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A provincial view of consumption risk sharing in Korea:Asset classes as shock absorbers[☆]

Victor Pontines[a,b]

[a] The South East Asian Central Banks (SEACEN) Research and Training Centre, Kuala Lumpur, Malaysia
[b] Centre for Applied Macroeconomic Analysis (CAMA), Australian National University (ANU), Canberra, Australia

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ABSTRACT

Using a unique data set on provincial net factor income flows disaggregated across the three asset classes of debt, equity and Foreign Direct Investment reinvested earnings in Korea, we investigated how these asset channels impacted consumption risk sharing during the Global Financial Crisis and the European sovereign debt crisis. Adopting spatial panel methods, this study found in the main that net factor flows of debt, equity and Foreign Direct Investment retained earnings have all contributed favourably to consumption risk sharing during these episodes, with Foreign Direct Investment retained earnings robust in its positive contribution in buffering shocks to consumption. These results suggest that one of the alleged benefits of financial integration in terms of providing the insurance needed to cushion the economy against adverse shocks is tangible and real at least in the context of Korea. We also obtain evidence that apart from asset channels, the combination of the government's social transfer payments and a certain measure of labour mobility help to contribute in mitigating shocks to consumption.

1. Introduction

One of the key purported benefits of financial openness is that it offers residents of countries a larger pool of resources or assets that they can hold and diversify across asset classes. Because these foreign assets (holdings of debt, equities and FDI) are intimately linked to the volatility of output abroad, and thus, are less susceptible to domestic or local output shocks, residents are then provided the opportunity to "smooth out" changes in their consumption resulting from fluctuations in domestic output. We would then expect that greater financial openness offers more diversification opportunities for residents of countries and as such, lead to increased risk sharing.

Recent evidence has shown that greater financial openness leads to increased risk sharing only for developed economies (Artis and Hoffmann, 2008; Kose et al., 2009).[1] As argued by Balli et al. (2013), however, these studies covered the period that relate to an era of financial upturn. For instance, Kose et al. (2009) referred to their sample period of 1987 to 2004 as the modern era of globalization. In that regard, we know little of how risk sharing performs during times of financial downturn or turmoil. One possible indication on how risk sharing can play out during a crisis is the observation that during the Global Financial Crisis and the European sovereign debt crisis, given that many countries were affected by these two crises, imply that the risk was shared, although the degree of risk sharing was imperfect as some countries were stricken more by the crises than others (Mendoza and Quadrini, 2010).

A later study by Balli et al. (2013) provided formal evidence on this issue. They examined how international risk sharing performed during the Global Financial Crisis for a set of advanced economies as well as looked at the relative contribution of the receipts and payments of net factor income flows (debt, equity and FDI reinvested earnings) on consumption risk sharing during this same period. They found that the financial crisis contributed only to a slight drop in consumption risk sharing in the countries comprising the European monetary union (EMU) and OECD countries. They also found that net factor income flows from debt assets delivered better risk sharing than equity in the case of the OECD than in the European monetary union, while FDI supported consumption only in the OECD during the crisis.

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E-mail address: vpontines@seacen.org.

[1] On the other hand, Bai and Zhang (2012) found little evidence of larger risk sharing among developed economies.

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Our paper contends with these same two issues on how consumption risk sharing fared during crises times, particularly, during the Global Financial Crisis and the European sovereign debt crisis, as well as the issue of the relative contribution of these three asset classes (debt, equity and FDI reinvested earnings) on consumption risk sharing during these crises. However, the paper's key contribution is on the examination of these issues from a national risk sharing perspective by utilizing data on provincial and metropolitan cities. Previous studies that investigated both issues from the angle of national risk sharing, especially the second one, is non-existent. Earlier empirical research on national consumption risk sharing has concentrated in general on the degree of consumption risk sharing using much earlier data for US states and Canadian provinces (Asdrubali et al., 1996; Crucini, 1999; Crucini and Hess, 2001; Athanasouli and van Wincoop, 2001).

The lack of publicly available regional data on net factor income flows disaggregated across the three asset classes of debt, equity and FDI reinvested earnings is the most likely reason for this dearth of studies, particularly, on the second issue. For this paper, in addition to publicly available data on regional consumption and GDP, we exploit available annual regional data on net factor income flows disaggregated across the three asset classes in the case of Korea.[2,3] Specifically, the data is available for the entire 16 Korean provinces and metropolitan cities (henceforth provinces). Korea offers as an interesting case. After being one of the East Asian country hardest hit by the 1997 Asian financial crisis, Korea did not reverse course and continue on a path of a gradual and systematic liberalization of capital flows initially announced in 1998 (IMF, 2012). From 2005 to 2007, locally owned Korean banks and the branches of foreign banks in Korea experienced rapid inflows in the form of short-term liabilities. The country was at the sharp end of the financial turmoil after the failure of Lehman Brothers in September 2008 and again during the European sovereign debt crisis when it experienced substantial capital outflows (Bruno and Shin, 2014; BOK, 2010, 2012, 2013, 2014, 2015).

One other innovation that we introduce in this study is that we employ the technique of spatial econometrics to analyse the issues with direct relevance to consumption risk sharing. To the best of our knowledge, while this technique has been applied to various economics and financial issues, this the first time that this method is being applied for the issue of consumption risk sharing.[4] It is becoming a standard nowadays that when dealing with regional or provincial data, a spatial approach needs to be considered. Perhaps, the most important argument for considering a spatial approach is that the independence assumption between observations is no longer valid. Provinces or regions that are located much closer to each other within a nation are more related than distant ones such that externalities or neighbourhood effects need to be considered using spatial variables such as distance. Conventional regression models assume that observations are independent of one another and as such, fail to take account of this dependence between observations. This can lead to estimation results that are biased.

The main findings of this paper are as follows: first, similar to earlier estimates of national consumption risk sharing in other advanced countries, the degree of consumption risk sharing in Korea is also imperfect with estimates that range from 47 per cent to 61 per cent, although relatively lower compared to earlier estimates obtained for US states and Canadian provinces. Second, net factor income flows of debt, equity and FDI retained earnings have all contributed favourably to consumption risk sharing during major episodes of high global economic volatility (i.e., Global Financial Crisis and the eurozone crisis) with FDI retained earnings robustly positive in contributing to consumption risk sharing in Korea during these turbulent periods. Third, we also obtain evidence in one of our robustness checks that closer to the period of the intense volatility in international financial markets, not only the overall degree of consumption risk sharing increased, but the net contributions of the three asset classes to consumption smoothing in Korea likewise increased. Finally, we also obtain evidence that not only asset channels, but also the combination of the government's social transfer payments and a certain measure of labour mobility helped to contribute in mitigating shocks to consumption.

The rest of the paper is organized as follows. The next section briefly provides a review of the related literature. Section 3 discusses the models and the main technique employed in this study. Section 4 discusses the data, presents some stylized facts and the empirical results. Section 5 presents the results of the battery of robustness tests conducted in this paper. The last section concludes.

2. Related literature

The literature on consumption risk sharing is voluminous. Because of this and in the interest of conciseness, our aim in this sub-section is to summarize the findings of studies that have direct relevance to our study. Our study connects two separate strands of literature within the overarching topic of consumption risk sharing. The first strand of literature assesses the degree of risk sharing within a country using state or provincial level data, with studies mostly focused on US states and Canadian provinces. This strand of literature is generally based on regressions of consumption growth and some measure of income growth, and the general finding from this literature is that consumption risk sharing is less than perfect. For instance, in an influential study, Asdrubali et al. (1996) estimated the amount of consumption risk sharing in the US and found that it is far from perfect. Based on the decomposition that they developed which identified distinct channels of risk sharing amongst US states, they found that for the period of 1963–1990, 75 per cent of shocks are shared amongst US states.

Using a revision to the method of Asdrubali et al. (1996), Mélitz and Zumer (1999, 2002) and Asdrubali and Kim (2004) found similar results for US states. The related studies of Crucini (1999) and Crucini and Hess (2001) assumed that the permanent income hypothesis hold and used as their measure of income growth, time series of innovations to permanent income for each region. Both studies found that for the period of 1973 to 1991(Crucini, 1999) and 1971 to 1991 (Crucini and Hess, 2001), the degree of consumption risk sharing tends toward 90 per cent, suggesting quite a high degree of consumption risk sharing.

The second strand of literature are studies that examine the impact of factor income flows on the extent of international consumption risk sharing amongst a group of countries. Sørensen et al. (2007) first documented the effect of foreign asset and liability holdings on consumption risk sharing in the OECD and European monetary union (EMU) over the period 1993–2003. They found that larger holdings of equity and FDI components of foreign assets are associated with more international risk sharing than holdings of debt. With regard to foreign liabilities, only FDI liabilities was found to have a significant role on consumption risk sharing. Demyanyk et al. (2008) employed a similar econometric specification as Sørensen et al. (2007) using data for EMU and EU countries over the period 1996–2006 and found that only the debt holdings of foreign assets have a significant role on consumption risk sharing. Kose et al. (2009) using annual data over the period 1960–2004 for 69 countries comprising a mix of developed, developing and emerging market economies found that only developed countries had attained better risk sharing outcomes during the period of globalization, whereas, developing countries had not benefited.

Employing a similar econometric specification as

[2] In this study, Korea refers to the Republic of Korea.

[3] The available data is basically the individual region's net factor income, that is, receipts by the region from non-residents located abroad less payments made by the same region to non-residents located abroad, with respect to the three respective factor or asset classes.

[4] For instance, the technique has been applied to analyze sovereign risks in emerging markets (Kişla and Önder, 2018), house price dynamics (Cohen et al., 2016), apartment transaction prices during boom and bust (Hyun and Milcheva, 2018), to mention a few.

Sørensen et al. (2007) and using data over the period 1970–2005 for 35 developed and emerging market economies, Bracke and Schmitz (2011) also found the same results as Kose et al. (2009). They further showed, nonetheless, that when a certain measure of net capital gains behaved in a countercyclical way, that is, positive (negative) when the domestic economy is growing more slowly (rapidly) than the rest of the world, there is improved consumption risk sharing. However, this finding also only holds for developed economies. Balli et al. (2012) also considered a certain measure of capital gains using data over the period 1992–2007 for EMU, EU and OECD countries. They found that risk sharing from capital gains is higher than risk sharing from factor income flows for EU and OECD countries, whereas, risk sharing from factor income flows is higher for eurozone countries. Much closer to our work is the study by Balli et al. (2013), using data over the period 1999–2009 for EMU and OECD countries, which found that the Global financial crisis contributed only to a slight drop in consumption risk sharing in the countries of the EMU and OECD. They also found that net receipts from debt assets delivered better consumption risk sharing than equity in the case of the OECD than in the EMU, while FDI supported consumption only in the OECD during the crisis.

