Monthly Estimates of U.S. Cross-border Securities Positions

Carol C. Bertaut and Ralph W. Tryon

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Abstract:
This paper reports monthly estimates of U.S. cross-border securities positions obtained by combining the (now) annual TIC surveys with monthly transactions data adjusted for various differences in the two reporting standards. Our approach is similar to that of Thomas, Warnock and Wongswan (2004), but in addition to having a somewhat larger dataset we are able to make some simplifications to the numerical procedure used and we incorporate additional adjustments to the transactions data. This paper describes the procedure used and presents the monthly results. In addition, we discuss how the procedure can be extended to extrapolate holdings estimates beyond the most recent survey values. We focus primarily on U.S. liabilities to foreign holders, because more data is available than for U.S. claims, but we show how our methodology can be applied to U.S. claims as well. We also provide some guidance on how the changes in estimated holdings can be decomposed into flows, valuation changes, and other factors. Time series of estimates of holdings, by country, are available for download.

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1. Introduction

Cross-border holdings of securities between the United States and the rest of the world are growing in size and importance. As of end-December 2006, U.S. residents held about $5.6 trillion in foreign stocks and bonds, compared with holdings of $2.1 trillion five years earlier, while foreign residents held about $8 trillion in U.S. long-term securities, more than double their holdings in 2001. Periodic surveys of holdings provide our most accurate and detailed information on cross-border securities holdings, but these surveys have several disadvantages. First, the surveys are relatively infrequent: until recently, surveys were as much as five years apart. They are now conducted annually, but a higher frequency time series of positions is desired by market participants and policy analysts. Second, survey results are available only with a considerable lag: it takes about 8-9 months to get preliminary results and 10-12 months to get final results, after the nominal date of the survey. We would like a reliable way to base current estimates of holdings on the latest monthly securities transactions data, which are available with a lag of only 45 days, approximately. Finally, the surveys alone do not provide a basis for decomposing changes from one survey to the next into net transactions, valuation effects, and other adjustments, all of which would be helpful in analyzing the data. By estimating monthly positions using monthly transactions and valuation adjustments, we can estimate the desired decomposition as well.

We work with three sets of cross-border securities data collected by the Treasury International Capital (TIC) system. First, foreign holdings of U.S. securities are measured in the comprehensive surveys of U.S. liabilities to foreigners. These data are available by country of holder, by security type (Treasury bonds, agency bonds, corporate bonds, and equities), and by type of holder (official or private) for nine different dates: December 1984, December 1989, December 1994, March 2000, June 2002, June 2003, June 2004,

June 2005, and June 2006.[1] There are about 80 countries in the sample.[2] Second, on the claims side, surveys of U.S. holdings of foreign securities were taken in March 1994, December 1997, December 2001, December 2003, December 2004, December 2005, and most recently for December 2006. Claims data are available by country of issuance for U.S. holdings of foreign bonds and foreign equities. We combine these periodic survey data with the third set of data, monthly transactions data on cross-border purchases and sales of U.S. Treasury, agency, corporate bonds, U.S. equities, and foreign stocks and bonds (the TIC S data).[3] Although the most recent liabilities and claims surveys provide considerable detail on the types of securities held (e.g. currency of issue, "straight" debt versus asset-backed, zero-coupon, or convertible debt, public versus private issuer, common stock versus preferred stock or mutual funds), the monthly transactions data limit our analysis to the broad characterizations listed.

The difficulties involved in making monthly estimates, particularly those caused by financial center transactions bias, have been discussed in a number of other papers (See Warnock and Mason (2001), Griever, Lee, and Warnock (2001), and Warnock and Cleaver (2002).) Thomas, Warnock, and Wongswan (2004) propose a methodology to generate monthly position estimates by country that use adjusted monthly transactions and are consistent with the reported survey positions. Our approach, discussed in the following sections, is similar to that of Thomas, Warnock, and Wongswan (hereafter TWW), but differs in a number of details.

