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Risk Sharing of Disaggregate Macroeconomic and Idiosyncratic Shocks

by Gregory D. Hess and Kwanho Shin

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Gregory D. Hess is at Oberlin College and a consultant to the Federal Reserve Bank of Cleveland. Kwanho Shin is at Korea University. This paper was prepared for the *Journal of International Economics* Conference, June 1999, in Gerzensee, Switzerland. The authors thank Fabio Canova, Michael Klein and Jaques Melitz for their very helpful comments.

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Abstract

We estimate the extent to which idiosyncratic and disaggregate macro shocks (such as regional and industry shocks) are not shared in the economy. Comparing the degree to which idiosyncratic and disaggregate macro shocks are not shared grants a deeper understanding as to why the economy lacks in specific areas of risk sharing arrangements. As well, it can point to areas where the economy's risk sharing capability can be enhanced. Using household data from the Panel Study of Income Dynamics, we find that a negligible
amount of risk (around 10%) is shared in the aggregate, about 50% is shared within regions and industries, while the remaining 40% is not shared with other households. These findings suggest that given the low level of international risk sharing, increased international integration may not lead to a significant increase in international risk sharing.

Key Words: Risk Sharing, Quantity Anomaly.

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1 Introduction

An important innovation for evaluating puzzles in international macroeconomics is to utilize intranational data. For example, an anomaly that has been well established using international data is that countries insufficiently share risk – see Backus, Kehoe and Kydland (1992).[1] This follows from an earlier literature where it has been argued that there is a 'home bias' in households' asset portfolios – see Feldstein and Horioka (1980) and the recent contribution to this literature by Baxter and Jermann (1997). Researchers have conjectured that international borders play a critical role in explaining this anomaly. To test this conjecture, a natural experiment is to use data that abstracts from national borders, namely intranational data. The results from this type of experiment can also be used to predict the future shape of international economics, as international pacts such as the EMU and NAFTA create a more borderless environment.

A geographic counterpart to a country in intranational data is a region. The intranational risk sharing literature has explored regional data within Canada (Crucini (1998) and Bayoumi and McDonald (1995)), Japan (Van Wincoop (1995)) and the United States (Atkeson and Bayoumi (1993), Crucini (1998), Hess and Shin (1997), Asdrubali, Sorensen, and Yosha (1996) and Sorensen and Yosha (1996)).[2] A general conclusion in the intranational literature is that, while intranational evidence for risk sharing is greater than that for international evidence, there is still evidence that the risk sharing within-countries is far from complete.

One common feature of the above intra- and international studies on macro shocks is that they use macro data such as regional or country aggregate consumption. An implicit assumption is that other types of risk sharing are complete: for example, risk sharing across households within regions is complete and other macro shocks such as industrial shocks are shared completely across industries. If this assumption is not true, then other shocks can

[1]Backus, Kehoe and Kydland (1992) find that even a weak prediction of international risk sharing, namely that aggregate consumption across countries should be more correlated than the aggregate output, is widely rejected using international data. See also the papers by Obstfeld (1994), Canova and Ravn (1996), and Kollman (1996). Fuhrer and Klein (1998) also examine the role of consumption durables in this analysis, as do Hess and Shin (1998).

[2]See the survey by Crucini and Hess (1999).

be co-mingled with regional shocks. Hence, this approach has difficulty in systematically pointing out what kinds of shocks households face and how much they are shared across households.[3] Therefore, to better understand risk sharing, we believe that we need to use household data and explicitly allow for various types of shocks. For example, we need to consider industry shocks which are deemed important determinants in intranational and international economic fluctuations.

Mace (1991) and Cochrane (1991) are two early attempts that employ micro data to test if risk sharing is complete across households. In sharp contrast to the macro studies, however, they just consider households' idiosyncratic shocks and conclude that complete risk sharing is generally not supported in the data. Since information asymmetry problems such as moral hazard and adverse selection make it difficult for households to insure perfectly against pure household specific risk, these results may not be surprising. One limitation of Mace and Cochrane is that they assume that all the risks originate from the idiosyncratic characteristics of households. A second limitation of Mace and Cochrane is that while they establish that risk sharing is not perfect within a country, they do not quantify how incomplete this risk sharing actually is.

Combining the benefits from both macro and micro studies, we investigate how households try to insure against three sources of shocks: regional, industrial and idiosyncratic shocks. Households face economic fluctuations that come from a number of different sources. Simply put, households live in regions and work in industries which, in addition to their household specific circumstances, contribute to the fluctuations in their economic resources. In fact, there is a line of literature that emphasizes these disaggregate sources of macro shocks that contribute to aggregate fluctuations. For example Norrbin and Schlagenhauf (1988), Altonji and Ham (1990), Clark (1998), Ghosh and Wolf (1998) and Clark and Shin (1999) decompose the sources of fluctuations into aggregate shocks, regional shock and industrial shocks and empirically estimate the importance of each type of shock. Hence

[3]For example, suppose that there is evidence of incomplete risk sharing across regions A and B. There are two possibilities. First the two regions may not share risks originating from regional shocks. Second, there could be no regional shocks but, rather, only industrial shocks, so that regions A and B completely specialize in two different industries and do not share industrial shocks. By just focusing on regional data we cannot distinguish between the above two cases.

we have to take into consideration that, even though aggregate shocks cannot be insured against, disaggregate macro shocks such as regional and industry shocks as well as idiosyncratic shocks can be.

When we compare how idiosyncratic shocks and disaggregate macro shocks such as regional and industrial shocks are shared, one major difference emerges. Since disaggregate macro shocks are much less subject to information asymmetry problems, one might expect that risk sharing for these types of shocks can be more easily obtained. However, as pointed out earlier, recent evidence of both international and intranational studies shows that regional shocks are not efficiently insured against.

Recently, utilizing household data, Hess and Shin (1999) extend macro shocks to include both industrial and regional shocks and investigate how they are shared in the economy. However, even though they employ micro data to examine the extent of risk sharing across regions and industries, they do not allow for incomplete risk sharing within regions and industries such that households only smooth their consumption out of their individual resources (i.e. permanent income).

Extending Hess and Shin (1999), this paper contributes to the literature in the following important ways. First, we introduce both disaggregate macro shocks and idiosyncratic shocks and explicitly measure the extent to which they are shared. More specifically, we allow for the possibility that idiosyncratic shocks within regions or industries are not shared with other households in the economy, and quantitatively estimate the fraction of idiosyncratic shocks as well as regional and industrial shocks that are not shared in the economy. Comparing the sizes of idiosyncratic and the disaggregate macro shocks not shared in the economy grants a deeper understanding as to the reason why the economy lacks in specific areas of risk sharing arrangements. As well, it can point to areas where the economy's risk sharing capability can be enhanced. For example, if the lack of risk sharing is primarily an issue of idiosyncratic shocks, then addressing issues of asymmetric information would be a major avenue to improve the economy's risk sharing ability. Alternatively, if disaggregate macro shocks are the most important source of risk that is not being shared, then macro fiscal policies could be designed to boost risk sharing (e.g. fiscal federalism may aid in helping low levels of regional risk sharing).

We find that a significant portion of pure idiosyncratic shocks is not shared in the economy. More importantly, however, an even larger portion of disaggregate macro shocks is also not shared in the economy. The remaining portion measuring the fraction of complete aggregate risk sharing within the country is less than 10 %. This apparent lack of risk sharing within one country shows that the border in international data may not be the major source of incomplete risk sharing across countries. Our finding also suggests that the increased integration of international economies is unlikely to significantly enhance future risk sharing across countries.

The paper's second innovation is to more closely analyze the extent to which a household's asset holdings affect its ability to share risk. There are a number of financial devices available in the economy to mainly hedge against disaggregate macro shocks and one may conjecture that only some households that do not own such assets have significantly less abilities to share these risks. We find, however, that in most sub-samples of households divided based on the assets that they hold, that the portion of disaggregate shocks not shared across is still quite large. Particularly, we find that households that own stocks more efficiently share risks against industrial shocks but they are much more vulnerable to regional shocks. This suggests that in addition to an international home bias problem, there may be an intranational home bias problem as well, as has been argued in papers by Huberman (1997,1999) and Coval and Moskowitz (1997a,b).

The remainder of the paper is organized as follows. Section 2 presents a model of various risk sharing arrangements including limited risk sharing of macro shocks and idiosyncratic shocks. Section 3 discusses the empirical implications of these theories and Section 4 presents the results of the empirical tests of these theories. We summarize in Section 5.