3. Methodology

3.1. Consumption risk-sharing and the contribution of net factor income flows

In this sub-section we first layout the basic non-spatial models as the starting point in our eventual incorporation of spatial interaction effects to these models that quantify the impact of net factor income flows on consumption risk sharing. We begin with the basic empirical specification of Sørensen et al. (2007) augmented by two-way fixed effects and is given by:

$$\Delta\log(ids\_C)_{jt} = \beta_U \Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \varepsilon_{it} \tag{1}$$

where $\Delta\log(ids\_C)_{jt} = \Delta\log(C)_{jt} - \Delta\log(C)_t$ and $\Delta\log(ids\_RGDPpc)_{jt} = \Delta\log(RGDPpc)_{jt} - \Delta\log(RGDPpc)_t$. In the present context, in contrast to Sørensen et al. (2007), *j* refers to the entire provinces comprising Korea as opposed to a group of OECD countries considered in the Sørensen et al. (2007) study, while *t* refers to the time-period. In this regard, C_{jt} and $RGDPpc_{jt}$ are province *j*'s year *t* real per capita consumption and real GDP per capita, respectively, and, C_t and $RGDPpc_t$ are the national real per capita consumption and real GDP per capita, respectively, in year *t*. $\Delta\log(ids\_C)_{jt}$ is then the growth of province *j*'s idiosyncratic real per capita consumption (i.e., the difference between the growth of province *j*'s real per capita consumption to the growth in national real per capita consumption), while $\Delta\log(ids\_RGDPpc)_{jt}$ is province *j*'s idiosyncratic real GDP per capita growth (i.e., the difference between the growth of province *j*'s real GDP per capita to the growth in national real GDP per capita). The parameter β_U measures the average comovement of the provinces' idiosyncratic real per capita consumption growth with their idiosyncratic real GDP per capita growth or idiosyncratic local output shocks. Finally, μ_j represents the *j*th province fixed effects, ν_t represents the *t*th year of time-period fixed effects, and ε_{it} is the error term.

The basic argument of the risk-sharing literature is that the fluctuations in the pooled or aggregate real consumption of the entire country (i.e., the group) cannot be smoothed or eliminated by the sharing of risk. Because of this, as can be observed from Eq. (1) above, to measure the amount of risk that is shared amongst the provinces, the fluctuations in the pooled or aggregate component must be removed from the provincial-level fluctuations to isolate the smoothable fluctuations in real per capita consumption (Søorensen and Yosha, 2000). Under perfect risk sharing, the left-hand side of Eq. (1) will be zero implying that β_U will be zero. The smaller the comovement between idiosyncratic real per capita consumption growth and idiosyncratic real GDP per capita growth, the higher the amount of consumption is buffered against domestic output fluctuations, the smaller the estimated value of the parameter, β_U. The metric, $1 - \beta_U$ measures then the level of consumption risk-sharing which can take the value of 1 if risk-sharing is perfect and the value of 0 if idiosyncratic real per capita consumption growth moves one-to-one with idiosyncratic real GDP per capita growth.[5]

From Eq. (1) above, we move next to the basic non-spatial empirical specification of the impact of different asset classes (bonds, equity, FDI) on consumption risk-sharing achieved through net factor income flows. In Balli et al. (2013), they first employed the national income accounts formulation of the net factor income (NFI) expressed as follows:

$$\text{NFT} \approx Net\_Interest\_Flows + Net\_Dividend\_Flows + Net\_Flows\_FDI\_Re\_E \tag{2}$$

where the net flows is the difference between the *receipts* from non-residents located abroad and the *payments* made to non-residents located abroad for that particular factor or asset class. Eq. (2) is simply the decomposition of the NFI into the net flows from the various factor income or asset classes in the form of net interest flows (*Net_Interest_Flows*) (i.e., debt), net dividend flows (*Net_Dividend_Flows*) (i.e., equity), and net flows on FDI reinvested earnings (*Net_Flows_FDI_Re_E*) (i.e., FDI reinvested earnings).[6] From this decomposition of the NFI, Balli et al. (2013) examined the influence of net factor income flows on consumption risk-sharing by extending the earlier empirical specification of Sørensen et al. (2007) given in Eq. (1) above as follows:

$$\Delta\log(ids\_C - FI)_{jt} = \beta_C^{+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \varepsilon_{it} \tag{3}$$

where $\Delta\log(ids\_RGDPpc)_{jt}$, μ_j, ν_t, and ε_{it} are as defined earlier, while *FI* corresponds to the net factor income flows of equity, bond, and FDI reinvested earnings, respectively. More precisely, and for completeness given the net flows from these three asset classes, Eq. (3) can be re-expressed as follows:

$$\Delta\log(ids\_C\_Net\_Dividend\_Flows)_{jt} = \beta_C^{div+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \varepsilon_{it} \tag{3a}$$

$$\Delta\log(ids\_C\_Net\_Interest\_Flows)_{jt} = \beta_C^{int+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \varepsilon_{it} \tag{3b}$$

$$\Delta\log(ids\_C\_Net\_Flows\_FDI\_Re\_E)_{jt} = \beta_C^{FDI+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \varepsilon_{it} \tag{3c}$$

where $\Delta\log(ids\_C\_Net\_Dividend\_Flows)_{jt} = \Delta\log(C - Net\_Dividend\_Flows)_{jt} - \Delta\log(C - Net\_Dividend\_Flows)_t$ is province *j*'s real per capita consumption less real per capita net dividend flows minus the national counterpart. $\Delta\log(ids\_C\_Net\_Interest\_Flows)_{jt} = \Delta\log(C - Net\_Interest\_Flows)_{jt} - \Delta\log(C - Net\_Interest\_Flows)_t$ is province *j*'s real per capita consumption less real per capita net interest flows minus the national counterpart. And, $\Delta\log(ids\_C\_Net\_Flows\_FDI\_Re\_E)_{jt} = \Delta\log(C - Net\_Flows\_FDI\_Re\_E)_{jt} - \Delta\log(C - Net\_Flows\_FDI\_Re\_E)_t$ is province *j*'s real per capita consumption less real per capita net flows of FDI reinvested earnings minus the national counterpart.

[5] The level of consumption risk-sharing, $1 - \beta_U$, can be derived from equation (1) as follows: omitting subscripts for simplicity, let $\hat{c} = \Delta\log(ids\_C)$ and $\hat{y} = \Delta\log(ids\_RGDPpc)$. Equation (1) can then be expressed as $\hat{c} = \beta_U\,\hat{y}$, and noting that $\beta_U = 1 - r$, where r = level of consumption risk sharing. Based on this, equation (1) becomes $\hat{c} = (1 - r)\,\hat{y}$ and solving now for r: $\frac{\hat{c}}{\hat{y}} = 1 - r$, and then $r = 1 - \frac{\hat{c}}{\hat{y}}$. Thus, $r = 1 - \beta_U$.

[6] Balli et al. (2013) also considered separately, the gross receipts and gross payments in each of the three asset classes for a group of OECD countries. In this study, however, we only use the net flows (difference between gross receipts and gross payments) in each of the three asset classes since these are the only available data at the provincial level for Korea.

Because each of the net receipts from the three asset classes are deducted from consumption to form the modified dependant variables in Eqs. (3a) to (3c), which is then regressed with the idiosyncratic real GDP per capita growth (i.e., domestic output shocks), the parameters, β_C^{div+}, β_C^{int+} and β_C^{FDI+} in Eqs. (3a) to (3c), respectively, can each be interpreted as indicating the presence, if any, of a buffering effect of the pertinent net factor income flows on consumption from fluctuations in domestic output. Specifically, according to Balli et al. (2013), a larger estimate in each of the parameters, β_C^{div+}, β_C^{int+} and β_C^{FDI+} relative to the estimate of the parameter β_U in Eq. (1) denote the increase in consumption risk-sharing or the contribution of the pertinent asset class in buffering shocks to consumption.[7] In other words, given the circumstance of shocks to domestic output, the ability of the provinces to smooth out their consumption and render themselves less susceptible to domestic output fluctuations depend on the extent of the range of foreign financial instruments (holdings of debt, equity and FDI) that provinces hold. These holdings provide the extra insurance or the additional investment opportunities to diversify or spread their consumption risk, as these holdings are less correlated with the volatility in domestic output. Thus, the provinces' holdings of foreign financial assets provide the 'external' insulation or adjustment mechanism in mitigating shocks to consumption from fluctuations in domestic output.

3.2. Spatial econometrics interpretation of consumption risk-sharing and the contribution of net factor income flows

The main advantage of working with spatial panels is that one can control for spatial-specific effects. Spatial units of observations such as regions, provinces and cities are likely to differ in their background variables, which can affect real per capita consumption growth (Elhorst, 2017). For instance, the extent of one province to trade financial assets with non-residents from other countries can depend on whether the province is located far away or close to the financial hubs of the nation. In this sub-section, we then present the estimating equations that incorporate spatial interaction effects to our basic empirical models that quantify the impact of net factor income flows on consumption risk sharing. For instance, we can expand Eq. (1) by augmenting it by two spatial terms, a spatial lagged dependant variable ($\sum_{j=1}^{n} W_{ij}(\Delta\log(ids\_C)_{jt})$) and a spatial correlated error term ($\sum_{j=1}^{n} W_{r,j}\varepsilon_{it}$) which can be expressed as follows:

$$\Delta\log(ids\_C)_{jt} = \lambda \times \sum_{j=1}^{n} W_{ij}(\Delta\log(ids\_C)_{jt}) + \beta_U^S \Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \rho \times \sum_{j=1}^{n} W_{r,j}\varepsilon_{it} + \varepsilon_{it} + \varphi_i \tag{4}$$

We can accord to the parameter, β_U^S, a similar interpretation just as we earlier attached to the parameter β_U in Eq. (1).[8] This basically measures the average comovement of the provinces' idiosyncratic real per capita consumption growth with their idiosyncratic real GDP per capita growth and as such, $1 - \beta_U^S$, measures the level of consumption risk sharing amongst the provinces.[9] In the spatial econometrics literature, having both a spatial lagged dependant variable and a spatial correlated error term such as Eq. (4) is referred to as a spatial autoregressive combined (SAC) model. In that regard and in an equivalent manner, we can also expand Eqs. (3a) to (3c) to a SAC model by the appropriate inclusion of spatial lagged dependant variable terms and spatial correlated error terms:

$$\Delta\log(ids\_C\_Net\_Dividend\_Flows)_{jt} = \lambda \times \sum_{j=1}^{n} W_{ij}(\Delta\log(ids\_C\_Net\_Dividend\_Flows)_{jt}) + \beta_C^{Sdiv+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \rho \times \sum_{j=1}^{n} W_{r,j}\varepsilon_{it} + \varepsilon_{it} + \varphi_i \tag{5a}$$

$$\Delta\log(ids\_C\_Net\_Interest\_Flows)_{jt} = \lambda \times \sum_{j=1}^{n} W_{ij}(\Delta\log(ids\_C\_Net\_Interest\_Flows)_{jt}) + \beta_C^{Sint+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \rho \times \sum_{j=1}^{n} W_{r,j}\varepsilon_{it} + \varepsilon_{it} + \varphi_i \tag{5b}$$

$$\Delta\log(ids\_C\_Net\_Flows\_FDI\_Re\_E)_{jt} = \lambda \times \sum_{j=1}^{n} W_{ij}(\Delta\log(ids\_C\_Net\_Flows\_FDI\_Re\_E)_{jt}) + \beta_C^{SFDI+}\Delta\log(ids\_RGDPpc)_{jt} + \mu_j + \nu_t + \rho \times \sum_{j=1}^{n} W_{r,j}\varepsilon_{it} + \varepsilon_{it} + \varphi_i \tag{5c}$$

where W_{ij} is the row-normalized spatial weights matrix that contains the inverse distances (in kilometres) between the capitals or central districts of each pair of provinces in Korea. This allows us to distinguish between neighbouring and distant provinces by decreasing the relative weights of the farther ones. The idea is that spatial dependence is expected to diminish with increasing distance.[10] Nonetheless, because an important consideration in spatial econometrics is how to specify the spatial weighting matrix (LeSage and Fischer, 2008), in the robustness checks of our estimation results, we will consider different alternative matrices as spatial weights. Also, in Eqs. (5a) to (5c), φ_i is a fixed error term which does not vary over time, while the rest of the variables are as defined earlier.