2. The discrepancy between survey positions and transactions-based positions estimates

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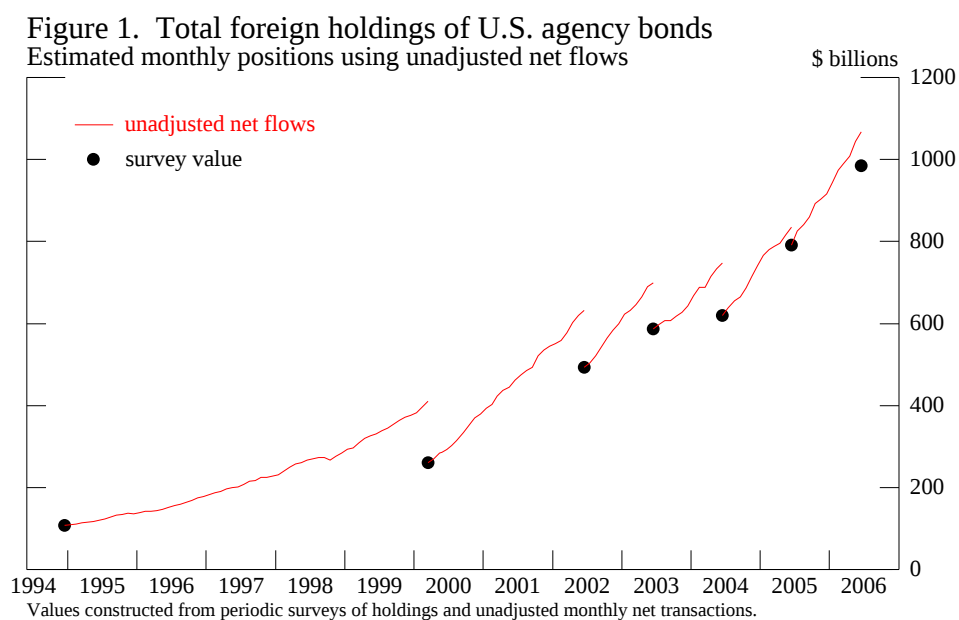
[1] Surveys of foreign holdings of U.S. securities were also conducted in 1974 and 1978, but the published data from these surveys is limited. The publicly available data for 1978 include total foreign holdings by country of U.S. equities and long-term debt securities, but with no breakdown by country by type of debt security. The survey for 1974 includes a breakdown between U.S. government debt securities and corporate debt securities, but data by country are available only for private foreign investors.
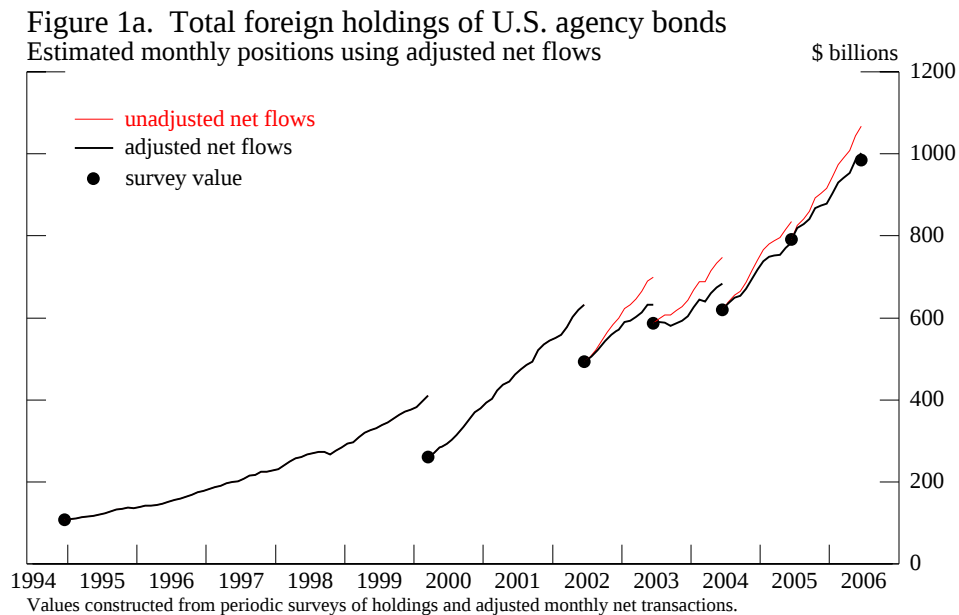
[2] Survey data are collected and reported for approximately 200 countries, but our sample is limited by the countries for which a time series of transactions data are also available.

