International Risk Sharing Across the Twentieth Century

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Abstract

Is international risk sharing really as low as most research has shown? Was it better in the laissez-faire heyday of international capital markets of the early twentieth century than in the recent past when controls and interventions hampered flows and intra-national integration took center stage? We take a look at the long-run evidence. To do this, we rely on recent work by Brandt, Cochrane and Santa Clara (2006) which develops a new measure of international risk sharing based on asset pricing models. We employ their measure for the period 1900 to 1999 for the US against its major trading partners. This paper finds evidence that international risk sharing has been very high throughout the twentieth century. Notwithstanding some small downward movements, there is no evidence that international risk sharing has improved dramatically over the last century. This calls into question either the validity of the measure or commonly held priors on international risk sharing in the long run.

1. Introduction

If risk sharing is an important and beneficial feature of international capital market integration, the gains have been ostensibly elusive. Studies like Backus, Kehoe and Kydland (1992) based on consumption data have found devastatingly low correlations in international consumption movements. Nevertheless, in a recent paper by Brandt, Cochrane, and Santa-Clara (2006)—henceforth, BCSC—a new view from asset markets is proposed. The authors find an extremely high level of risk sharing amongst several industrial nations between 1975 and 1998 based on the following measure:

$$(1)\quad M = 1 - \frac{\sigma^2 \ln\left(\frac{e_{t+1}}{e_t}\right)}{\sigma^2\left(\ln m^a_{t+1}\right) + \sigma^2\left(\ln m^h_{t+1}\right)}$$

This measure relates the volatility of the real exchange rate (e) to the volatility of the growth of marginal utility of consumption (m) in a foreign (a) and domestic (h) market. The notion is that the following equation links the real exchange rate to the growth in the marginal utilities:

$$(2)\quad \ln\left(\frac{e_{t+1}}{e_t}\right) = \ln m^a_{t+1} - \ln m^h_{t+1}$$

Equation (2) is very roughly related to an interest parity condition. The basis for the measure M is to relate the volatility of the difference in marginal utility growth, which should be close to zero in the case of perfect risk sharing, to the total amount of volatility to be explained. BCSC make the point that the equity premium literature suggests that the volatility of marginal utility growth, as implied by asset market excess returns, is on the order of 50 percent or more. Real exchange rate volatility is much less. From equation (2) we can see that if this is the case marginal utility growth must be highly correlated. This logic leads to the following interpretation of equation (1): as M increases, risk sharing improves.

Data from the world's richest countries over the past 30 years show that the volatility of exchange rates is on the order of ten percent while the volatility of marginal utility growth

inferred from the volatility of excess returns over risk-free rates is roughly 50 percent. These numbers imply a risk sharing measure of 0.98. Indeed, BCSC find values of *M* no lower than 0.98 between the US and the UK, Germany, and Japan during these years. This constitutes an almost staggering mystery given the strong rejection in the literature of even moderate international risk sharing based on low consumption correlations. Yet there is no clear theoretical reason to dispute the logic of the BCSC measure given that the alternative implies consumers are far away from their first-order conditions for utility maximization.

We propose to look at the long-run performance of *M* for the United States versus a set of developed countries. The merits of this approach are several. First, the particular sample (1975-1998) used in BCSC could be anomalous. Longer time series might present a resolution to the paradox. Moreover there are strong grounds to believe a priori that risk sharing in the last thirty years might have been much higher than in previous historical periods given that capital controls disappeared during these years amongst the richest nations. Looking back further, Obstfeld and Taylor (2004), in an authoritative survey of capital market integration, suggest that integration has followed a U-shaped pattern over the last 130 years. The high points of the U are the 1880-1913 period and the period from 1980 to the present. In these two periods, measures of gross flows of capital relative to GDP were quite high when compared to the period between 1920 and 1980. At the same time, gross flows amongst developed countries in the last ten to fifteen years have surpassed anything seen historically. Finally, to the best of our knowledge, no one has measured the amount of risk sharing prior to 1945 either from the consumption data or from the asset markets. High frequency/high quality consumption data only became available with the extension of national income accounting after World War II. The BCSC measure, to the extent it is a reliable measure, is one way to get a grasp on the extent of international risk sharing that

existed prior to the widespread adoption of heavily restrictive capital controls in the 1930s. However we are cautious in interpreting the BCSC measure as the only measure of risk sharing.