2 The Model

Consider an endowment economy which consists of R regions and I industries. The economy consists of H number of infinitely lived households that can be partitioned into either regions with H^r number of households living in each region r or industries with H^i number of households working in each industry i. The preferences of household h are represented by the expected lifetime utility expressed as:

$$\sum_{t=0}^{\infty} \beta^t E_0(U(c_{ht}^{ri})), \tag{1}$$

where c_{ht}^{ri} is consumption for household h in region r and industry i at time t and $0 < \beta < 1$ is the subjective discount factor that is assumed to be the same across households. E_0 represents the expectation operator conditional on information at time .[4]

Suppose that risk sharing is complete across all households in the economy. For the aggregate, since it is impossible to either save or dis-save, the feasibility constraint for the economy is:

$$c_t^a = \frac{1}{H}\sum_{h=1}^{H} c_{ht}^{ri} \leq \frac{1}{H}\sum_{h=1}^{H} y_{ht}^{ri} = y_t^a \qquad t = 0, 1, .. \tag{2}$$

where y_{ht}^{ri} is the endowment for household h in region r and industry i, and c_t^a and y_t^a are the aggregate consumption and the aggregate endowment across all the households in the whole economy at time t. The allocation under the complete risk sharing is obtained by the following problem solved by the global social planner:

$$\max \sum_{h=1}^{H} \omega_h \sum_{t=0}^{\infty} \beta^t E_0(U(c_{ht}^{ri})), \tag{3}$$

subject to equation (2). The planner assigns weights ω_h such that $0 < \omega_h < 1$ and $\sum_{h=1}^{H} \omega_h = 1$.

Suppose that we consider a special case of a time separable, CRRA utility function with a risk aversion coefficient σ. Then the first order conditions are:

$$\hat{\mu}_t = \omega_h (c_{ht}^{ri})^{-\sigma}, \qquad h = 1, ..., H, \qquad t = 0, 1, .. \tag{4}$$

where $\hat{\mu}_t = \mu_t/\beta^t$ and μ_t is the Lagrange multiplier associated with the feasibility con-

[4] In this specification, we do not explicitly introduce household preference shocks which could depend on observable factors such as age, family size and hours worked, or unobservable shocks, as this does not change the predictions of the model but does make the notation more burdensome. See Hess and Shin (1999). Of course, in the empirical work, we do control for these factors.

straint (2).

We can eliminate the weights, ω_h, by taking logs and first differencing equation (4), which yields:

$$\Delta log(\hat{\mu}_t) = -\sigma \Delta log(c^{ri}_{ht}) \tag{5}$$

where Δ is the first difference operator. Aggregating equation (5), the following equation holds:

$$\Delta log(c^{ri}_{ht}) = \Delta log(c^{a}_{t}) \tag{6}$$

As emphasized by Mace (1991), the major implication of complete risk sharing is that household consumption should change one-for-one with the aggregate consumption, irrespective of the household's endowment or income. This result arises essentially from the fact that, as shown in equation (5), the shadow value of the endowment is equalized across all the households irrespective of regions or industries.

So far we have considered the implication of intratemporal risk sharing across households at the same period. Another important avenue of sharing risk is through the dimension of different time periods, i.e. intertemporal consumption smoothing. Allowing households to smooth consumption intertemporally, however, does not change the above results at all in this case because there is no way to intertemporally substitute the aggregate endowment for the economy as a whole. The budget constraint remains the same and the resulting allocation would be the same.

Now we consider a second type of household that has only a limited ability to share risk. More specifically suppose that this type of household shares idiosyncratic risk completely across other households in the same region or industry while macro risks resulting from regional or industrial shocks are not shared with other households in different regions or industries. We examine the case for regional risk sharing first and then simply note the case for industries later. To concentrate on the implication of limited risk sharing across households, we maintain the assumption that intertemporal consumption smoothing is complete. Allowing intertemporal consumption smoothing implies that the regional aggregate endowment need not to be equal to regional aggregate consumption. The corresponding problem for a regional social planner is to maximize the weighted sum of expected lifetime utilities of households within the same region, $h \in r$, subject to the budget constraint on regional income:

$$\max \sum_{h \in r} \omega_h^r \sum_{t=0}^{\infty} \beta^t E_0(U(c_{ht}^{ri})), \tag{7}$$

subject to the regional budget constraint:

$$c_t^r + a_t^r \leq y_t^r + (1 + R_{t-1})a_{t-1}^r, \tag{8}$$

where $c_t^r = \frac{1}{H^r} \sum_{h \in r} c_{ht}^{ri}$ and $y_t^r = \frac{1}{H^r} \sum_{h \in r} y_{ht}^{ri}$, and $\sum_{h \in r}$ represents the summation across all households in region r. The regional social planner not only pools all the endowments in region r but also engages in the trade of the riskfree assets before distributing consumption appropriately.[5] The assigned weight to household h in region r is ω_h^r such that $0 < \omega_h^r < 1$ and $\sum_{h \in r} \omega_h^r = 1$.

Note that the regional social planner performs complete intertemporal consumption smoothing through the globally traded riskfree assets in the economy, but risk sharing is limited to the households in the same region. Then the first order conditions are:

$$\hat{\mu}_t^r = \omega_h^r (c_{ht}^{ri})^{-\sigma}, \quad h \in r, \tag{9}$$

and

$$(c_{ht}^{ri})^{-\sigma} = \beta(1 + R_t) E_t (c_{ht+1}^{ri})^{-\sigma}, \quad h \in r, \tag{10}$$

where $\hat{\mu}_t^r(s_\tau) = \mu_t^r(s_\tau)/\beta^t$ and μ_t^r is the Lagrange constraint associated with the regional budget constraint. E_t represents the expectation operator conditional on information at time t. There are two difference between this case and that of complete risk sharing presented above. First, since μ_t^r is common only to the households in the same region r equation (9) implies that the weighted marginal utility of the current consumption is equalized across all households in the same region, but not across regions. Second, the regional aggregate consumption differs from the regional aggregate endowment through borrowing and lending, which equalizes the appropriately discounted shadow values of the regional endowments

[5]This assumption can be justified if the definition of an agent includes a local government, which can borrow or lend in the global market.

across different time periods as shown in equation (10).[6] Two different first order conditions, (9) and (10), characterize two dimensions of risk sharing, intratemporal risk sharing and intertemporal consumption smoothing, which are independent propositions. In other words, one can assume either one of these two without assuming the other.

In this second model, there are two reasons why households prefer to consume a different amount than their current endowment: intratemporal risk sharing and intertemporal consumption smoothing. In practice, however, it is difficult to see exactly how household consumption deviates from its endowment due to each of these separate mechanism. Accordingly, most studies test the implication of risk sharing given that intertemporal consumption smoothing holds within each region. For example, Crucini (1999), Hess and Shin (1999) and Del Negro (1997) assume that intertemporal consumption smoothing is complete within regions and test how completely the innovations to permanent income are shared across households in differing regions. In the same manner we assume that equation (10) holds and concentrate on testing the implication of equation (9).

If we first log-difference equation (9) and aggregate it across households in the same region, we have:

$$\Delta log(c_{ht}^{ri}) = \Delta log(c_t^r). \tag{11}$$

With regional risk sharing only, household consumption moves one for one with regional aggregate consumption. If we log-difference equation (9) and aggregate across all households in the economy, we then have:

$$\Delta log(c_{ht}^{ri}) = \Delta log(c_t^a) + \frac{1}{\sigma}(\Delta \hat{\mu}_t^{a_r} - \Delta log(\hat{\mu}_t^r)) \quad r = 1, ..., R, \tag{12}$$

where $\hat{\mu}_t^{a_r} = \frac{1}{R}\sum_{r=1}^{R} log(\hat{\mu}_t^r)$. Note that household consumption no longer moves one for one with aggregate consumption due to the lack of risk sharing across different regions. This is reflected by the last term in equation (12) that denotes the deviation of the shadow value of endowment in region r from the aggregate economy. By adding and subtracting

[6] We can also assume complete intertemporal consumption smoothing for the previous case of complete risk sharing, but in that case, since the global aggregate consumption and the global aggregate endowment would be the same, the interest rate would change so that the appropriately discounted shadow values of the aggregate endowment across different time periods would be equalized.