[3] We focus on estimates of holdings of long-term securities in this paper because timely estimates of cross-border holdings of short-term securities are reported elsewhere by the TIC system. For further information on the TIC cross-border securities data, refer to Bertaut, Griever, and Tryon (2006).

There is a substantial discrepancy between the reported survey positions and position estimates derived from the monthly transactions data as published by the Treasury. This discrepancy is illustrated in Figure 1, which shows the total foreign holdings of U.S. agency bonds. The round dots show the reported survey holdings for seven surveys from 1994 to 2006. The lines starting from each dot show the cumulated monthly transactions starting from the survey value and continuing up until the subsequent survey. As the figure shows, in every case the cumulation of the monthly positions noticeably overstates the position at the time of the next survey.
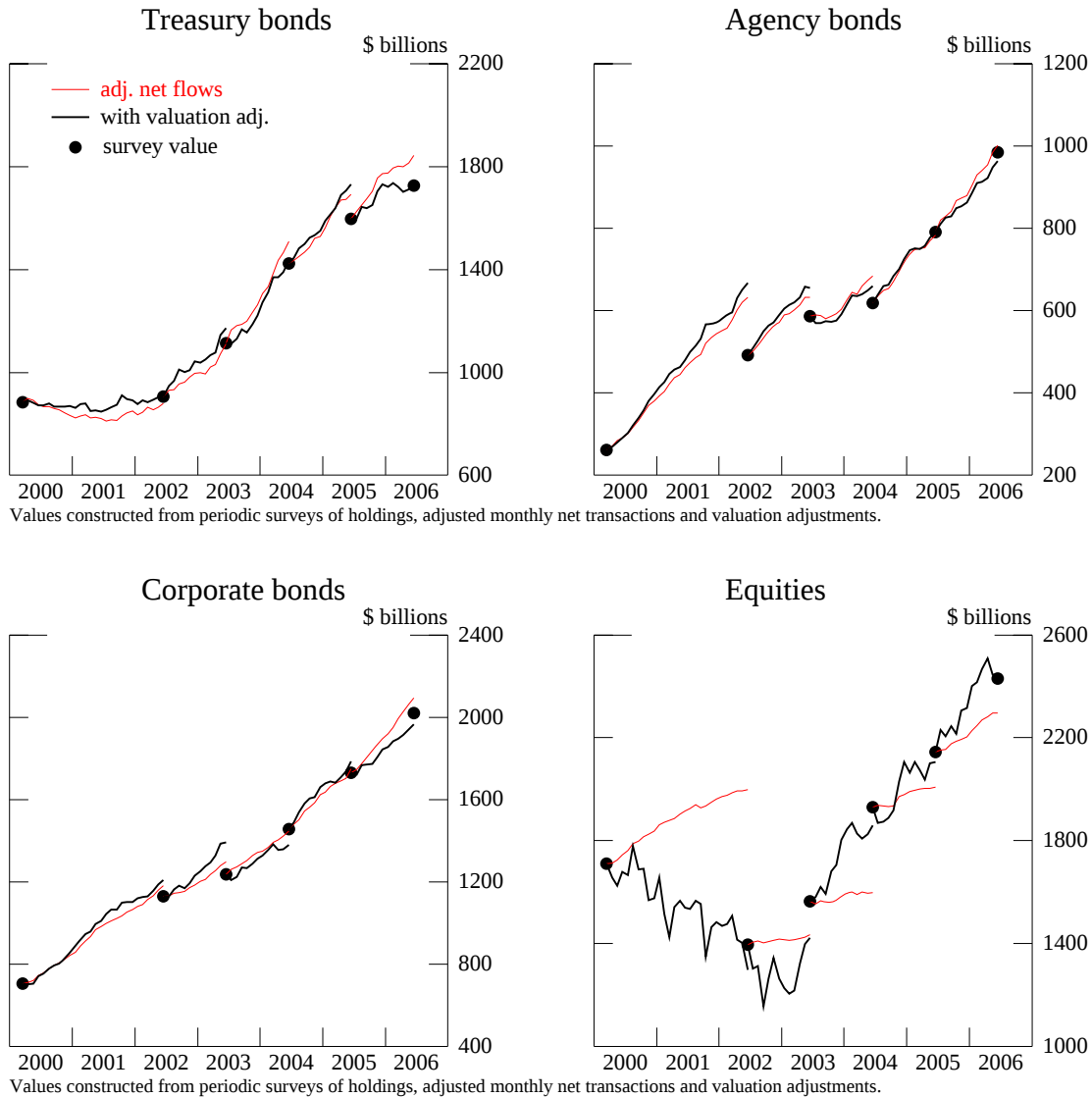
There are several reasons for the discrepancy between the reported survey holdings and cumulated monthly positions from the net transactions data. One is that the underlying monthly transactions data cannot account for all changes in holdings of securities included in the periodic surveys. For example, the transactions data for agency bonds do not include repayment flows of principal on asset-backed agency securities. We are able to adjust the transactions data starting in 2002 for these and other discrepancies, including principal repayment flows on asset-backed corporate securities, acquisitions of equity through stock swaps, and transactions in nonmarketable treasury bonds; the results using adjusted net flows for agency bonds are shown in Figure 1a. (See Appendix A for details on the adjustments for stock swaps and asset-backed securities.)