There are a few reasons to be suspicious. Our long-run view of *M* exhibits little evidence for either a secular improvement in international risk sharing nor is there evidence of a strong U shaped pattern in risk sharing. Rather, we find that periods of strong exchange rate volatility like the 1930s, the late 1960s/early 1970s, and the mid-1980s have the lowest measures. But the risk sharing index we calculate is nearly *always* above 0.90 for the entire twentieth century. This suggests that international risk sharing has been remarkably constant over time.

This result sits at odds both with the view from the consumption correlations literature and the view from economic history that capital market integration was very low between roughly 1930 and 1970. This paradox suggests that the BCSC measure is faulty in some other regard. As is typical with using price-based evidence other factors could be driving the findings, in that the underlying correlations are not sufficient evidence of a risk sharing mechanism. After reviewing the evidence, we propose the possibility that the measure *M* may be hard to interpret as a risk sharing measure when exchange rate volatility is low for other reasons beside goods market arbitrage. When this is so, marginal utility growth measured via the exchange rate appears to be highly correlated. But this could be due to the underlying similarity of fundamentals and policies. Moreover, Imbs, Mumatz, Ravn, and Rey (2005) argue that the half-life of deviations in the real exchange rate is 11 months and many studies suggest longer. This seems too long to make sense in the context of a continuous time model.

The rest of this paper proceeds first to a brief introduction to the BCSC derivation of *M*. We then present our data and results for the period 1900 to 2000. After the presentation of the measure we provide some discussion. Finally we offer some speculations on why the asset

market view of international risk-sharing implies such high levels of risk sharing over the entirety of the twentieth century.

2. Measuring International Risk Sharing via Asset Markets

This paper borrows the approach of BCSC to calculate the risk sharing measure of equation (2). The measure is fully explained and derived in BCSC while more detail is provided here in Appendix I. It arises from a standard asset pricing formula. Agents invest in a domestic and a foreign risky asset and each have access to a domestic and foreign risk-free asset. The exchange rate links the returns in foreign currency to returns in domestic units.

To implement the empirical measure of *M*, BCSC show that one needs only to calculate the equity premium by country and the real exchange rate. We use sample analogs to the theoretical constructs in BCSC. The equity premium is calculated as the real rate of return (using ex post observations of inflation) from national stock indices over a risk-free short term rate of interest. Real exchange rates are constructed using widely available data on monthly nominal exchange rate and annual price indexes. All data is either monthly or else annual data is suitably made into monthly growth rates. BCSC derive the following expression

$$(3)\quad \hat{M} = 1 - \frac{\Sigma^{ee}}{\mu^{h'}\Sigma^{-1}\mu^{h} + \mu^{a'}\Sigma^{-1}\mu^{a}}$$

where *h* denotes a home or domestic variable and *a* denotes a foreign variable. The following expressions are used to calculate equation (3). The components we need are domestic excess stock market returns $R_{t+\Delta}$, foreign excess returns $I_{t+\Delta}$, the real exchange rate, e_t (where an increase is an appreciation of the US dollar), and the domestic and foreign interest rates $r_{t+\Delta}$ and $i_{t+\Delta}$. Time is measured in months so that the symbol Δ is equal to one month. Now if the shocks to home and foreign returns and the exchange rate are collected in dz we have

$$\mathrm{dz} = \begin{bmatrix} \mathrm{dz}^h \\ \mathrm{dz}^e \\ \mathrm{dz}^a \end{bmatrix} \text{ and}$$

$$\Sigma = \frac{1}{\mathrm{dt}} \mathrm{E}\left(\mathrm{dz}\mathrm{dz}'\right) = \begin{bmatrix} \Sigma^{hh} & \Sigma^{he} & \Sigma^{ha} \\ \Sigma^{eh} & \Sigma^{ee} & \Sigma^{ea} \\ \Sigma^{ah} & \Sigma^{ae} & \Sigma^{aa} \end{bmatrix},$$

where Σ is the covariance matrix of returns defined below. The vector of expected excess returns on domestic stocks, the exchange rate and foreign stocks for the home investors is

$$(4)\ \mu^h = \begin{bmatrix} \theta^h - r^h \\ \theta^e + i - r \\ \theta^a - i + \Sigma^{ea} \end{bmatrix}.$$

and the equivalent expression for investors abroad is

$$(5.)\ \mu^a = \begin{bmatrix} \theta^h - r - \Sigma^{eh} \\ \theta^e + i - r - \Sigma^{ee} \\ \theta^a - i \end{bmatrix}.$$

In these expressions θ^i,(i=h,a) is the instantaneous *real* return on domestic and foreign risky assets and θ^e is the rate of change of the exchange rate.

