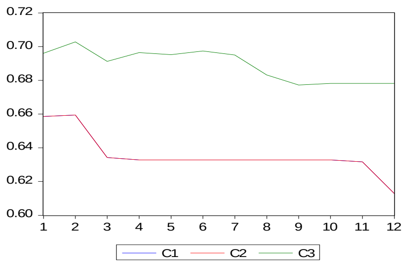

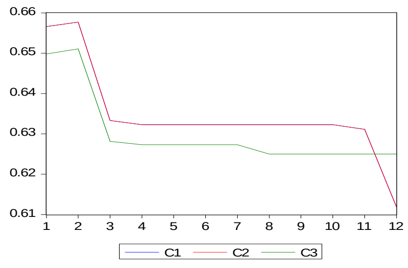

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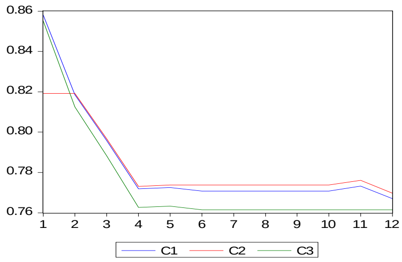

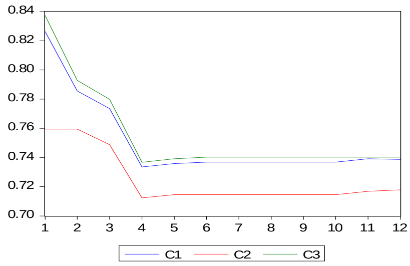

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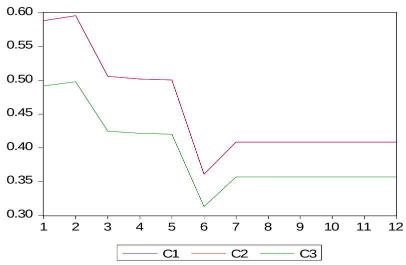

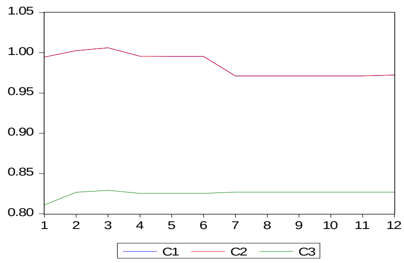

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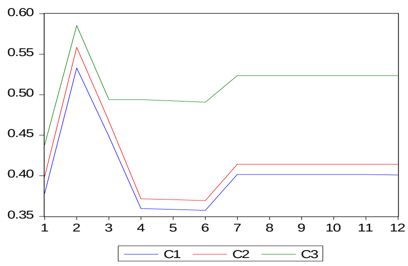

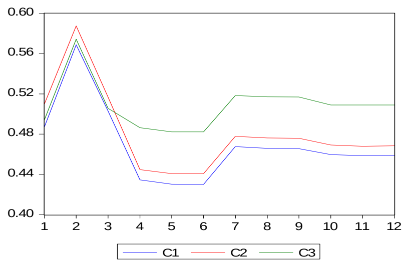

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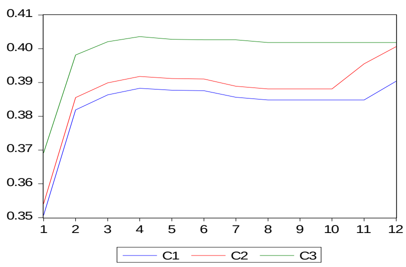

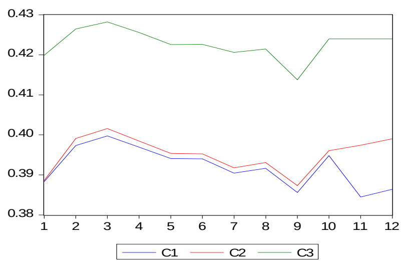

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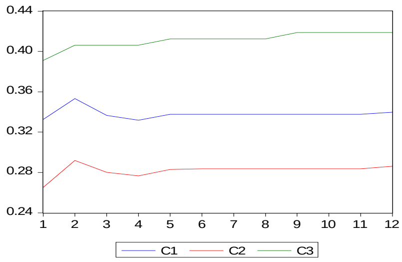

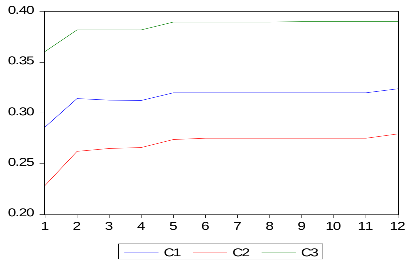

USA