Figure 1. Total foreign holdings of U.S. agency bonds
Estimated monthly positions using unadjusted net flows

Values constructed from periodic surveys of holdings and unadjusted monthly net transactions.

Figure 1a. Total foreign holdings of U.S. agency bonds
Estimated monthly positions using adjusted net flows $ billions

Values constructed from periodic surveys of holdings and adjusted monthly net transactions.

As expected, using the adjusted net flows bring the estimated positions closer to the survey results, but a noticeable gap still remains. Another factor that contributes to the discrepancy is that the transactions data do not reflect any valuation changes, which do affect the measured positions reported in the periodic surveys. Figure 2 reports total foreign holdings of treasury bonds, agency bonds, corporate bonds, and equities estimated using adjusted net flows with and without allowance for valuation changes. (See Appendix B for details on how the allowance for valuation changes was made.)

Figure 2. Total foreign holdings of U.S. long-term securities
Estimated monthly positions using adjusted net flows

Treasury bonds

Agency bonds

Corporate bonds

Equities

Values constructed from periodic surveys of holdings, adjusted monthly net transactions and valuation adjustments.

Again, as we would expect, allowing for valuation changes brings the estimates closer to the reported surveys, but does not eliminate the gaps entirely. Unsurprisingly, the effect of including valuation changes is much larger for equities than it is for any of the bonds.
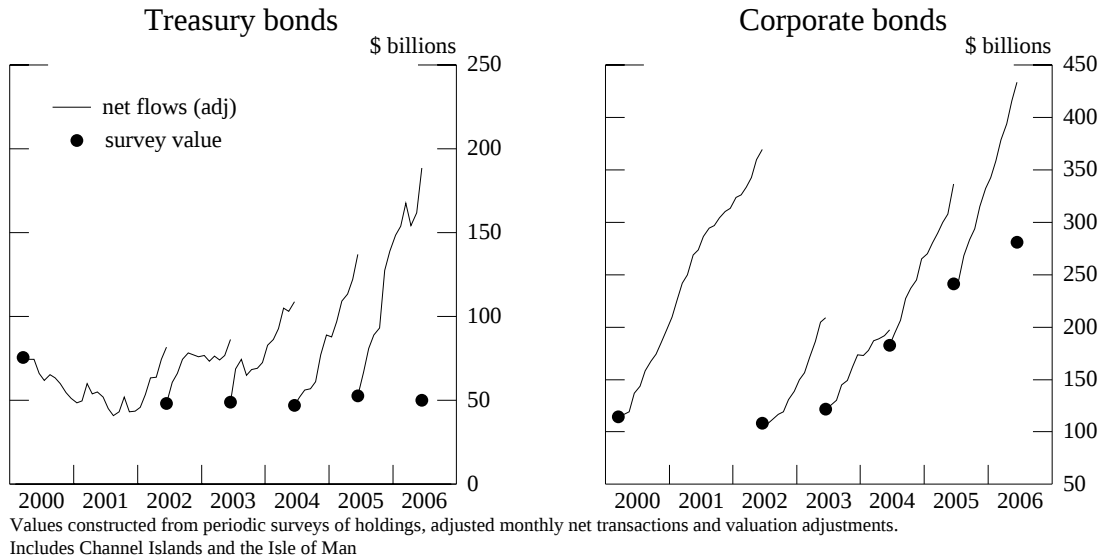
Thus far, we have considered the challenges in constructing estimates of holdings of U.S. securities by all foreigners. An additional complication arises in constructing estimated positions for individual country holdings based on the reported monthly transactions by country because of the geographic distortion caused by financial center transaction bias