The parameters β_C^{Sdiv+}, β_C^{Sint+} and β_C^{SFDI+} in Eqs. (5a) to (5c) can also be accorded similar interpretations just as we previously done with the parameters, β_C^{div+}, β_C^{int+} and β_C^{FDI+} in Eqs. (3a) to (3c). These parameters indicate the presence, if any, of a buffering effect of net factor income flows on consumption growth from fluctuations in idiosyncratic real GDP per capita growth. A larger estimate of these parameters relative to the estimate of the parameter β_U^S (Eq. (4)) indicate an increase in consumption risk-sharing or that the net flows from the pertinent asset class contribute in buffering shocks to consumption.[11] Also from Eqs. (5a) to (5c) above, λ is the coefficient of the spatial lagged dependant variable which is the measure of association amongst the spatial units, while, ρ denotes the coefficient of the spatial correlated error term which indicates the spatial association amongst the regression residuals. Finally, nested in a SAC model are two alternative specifications of spatial models. Specifically, if $\lambda = 0$ and $\rho \neq 0$, Eqs. (4) and (5a) to (5c) are represented by a spatial error model (SEM). If, on the other hand, $\lambda \neq 0$ and $\rho = 0$, a spatial lagged dependant model (SLM)

[7] The increase in consumption risk-sharing as denoted by the respective parameters β_C^{div+}, β_C^{int+} and β_C^{FDI+} can be shown as follows: again, omitting subscripts for simplicity, let $\hat{c} - \hat{f} = \Delta\log(ids\_C - FI)$. Equation (3), for instance, can then simply be expressed as $\hat{c} - \hat{f} = \beta_C^+\hat{y}$, and recalling that β_C^+ refers to any of the three parameters β_C^{div+}, β_C^{int+} and β_C^{FDI+} and noting that $\beta_C^+ = 1 - r'$. So that, equation (3) can also be alternatively expressed as $\frac{\hat{c} - \hat{f}}{\hat{y}} = 1 - r'$. From footnote 5, we had $\frac{\hat{c}}{\hat{y}}$ such that $\frac{\hat{c} - \hat{f}}{\hat{y}} - \frac{\hat{c}}{\hat{y}}$ is equal to $\beta_C^+ - \beta_U$. It also follows from $\frac{\hat{c} - \hat{f}}{\hat{y}} - \frac{\hat{c}}{\hat{y}}$ that $\frac{\hat{f}}{\hat{y}} = r' - r$. The term $r' - r$ is the change in consumption risk-sharing which will be positive if r' is larger than r. One can then see that this condition holds as long as the parameter β_C^+ in equation (3) is larger compared to β_U in equation (1). In other words, the pertinent asset class or factor income contributes positively or there is an increase in consumption risk-sharing when the parameters β_C^{div+}, β_C^{int+} and β_C^{FDI+} in equations (3a) to (3c), respectively, are larger relative to the parameter β_U .

[8] To distinguish our spatial parameters to the non-spatial ones, we include the capital letter S as superscript when referring to the spatial parameters.

[9] Refer to footnote 5 for the simple mathematical derivation.

[10] This follows from Tobler's first law of geography that, "everything is related to everything else, but near things are more related than distant things."

[11] Refer to footnote 7 for the simple mathematical explanation. Also refer towards the end of the discussion in sub-section 3.1 for the intuitive explanation of the interpretation of these parameters.

represents Eqs. (4) and (5a) to (5c). Thus, the SAC models presented above assume that $\lambda \neq 0$ and $\rho \neq 0$.

4. Empirical results

4.1. Data

We use a dataset consisting of a panel of 16 provinces and metropolitan cities for Korea for which annual data are available for the variables that we utilized in this study. Our period of study is from 2008 to 2015, which surround the years of the Global Financial Crisis and the European sovereign debt crisis. All of the variables were measured in real per capita terms and were constructed by dividing real values by the population series. The variables utilized in this study such as real GDP (in 2010 prices), real final consumption (also in 2010 prices and defined as the sum of household consumption and government consumption), GDP deflators, net factor income flows (i.e., net dividend flows, net interest flows and net flows of FDI retained earnings)[12] and population were obtained from the Korea Statistical Information Service (http://kosis.kr/eng/). The net factor income flows were first converted to real terms using the available GDP deflators and subsequent real per capita figures were obtained by dividing the real net factor income flows by the population. For our period of study, national and provincial population data are available for the years 2005, 2010 and 2015.

4.2. Some stylized facts

A cursory examination of Korea's real GDP growth performance from 2008 to 2015 indicate that the country was affected in ways by the global economic volatility that ensued during the Global Financial Crisis (GFC) and the subsequent eurozone crisis. Based on Fig. 1, there was a V-shaped movement in Korea's real GDP growth between 2008 and 2010 in which there was a clearly defined trough in 2009 followed by a strong recovery in 2010. However, real GDP growth in Korea definitely slowed after that until the end of the period of our observation.

The actual experience at the national level was also felt to varying extent at the provincial level. Ten (i.e., Busan, Chungcheongnam-do, Daegu, Gangwon-do, Gyeonggi-do, Gyeongsangbuk-do, Incheon, Jeollabuk-do, Jeollanam-do and Ulsan) of the sixteen provinces experienced an almost identical trajectory in real GDP growth from 2008 to 2015. Five (i.e., Busan, Daegu, Gyeongsangbuk-do, Incheon and Ulsan) of these ten provinces also underwent negative real GDP growth in 2009, while three of the ten provinces experienced negative real GDP growth in other years (i.e., Ulsan in 2008, Jeollabuk-do in 2012 and Jeollanam-do in 2013). Meanwhile, the other provinces definitely experienced a slowdown in real GDP growth between 2011 to the end of the period of our observation (see the set of figures in Appendix Fig. 1 in the supplementary Appendix in support of the discussions made on this part) .[13]

A visual evidence on the likely contribution of the three asset classes to consumption risk sharing can be observed from Fig. 2. We would tend to think that if holding different types of foreign assets can smooth domestic consumption from the vagaries of fluctuations in domestic output, at each point in time, the correlation between the growth in idiosyncratic real per capita GDP ($\Delta\log(ids\_RGDPpc)_{jt}$) and domestic consumption ($\Delta\log(ids\_C)_{jt}$) should not be of the same magnitude, and, ideally, of opposite sign compared to the correlation between the growth in idiosyncratic real per capita GDP ($\Delta\log(ids\_RGDPpc)_{jt}$) and domestic consumption *less* the income from the three asset classes ($\Delta\log(ids\_C - FI)_{jt}$ with *FI* corresponding to the net flows of equity, bond, and FDI reinvested earnings, respectively). If such is the case, this means that holding foreign assets are less susceptible to local output shocks, allowing domestic residents to smooth out their consumption.

In this regard, we can then observe from Fig. 2 that it was only in 2015 that the correlation between $\Delta\log(ids\_RGDPpc)_{jt}$ and $\Delta\log(ids\_C)_{jt}$ is almost identical to the correlation between $\Delta\log(ids\_RGDPpc)_{jt}$ and $\Delta\log(ids\_C - FI)_{jt}$), whereas in other years the correlations have substantially diverged, especially so in 2011 in which the correlation was of opposite signs.[14] This importantly suggests, judged on the basis of a visual examination of correlations, that holding different types of foreign assets afford diversification opportunities in terms of mitigating shocks to domestic consumption from domestic output volatility.

We also provide in Figs. 3.A to 3.C a visual examination for three separate years, 2008, 2011 and 2015 of the distribution in the share of provincial consumption to national consumption (located at the upper left-hand corner of each figure) as well as the share in the respective provincial factor income inflows and outflows to national factor income inflows and outflows (located at the upper right-hand to the lower right-hand corners of each figure).

We can clearly observe from these set of figures that there are two areas that consistently dominate the rest of the provinces in terms of these key variables in our empirical analysis. This will be Korea's capital, Seoul and its neighbouring area of Gyeonggi-do.[15] It will then be interesting to see later in our empirical analysis whether the dominance of these two areas in these variables will have a significant impact on our various risk-sharing estimates.[16]

4.3. Consumption smoothing and the buffering effects of various net factor income flows

<u>A. Baseline case</u>

Table 1 shows our baseline results using fixed effects estimation. The fixed effect is more suitable for our study because in a random-effect, apart from its strong assumption that there is no correlation between our explanatory variable and the cross-sectional fixed effect, it is only appropriate when the samples are randomly drawn from the population. However, in view that we are examining all provinces in Korea, the fixed-effect is more suitable for our purpose.

Table 1 has four columns, with column (1) reporting the estimation results of the non-spatial fixed-effect model corresponding to Eq. (1), while the estimation results corresponding to Eqs. (3a), 3b) and (3c) are shown in columns ((2) to (4) in that particular order. The first observation we can make is that about 52 per cent (column 1) of idiosyncratic consumption growth remains unsmoothed such that there is an almost equivalent level of consumption risk sharing that takes place up to around 48 per cent. Although this level of risk sharing is imperfect, these estimates are strongly statistically significant. The contribution to consumption risk-sharing of the net flows from the three asset classes, i.e., equity (column (2)), bonds (column (3)) and FDI retained earnings (column (4)) can be examined by comparing the reported results in these three columns to column (1). Our baseline results

[12] Available data is only in net flows, which is basically the difference between the receipts from non-residents located abroad to payments made to non-residents located abroad for that particular factor or asset class.