With this notation the sample analogs to the above are given by

$$\theta^h - r = \frac{1}{\Delta} E_T R_{t+\Delta},$$

$$\theta^a - i = \frac{1}{\Delta} E_T I_{t+\Delta},$$

$$\theta^e + i - r = \frac{1}{\Delta} E_T \left(\frac{e_{t+\Delta} - e_t}{e_t} + i_{t+\Delta} - r_{t+\Delta} \right),$$

$$dz^h = R_{t+\Delta} - E_T R_{t+\Delta},$$
$$dz^a = I_{t+\Delta} - E_T I_{t+\Delta},$$
$$dz^e = \left(\frac{e_{t+\Delta} - e_t}{e_t} \right) - E_T \left(\frac{e_{t+\Delta} - e_t}{e_t} \right), \text{ and}$$
$$\Sigma = \frac{1}{\Delta} E_T \left(dzdz' \right).$$

As in BCSC we use real returns by deflating for realized inflation. Our base country is the US and the foreign countries and the years for which we have data are Australia (1920-1999), Belgium (1950-1999), Canada (1935-1999), Finland (1960-1999), France (1900-1989), Germany (1925-1999), Italy (1925-1999), Japan (1920-1999), Netherlands (1950-1999), South Africa (1960-1999), Spain (1940-1999), Sweden (1960-1999), and the UK (1900-1999). We calculate the index with overlapping ten year periods 1900-1909, 1905-1914, 1910-1919,…, 1990-1999, resulting in a total of 159 observations. We eliminate the period comprising World War II as capital markets were faced with strict controls during these periods, as other economic relations were not characteristic of market based allocation, and due to issues related to data reliability. All data are taken from the Global Financial Database.

3. Risk Sharing in the Long Run

The risk sharing index is high in absolute terms throughout the entire twentieth century. Figure 1 plots the risk sharing index for the US and the G7 countries in our sample: Canada, France, Germany, Italy, Japan, and the UK. For these pairs, the measure never dips below 0.80 with one exception (Italy in 1985-1995). The average value for the six series is 0.97 with fully 92% of observations being above 0.90 in value. Interestingly, there are times when risk sharing uniformly declines. These periods are 1930-1939, 1965-1975, and 1980-1995. They coincide with large exchange rate swings relative to the volatility in excess returns; hence, the risk sharing

measure dips. It is interesting to note that the risk sharing index for the US and UK is at its maximum prior to World War I between 1900-1915 and in the immediate aftermath of World War II between 1950 and 1965. This is also true in the French case.

These data underline one of our fundamental points: there is most definitely no U-shaped pattern of risk sharing over the long-run as 1980-1995 appears to have as little international risk sharing as the depression years of 1930-1939.

Figure 2 displays the time series plots for our risk sharing measures for all of the countries in our sample. A similar pattern to Figure 1 is noticeable in Figure 2. With three exceptions (Finland in 1965-1975, South Africa in 1980-1990, Spain in 1985-1995), the risk sharing index is above 0.80. For the most part, the risk sharing index stays above 0.90. Risk sharing is again noticeably lower in periods of exchange rate turbulence with the largest swings coming in 1930-1939, 1965-1975, and 1980-1995. Remarkably risk-sharing in the Bretton Woods era does not seem to be significantly different from that in the 1990s.

Frankly, these patterns seem remarkable. The overall level of international risk sharing over the long run is high. This is in line with the observations in BCSC for 1.1975-6.1998. However, these findings still pose a paradox or, at least, a disconnect with the previous literature on international risk-sharing because they are strongly out of line with the consumption correlation calculations that are widely known and extensively documented. Moreover, the level does not seem to depend on trading technologies in either financial markets or in goods markets. Financial market efficiency is thought to have expanded considerably and trade costs are widely believed to have fallen over time. Neither seems to matter for long-run patterns of risk sharing as measured here.