(see Griever, Lee, and Warnock (2001) and Warnock and Cleaver (2002)). By design, the monthly transactions data are recorded according to country of the first cross-border counter-party, and not the country of the ultimate buyer or actual seller or issuer of the security. As a result, the monthly transactions data report purchases and sales that are concentrated in major international financial centers. For example, in 2005, nearly two-thirds of reported purchases and sales of U.S. long-term securities were recorded against the United Kingdom and Caribbean financial centers. Thus, constructing estimated positions based on the country-level monthly transactions data will tend to generate estimates of holdings by residents of such financial center locations that considerably overstate actual holdings as reported in the next survey, and will tend to underestimate holdings by residents of other countries.

Figures 3 and 3a illustrate this problem for holdings of U.S. Treasury and corporate bonds by residents of the United Kingdom[4] and the euro area. For the U.K., estimated positions, even after adjusting for omitted securities and valuation changes, are consistently much higher than the survey results, presumably representing transactions in U.S. securities made in the U.K. on behalf of third parties.

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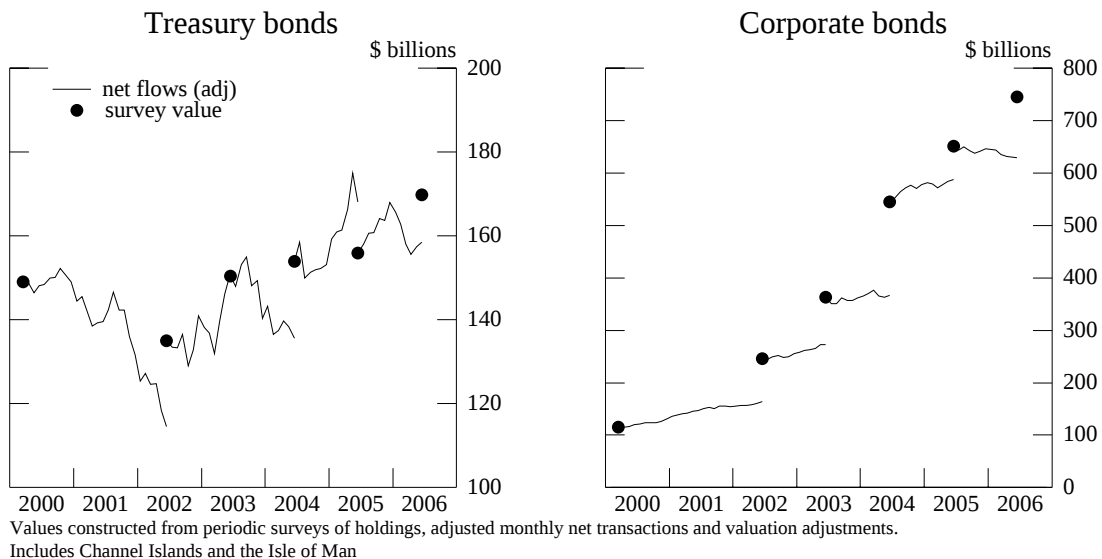
[4] Because transactions data for the United Kingdom are not available separately from data for the Channel Islands and the Isle of Man prior to 2001, the concept "United Kingdom" throughout this paper refers to the consistently defined broader aggregate.