$\Delta log(c_t^a)$ from the right hand side of equation (11), we derive the following equation:

$$\Delta log(c_{ht}^{ri}) = \Delta log(c_t^a) + (\Delta log(c_t^r) - \Delta log(c_t^a)). \qquad (13)$$

Comparing equation (13) with equation (12), we can see that the difference between the regional aggregate consumption and the global aggregate consumption, $\Delta log(c_t^r) - \Delta log(c_t^a)$ summarizes the difference of the shadow value of the endowment in region r and that in the aggregate economy.

So far we have only considered the implication of regional risk sharing. By the same procedure, we can also think of industry risk sharing: risk sharing is complete within industries but not across industries. We can derive similar first order conditions and by manipulating the first order condition similar to equation (9), we can derive the following equation for industrial risk sharing:

$$\Delta log(c_{ht}^{ri}) = \Delta log(c_t^a) + (\Delta log(c_t^i) - \Delta log(c_t^a)). \qquad (14)$$

Again the second term on the right hand side equation (14), $\Delta log(c_t^i) - \Delta log(c_t^a)$ represents the difference of the shadow value of the endowment in industry i from the aggregate. Hence, with industrial risk sharing, the growth rate of household consumption is no longer equal to the growth rate of the aggregate consumption and the difference is measured by the deviation of the industrial aggregate consumption from the global aggregate consumption.

Finally suppose a third type of households exists that cannot share risk with any other household in the economy. Compared to the households of the previous types, the households of this type do not share even idiosyncratic risks to their incomes with any other households in the same region (or industry). However we still maintain that they have access to a globally traded, riskfree asset. Hence even though risk sharing across households, namely intratemporal consumption smoothing, is ruled out, the household is able to smooth consumption intertemporally. Then its budget constraint is:

$$c_{ht}^{ri} + a_{ht}^{ri} \leq y_{ht}^{ri} + (1 + R_{t-1}) a_{ht-1}^{ri} \qquad (15)$$

where a_{ht}^{ri} is the amount of the riskfree assets held by household h in region r and industry i at time t and R_{t-1} is the riskfree rate of return at time $t-1$. The first order conditions are:

$$\mu_{ht}^{ri} = (c_{ht}^{ri})^{-\sigma} \tag{16}$$

and

$$(c_{ht}^{ri})^{-\sigma} = \beta(1+R_t)E_t(c_{ht+1}^{ri})^{-\sigma}, \tag{17}$$

where μ_{ht}^{ri} is the shadow value of the household's wealth at time t.

Since the shadow value of endowment, μ_{ht}^{ri}, is different across households, equation (16) shows that the marginal utility of consumption for the household is not equalized across any other households in the economy, while equation (17) implies that it is equalized, after appropriately discounted, across different time periods for the same household. When we take log differences of equation (16), we have the following equation:

$$\Delta log(\mu_{ht}^{ri}) = -\sigma \Delta log(c_{ht}^{ri}). \tag{18}$$

Aggregating this across households in the same region yields:

$$\Delta log(c_{ht}^{ri}) = \Delta log(c_t^r) + \frac{1}{\sigma}(\Delta \hat{\mu}_t^{r_h} - \Delta log(\hat{\mu}_{ht}^{ri})) \quad r = 1, ..., R, \tag{19}$$

where $\hat{\mu}_t^{r_h} = \frac{1}{H_r}\sum_{h\in r} log(\hat{\mu}_t^{ri})$. Now the growth rate of household consumption differs from that of the regional aggregate consumption because the shadow values of endowment are not equalized across households even in the same region. Extending equation (19) we can also easily see that the growth rate of household consumption differs from that of aggregate consumption due to the differences in the shadow values of endowments across households in the economy.

The above results show that it is now difficult to argue how individual household consumption moves in connection with other aggregate measures of consumption. However since we assume that intertemporal consumption smoothing is complete, it is possible to derive the implication on household consumption process from equation (17) if we take a quadratic approximation of the utility function around the steady state.[7] Suppose that $\beta(1+R_t)$ is approximately equal to 1. Then we can easily show that

$$\Delta c_{ht}^{ri} = (1-\beta)\sum_{k=0}^{\infty}\frac{1}{\beta^k}(E_t - E_{t-1})y_{ht+k}^{ri}. \tag{20}$$

Since innovations to future endowments are not predictable, equation (20) leads to the well-known proposition that the consumption process follows a random walk, and this implication of intertemporal consumption smoothing has been extensively examined since the seminal paper by Hall (1978).

3 Empirical Implications

In the previous section we have seen that, while either complete or regional (industrial) risk sharing implies that the first two types of households' consumption moves with the contemporaneous aggregate measures such as aggregate consumption or regional (industrial) consumption, the household consumption of the third type lacks in any contemporaneous linkages to any aggregate measures. This makes it difficulty to empirically estimate the importance of these types of households. However once we assume an endowment process (i.e. for labor income) and estimate it, we can then link the consumption process of this third type of household to innovations in expectations about future endowments. ¿From now on for notational convenience we now drop the superscript for the household's region and industry and suppose that y_{ht} is a stationary ARMA (Autoregressive Moving Average) process with mean μ, so that if z_{ht} is the deviation from the mean, $y_{ht}-\mu$, we write:

$$\rho(L)z_{ht} = \gamma(L)u_{ht} \tag{21}$$

where $\rho(L) = 1+\rho_1 L+\rho_2 L^2+...$, $\gamma(L) = 1+\gamma_1 L+\gamma_2 L^2+...$, L the lag operator and u_{ht}, a serially uncorrelated process. We assume that the conditions required for stationarity are satisfied for $\rho(L)$ and $\gamma(L)$. Then we can easily derive that equation (20) can be converted

[7]Taking a quadratic approximation for the CRRA utility function implies that a precautionary motive for savings is ignored.

to the following:

$$\Delta c_{ht} = (1-\beta)\frac{\gamma(\beta)}{\rho(\beta)}u_{ht}. \tag{22}$$

Once we calculate the innovation to the income process, equation (22) shows how consumption changes respond to the innovation.

One difficulty in empirically implementing equation (22) along with previous equations resulting from either complete or limited risk sharing is that equation (22) is represented in terms of levels while the previous equations are all in log-levels. Since it can be easily shown that all the previous equations also hold in terms of levels, one possibility is that we use levels for the empirical analysis.[8] However this choice would be inconsistent with other studies that find that consumption and income processes are closer to log-linear than linear. Hence, following Campbell and Mankiw (1989) and Crucini (1999), it is more convenient to take a log-linear approximation of equation (22) as follows:

$$\Delta log(c_{ht}) = (1-\beta)\frac{\gamma(\beta)}{\rho(\beta)}\eta_{ht} \equiv \Delta log(y^p_{ht}) \tag{23}$$

where η_{ht} is appropriately redefined error process assumed to be uncorrelated. We refer to this final term simply as the 'revision in the log of permanent income', namely $\Delta log(y^p_{ht})$.

Suppose that θ_a $(= 1-\theta_r-\theta_i-\theta_p)$, θ_r, θ_i and θ_p represent the portions of the consumption process that conform to complete risk sharing, regional risk sharing, industrial risk sharing and no risk sharing respectively, then it follows from equation (6), equation (13), equation (14) and equation (23) that an expression for household consumption is provided:

$$\Delta log(c_{ht}) \;=\; \theta_a\Delta log(c^a_t) + \theta_r\Delta log(c^r_t) + \theta_i\Delta log(c^i_t) + \theta_p\Delta log(y^p_{ht}). \tag{24}$$

Equation (24) is easily converted to the following equation:

$$\begin{aligned}\Delta log(c_{ht}) - \Delta log(c^a_t) \;&=\; \theta_r(\Delta log(c^r_t) - \Delta log(c^a_t)) + \theta_i(\Delta log(c^i_t) - \Delta log(c^a_t)) \\ &+\; \theta_p(\Delta log(y^p_{ht}) - \Delta log(c^a_t)).\end{aligned} \tag{25}$$

[8] Once we assume CARA utility function instead of CRRA utility function, we can derive similar equations such as equation (6), equation (13) and equation (14) in terms of levels.