In terms of the levels of risk sharing, BCSC go to great lengths to demonstrate that their finding of very high risk sharing is not due to incomplete markets. They demonstrate that to drive risk sharing down to levels below 0.70 extra risks not spanned by the financial markets must be uncorrelated or negatively correlated and their volatility must be quite high—on the order of 50 percent or greater. Additional uncorrelated risks do not seem to be the reason that the measure *M* is so high. On the other hand, high cross-country correlations and volatility raise the measure but not by more than 0.04 index points. It is possible that we are overstating risk sharing more in the early period than in the later periods because of the greater differences in economic structure between France, the UK, and the US. But these (negatively correlated) shocks would have to be large. While this measure might be too high for peripheral countries, it is hard to think of substantive and ubiquitous negatively correlated shocks for France, the UK, and the US prior to 1913.

3. Risk Sharing over the Long-Run in Comparative Terms

3.1 Patterns of Risk Sharing Prior to World War I

The first wave of globalization between 1850 and 1913 generated massive integration in goods and capital markets. British, French, and German savings scoured the globe in search of viable projects. Many of these included profitable foreign investments, and by the first decade or so of the twentieth century much of British (and probably much of French and German) investment took the form of foreign direct investment via majority equity holdings (Svedberg, 1978). Capital flowed across borders largely without the impediment of government imposed controls. The negative net foreign asset positions in the developing world and the British offshoots like Australia, Canada, New Zealand, and the US were quite large. Australia and

Canada alone had persistent measured current account deficits on the order of 4 to 5 percent of GDP after 1870.

While the theoretical benefits of these capital flows have been noted by Obstfeld and Taylor (2004), no one to our knowledge has come up with a measure of risk sharing in this period. Traditional measures of consumption correlations would be difficult to implement since the national income data is sketchy and not always reliable especially at high frequencies. Our measure is consistent with the conventional wisdom that international capital markets of the time were well integrated. It shows that the capital markets and the goods markets covered most of the risk spanned by the available marketable assets. The measure of risk sharing between the UK and the US is significantly higher in this period than in the 1980s and 1990s. This is compatible with Obstfeld and Taylor's (2004) insights on (the lack of) asset market frictions in this earlier hey day of globalization. It is also consistent with the measure of trade integration provided in Jacks, Meissner, and Novy (2006). There the authors show that trade costs were very low between the two countries up to 1913. Both of these are necessary conditions for allowing for optimal risk sharing (Fitzgerald, 2006)

3.2 Patterns of Risk Sharing in the Interwar Period

Although the measure declines a bit in the tumultuous interwar period, it never falls below 0.90. Here the sample is larger than prior to 1913. Also, despite this being a period of relatively high exchange rate volatility and volatility in real activity in many countries, the risk sharing measure holds up fairly strongly. The economic history literature argues that capital and goods markets recovered the level of integration attained in the run up to World War I by the mid-1920s. It is also clear that the global trading system and international capital markets soon

fell apart at the seams. In the 1930s, nations imposed prohibitive duties, implemented exchange rate policies to trigger competitive devaluations, and raised significant barriers to the free movement of capital. This would seem to be a prime testing ground for the impact of beggar-thy neighbor policies.

A lot of the turmoil amongst the major countries was short-run rather than long-run. Nations reflated together after the rough years of 1931-1936, and amongst the major countries, exchange rate coordination via the Tripartite agreement improved (Bordo, Humpage and Schwartz, 2006). The fact that the measure falls, but only slightly, gives further historical vindication to the observation made in BCSC that the marginal utility growth of risks not insured in asset markets would have to be extremely volatile *and* exchange rate movements would have had to have been extremely high to yield a low level of risk sharing. In other words, the BCSC measure here suggests a moderate decline in the ability of nations to insure risk across the period but nothing extreme in absolute terms.

3.3 Patterns of Risk Sharing in the Post-World War II Era

This period spans several major macroeconomic events: the post-war European miracle accompanied by low inflation, the collapse of Bretton Woods, and the major US dollar exchange rate volatility of the 1980s. With only a handful of exceptions amongst our large sample does the index *M* fall below 0.90. The surprising thing is that the measure stays above 0.95 in the 1950s when current account convertibility was extremely limited and international capital flows were also relatively meager. The measure is lowest in 1965-1975 and 1985-1995. These periods span the largest amount of exchange rate volatility amongst leading nations and yet the measure in the early 1970s is above 0.95 (excluding the observations for Finland). In the 1980s the measure

against smaller emerging markets and Italy dives to between 0.75 and 0.90 but for other major countries it is still above 0.90. Again, the ability of asset markets and goods markets stabilize risks seems remarkable.