[13] These figures are not included in the main text for brevity and to save space.

[14] It is then helpful that in our formal empirical estimations, one of our robustness tests excludes observations for the year 2015 to check the sensitivity of our main results.

[15] Another of Seoul's neighbouring area, Incheon, we do not observe this province to have stood out relative to the other provinces with respect to these set of variables. To save space, we placed in Appendix Figures 2.A to 2.E of the supplementary Appendix the figures for the other years, i.e., 2009, 2010, 2012, 2013 and 2014 and these figures provide similar story in terms of the concentration in the two areas of Seoul and Gyeonggi-do for these same set of variables.

[16] We do this in one of our robustness tests by excluding Seoul and Gyeonggi-do from the spatial panel estimations.

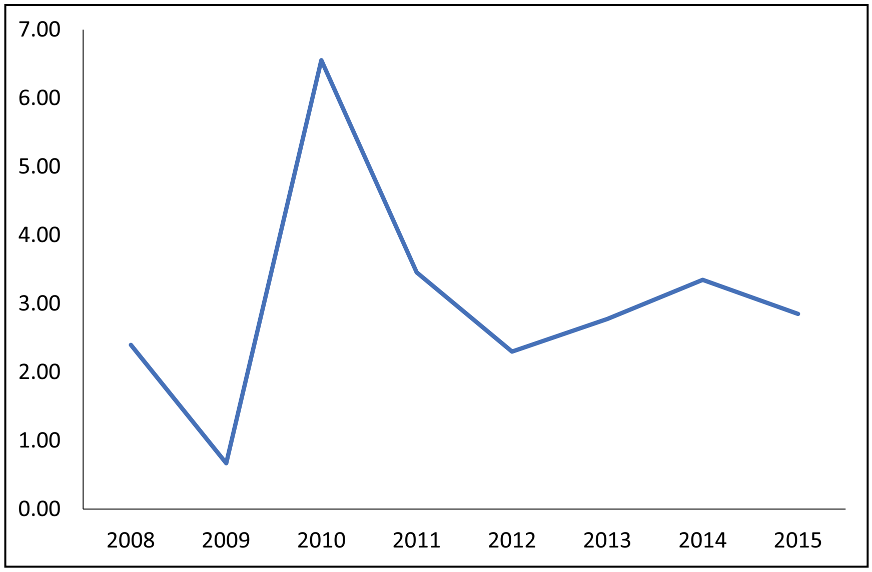

Fig. 1. Real GDP Growth of Korea, 2008–2015 (In %).

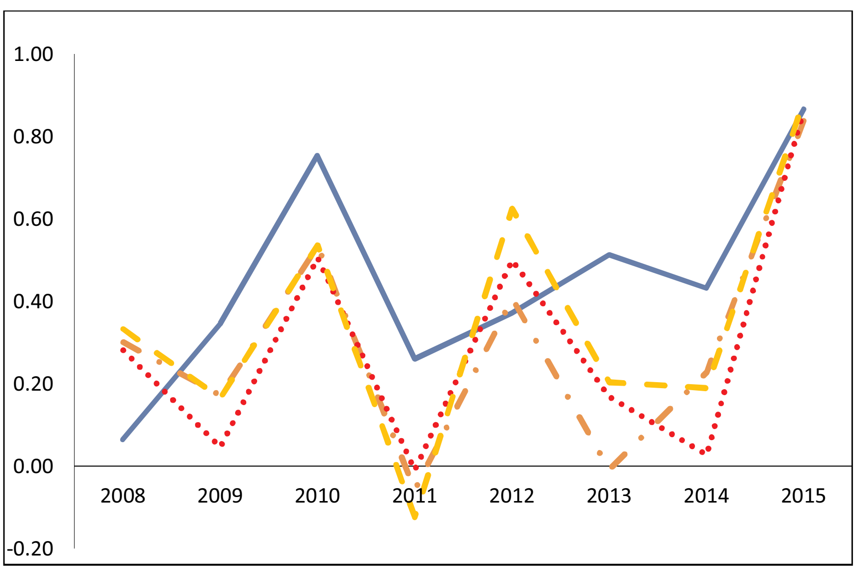

Fig. 2. Correlations and the Contribution of net factor income flows to consumption risk sharing, 2008–2015
Notes: Solid line – correlation between Δlog(ids_C) and Δlog(ids_RGDPpc)
Dot and Dash line – correlation between Δlog(ids_C_Net_Dividend_Flows) and Δlog(ids_RGDPpc)
Dot line – correlation between Δlog(ids_C_Net_Interest_Flows) and Δlog(ids_RGDPpc)
Dash line – correlation between Δlog(ids_C_Net_Flows_FDI_*Re*_E) and Δlog(ids_RGDPpc).

suggest that because our estimate of the parameters, β_C^{div+} (56 per cent), β_C^{int+}(61 per cent) and β_C^{FDI+}(63 per cent) were all higher relative to our estimate of β_U (52 per cent), all three asset classes contributed favourably to buffering shocks to consumption with FDI retained earnings contributing the most (at 11 percent = 63 per cent − 52 per cent) followed by debt (at 9 percent) and then by equity (4 percent). These estimates are again strongly statistically significant.

B. Main results

If there is spatial dependence within our panel data, however, the estimated coefficients from our baseline panel fixed effects are biased upwards (Elhorst, 2017). To test for the presence of spatial dependence, we follow Anselin et al. (2008) and conduct the Lagrange Multiplier (LM) tests for a spatial lagged dependant variable (i.e., LM spatial lag) and a spatial correlated error term (i.e., LM spatial error). The LM test is based on the residuals of an OLS regression. If the non-spatial model is rejected in favour of the spatial lag dependant variable model, the spatial correlated error model, or in favour of both models, then models which incorporates such spatial interaction effects are appropriate to use.

Table 2 presents the classic LM tests results and their robust counterparts for the different model specifications. The table contains four panels: Panels A, B, C and D present the LM test results for Δ log $(ids\_C)_{jt}$, Δ log$(ids_C_Net_Dividend_Flows)_{jt}$, Δ log$(ids_C_Net_Interest_Flows)_{jt}$, and Δ log$(ids_C_Net_Flows_FDI_Re_E)_{jt}$ equations, respectively. According to these LM tests, the hypothesis of no spatial lag dependant variable and the hypothesis of no spatial correlated error term were not rejected for all equations with province fixed effects as well as both hypotheses not rejected for all equations with time-period fixed effects. However, both hypotheses were rejected (either at the 7 per cent or 5 per cent significance level) for all equations with province and time-period fixed effects using the classic LM tests (except for the Δ log $(ids\_C\_Net\_Interest\_Flows)_{jt}$ which also rejects the hypothesis of no spatial lag dependant variable using the robust LM test). Overall, these results suggest that a spatial model with two-way fixed effects (province and time-period fixed effects) rather than a non-spatial model is the appropriate specification to use.

Table 3 reports our main results of our spatial two-way fixed-effect models corresponding to Eqs. (4) and 5a) to (5c). Specifically, column ((1) corresponds to the estimation of Eq. (4), while columns (2), (3) and (4) correspond to the estimation of Eqs. (5a), 5b) and (5c), respectively. Each column of this table contains three panels of estimation results:

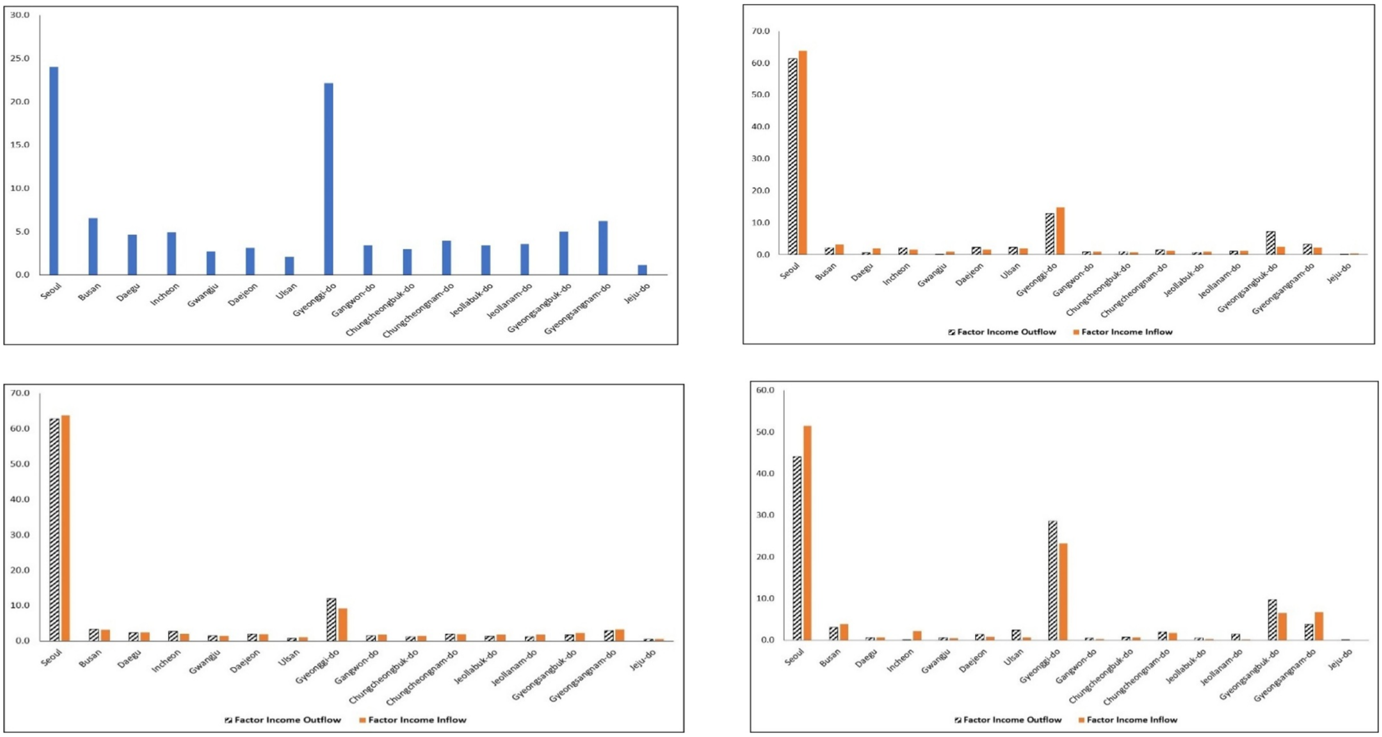

Fig. 3. A. Distribution of Provincial Consumption and Factor Income Outflows and Inflows in 2008 (In %)
Notes: (i) Upper-left hand corner chart shows the share of the level of provincial final consumption to national final consumption; (ii) Upper-right hand corner chart shows the share of the level of provincial dividends outflows and dividends inflows to national outflows and inflows, respectively; (iii) Lower-left hand corner chart shows the share of the level of provincial interest outflows and interest inflows to national outflows and inflows, respectively; (iv) Lower-left hand corner chart shows the share of the level of provincial FDI earnings outflows and FDI earnings inflows to national outflows and inflows; (v) Absolute values of the level of inflows and outflows were taken.

the top panel (labelled (i) SAC) reports the fixed-effect estimation results from the SAC model, and the middle (labelled (ii) SLM) and bottom panels (labelled (iii) SEM) report the fixed-effect estimation results from the SLM and SEM models, respectively. We begin our analysis with the results reported in column ((1) of Table 3. We find that in the SAC model about 52 per cent of idiosyncratic consumption growth remains unsmoothed such that there is an almost equivalent level of consumption risk sharing that takes place of around 48 per cent. In addition to an imperfect risk sharing albeit with strong statistical significance, these estimates are identical to our earlier baseline estimates reported in Table 1. The two spatial coefficients, ρ and λ, however, are statistically insignificant. Similar observations can also be made regarding the estimates of these two spatial coefficients from the other SAC models reported in the rest of the columns in Table 3.