It is in the caveat that we point out the differences between equation (25) and the one estimated in Hess and Shin (1999). First, since the equation estimated in Hess and Shin (1999) is basically equivalent to equation (25) except that θ_p is assumed to be zero, the possibility of not sharing idiosyncratic risk with any other households in the same region or industry is excluded. Hence all households are assumed to have at least some limited ability to share risk (e.g. within and across regions and industries). In the present model, we explicitly introduce households that cannot share risk at all and it is important to measure the portion of these households. Second, distinguishing between households of limited ability of risk sharing and those of no ability allows us to evaluate the size of limited risk sharing actually occurring inside regions or industries. For example, in Hess and Shin (1999), the portion of households sharing risk within regions is measured by the estimated coefficient of $\Delta c_t^r - \Delta c_t^a$ in a similar regression as (25): the coefficient is interpreted as the result of actual risk sharing undertaken in the region. However if every household in the same region receives the same increase in its permanent income, then there is no necessity for households in the same region to share risk. The fact that they decide to live in the same region automatically guarantees that risk sharing is obtained in the same region. In the present model, since both the measure of permanent income for each household and Δc_t^r are used as regressors we can actually estimate the importance of risk sharing made within regions through some other mechanisms such as through financial assets.

4 Empirical Results

4.1 The Data

The data for this study is from the Panel Study on Income Dynamics (PSID). We adopt a standard treatment of the data as detailed in the appendices to Carroll (1994) and Zeldes (1989), among others. The panel data set is cleaned for the poverty sub-sample in 1968, splitoffs from households, non-responses, and those households whose head is either below 26 or above 62 years of age. Although we allow for changes in family composition, we exclude from the data families whose head of household changes. We construct a continuous panel of households from 1981-1987. Earlier and later years were excluded due to the omission of consumption data from the PSID. Consistent with the literature, as the PSID only provides data for food expenditure at home and away, we use this as our consumption expenditure measure.[9]

For income, we distinguish between labor earnings ($\mathbf{y^L}$), total earnings ($\mathbf{y^T}$) which include labor earnings and non-labor earnings, and disposable income ($\mathbf{y^D}$) which subtracts net taxes from total earnings. The data for consumption and income were converted to real 1987 dollars. The data set also provides relevant demographic information which we use below such as the household's region of residence, industry workplace of household members, age of head of household **(AGE)**, number of hours worked by household members **(Hours)**, and measures of family size– Annual Food Needs **(AFN)**. The PSID also provides information on the household's regional location and industrial workplace: these are listed in the Data Appendix. Following Mace (1991), we calculate for each household an aggregate, regional and industry measure of consumption which excludes the household in question, so as to the avoid potential endogeneity of our right hand side variables.

In addition, the 1984 PSID study also asked a number of questions regarding the household's asset holdings. Since the theory of aggregate risk sharing is based upon an environment of complete markets, one would believe that households who hold assets would be more likely to diversify their risks. The assets ownership considered below are: a house (House), a pension at work (Pension), other real estate (Real Estate), farm or business (Farm/Business), stocks (Stock), a checking or savings account or certificate of deposit (Savings), and a bond, bond fund or life insurance (Bonds/Insurance). As well, since Zeldes (1989) and others argue that households are less likely to be liquidity constrained if they own a house or stocks, we also consider this as well (House or Stock). A list of the PSID's 1984 questions for financial asset ownership are presented in the Data Appendix.

4.2 Empirical Regularities

Before examining our estimation results, we present some descriptive statistics of the data. In Tables 1A and 1B, we present some simple cross-correlations of consumption and labor

[9]Atkeson and Ogaki (1996) provide supporting evidence on the additive separability of food in household preferences for India.

income.[10] The table reveals two key aspects of the data as regards consumption insurance: First, in direct contrast to the findings in regional studies for the U.S. cited above, the average correlation between household consumption and aggregate consumption (.063) are higher than the average correlation between household income and aggregate income (.058). However, this phenomena also holds for the regional and industry measures of consumption and income. Hence, while there seems to be some support for risk sharing in the data, the simple correlations cannot distinguish between whether this is happening at the within region and industry level, or at the aggregate level (i.e. across region and industry level). The formal evidence presented below in sub-section 4.3 will separate out these issues.

Second, a household's consumption correlation with aggregate consumption does not seem to rise when the household chooses to hold assets. In fact, for households that own other real estate, farms or business, or stocks, the cross correlation household consumption with aggregate consumption lies below the cross correlation of household labor income with aggregate labor income. Indeed, this is a violation of the simple prediction of consumption insurance as pointed to by Backus, Kehoe and Kydland (1992).

There are two additional pieces of evidence that the holding of assets is not contributing substantially to aggregate risk sharing. First, as demonstrated in Table 1B, the correlation of labor income and total income (labor plus non-labor income) is typically very high across sub-samples – approximately .95.[11] One would expect that, *ceteris paribus*, the ownership of assets would provide a hedge against labor earnings, so that the correlation of total income growth with labor income growth would fall as a household owned additional types of assets. As the results in Table 1B demonstrate, however, this is generally not the case.

The second piece of evidence that non-labor earnings are not providing a substantial hedging or insurance role for households can be found in the results to Table 2. Asdrubali, Sorensen and Yosha (1996) provide a compelling methodology for understanding how underlying shocks to income get smoothed through alternative channels.[12] Adopting this method

[10] Each correlation is the household's correlation with the appropriate column variable, which is then averaged over all relevant households in the sample.

[11] In fact, the lowest correlation is for those households who own a business or a farm, and this low correlation is likely to be due to the endogeneity for these households of declaring their income as non-labor earnings rather than as wages or salary.

[12] Also see Melitz and Zumer (1999).

for our application, begin with the following identity:

$$y_{ht}^{L}=\left(\frac{y_{ht}^{L}}{y_{ht}^{T}}\right)\cdot\left(\frac{y_{ht}^{T}}{y_{ht}^{D}}\right)\cdot y_{ht}^{D} \tag{26}$$

Following Asdrubali, Sorensen and Yosha (1996), the smoothing of labor income takes place capital markets and the tax-transfer system if $\left(\frac{y_{ht}^{L}}{y_{ht}^{T}}\right)$ and $\left(\frac{y_{ht}^{T}}{y_{ht}^{D}}\right)$ co-vary positively with y_{ht}^{L}, respectively. Applying the methodology in Asdrubali, Sorensen and Yosha (1996) to expression (26), it can be shown that the variation in the growth in household labor income can be decomposed as $1=\gamma^{K}+\gamma^{T}+\gamma^{U}$, where these parameters are obtained from the following regressions:[13]

$$\begin{aligned} Capital\ Markets &: \Delta(log(y_{ht}^{L}))-\Delta(log(y_{ht}^{T}))=\gamma^{K}\Delta log(y_{ht}^{L})+u_{ht}^{K}\\ Taxes\ \&\ Transfers &: \Delta(log(y_{ht}^{T}))-\Delta(log(y_{h}^{D}t))=\gamma^{T}\Delta log(y_{ht}^{L})+u_{ht}^{T}\\ Unsmoothed &: \Delta(log(y_{ht}^{D}))=\gamma^{U}\Delta log(y_{ht}^{L})+u_{ht}^{U}\end{aligned} \tag{27}$$

The Capital Market equation, where the difference between labor income growth and total income growth is regressed against labor income growth, reflects the extent to which capital markets help to smooth shocks to labor income growth (γ^{K}). The Tax and Transfer equation, where the difference between total income growth and disposable income growth is regressed against labor income growth, reflects the extent to which taxes and transfers smooth shocks to labor income growth (γ^{T}). The final equation reflects the amount of labor income growth that is not smoothed by either capital markets or taxes and transfers, and hence is labeled Unsmoothed (γ^{U}).

Estimation results for (27) are present in Table 2. The rows of the table present estimates of the smoothing parameters γ^{K}, γ^{T} and γ^{U} as well as the parameter's estimated standard errors. There are three key findings. First, non-labor earnings (i.e. capital markets) play only a limited role in smoothing shocks to labor income. For example, for the complete

[13]As in Asdrubali, Sorensen and Yosha (1996), each equation also includes a constant and time dummy variables.

sample, capital markets smooth only 1.6 percent of shocks to labor income. The asset that appears to provide the greatest smoothing role is stocks, which provides a smoothing role for labor income of 2.9 percent. Even so, the magnitude of even the smoothing role for capital markets for households that own stocks is rather limited. Second, the smoothing role for taxes and transfers is substantially larger than that for capital markets. Returning to the example of the complete sample, taxes and transfers smooth 23.7 percent of the shocks to labor income growth. This smoothing role is over ten times larger than that for capital markets. Finally, the estimates in the table suggest that much of the shocks to labor income growth are unsmoothed. For the entire sample of households, 73.4 percent of labor income fluctuations are left unsmoothed. The range spans from a high of 78.9 percent for households that own real estate (other than their primary home) to a low of 64.0 for those who own bonds or life insurance.[14]

While the results in Table 2 are suggestive of an extremely limited role for capital markets in smoothing fluctuations in labor income, it is likely to be very downward biased due to the fact that much of asset wealth may be in the form of unrealized capital gains and losses which will not be reported until realized. Hence a household's 'true' non-labor earnings may be imprecisely measured by their 'reported' non-labor earnings, and it is the former that is a main determinant of the extent to which agents consume out of lifetime resources.[15] Accordingly, while we have documented only a small role for capital markets in helping to smooth income (Table 2), raising the cross correlation of consumption (Table 1A) and lowering the cross correlation of labor income to total income (Table 1B), the results presented below provide a more direct measure for assessing the extent to which asset holdings by households affect their ability to share risk.