4. PPP, Arbitrage and Risk Sharing

One reason that *M* is so high is that exchange rates are not very volatile relative to the implied volatility of marginal utility growth. If goods markets were perfectly integrated, then asset holders who take their gains abroad to cover losses at home will do so in real goods generated in the foreign market. These purchases and exports would lead to price equalization in a simple one commodity world. When exchange rates fluctuate the market may be indicating that risk sharing is being impeded. Assuming preferences are homogeneous across countries, consumption cannot grow at the same rate given different relative prices.

In fact, the lesson from the BCSC measure and the data presented here is that that real exchange rates are not nearly as volatile as excess returns in asset markets. This appears to be consistent with the failure of uncovered interest parity conditions found many times over in the literature. Exchange rates do not fluctuate nearly enough to erase persistently wide margins in returns across countries. This appears to be the case in our methodology despite using fairly long time horizons. Were something like interest parity to hold we suspect that the risk sharing measure would show significantly less risk sharing. And in fact 95 percent of the variance in *M* across all observations is explained by the variance of real exchange rate volatility. The mystery remains as to why exchange rates do not move nearly as much as return differential implies they should. This conundrum appears to be the case over the very long-run across a number of different regimes.

Even so exchange rates do fluctuate and shocks take time to dissipate. The half life of deviations of the real exchange rate from its long-run equilibrium value has been estimated recently by Imbs, Mumatz, Ravn and Rey (2005) as about 11 months. This is shorter than the previous consensus view of four to five years established using long-run data but it still not as instantaneous as theory would predict. If nearly perfect risk-sharing is a fact of life, then it does not seem to occur instantaneously but only at slightly longer horizons of one to five years. At the micro level, this seems too long to be consistent with period to period consumption smoothing.

5. Conclusion

Using a measure due to Brandt, Cochrane and Santa-Clara (2006), we take the first long-run view of international risk sharing based on asset price data. We find that risk sharing has been consistently high over the long-run. It is much higher than the view generated from previous studies which looked at consumption correlations alone. The high level of risk sharing over a long period with large changes in international capital market integration deepens the mystery clearly enunciated in the Brandt, Cochrane and Santa-Clara paper.

We do not think of investors as being overly well diversified in their asset holdings and hence it would be difficult for them to insure risks in foreign markets if they have no position in such markets. Extreme home bias in preferences could be a resolution to the price-quantity paradox we are facing here, but we are unaware of any model that can generate such distinct findings and sensitivity testing in BCSC suggests this is not a problem.

Aggregation and the distribution of risk sharing is another problem for interpreting our results. Asset market participation is weak in most countries and has most likely increased strongly over the last one hundred years. Those participating have typically skewed their

holdings in the last few decades toward home equities though this appears to be changing quite rapidly. Only a select few in the past have been able to reap the rewards of diversification. Still, of those that participate, risks seem to be well diversified.

We also speculate that there is a lot more to the fact that exchange rate volatility is so low relative to asset market volatility (‘exchange rates are too smooth’ in the words of BCSC) than mere goods market arbitrage. Common, uninsured monetary and real supply shocks due to the fact that our sample of nations are roughly technologically comparable means that exchange rates may be a lot less volatile than they would be in two separate island economies. Whatever the case may be, the asset market view suggests that over the long run through diverse institutional environments risk sharing has been quite high. .

Appendix I

The BCSC model is a standard continuous time finance problem. There are real returns on risk free assets (B^i), equities (S^i) and from the exchange rate e where $i = h,a$. These are given by the following diffusion processes:

$$\frac{\mathrm{d}B^h}{B^h} = r^h \mathrm{d}t,$$
$$\frac{dS^h}{S^h} = \theta^h \mathrm{d}t + \mathrm{d}z^h,$$
$$\frac{\mathrm{d}e}{e} = \theta^e \mathrm{d}t + \mathrm{d}z^e,$$
$$\frac{\mathrm{d}B^a}{B^a} = r^a \mathrm{d}t, \text{ and}$$
$$\frac{\mathrm{d}S^a}{S^a} = \theta^a \mathrm{d}t + \mathrm{d}z^a.$$