Figure 3. U.K. holdings of U.S. long-term securities
Estimated monthly positions using adjusted net flows with valuation changes

Treasury bonds

Corporate bonds

Values constructed from periodic surveys of holdings, adjusted monthly net transactions and valuation adjustments.
Includes Channel Islands and the Isle of Man

Many of the third parties to U.S.– U.K. transactions reside in the euro area, and we see in
Figure 3a that the actual euro area positions, as measured by the surveys, are almost always
higher than the estimates based on transactions data.

Figure 3a. Euro-area holdings of U.S. long-term securities
Estimated monthly positions using adjusted net flows with valuation changes

Treasury bonds

Corporate bonds

Values constructed from periodic surveys of holdings, adjusted monthly net transactions and valuation adjustments.
Includes Channel Islands and the Isle of Man

Unfortunately, we do not have a data source that would permit us to adjust the transactions
data for this financial-center effect.

Thus, adjusting for omitted transactions and valuation changes does not completely eliminate the discrepancy between positions as reported in the periodic surveys and as constructed using monthly transactions data, at either the country or the aggregate level. We assume that the surveys accurately measure securities positions as of the survey date; this implies that the sum of the observed, adjusted net transactions, corrected for valuation changes, is in error by the amount of the gap between the survey and the sum of net transactions.[5] This gap is assumed to represent the financial center effect discussed above, as well as unknown errors and omissions in the monthly transactions data of current S-form reporters, and transactions conducted by entities that have not yet been identified as prospective reporters. In addition, the gap may be due to various measurement and approximation errors in the construction of the prices used to calculate the valuation adjustments, and to transactions costs, which are included in reported transactions but not in survey positions.

3. Estimating monthly positions between surveys

As noted in the introduction, there are a number of reasons why it would be useful to construct a series of estimated monthly positions for the periods between the benchmark surveys, and more particularly, for the period from the latest survey to the most current monthly transactions data. As we have seen, even after making a number of needed adjustments, the monthly data remain noticeably inconsistent with the survey data. For estimates between surveys, simply extending a given survey value using adjusted transactions and valuation changes is unsatisfactory because the resulting positions are inconsistent with the known values of the next survey. And given this observed

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[5] Although the liabilities surveys are thought to be comprehensive in their coverage of total foreign holdings of U.S. securities, an important caveat to the accuracy of the surveys is that the country attribution of foreign holdings can be distorted by "custodial bias". If a foreign investor acquires U.S. securities and holds them with a foreign custodian bank, the foreign bank will typically employ a U.S. custodian bank to facilitate settlement and custody operations. When the U.S. bank reports these holdings on the U.S. liabilities survey, it typically will only know that the securities are held at the foreign custodian bank, and will not know the nationality of the actual foreign owner. Thus, the U.S. liabilities surveys tend to attribute very large foreign holdings to countries that are major custodial, securities management, or depository centers, such as Belgium, the Cayman Islands, Luxembourg, and Switzerland. This "custodial bias" is separate from the "financial center" bias in the monthly transactions data. For more information on the problem of "custodial bias" and a discussion of how the IMF's CPIS asset surveys can help us gain a better understanding of the ultimate foreign owners of U.S. securities, see Bertaut, Griever, and Tryon (2006).

discrepancy between survey values, it should be possible to do better in estimating current holdings than simply extending forward from the last survey value using net transactions and valuation changes.