[14]These numbers differ from those in Asdrubali, Sorensen and Yosha (1996): They find that for state level data, 39 percent of shocks to Gross State Product is smoothed by capital markets, and 13 percent is smoothed by the federal government. On important source of this discrepancy is that, since they use state level data, they do not capture idiosyncratic shocks specific to households that are not shared.

[15]In addition, an agent could truthfully report zero non-labor earnings and still have access to assets which allow it to transfer resources across time. Common examples of this are social security contributions and benefits, as well as a checking account that pays a zero rate of interest. Of course, one cannot borrow or lend against future social security payments.

4.3 Formal Evidence for Risk Sharing

In this section, we present our estimates of the fraction of household consumption behavior that is due to within region risk sharing, within industry risk sharing, aggregate risk sharing, and the extent to which households do not share risk but rather consume out of their individual permanent incomes. The equation we estimate is:

$$\begin{aligned}\Delta log(c_{ht}) - \Delta log(c_t^a) &= \theta_r(\Delta log(c_t^r) - \Delta log(c_t^a)) + \theta_i(\Delta log(c_t^i) - \Delta log(c_t^a)) \\ &+ \theta_p(\Delta log(y_{ht}^p) - \Delta log(c_t^a)) + \delta X_{ht} + \epsilon_{ht}. \qquad (28)\end{aligned}$$

Equation (28) differs from that outlined in section 3 only by the inclusion of heterogenous, time varying preferences across households. Part of these preferences are functions of observable variables which we embody in δX_{ht}. As in Hess and Shin (1999), the variables we use are: Age, Age^2, the growth in hours worked by the household (HOURS) and the change in the household's size as represented by their annual food needs (AFN). The age and family size variables are standard in the literature (e.g. see Zeldes). The inclusion of hours is discussed extensively in Hess and Shin (1999), and is based on incorporating leisure into the household's utility function. Unobservable preference shocks are embodied in the error term ϵ_{ht}.

As discussed above, an essential element for estimating this specification is to include an estimate of the revision in permanent income, $\Delta log(y_{ht}^p)$. This requires an investigation into the time series dynamics of household labor income and then using these estimates to construct household measures of permanent income. The equation we estimated on the PSID data for household labor income is as follows:

$$log(y_{ht}^L) = \alpha_h + \rho log(y_{ht-1}^L) + \gamma Z_{ht} + \eta_{ht} \qquad (29)$$

We include standard demographic variables into the household labor income equation such as Age, Age^2 and an eduction variable for the number of formal years of eduction the head of household has undertaken (Educ). The first two terms capture the hump-shaped feature of household labor income. The latter term captures the benefits to eduction on raising a household's labor income profile.

Equation (29) is a standard fixed effects, dynamic panel data model. Unfortunately, the estimation of this relatively straightforward specification is problematic, for reasons pointed out below. Table 3 provides results from a number of alternative approaches to estimating this panel data model. The first column of results reports the simple ordinary least squares (OLS) estimate of this model, where we do not allow for fixed effects but rather assume that all households share the same intercept term. For this case, the estimate of ρ is quite high, above .7, while the demographic variables are significant and consistent with hump-shaped labor income profiles. The second column of results were also obtained with OLS, except that fixed effects were removed from the data. Strikingly, the estimate of income's persistence, ρ, falls dramatically to less than .1, although still statistically different from zero at the .01 level. The differences in these two approaches is that the fixed effect allows for permanent differences in income levels across households: omitting them (as is done in column (I)) forces these persistent differences to be allocated to the dynamic persistent term ρ.

Unfortunately, the OLS- fixed effects estimator itself provides downward biased estimates of the persistence term ρ – see Nickell (1981) and Anderson and Hsiao (1982). This accounts for the small estimated value of ρ in column (II), especially given the panel's short time dimension. Fortunately, there are a number of useful approaches to circumvent this bias. In particular, there are a number of useful instrumental variables estimation procedures which omit instruments (which OLS does not) which are correlated the transformed residuals. Columns (III) - (IV) provide estimates using three of these procedures. The results in Column (III) were obtained by using the Anderson-Hsiao (1982) estimator (AH), which effectively first differences the specification (thereby removing the fixed effect) and then uses twice lagged labor income ($log(y^L_{t-2})$) and exogenous variables as instruments. The estimation result for the autoregressive term is .45, while the remaining demographic variables remain standard. The results in column (IV) are estimated using the Arellano and Bond (AB) (1991) estimator. The essential difference between the AB estimator and the AH estimator is that the latter expands the list of instruments as the sample size increases.[16] Importantly, the estimated coefficient for ρ falls only slightly to .43. Finally, in the final column we estimate the panel data model using the AH instruments, but allowing for correlation in the error terms across time, much as in three stage least squares (i.e. a combination of instrumental variables and seemingly unrelated estimation). The estimate of the autoregressive coefficient, ρ, changes slightly to .36. Taken together, these three unbiased instrumental variables approaches to estimating the persistence of household income provide relatively consistent findings.

In summary, after controlling for standard demographic variables, household labor income has stationary fluctuations with an autoregressive parameter of approximately .4. To convert this income process into one for innovations to permanent income, one must use the standard formula in expression (22). As the three instrumental variables estimates provide relatively similar estimates of ρ, for the remainder of the paper we use the estimate from the AH estimator and also set the discount factor to .95, which corresponds to a risk free rate of interest of approximately 5.2 percent.[17] Constructing measures of the revision in permanent income in this fashion provides a series that is still highly correlated with the change in household labor income (around .9), though remarkably smoother (the standard deviation is approximately 10 time smaller).

Table 4 presents the empirical estimates of equation (28). The results in column (I) provide an estimate of θ_r after imposing that θ_i and θ_p are zero, so that $\theta_a = 1 - \theta_r$. This allows us to gauge the extent of the deviations from aggregate risk sharing due solely to the lack of risk sharing across regions. The results reported in columns (II) and (III) repeat those in column (I), except that we isolate the effect of within industry risk sharing and household consumption smoothing via permanent income rather than within regional risk sharing as we study departures from aggregate risk sharing. In the final column, we estimate all effects simultaneously.

The results in Table 4 point to the fact that the lack or risk sharing across regions and industries, as well as within regions and industries, provide economically significant and

[16]For example, the set of instruments for the equation in year the final year of the sample can include more lags of household income simply because there is more data available.

[17]We experimented with other values of the discount factor ranging between .9 and .99 and the results in this paper are not meaningfully affected by our choice of .95.

statistically significant departures from aggregate risk sharing. According to the estimates, if we just identify the amount of within region versus across regions risk sharing, 22 percent is not shared across regions, and this effect is significant at the 10 percent level of statistical significance – column (I). In addition, almost 33 percent of risk is shared within industries rather than across them – column (II).[18] The empirical results reported in column (III) where we distinguish between consuming out of permanent income and risk sharing, provides an estimate that approximately 40 percent of consumption is due to the former motive as compared to 60 percent for the latter.[19] However, the estimates in column (IV), where we combine the motives for departure from aggregate risk sharing, report the most damaging evidence against aggregate risk sharing. The fractions of risk that are shared within regions and industries are approximately .2 and .3, respectively, while around 40 percent of consumption is driven by individual household permanent income motives. Taken together, this suggests that the fraction of risk that is shared across all households is less than .10 (1 -.4-.3-.2 = .1). In the bottom row of the table we report the p-value of the test that $\theta_a = 1 - \theta_r - \theta_i - \theta_p = 0$. In column (IV), when all motives for explaining consumption behavior are allowed for, this hypothesis cannot be rejected at conventional levels of significance.