Discount factors price the assets according to the following equation

$$\frac{\mathrm{d}\Lambda^i}{\Lambda^i} = -r^i \mathrm{d}t - \mu^i{}' \Sigma^{-1} \mathrm{d}z, \; i = h,a$$

where

$$r^i \mathrm{d}t = -\mathrm{E}\left(\frac{\mathrm{d}\Lambda^i}{\Lambda^i}\right),$$
$$\mu^i \mathrm{d}t = -\mathrm{E}\left(\frac{\mathrm{d}\Lambda^i}{\Lambda^i} dR\right),$$

and R is an excess returns process. The rest of the model is illustrated above and sample counterparts are used for population moments. We, like BCSC, assume constant conditional covariances between growth in marginal utility and the excess return process.

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Figure 1: Risk Sharing Index, 1900-1999, US versus the G7

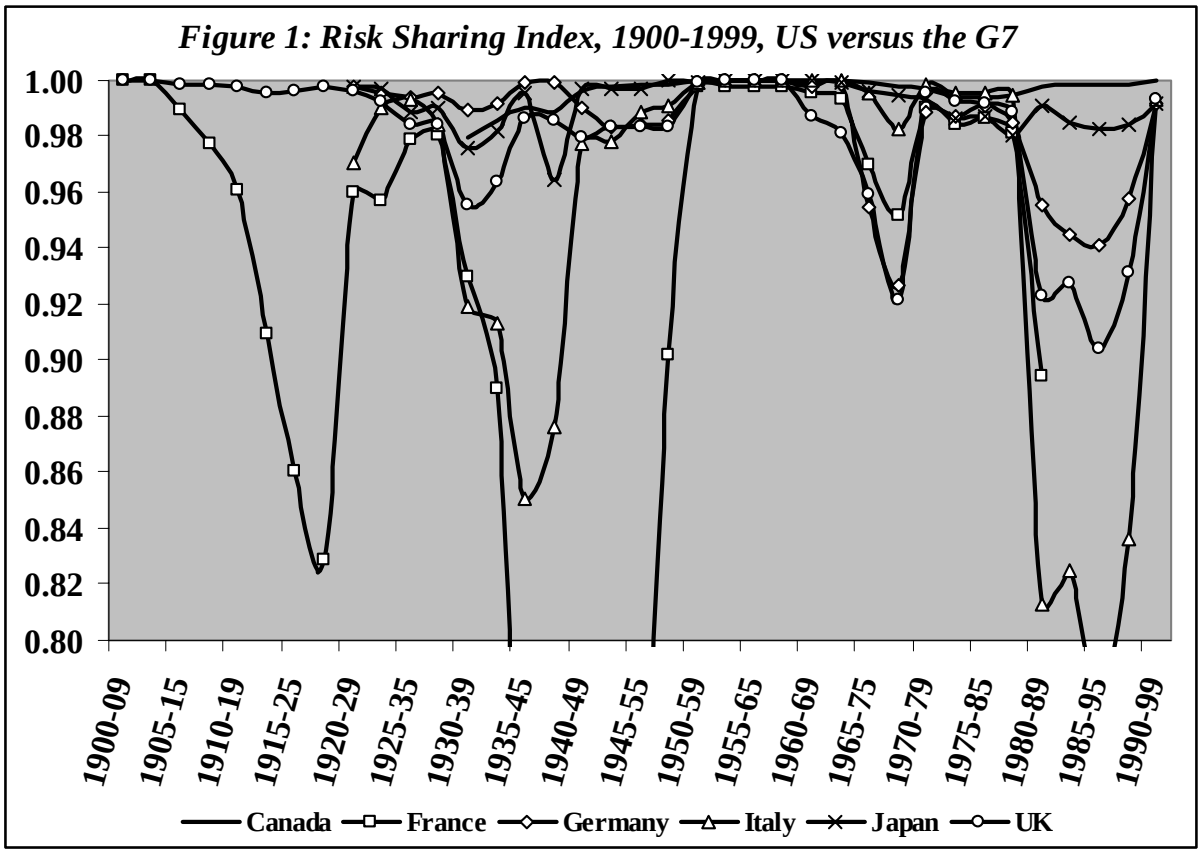

Figure 2: Risk Sharing Index, 1900-1999, US versus all others