Recall that the SAC model nests two alternative spatial panel models, i.e., the SLM model (which restricts ρ equal to zero) and the SEM model (which restricts λ equal to zero). The results reported in column (1) of Table 3 for these two alternative spatial panel models reveal that the level of unsmoothed shocks to idiosyncratic consumption growth according to the SEM model is also at around 52 per cent, whereas according to the SLM model, it is slightly lower at around 49.5 per cent (consumption risk sharing is then at about 50.5 per cent). Both these estimates of consumption risk sharing are relatively lower compared to estimates obtained for US states and Canadian provinces using much earlier data. In the case of US states, for instance, the estimates ranged from 75 per cent (Asdrubali et al., 1996) to 94 per cent (Crucini, 1999), whereas for Canadian provinces, it is between 88 per cent to 90 per cent (Crucini, 1999; Crucini and Hess, 2001). Furthermore, in contrast to the estimates of the two spatial coefficients in the SAC model, their respective estimates in the SLM and SEM models were found to be significant. In view of these results, our preference from this point is to focus our analysis on the estimated results obtained from our SLM and SEM models, including those of the reported robustness tests.

Next, we turn our attention to the next important question in this study of how our net flows from the three asset classes contributed in buffering shocks to consumption. Our answer to this question is provided in the remainder of the columns (columns (2) to (4)) in Table 3. The first notable observation we can gather from these set of estimation results is that all the respective estimates of λ and ρ in the SLM and SEM models were found to be statistically significant. The second notable observation is that net flows from the three asset classes contributed positively to consumption risk sharing. Again, recall that in order to support this finding, our estimate of the parameters β_C^{Sdiv+}, β_C^{Sint+} and β_C^{SFDI+} should be larger than our estimate of the parameter β_U^S. Indeed, our respective estimates of these parameters confirm this finding. Compared to our estimates of β_U^S which are 49.5 per cent in SLM and 52 per cent in SEM (column 1), the estimates of β_C^{Sdiv+} are reported in column (2) at 51.5 percent in SLM and 53 per cent in SEM, β_C^{Sint+}at 54 per cent in SLM and 55 per cent in SEM (column (3)), and the estimates of β_C^{SFDI+}reported in column (4) at 57 per cent in SLM and 59 per cent in SEM. Based on these reported estimates, our next notable finding is that similar to our results in the baseline, in the non-spatial case (again refer to Table 1), FDI retained earnings contributed the most (7.5 per cent in SLM and 7 per cent in SEM), followed by debt (4.5 per cent in SLM and 3 per cent in SEM) and then by equity (2 percent in SLM and 1 per cent in SEM). In contrast to our baseline estimates, however, the contribution of these three asset classes in buffering shocks to consumption are relatively smaller. This is because our estimates of the spatial parameters β_C^{Sdiv+}, β_C^{Sint+} and β_C^{SFDI+} are relatively smaller compared to the estimates of the parameters β_C^{div+}, β_C^{int+} and β_C^{FDI+} in the non-spatial, baseline case. We can then argue that this latter outcome arises because of the upward bias inherent in our estimates of these coefficients in the baseline case.

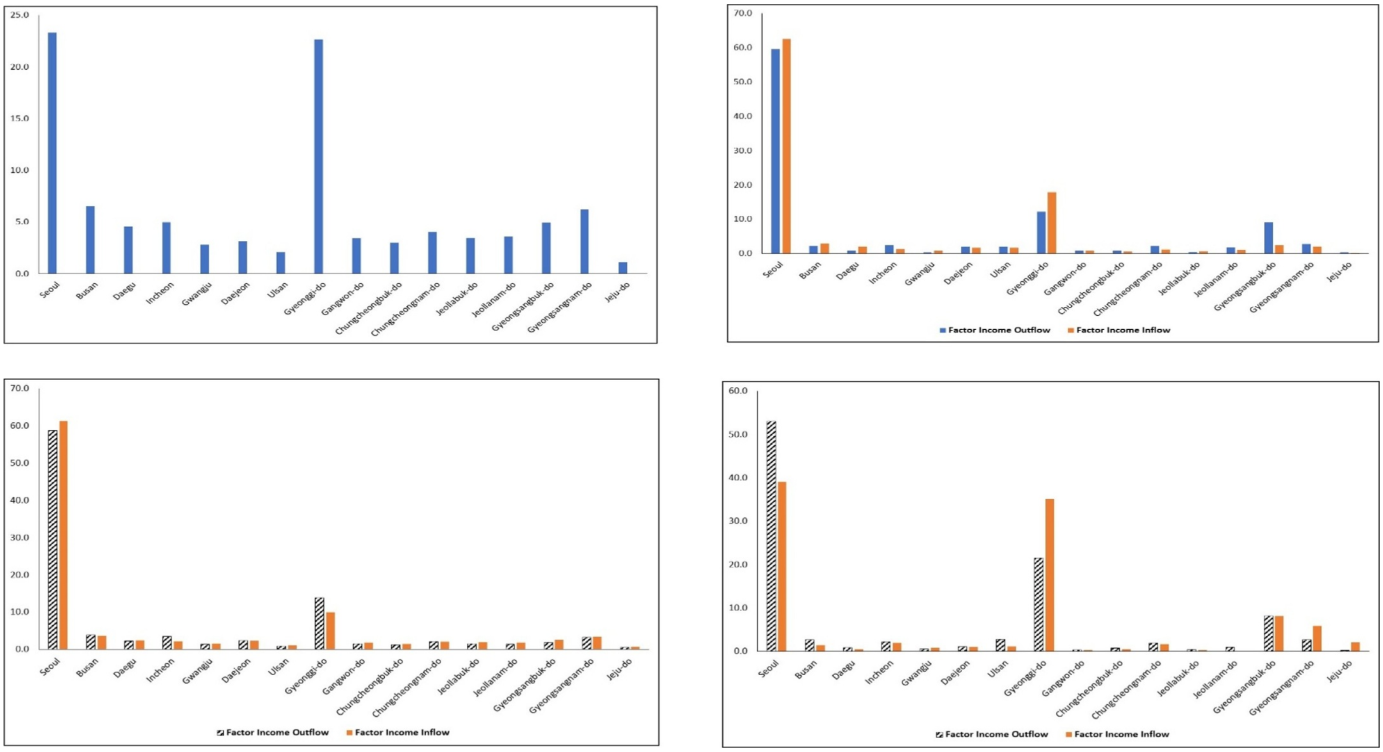

Fig. 3. B. Distribution of Provincial Consumption and Factor Income Outflows and Inflows in 2011 (In %)

Notes: (i) Upper-left hand corner chart shows the share of the level of provincial final consumption to national final consumption; (ii) Upper-right hand corner chart shows the share of the level of provincial dividends outflows and dividends inflows to national outflows and inflows, respectively; (iii) Lower-left hand corner chart shows the share of the level of provincial interest outflows and interest inflows to national outflows and inflows, respectively; (iv) Lower-left hand corner chart shows the share of the level of provincial FDI earnings outflows and FDI earnings inflows to national outflows and inflows; (v) Absolute values of the level of inflows and outflows were taken.

5. Robustness checks and extensions

This section examines the robustness of our main results along various dimensions: using different alternative distance matrices as spatial weights (i.e., the inverse squared distances, the two ($k = 2$) and three nearest neighbours ($k = 3$) of the respective provinces,[17] the inverse distance with cut-offs (250 kms. and 350 kms.)), consider different periods to account for the crises years, i.e., 2008–2012 and 2008–2011, examine how the dominance of a few provinces drive the main results, account for the importance of the government income redistribution policy as well as consider the effect of labour mobility in buffering shocks to consumption. We can consider the last two dimensions as extensions to our main results.[18]

5.1. Different spatial weights

5.1.1. Inverse squared distance as spatial weights

In this sub-section, we will examine the sensitivity of our main findings by considering this time, the inverse squared distances (assumes that neighbouring relations are nonlinear and decline quicker the farther the distance) between the capitals or central districts of each pair of provinces in Korea as an alternative spatial weight in the estimation of our spatial models corresponding to Eqs. (4) and (5a) to (5c). Table 4 presents the estimation results. We observe in the main that the consumption risk sharing that takes place is about 50 per cent and 49 per cent in the SLM and SEM models, respectively. These estimates are quite close to the level of risk sharing that we found in the main results and these estimates are strongly statistically significant.

How about the contribution of the three asset classes in buffering shocks to consumption? Again, FDI retained earnings contributed the most (10 per cent in SLM and 10 per cent in SEM), followed by debt (7 per cent in SLM and 7 per cent in SEM) and then by equity (4 per cent in SLM and 4 per cent in SEM). These reported estimates in Table 4 are also quite close to the net contributions of the three asset classes to risk sharing found in the main results. Furthermore, we can again observe that these same reported contributions of the three asset classes in buffering shocks to consumption are relatively smaller compared to the baseline results (except for equity for which the net contribution is identical at 4 per cent in the main and baseline cases). This again points to the upward bias in the estimates of the coefficients in the baseline case.

5.1.2. Nearest neighbours as spatial weights matrices

The next alternative spatial weights matrix that we consider in the estimation of our spatial models and test the robustness of our main results is to use the two and three closest neighbours of each of the provinces. The idea is that after obtaining the distances between the capitals or central districts of each pair of provinces in Korea, we rank them and then consider as neighbours the two or three closest ones to a particular province. Table 5 presents the results for the spatial weights matrix constructed using the two closest neighbours, while Table 6 is for the spatial weights matrix constructed using the three closest neighbours. We find the results of this sensitivity test to be qualitatively identical with the main results. First, the consumption risk sharing that takes place (about 49 per cent in the SLM model and around 47 per cent in the SEM model in both tables) is almost of the same magnitude and statistical significance as the level of risk sharing obtained in the main

[17] k is usually denoted in the spatial econometrics literature as the number of nearest neighbours.