The results in Table 4 suggest that when we consider all households in the sample, there does not seem to be significant levels of aggregate risk sharing taking place, although about half of risk is shared within a household's region and industry. Of course, households may differ in their abilities to share risk across different dimension depending on the types of assets that they hold. In Table 5 we estimate equation (28) for different sub-samples based on the assets that they own. Each sub-sample consists of all the households that own the listed asset in the top row of the table. Hence the households contained in each sub-sample

[18] These findings are similar to those in Hess and Shin (1999), despite using a different sample of the PSID due to reporting issues for some asset variables used in this paper. Moreover, if we include in the regression a measure of current income, the coefficient is insignificantly different from zero.

[19] Though not reported, if we estimate do not measure the key variables as deviations from $\Delta log(c_t^a)$, then this standard permanent income consumption regression provides an estimated coefficient of approximately .8 on the response of household consumption to revisions in their permanent income. This estimate is significantly different from zero at below the .01 level though not significantly different from one. This accords well with the view that households are consuming out of permanent income. See DeJuan and Seater (1999) for additional evidence in favor of the permanent income hypothesis for U.S. households using the Consumer Expenditure Survey.

may hold assets other than the particular asset listed on the top, but each sub-sample excludes those houesholds that do not hold the particular asset listed at the top. At the bottom of the table we also report test results for a number of important hypotheses. The first reports the extent of within industry and region risk sharing ($\theta_r + \theta_i$) and presents the p-value for the hypothesis that this channel of risk sharing is zero. The second presents the estimate of aggregate risk sharing obtained from the identity $\theta_a = 1 - \theta_r - \theta_i - \theta_p$, as well as the p-value from the test of the null hypothesis that $\theta_a \leq 0$ versus the alternative that $\theta_a > 0$. Finally, we report the p-value for the test of the null hypothesis that $\theta_r = \theta_i = \theta_p = 0$.

Table 5 reveals four key findings. First, as demonstrated in the bottom row of the table, in seven out of the eight sub-samples considered, we can reject the hypothesis that θ_r, θ_i, and θ_p are all jointly zero at conventional levels of significance. The sole exception is the households who own bonds or life insurance. Since the households contained in this subsample may hold some other assets, we can not conclude that just bonds or life insurance substantially enhance the ability of sharing risks. However we can conjecture that households that are cautious enough to hold life insurance tend to hold other diverse assets to contribute to a better risk-sharing arrangement.

Second, there is strong evidence that within region and industry risk sharing is quite strong. For example, in six of the eight cases, the coefficient on θ_i is statistically different from zero at below the .1 level. The exceptions are households that own stocks and bonds or life insurance. Also, in half of the cases, the coefficient on θ_r is statistically different from zero at below the .1 level. Taken together, risk sharing within regions and industries is large and statistically different from zero: in seven of the eight cases, $\theta_r + \theta_i$ is statistically different from zero. In addition, for these seven cases when the combination is significant, the value ranges from a low .487 to a high of .812.

The case of families that own some stock is quite interesting in its own right. In particular, for families that own stock, estimates of both θ_i and θ_p become insignificantly different from zero, while the fraction of risk shared within the region takes on its largest value of any sub-sample. This suggests that stock holdings are not particularly good at diversifying region specific risk (and that they are a good means for diversifying industry specific risk) or that households demonstrate a region or 'familiarity' bias to holding stocks. Additional evidence for this 'regional home bias' can be found in Huberman (1997,1999) and Coval and Moskowitz (1997a,b). The international home bias problem, whereby international risk sharing through holding stocks is quite limited, is well known in the literature (e.g. Baxter and Jermann (1997)). An important question, though, is whether the increased integration of international asset markets will lead to an end to the home bias problem. Our findings, using intranational evidence, however, are that the regional home bias problem is still quite large even within a well integrated country. Hence, the international home bias problem is unlikely to disappear even after international integration improves substantially.

Third, revisions in household permanent income also seem to be important driving forces in household consumption, regardless of the types of assets held. In six of the eight cases the coefficient on θ_p is statistically different from zero: the two cases where it is insignificant are for stock holders and those who own bonds or insurance. Importantly, stockholders show the smallest coefficient on θ_p.

Finally, there is only weak evidence that the ownership of assets contributes much to aggregate risk sharing.[20] The strongest evidence of any significant contribution from aggregate risk sharing comes from households that own Bonds/Insurance or housing or stocks. For these two cases, one cannot reject that θ_a is greater than zero at below the .1 level of statistical significance.

The results presented in Table 6 further dramatize the different propensities to share risk based on the number of alternative assets held by each household. The estimates of equation (28) presented in this table are for sub-samples of the data based on the number of types of assets owned by the household. Operationally, we sum the responses to the seven individual assets held, and the results correspond to those households that hold less than or equal to the number of types of assets reported at the top of each column ranging from one to six.[21] *Ceteris Paribus* one would conjecture that as a household holds an increased number of different assets that this should be an avenue for them to share risk with other households. The results in Table 6 in fact demonstrate that, as the number of

[20] McCarthy (1995) finds that aggregate risk sharing improves when households are less likely to be liquidity constrained. However, he does not consider within region and industry risk sharing.

[21] We also tried sorting the households based on their levels of wealth held in each asset, but too few households reported these figures to make such a disaggregate estimation viable.

assets households hold increases up to four, they do share more risk within their regions and industries, but not across them. Further increasing the number exceeding four does not show any further evidence of risk sharing even within their regions and industries. This result is summarized by the following two key findings to this table. First, households who hold just one or fewer assets demonstrate strong consumption smoothing behavior.[22] The estimate of θ^p is insignificantly different from one ($\hat{\theta}^p = 1.075$), and the fraction of risk that is shared within industries or regions ($\hat{\theta}^r + \hat{\theta}^i = 0.004$) is insignificantly different from zero. Moreover, the level of aggregate risk sharing is essentially zero ($\hat{\theta}^a = -0.079$) . As households increase their number of assets to four, however, the estimated fraction of consumption smoothing tends to fall to approximately .4, while the fraction of risk that is shared within industries and regions rises to approximately .5. Again the estimated fraction of aggregate risk sharing is less than .1, and this estimate is insignificantly different from zero. Further increasing the number of assets does not significanltly change the estimated values of them. In summary, the results in Tables 5 and 6 only slightly modify the view that there is very little aggregate risk sharing across households in the sample, while there is still a significant amount of within region and industry risk sharing which tends to rise as households hold more assets.

5 Conclusion

Intranational data provides a natural experiment for re-evaluating puzzles in international macroeconomics. An anomaly that has been well established using international data is that countries insufficiently share risk – see Backus, Kehoe and Kydland (1992). This follows from an earlier literature where it has been argued that there is a 'home bias' in households' asset portfolios – see Feldstein and Horioka (1980) and the recent contribution to this literature by Baxter and Jermann (1997).

The evidence we present in this paper suggests that the level of aggregate intranational risk sharing is negligible. Based on consumption risk sharing regressions, we find that approximately 30% of risk sharing is within industries, 20% of risk sharing is within regions,

[22] To note, only about 15 households report holding no assets.

40% is unshared with other households, and only 10% is shared in the aggregate. Asymmetric information problems have been pointed to as the main source of the lack of insurance against pure idiosyncratic shocks. In addition, it appears that there are a number of financial devices available to households to hedge against other shocks such as regional and industrial shocks. However, one would expect that since regional and industrial shocks do not suffer from incentive problems as do idiosyncratic shocks, that these financial devices should be amply supplied and demanded in order to bring about a more extensive level of intranational risk sharing. Our paper finds that such financial instruments do not exist or are not sufficiently used to diversify these macro risks. Thus it would seem to be very important to understand why.

One explanation is that financial assets do not exist to help overcome region (or country) specific risk and industry related risk. One would think that, as the pace of financial innovation has quickened and participation in financial markets has expanded, that this explanation should weaken through time. Of course, idiosyncratic risk which is still subject to incentive problems may be hard to overcome. As well, since much of a household's human capital is industry specific (as may be their pension assets), the amount of industry specific risk to diversify may be quite large.

An alternative explanation is that households like to invest only in 'the familiar', which would lead them to diversify some idiosyncratic risk but which may not lead to much aggregate risk sharing. Intranational evidence in support of this type of domestic home bias is provided in Coval and Moskowitz (1997a,b) and Huberman (1997,1999). Indeed, given the evidence provided in this paper of the low level of aggregate risk sharing even within the U.S., cross country risk sharing is likely to remain a distant goal for quite some time.