[18] For these three latter robustness checks, I thank two anonymous referees for making these suggestions.

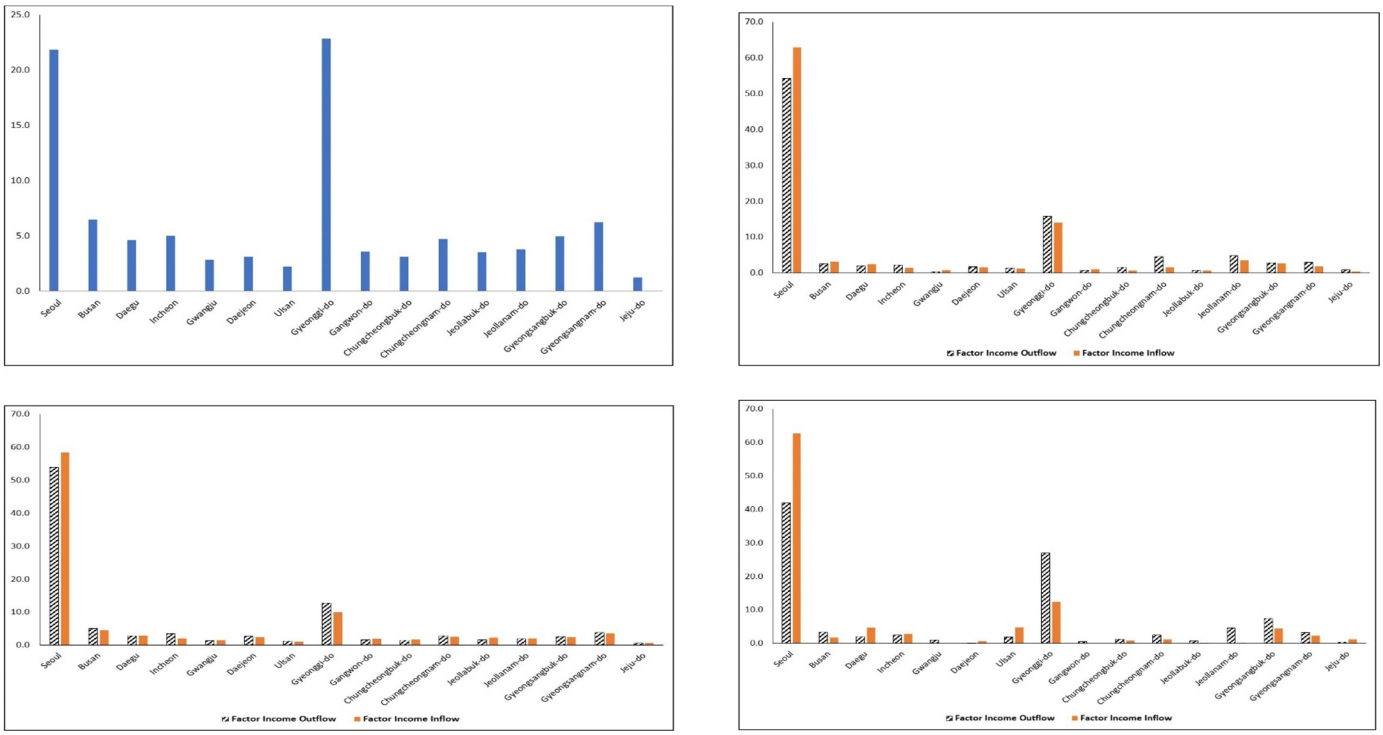

Fig. 3. C. Distribution of Provincial Consumption and Factor Income Outflows and Inflows in 2015 (In %)
Notes: (i) Upper-left hand corner chart shows the share of the level of provincial final consumption to national final consumption; (ii) Upper-right hand corner chart shows the share of the level of provincial dividends outflows and dividends inflows to national outflows and inflows, respectively; (iii) Lower-left hand corner chart shows the share of the level of provincial interest outflows and interest inflows to national outflows and inflows, respectively; (iv) Lower-left hand corner chart shows the share of the level of provincial FDI earnings outflows and FDI earnings inflows to national outflows and inflows; (v) Absolute values of the level of inflows and outflows were taken.

Table 1
Consumption smoothing and the buffering effects of various net factor income flows Baseline results: non-spatial models.

	(1) $\Delta\log(ids\_C)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
$\Delta\log(ids\_RGDPpc)_{jt}$	0.522***	0.562***	0.614***	0.633***
	(0.066)	(0.141)	(0.142)	(0.128)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

results.

Second, FDI retained earnings again contributed the most (7 per cent (SLM and SEM)) in Table 5 and 8 per cent (SLM and SEM) in Table 6) in terms of the contribution of the three asset classes in buffering shocks to consumption. Next is also debt (5 per cent (SLM and SEM)) in both Tables 5 and 6) and followed by equity (1.5 per cent in SLM and 2 per cent in SEM) in Table 5, while none (SLM and SEM) in Table 6). Third, with the exception of the net contribution of equity in the SLM and SEM models in Table 6, these reported estimates are just about of the same level of contributions to risk-sharing that we found for these three asset classes in the main results. Likewise, compared to the baseline case, these same reported estimates of the asset classes' contributions in buffering shocks to consumption are smaller relative to the former, which again reinforces the observation of the upward bias inherent in our baseline results.

5.1.3. Inverse distance with cut-offs as spatial weights matrix

The last alternative spatial weights matrix that we will consider to check the sensitivity of our main results is to use the inverse distance with cut-offs of 250 kms. and 350 kms., respectively. The idea is that we only compute the inverse distances between the capitals or central districts of a particular pair of provinces if the distance between them is less than the maximum distance of 250 kms. and 350 kms., respectively, whereas it is accorded a weight of zero if the distance is farther than these cut-offs. Table 7 presents the results for the spatial weights matrix constructed using the inverse distance with cut-off of 250 kms., while Table 8 presents the results with cut-off of 350 kms.

The results presented in these two tables suggest that again, our main results hold, i.e., one, the consumption risk sharing that takes place is almost of the same magnitude and statistical significance in the main results and two, FDI retained earnings contributed the most, followed by debt, and last is equity in terms of the contributions of these asset classes to risk-sharing. Three, the level of contributions to risk-sharing by these three asset classes are comparable to those found in the main results. Finally, also similar to the main results, when compared to the baseline case, the estimates of the contributions of the asset classes in buffering shocks to consumption are relatively smaller, which we again interpret as revealing the upward bias in our baseline results.

Table 2
LM test results for choosing between spatial and non-spatial models.

Panel A. dependant variable: $\Delta\log(ids\_C)_{jt}$	Province fixed effect	Time-Period fixed effect	Province and Time-Period fixed effect
LM spatial lag	0.151	1.482	4.027
	[0.698]	[0.223]	[0.045]
LM spatial error	0.665	1.559	4.386
	[0.415]	[0.212]	[0.036]
Robust LM spatial	0.570	0.010	0.009
lag	[0.450]	[0.920]	[0.924]
Robust LM spatial	1.085	0.087	0.368
error	[0.298]	[0.768]	[0.544]
Panel B. dependant variable: $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	**Province fixed effect**	**Time-Period fixed effect**	**Province and Time-Period fixed effect**
LM spatial lag	0.872	3.297	4.144
	[0.350]	[0.069]	[0.042]
LM spatial error	0.708	2.646	3.458
	[0.400]	[0.104]	[0.063]
Robust LM spatial	0.230	1.392	1.375
lag	[0.631]	[0.238]	[0.241]
Robust LM spatial	0.066	0.741	0.688
error	[0.797]	[0.390]	[0.407]
Panel C. dependant variable: $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	**Province fixed effect**	**Time-Period fixed effect**	**Province and Time-Period fixed effect**
LM spatial lag	1.481	3.859	5.618
	[0.224]	[0.049]	[0.018]
LM spatial error	0.837	2.707	4.122
	[0.360]	[0.100]	[0.042]
Robust LM spatial	1.658	3.455	3.984
lag	[0.198]	[0.063]	[0.046]
Robust LM spatial	1.014	2.303	2.487
error	[0.314]	[0.129]	[0.115]
Panel D. dependant variable: $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$	**Province fixed effect**	**Time-Period fixed effect**	**Province and Time-Period fixed effect**
LM spatial lag	1.511	4.287	5.516
	[0.219]	[0.038]	[0.019]
LM spatial error	1.330	3.095	4.197
	[0.249]	[0.079]	[0.041]
Robust LM spatial	0.184	2.673	2.620
lag	[0.668]	[0.102]	[0.106]
Robust LM spatial	0.003	1.480	1.301
error	[0.954]	[0.224]	[0.254]

Notes: (a) Numbers in square brackets are probability values. (b) For the definition of the variable refer to the main text.

Taken together, these results using different alternative distance matrices as spatial weights lend further credence to the main results of this paper.

5.2. Different time periods

Until this point, all of our reported estimation results are for the period of 2008 to 2015, which surround the years of the Global Financial Crisis and the European sovereign debt crisis. Specifically, the collapse of Lehman Brothers in September 2008 explains the choice of 2008 as the start of the sample period, while the reason for ending the sample period in 2015 has to do with the fact that the quantitative easing program in the eurozone started then. However, pinpointing exactly as to when the eurozone crisis ended can still be debatable. In this sub-section, we estimate our spatial panel models for two different periods. One is for a shorter sample period of 2008 to 2012, the other for an even shorter period of 2008 to 2011. In the former, 2012 was also the year that ECB President Mario Draghi made the quite famous remark, “whatever it takes” to dramatically account for the dire situation that the eurozone was facing at that time.[19] With regard to the latter even shorter period, as the Greek financial crisis was unfolding, 2011 was the year that European leaders for the first time publicly declared that Greece's departure from the eurozone was a possibility.[20] It was also in this year that Portugal requested for a bailout, which was quickly approved by the EU.[21]

Table 9 presents the results for the period of 2008 to 2012, while Table 10 presents the estimation results for the 2008 to 2011 period. In both of these relatively shorter sample periods, we find the following :[22]

[19] The remark was made by Mario Draghi in a speech in London on July 26, 2012.

[20] The public declaration was made in a G20 summit held in Cannes, France on November 3, 2011.

[21] Portugal requested for a bailout package on April 6, 2011 and was officially approved on May 16, 2011.

[22] We cannot further reduce the window of the period of our examination because of the number of observations in our estimations.

Table 3
Consumption smoothing and the buffering effects of various net factor income flows Main results: spatial models using inverse distances as spatial weights.

	(1) $\Delta\log(ids\_C)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SAC				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.519***	0.520***	0.540***	0.574***
	(0.061)	(0.138)	(0.136)	(0.124)
ρ	−0.045	−0.012	−0.045	−0.007
	(0.043)	(0.074)	(0.061)	(0.053)
λ	−0.001	−0.032	−0.008	−0.041
	(0.034)	(0.077)	(0.057)	(0.057)
(ii) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.495***	0.515***	0.537***	0.570***
	(0.059)	(0.124)	(0.123)	(0.112)
λ	−0.035**	−0.042**	−0.052***	−0.047***
	(0.017)	(0.018)	(0.018)	(0.018)
(iii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.519***	0.530***	0.548***	0.588***
	(0.060)	(0.130)	(0.131)	(0.118)
ρ	−0.046**	−0.040**	−0.047**	−0.044**
	(0.018)	(0.018)	(0.018)	(0.018)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 4
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: inverse squared distances as spatial weights).

	(1) $\Delta\log(ids\_C)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.498***	0.543***	0.573***	0.603***
	(0.059)	(0.127)	(0.127)	(0.115)
λ	−0.008**	−0.005	−0.009*	−0.007**
	(0.004)	(0.005)	(0.005)	(0.005)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.507***	0.548***	0.576***	0.609***
	(0.060)	(0.128)	(0.129)	(0.116)
ρ	−0.010**	−0.004	−0.007	0.006
	(0.005)	(0.005)	(0.005)	(0.005)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 5
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: k nearest neighbors as spatial weights, $k = 2$).

	(1) $\Delta\log(ids\_C)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.514***	0.525***	0.559***	0.581***
	(0.061)	(0.126)	(0.127)	(0.115)
λ	−0.050	−0.177*	−0.178*	−0.19**
	(0.089)	(0.097)	(0.096)	(0.095)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.531***	0.550***	0.577***	0.604***
	(0.061)	(0.131)	(0.132)	(0.119)
ρ	−0.135	−0.173*	−0.142	−0.175*
	(0.100)	(0.100)	(0.100)	(0.100)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 6
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: k nearest neighbors as spatial weights, $k = 3$).

	(1)	(2)	(3)	(4)
		A. Equity	B. Interest	C. Foreign Direct Investment (FDI)
	$\Delta\log(ids\_C)_{jt}$	$\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	$\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.513***	0.513***	0.562***	0.586***
	(0.060)	(0.124)	(0.127)	(0.114)
λ	−0.112	−0.308**	−0.240*	−0.262**
	(0.115)	(0.125)	(0.124)	(0.124)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.532***	0.533***	0.577***	0.607***
	(0.061)	(0.130)	(0.131)	(0.118)
ρ	−0.195	−0.289**	−0.190	−0.231*
	(0.127)	(0.128)	(0.126)	(0.127)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 7
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: inverse distances with cutoff < 250 kms as spatial weights).

	(1)	(2)	(3)	(4)
		A. Equity	B. Interest	C. Foreign Direct Investment (FDI)
	$\Delta\log(ids\_C)_{jt}$	$\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	$\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.507***	0.534***	0.566***	0.594***
	(0.060)	(0.126)	(0.126)	(0.114)
λ	−2.079	−2.530	−3.288*	−2.894*
	(1.567)	(1.693)	(1.709)	(1.684)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.524***	0.543***	0.575***	0.607***
	(0.060)	(0.129)	(0.130)	(0.117)
ρ	−3.032*	−2.274	−2.787	−2.500**
	(1.751)	(1.723)	(1.743)	(1.733)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

First, the level of consumption risk-sharing is relatively larger compared to the main results. Second, with the lone exception of debt in the SEM model in Table 10, all asset classes again contributed positively in buffering shocks to consumption during these two periods. Third, this time, however, equity contributed more in buffering shocks to consumption, followed by FDI retained earnings, and then by debt. Fourth, the contributions of these asset classes to risk-sharing are relatively larger compared to the main results (again, with the exception of debt in the SEM model in Table 10). Finally, the observed upward bias inherent in our baseline estimates remains. Based on these final set of robustness checks, the results validate our main findings that consumption risk sharing in Korea is imperfect, asset classes have contributed favourably to consumption risk sharing with FDI retained earnings robustly contributing to buffering shocks to consumption.

5.3. Accounting for a few influential areas

One of the key observations we made in the section on stylized trends is the dominance of Seoul and Gyeonggi-do with respect to our variables. We then examine the sensitivity in our main results by excluding these two areas in our spatial panel estimations. Table 11 presents the results.

Column (1) of this table reports that the estimated level of unsmoothed shocks to idiosyncratic consumption growth are 43 per cent and 46.5 per cent for the SLM and SEM models, respectively. Both these estimates are statistically significant and are relatively smaller compared to the main results presented in Table 3. This finding implies that the level of consumption risk sharing is relatively larger (57 per cent according to the SLM model and 53.5 per cent according to the SEM model) compared to the main results. In terms of the buffering effects of the net flows from the three asset classes, we find that debt (column (3)) and FDI retained earnings (column (4)) both in the SLM model contributed positively (i.e., 2.5 per cent for debt, while 2 per cent for FDI retained earnings) in buffering shocks to consumption, whereas, equity (column (2)) did not contribute. Also, the inherent bias in our baseline estimates remain. We also report in a supplementary appendix (Appendix Tables 1.A to 1.F), the robustness of the results presented in Table 11 to the use of alternative spatial weights and a shorter time period in the spatial panel estimations. In these set of results, we obtain similar but stronger findings in which the positive buffering effects of debt and FDI retained earnings to shocks in consumption are statistically significant in both SLM and SEM models in almost all regressions.[23]

[23] As to equity's contribution in buffering shocks to consumption, we still found that equity did not contribute, except in two of the regressions (see Appendix Table 1.A of the supplementary appendix).

Table 8
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: inverse distances with cutoff < 350 kms as spatial weights).

	(1)	(2)	(3)	(4)
		A. Equity	B. Interest	C. Foreign Direct Investment (FDI)
	$\Delta\log(ids\_C)_{jt}$	$\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.498***	0.520***	0.545***	0.578***
	(0.060)	(0.125)	(0.124)	(0.113)
λ	−2.945*	−3.638**	−4.546***	−3.994**
	(1.608)	(1.730)	(1.733)	(1.714)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.518***	0.535***	0.556***	0.595***
	(0.060)	(0.130)	(0.131)	(0.118)
ρ	−3.768**	−3.455*	−4.100***	−3.680**
	(1.772)	(1.765)	(1.778)	(1.771)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 9
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: inverse distances as spatial weights, 2008–2012 time period).

	(1)	(2)	(3)	(4)
		A. Equity	B. Interest	C. Foreign Direct Investment (FDI)
	$\Delta\log(ids\_C)_{jt}$	$\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.387***	0.519***	0.435***	0.515***
	(0.071)	(0.153)	(0.159)	(0.144)
λ	−0.040*	−0.033	−0.059***	−0.048**
	(0.022)	(0.022)	(0.023)	(0.023)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.406***	0.520***	0.416**	0.515***
	(0.072)	(0.157)	(0.167)	(0.149)
ρ	−0.051**	−0.028	−0.056**	−0.045*
	(0.023)	(0.023)	(0.023)	(0.023)
Observations	80	80	80	80

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 10
Consumption smoothing and the buffering effects of various net factor income flows (Robustness tests of main results: inverse distances as spatial weights, 2008–2011 time period).

	(1)	(2)	(3)	(4)
		A. Equity	B. Interest	C. Foreign Direct Investment (FDI)
	$\Delta\log(ids\_C)_{jt}$	$\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	$\Delta\log(ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.417***	0.539***	0.438**	0.516***
	(0.077)	(0.168)	(0.176)	(0.159)
λ	−0.038	−0.028	−0.058**	−0.044*
	(0.024)	(0.025)	(0.026)	(0.025)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.443***	0.544***	0.422**	0.519***
	(0.077)	(0.171)	(0.185)	(0.165)
ρ	−0.054**	−0.023	−0.054**	−0.041
	(0.026)	(0.025)	(0.026)	(0.026)
Observations	64	64	64	64

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 11
Consumption smoothing and the buffering effects of various net factor income flows (Robustness test of main results: accounting for a few influential areas (excluding Seoul and Gyeonggi-do in the spatial panel estimations with inverse distances as spatial weights).

	(1) $\Delta\log(ids\_C)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.434***	0.418***	0.455***	0.449***
	(0.061)	(0.129)	(0.132)	(0.115)
λ	−0.050**	−0.089***	−0.078***	−0.098***
	(0.022)	(0.023)	(0.023)	(0.022)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.465***	0.428***	0.458***	0.461***
	(0.063)	(0.140)	(0.142)	(0.126)
ρ	−0.068***	−0.085***	−0.072***	−0.093
	(0.024)	(0.023)	(0.024)	(0.023)
Observations	112	112	112	112

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 12
Consumption smoothing and the buffering effects of various net factor income flows (Robustness test of main results: accounting for a few influential areas (excluding Seoul, Gyeonggi-do and Jeollabuk-do in the spatial panel estimations with inverse distances as spatial weights).

	(1) $\Delta\log(ids\_C)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.448***	0.433***	0.471***	0.463***
	(0.063)	(0.131)	(0.133)	(0.117)
λ	−0.046**	−0.085***	−0.078***	−0.096***
	(0.023)	(0.024)	(0.024)	(0.023)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.479***	0.450***	0.479***	0.481***
	(0.065)	(0.142)	(0.143)	(0.127)
ρ	−0.065***	−0.081***	−0.071***	−0.091
	(0.024)	(0.024)	(0.024)	(0.024)
Observations	104	104	104	104

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 13
Consumption smoothing and the buffering effects of various net factor income flows (Extension of main results: real provincial consumption includes provincial social transfer payments made by the government with inverse distances as spatial weights).

	(1) $\Delta\log(ids\_C\_tr)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.450***	0.517***	0.539***	0.569***
	(0.058)	(0.125)	(0.124)	(0.113)
λ	−0.037**	−0.039**	−0.048***	−0.044**
	(0.017)	(0.018)	(0.018)	(0.018)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.471***	0.530***	0.550***	0.586***
	(0.060)	(0.130)	(0.131)	(0.119)
ρ	−0.045**	−0.037**	−0.043**	−0.040**
	(0.018)	(0.018)	(0.018)	(0.018)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

We also considered as part of our robustness check in this sub-section, the areas where the National Pension Service (NPS), one of the biggest investors in Korea, are located.[24] In addition to its major presence in the areas of Seoul and Gyeonggi-do, the NPS's main headquarter is located in Jeollabuk-do. We then estimated our spatial panel regressions that not only exclude Seoul and Gyeonggi-do, but also the key province of Jeollabuk-do. The results are presented in Table 12.