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Data Appendix

Regions

There are nine Regional Divisions in our analysis:

- **New England (NENG):** Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.
- **Middle Atlantic (MATL):** New Jersey, New York and Pennsylvania.
- **East North Central (ENC):** Illinois, Indiana, Michigan, Ohio, and Wisconsin.
- **West North Central (WNC):** Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota and South Dakota.
- **South Atlantic (SATL):** Delaware, the District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia and West Virginia.
- **East South Central (ESC):** Alabama, Kentucky, Mississippi and Tennessee.
- **West South Central (WSC):** Arkansas, Louisiana, Oklahoma and Texas.
- **Mountain (MTN):** Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming.
- **Pacific (PAC):** Alaska, California, Hawaii, Oregon and Washington.

Industries

There are twelve industries in our analysis. The industries are Agriculture, Forestry and Fisheries (AFF), Mining (MIN), Construction (CON), Manufacturing (MAN), Transportation, Communication and other Public Utilities (TCPU), Wholesale and Retail Trade (WRT), Finance, Insurance and Real Estate (FIRE), Business and Repair Services (BRS), Personal Services (PS), Entertainment and Recreational Services (ERS), Professional and Related Services (PRS), and Public Administration (PA).

Assets

There are seven asset questions used to distinguish households by the types of assets that they hold 'Yes' answers to these questions were coded as 1, and all other responses were coded 0:

- **House:** Do you have ownership of your current residence?
- **Pension:** Does the head of household's current job provide him/her with a pension?

- **Real Estate:** Do you have positive net value of real estate other than your main home?
- **Farm/Business:** Do you have positive net value in a farm or business asset?
- **Stock:** Do you have shares in publicly held corporations, mutual funds, or investment trusts, including stocks in IRAs?
- **Savings:** Do you have a checking account, savings account, money market fund, certificate of deposit, savings bond, Treasury Bill or other IRA?
- **Bonds/Insurance:** Do you other investments in trusts or estates, bond funds, life insurance policies or special collections?

Table 1A : Empirical Regularities of Household Consumption Growth 1982-1987 PSID Data

	Correlation of $\Delta log(c_{ht})$ with			
Sample	$\Delta log(c^a)$	$\Delta log(c^r)$	$\Delta log(c^i)$	N
ALL	.063	.055	.063	994
House	.067	.055	.056	796
Pension	.068	.063	.063	579
RealEst.	.020	.015	.022	263
Farm/Business	.031	.063	.029	225
Stock	.047	.046	.027	359
Savings	.059	.053	.059	908
Bonds/Insurance	.069	.052	.055	327
House or Stock	.057	.052	.048	835

Notes: $\Delta log(c_{ht})$, Δc^a, Δc^r, and Δc^i are the growth in household, aggregate, regional and industry consumption of food, respectively. N is the number of households. The column labeled Sample refers to the sub-sample of the data examined. These sub-samples are discussed in the text. The correlations were obtained by calculating for each household's correlation of consumption growth with the variable listed in the column, and then averaging over all households in the sample.

Table 1B: Empirical Regularities of Household Labor Income Growth 1982-1987 PSID Data

	Correlation of $\Delta log(y^L_{ht})$ with					
Sample	$\Delta log(y^a)$	$\Delta log(y^r)$	$\Delta log(y^i)$	$\Delta log(y^T_h t)$	$\Delta log(y^D_{ht})$	N
ALL	.058	.030	.031	.954	.877	994
House	.057	.027	.032	.948	.864	796
Pension	.068	.031	.028	.983	.874	579
RealEst.	.040	.027	.034	.953	.932	263
Farm/Business	.042	.048	.055	.906	.857	225
Stock	.060	.023	.022	.957	.851	359
Savings	.059	.031	.032	.954	.875	908
Bonds/Insurance	.024	.028	.040	.945	.822	327
House or Stock	.060	.027	.032	.949	.866	835

Notes: See Table 1a. $\Delta log(y_{ht})$, $\Delta log(y^a)$, $\Delta log(y^r)$, and $\Delta log(y^i)$ are the growth in household, aggregate, regional and industry consumption of food, respectively. $\Delta log(y^L_{ht})$, $\Delta log(y^T_h t)$, and $\Delta log(y^D_{ht})$, are the growth in household labor income, total income (labor plus non-labor income), and disposable income (total income less net taxes), respectively. The correlations were obtained by calculating for each household's correlation of labor income growth with the variable listed in the column, and then averaging over all households in the sample.

$$\begin{aligned} Capital\ Markets &: \Delta(log(y^L_{ht})) - \Delta(log(y^T_{ht})) = \gamma^K \Delta log(y^L_{ht}) + u^K_{ht} \\ Taxes\ \&\ Transfers &: \Delta(log(y^T_{ht})) - \Delta(log(y^D_h t)) = \gamma^T \Delta log(y^L_{ht}) + u^T_{ht} \\ Unsmoothed &: \Delta(log(y^D_{ht})) \qquad\qquad = \gamma^U \Delta log(y^L_{ht}) + u^U_{ht} \end{aligned}$$

Table 2: 'Smoothing' of Household Labor Income Growth
1982-1987 PSID Data

Sample	*CapitalMarkets* ($\hat{\gamma}^K$)	*Taxes&Transfers* ($\hat{\gamma}^t$)	*Unsmoothed* ($\hat{\gamma}^u$)	*Nobs.*
ALL	$.016^b$	$.237^a$	$.734^a$	5964
	(.007)	(.043)	(.043)	
House	$.023^b$	$.245^a$	$.717^a$	4776
	(.009)	(.057)	(.055)	
Pension	.003	$.296^a$	$.677^a$	3474
	(.007)	(.087)	(.083)	
RealEst.	.023	$.146^a$	$.789^a$	1578
	(.015)	(.017)	(.043)	
Farm/Business	.018	$.189^a$	$.757^a$	1350
	(.019)	(.040)	(.052)	
Stock	$.029^b$	$.291^a$	$.678^a$	2154
	(.012)	(.102)	(.097)	
Savings	$.021^a$	$.242^a$	$.726^a$	5448
	(.008)	(.047)	(.097)	
Bonds/Insurance	$.018^c$	$.310^a$	$.640^a$	1962
	(.011)	(.114)	(.103)	
House or Stock	$.023^a$	$.241^a$	$.721^a$	5010
	(.009)	(.055)	(.053)	

Notes: Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} refer to statistical significance at below the .01, .05 and .10 levels, respectively. The rows of the table denote the sub-sample of the data. Nobs. is the number of panel data observations, $N \times T$, the number of households multiplied by the number of time series observations.

$$log(y^L_{ht}) = \alpha_i + \rho log(y^L_{ht-1}) + \gamma X_{ht} + y_{ht}$$

Table 3: Panel Data Regression of Household Income
1982-1987 PSID Data

	(I)	(II)	(III)	(IV)	(V)
	OLS w/o FE	OLS w/ FE	AH w/ FE	AB w/ FE	AH 3SLS w/ FE
Constant	1.165^a	$.009^a$	NA	NA	.034
	(.107)	(.004)	(NA)	(NA)	(.001)
ρ	$.783^a$	$.094^a$	$.448^a$	$.429^a$	$.360^a$
	(.008)	(.014)	(.071)	(.067)	(.034)
Age	.001	$.060^a$	$.046^a$	$.047^a$	$.064^a$
	(.005)	(.008)	(.007)	(.007)	(.003)
Age^2	$-.005$	$-.073^a$	$-.066^a$	$-.067^a$	$-.091^a$
	(.006)	(.010)	(.008)	(.008)	(.003)
Educ	$.032^a$	$.025^a$	.008	$.009^c$	$.007^b$
	(.003)	(.009)	(.006)	(.006)	(.003)
s	.403	.326	.366	.364	.345
$Nobs$	5964	5964	3976	3976	3976

Notes: See Table 1A-C. Estimated standard errors are in parentheses. The first column reports ordinary least squares estimates of the parameters when there is no allowance for Fixed Effects. The second column reports ordinary least squares estimates of the parameters, allowing for fixed effects. The third and fourth column reports Anderson-Hsiao (1982) estimates and Arellano and Bond (1991) of the parameters, respectively. The final column reports estimates of the parameters using a three stage least squares version of the Anderson-Hsiao (1982) estimator. s reports the estimated standard error of the residual.

$$\Delta log(c_{ht}) - \Delta log(c_t^a) = \theta_r(\Delta log(c_t^r) - \Delta log(c_t^a)) + \theta_i(\Delta log(c_t^i) - \Delta log(c_t^a)) + \theta_p(\Delta log(y_t^p) - \Delta log(c_t^a)) + \delta X_{ht} + \epsilon_{ht}.$$

Table 4: Consumption Risk Sharing Regressions
1982-1987 PSID Data

Regressors	(I)	(II)	(III)	(IV)
Age_{ht}	$.018^a$	$.018^a$	$.018^a$	$.017^a$
	(.003)	(.003)	(.003)	(.003)
$Age_{ht}^2/100$	$-.020^a$	$-.020^a$	$-.020^a$	$-.020^a$
	(.003)	(.003)	(.003)	(.003)
AFN_{ht}	$.666^a$	$.665^a$	$.660^a$	$.661^a$
	(.028)	(.028)	(.028)	(.028)
$\Delta log(Hours_{ht})$	$-.035^c$	$-.034^c$	$-.045^b$	$-.044^b$
	(.018)	(.018)	(.018)	(.018)
$\Delta log(c_t^r) - \Delta log(c^a)$	$.222^c$			$.218^c$
	(.124)			(.123)
$\Delta log(c_t^i) - \Delta log(c^a)$		$.326^a$		$.310^a$
		(.112)		(.112)
$\Delta log(y_{ht}^p) - \Delta log(c^a)$			$.398^a$	$.389^a$
			(.105)	(.105)
$\overline{R}^2$	.260	.261	.262	.263
$Nobs$	5958	5958	5958	5958
$\theta^r + \theta^i$				.527
				[.001]
θ^a	.778	.674	.602	.082
	[.001]	[.001]	[.001]	[.672]

Notes: See Tables 2 and 3. $\overline{R}^2$ is the adjusted R-squared. The p-values for the test that $\theta^r + \theta^i = 0$ and $\theta^a = 1 - \theta^r - \theta^i - \theta^p = 0$ are reported in square brackets, immediately below the corresponding row. These regressions were estimated with an AR(1) error term, and time effects have been removed from the obervable preference variables, X_t.

Table 5: Consumption Risk Sharing Regressions
1982-1987 PSID Data

$Variable$	$House$	$Pension$	$RealEst.$	$Farm/Business$
Age_{ht}	.020^a	.020^a	.010	.025^a
	(.003)	(.004)	(.007)	(.007)
$Age^2_{ht}/100$	$-$.023^a	$-$.023^a	$-$.012	$-$.029^a
	(.004)	(.005)	(.008)	(.008)
AFN_{ht}	.618^a	.660^a	.583^a	.570^a
	(.032)	(.036)	(.059)	(.062)
$\Delta log(Hours_{ht})$	$-$.043^b	$-$.071^a	$-$.071^b	$-$.003
	(.020)	(.027)	(.039)	(.035)
$\Delta log(c^r_t) - \Delta log(c^a)$	.194	.381^b	.153	.458^c
	(.133)	(.154)	(.229)	(.265)
$\Delta log(c^i_t) - \Delta log(c^a)$	.309^a	.272^c	.433^c	.353^c
	(.120)	(.154)	(.224)	(.206)
$\Delta log(y^p_{ht}) - \Delta log(c^a)$	.269^b	.292^b	.514^a	.569^a
	(.115)	(.145)	(.195)	(.185)
$\overline{R}^2$	.237	.269	.216	.283
$Nobs$	4772	3471	1578	1349
$\theta^r + \theta^i$	.503	.653	.587	.812
	[.004]	[.002]	[.065]	[.015]
θ^a	.226	.053	$-$.101	$-$.381
	[.140]	[.417]	[.906]	[.923]
$\theta^p = \theta^r = \theta^i = 0$	[.002]	[.003]	[.011]	[.002]

Notes: See Table 4. The top row reports the type of asset held by households in the sub-sample. p-values are reported in square brackets. $(\theta_r + \theta_i)$ is the amount of within industry and region risk sharing, and immediately below is presented the p-value for the hypothesis this channel of risk sharing is zero. Estimates of θ_a are reported from the identity: $1 - \theta_r - \theta_i - \theta_p$. Immediately below is the p-value from the test of the null hypothesis that $\theta_a \leq 0$ versus the alternative that $\theta_a > 0$. The final row reports the p-value for the test of the null hypothesis that $\theta_r = \theta_i = \theta_p = 0$. Continued on next page.

Table 5 (continued): Consumption Risk Sharing Regressions 1982-1987 PSID Data

Variable	*Stock*	*Savings*	*Bonds or Life Insurance*	*House or Stock*
Age_{ht}	$.017^a$	$.017^a$	$.022^a$	$.020^a$
	(.005)	(.003)	(.005)	(.003)
$Age^2_{ht}/100$	$-.020^a$	$-.020^a$	$-.025^a$	$-.023^a$
	(.006)	(.004)	(.006)	(.004)
AFN_{ht}	$.614^a$	$.671^a$	$.675^a$	$.636^a$
	(.043)	(.028)	(.050)	(.031)
$Hours_{ht}$	.005	$-.039^b$	$-.039$	$-.035^c$
	(.033)	(.019)	(.034)	(.020)
$\Delta log(c^r_t) - \Delta log(c^a)$	$.506^a$	$.211^c$	.185	.197
	(.187)	(.126)	(.210)	(.129)
$\Delta log(c^i_t) - \Delta log(c^a)$	.163	$.366^a$	.116	$.289^b$
	(.178)	(.115)	(.191)	(.118)
$\Delta log(y^p_{ht}) - \Delta log(c^a)$	.097	$.431^a$	.251	$.241^b$
	(.169)	(.107)	(.183)	(.113)
$\overline{R}^2$	.266	.275	.227	.250
$Nobs$	2151	5444	1960	5006
$\theta^r + \theta^i$	.669	.577	.302	.487
	[.008]	[.001]	[.280]	[.005]
θ^a	.232	$-.008$	.446	.270
	[.221]	[.964]	[.091]	[.094]
$\theta^p = \theta^r = \theta^i = 0$	[.034]	[.001]	[.381]	[.004]

Notes: See prior page.

Table 6 : Consumption Risk Sharing Regressions
1982-1987 PSID Data

	Number of Assets Held					
Variable	$\leq$ *One*	$\leq$ *Two*	$\leq$ *Three*	$\leq$ *Four*	$\leq$ *Five*	$\leq$ *Six*
Age_{ht}	.008	.009	.017***	.017***	.017***	.017***
	(.013)	(.007)	(.005)	(.003)	(.003)	(.003)
$Age_{ht}^2/100$	−.008	−.009	−.019***	−.019***	−.020***	−.019***
	(.016)	(.009)	(.005)	(.004)	(.004)	(.004)
AFN_{ht}	.622***	.763***	.702***	.685***	.663***	.662***
	(.10242)	(.065)	(.039)	(.032)	(.029)	(.028)
$Hours_{ht}$	−.090	−.038	−.055**	−.044**	−.041**	−.046**
	(.056)	(.037)	(.024)	(.020)	(.019)	(.019)
Δy_{ht}^p	1.075***	.728***	.514***	.374***	.376***	.376***
	(.40967)	(.254)	(.153)	(.122)	(.110)	(.106)
Δc_t^r	.170	.071	.025	.155	.204	.215*
	(.563)	(.314)	(.182)	(.143)	(.129)	(.124)
Δc_t^i	−.166	.287	.412***	.377***	.338***	.319***
	(.420)	(.266)	(.161)	(.130)	(.116)	(.113)
$\overline{R}^2$	.227	.275	.294	.276	.266	.263
$Nobs$	532	1318	2973	4562	5592	5898
$\theta^r + \theta^i$	.004	.359	.436	.532	.542	.534
	[.994]	[.374]	[.073]	[.005]	[.001]	[.001]
θ^a	−.079	−.088	.048	.092	.081	.089
	[.921]	[.851]	[.863]	[.682]	[.689]	[.649]
$\theta^p = \theta^r = \theta^i = 0$	.075	.019	.001	.001	.001	.001
	[.181]	[.020]	[.001]	[.001]	[.001]	[.001]

Notes: See Table 5. The number of assets held by the family is determined by summing the responses to the seven individual assets held. The reported results correspond to those households that hold less than or equal to the number of assets reported at the top of each column.