We obtain results that are almost similar to the results reported in Table 11. That is, the estimated level of unsmoothed shocks to idiosyncratic consumption growth are statistically significant and relatively smaller compared to the main results, and as such the level of consumption risk sharing is relatively larger. Moreover, debt and FDI retained earnings, also both in the SLM model contributed positively (i.e., 2 per cent for debt, while 1 per cent for FDI retained earnings) in buffering shocks to consumption, whereas, equity did not contribute. Again, the observed upward bias inherent in our baseline estimates remains. Similar to the robustness of our results presented in Table 11, the results reported in Table 12 are also robust to alternative spatial weights and a shorter time period in the spatial panel estimations (see Appendix Tables 2.A to 2.F of the supplementary Appendix). For these set of results, we also obtain stronger findings in which the positive buffering effects of debt and FDI retained earnings to shocks in consumption are statistically significant in both SLM and SEM models in majority of the regressions. Thus, these results provide confirmatory evidence that almost all of our main results hold and are not sensitive to the influence of a few key and dominant areas.[25]

5.4. Accounting for provincial social transfer payments made by the government

The role of social transfer payments made by the government to the provinces is important in Korea. This can then also contribute in buffering shocks to consumption. For instance, OECD (2013) and Hwang (2016) emphasized that Korea's welfare spending has increased faster than any other OECD country in the last decade. In serving as an extension to our main results, we can account for the role of social transfer payments made by the government to the provinces by adding to provincial final consumption, data on provincial social transfer payments.[26] In doing so, we then construct a modified measure of province *j*'s idiosyncratic real per capita consumption, which we denote here as $\Delta\log(ids\_C\_tr)_{jt}$. By including provincial social transfer payments in our definition of final consumption, we can then expect from this part of our spatial panel estimates that the income redistribution policy of the government cushions the provinces against adverse shocks to consumption when the buffering effects of the net flows from the three asset classes are either equal to or higher in magnitude relative to the main results (i.e., the case in which provincial social transfer payments are not included in final consumption) presented in Table 3. The results are presented in Table 13.

Again, we obtain similar results in the sense that the estimated level of unsmoothed shocks to idiosyncratic consumption growth are statistically significant and relatively smaller (column (1)) compared to the main results presented in the same column of Table 3, and as such the level of consumption risk sharing is relatively larger. Likewise, FDI retained earnings contributed the most (column (3) compared to column (1) of Table 13), followed by debt (column (2) compared to (1)), and last is equity (column (2) compared to (1)) in terms of the contributions of these asset classes to risk-sharing. More importantly, given that these estimated 'buffering' coefficients are either equal to or higher in magnitude relative to the main results (columns (2)-(4) of Table 13 compared to the same columns of Table 3) suggest the cushioning role of social transfer payments to shocks in consumption.[27] Also, the inherent bias in our baseline estimates remains. We again provide robustness checks (i.e., using alternative spatial weights and shorter time period) contained in a supplementary Appendix (see Appendix Tables 3.A to 3.F) of our results presented in Table 13, and these results validate the findings we obtain in this sub-section.

5.5. Role of provincial labour mobility

The other extension to our main results is another widely known mechanism by which shocks to consumption can be dampened is through labour mobility across the provinces.[28] One line of argument asserts that, for instance, two provinces (province One and province Two) have integrated labour markets, that is, workers can easily move between the two provinces due, say, to workers sharing a common language. Then, an adverse shock hits province One which renders output to fall and unemployment to rise in this province. Adversely affected workers from this province can then migrate to province Two, which was not hit by the negative shock and where unemployment is lower. Since this migration can occur with ease, the impact of the negative shock on province One will be less painful. In other words, the adjustment from the adverse shock can occur through migration (Mundell, 1961).

One limitation that we face in this sub-section to account for labour mobility is that our data source, Korea Statistical Information Service does not provide data on worker migration between provinces.[29] Nevertheless, one imperfect proxy that we can utilize to account for this mechanism of adjustment to adverse shocks in consumption is that we have available data on provincial wages. One reasonable argument we can make as justification in the use of this variable as proxy for labour mobility is that workers will tend to migrate in areas or provinces where the level of wages are relatively higher, since we believe that there should be a high correlation between provincial wages and labour mobility. Because labour mobility can be regarded as an 'internal' adjustment mechanism to shocks in consumption as opposed to the

[24] I thank an anonymous referee for pointing this out.

[25] This time around we found equity to have contributed in buffering shocks to consumption in four of the regressions (see Appendix Tables 2.A and 2.F of the supplementary appendix). However, we still consider these results to be relatively weaker compared to the buffering effects we found for debt and FDI retained earnings.

[26] Fortunately, the Korea Statistical Information Service (http:kosis.kr/eng/) makes available data on social transfer payments made by the government to the provinces. In addition, we can add this data to final consumption because even though, as earlier mentioned, final consumption is defined in this paper as the sum of household consumption and government consumption (the Korea Statistical Information Service does not provide separate data for these two expenditure accounts on a provincial level), social transfer payments are excluded from government consumption as per definition of national income accounts. Thus, our estimates in this sub-section are not contaminated by any double-counting problem.

[27] To a lesser extent is the 'buffering' coefficients under FDI retained earnings (column 4) which is almost equal to the estimated coefficients reported in column (4) of Table 3.

[28] This is often cited, for instance, as one of the criteria for a successful currency area (i.e., when entire regions share a single currency). For example, part of the reason for the creation of the euro was the belief that while individual countries of the European Union (EU) do not each form an optimal currency area, whereas the member countries of the EU as a whole do form an optimal currency area. However, a currency area does not have to be a currency union of individual countries. When entire regions within a single country share a single currency, it can also be considered a currency area. Some economists, for instance, argue that the United States form an optimal currency area.

[29] Although, it should be noted at this point that the distances between provinces, which, as earlier mentioned, calculated as the distance between the capitals or central districts of each pair of provinces, were used in various ways as spatial weights to estimate the spatial panel models. This then directly account for the frictions in moving between provinces as this allows us to distinguish between neighbouring and distant provinces.

Table 14
Consumption smoothing and the buffering effects of provincial wages (Extension of main results: accounting for provincial labour mobility with inverse distances as spatial weights).

	(1) $\Delta\log(ids\_C\_wages)_{jt}$	(2) A. Equity $\Delta\log(ids\_Net\_Dividend\_Flows)_{jt}$	(3) B. Interest $\Delta\log(ids\_Net\_Interest\_Flows)_{jt}$	(4) C. Foreign Direct Investment (FDI) $\Delta\log\ (ids\_Net\_Flows\_FDI\_Re\_E)_{jt}$
(i) SLM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.544***	0.527***	0.539***	0.560***
	(0.107)	(0.111)	(0.111)	(0.105)
λ	−0.045**	−0.042**	−0.049***	−0.045**
	(0.018)	(0.018)	(0.018)	(0.018)
(ii) SEM				
$\Delta\log(ids\_RGDPpc)_{jt}$	0.561***	0.543***	0.554***	0.578***
	(0.112)	(0.116)	(0.117)	(0.110)
ρ	−0.040**	−0.038**	−0.042**	−0.040**
	(0.018)	(0.018)	(0.018)	(0.018)
Observations	128	128	128	128

Notes: (a) For the definition of the variables refer to the main text. The variables below each column number denote the dependant variables.
(b) numbers in parentheses are standard errors.
(c) ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

buffering effects of the three asset classes as an 'external' adjustment mechanism to shocks in consumption via the financial diversification opportunities offered abroad, this time, we add to our original final consumption variable our proxy variable for labour mobility and construct a modified measure of province *j*'s idiosyncratic real per capita consumption denoted here as $\Delta\log(ids\_C\_wages)_{jt}$ before estimating our spatial panel specifications.

Our expectation in this instance is similar to the previous sub-section in which our proxy measure for labour mobility cushions the provinces against adverse shocks to consumption when the buffering effects of the net flows from the three asset classes are either equal to or higher in magnitude relative to the main results (i.e., the case in which provincial wages are not added to final consumption) presented in Table 3. The results are presented in Table 14.

In this case, the estimated level of unsmoothed shocks to idiosyncratic consumption growth are statistically significant, but relatively smaller (column (1)) compared to the main results presented in Table 3, and as such the level of consumption risk sharing is slightly smaller (46 per cent compared to 50.5 per cent in the SLM model, while 44 per cent compared to 48 per cent in the SEM model). Moreover, it is only FDI retained earnings (2 per cent in both SLM and SEM models) amongst the three asset classes that contributed to risk-sharing. More importantly, given that the estimated 'buffering' coefficients are either equal to or higher in magnitude relative to the main results (again, to reiterate, the main results does not add provincial wages in final consumption), suggest the cushioning role of our proxy measure for labour mobility to shocks in consumption.[30] Finally, the inherent bias found in the baseline results still holds.

We again provide robustness checks (i.e., using alternative spatial weights and shorter time period) contained in a supplementary Appendix (see Appendix Tables 4.A to 4.F) of our results presented in Table 14. For these set of results, we obtain stronger findings in which the three buffering coefficients are relatively larger than the main results in majority of the regressions. In addition to the confirmation that our main results is not sensitive to accounting for the role of labour mobility, we also interpret our findings in this sub-section to indicate that there is an important role for labour mobility as an internal adjustment mechanism to shocks in consumption in Korea.

[30] In this case, the 'buffering' coefficients under FDI retained earnings (column 4) are found to be relatively smaller compared to the estimated coefficients reported in column (4) of Table 3.

6. Conclusion

In this paper, using provincial data on regional consumption, GDP and uniquely available data in the case of Korea on provincial net factor income flows disaggregated across the three asset classes of debt, equity and FDI reinvested earnings, we investigated how these asset channels impacted on consumption risk sharing during crises times, particularly, during the Global Financial Crisis and the European sovereign debt crisis. We documented that intra-national consumption risk sharing in Korea was imperfect just as with earlier estimates using data for US states and Canadian provinces, although the degree of consumption risk sharing observed in Korea is relatively lower compared to estimates found for US states and Canadian provinces which used much earlier data. We also found that net flows of debt, equity and FDI retained earnings have all contributed favourably to consumption risk sharing during the crises with FDI retained earnings consistently contributing to risk sharing in all of our estimation results.

We interpret these results as evidence that one of the alleged benefits of financial integration in terms of providing consumption risk sharing opportunities is tangible and real in the context of Korea. This is important as this suggests that during times of high global economic volatility, different asset channels can provide the insurance to mitigate shocks befalling the economy. We also obtain evidence that not only asset channels, but also the combination of the government's social transfer payments and a certain proxy measure of labour mobility help to contribute in mitigating shocks to consumption.

The findings obtained by this study on asset channels can also be interpreted as providing evidence, or in a sense, vindication to Korea's pursuit of a gradual and systematic liberalization of its capital account, a process that began in 1998, just a few years after being hit by the Asian financial crisis. Our findings suggest that as a result of this policy objective, portfolio diversification opportunities had developed with beneficial welfare effects in the form of asset channels providing insurance during episodes of uncertainty in international financial markets.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jjie.2020.101063.

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