Our basic problem, then, is to distribute the known error observed when a new survey is conducted across the months between survey dates so as to generate a more accurate set of monthly position estimates. When applied country by country, this approach will generate estimates that correct for financial center bias and more accurately reflect holdings of residents of the country in question. Of course, we do not know when during the inter-survey period the measurement errors occurred; we only know the size of the cumulative error as observed on the new survey date.

Beginning with an initial survey position, an estimate of the position at a future date t can be constructed as

$$(1) \qquad \hat{S}_t = S_0(1+\hat{\pi}_{0,t}) + \sum_{i=1}^{t} \hat{N}_i(1+\hat{\pi}_{i,t})$$

where S_0 is the latest survey value for a given country, security, and holder; $\hat{S}_t$ is the estimated position at time $t > 0$, $\{\hat{N}_i\}$ is the sequence of net flows from time 1 to t, and $\hat{\pi}_{i,t}$ is the rate of increase in the price of security S over the period i to t, with $\pi_{i,i} = 0$.[6] We assume that S_0 is actually known; $\hat{N}_i$ and $\hat{\pi}_{i,t}$ are observed with error and $\hat{S}_t$ is an estimate. When $t = T$, the date of the next survey, S_T is known, and we can define the "gap" between the actual and the estimated survey positions:

$$(2) \qquad G_T = S_T - \hat{S}_T$$

We model the measurement errors in security prices (ε_t) as

$$(3) \qquad (1+\pi_t) = (1+\hat{\pi}_t)(1+\varepsilon_t)$$

where ε_t is the multiplicative error in observing the true monthly valuation change, π_t. We model transactions costs and other errors in net transactions as

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[6] Strictly speaking, we assume that all observations are made on the last day of the month, and thus we do not adjust for valuation changes on flows over the course of the month.

(4) $$N_t = (1 + \beta_t)\hat{N}_t$$

where β_t includes both effects in multiplicative form. (We assume that transactions costs and other measurement errors are equal percentages of both purchases and sales, so that β_t may be applied directly to net transactions.) For the results to be plausible we require $\hat{S}_t \geq 0$ for all t, something that is by no means true in the data.[7] We impose nonnegativity by adjusting $\hat{N}_t$ by a quantity just large enough to bring $\hat{S}_t$ to zero in any month in which it would otherwise be negative.

A little algebra (see Appendix C) shows that we can write the estimated position $\tilde{S}_t$ as the constructed position ($\hat{S}_t$) plus the share of the final gap allocated to month t, discounted for actual valuation changes from time t to T:

(5) $$\tilde{S}_t = \tilde{S}_{t-1}(1 + \hat{\pi}_t) + \hat{N}_t + \frac{\lambda_t G_T}{\pi_{t,T}}$$

where

(6) $$\lambda_t = \lambda\left(\hat{S}_i, \hat{\pi}_i, \hat{N}_i, \varepsilon_i, \beta_i\right), \ i = 0, T, \ \sum \lambda_t = 1.0$$

and it can be shown that $\tilde{S}_T = S_T$ and that the law of motion (equation (1)) holds for $\tilde{S}$, so that the sequence $\tilde{S}_t, t = 1, T$, is "survey consistent" in the sense of TWW.

The difficulty, of course, is that equation (6) includes the unobserved measurement errors ε_t and β_t, about which we have essentially no prior information.[8] We simply don't know whether these errors are serially correlated or not, whether they have zero mean or not, or what their comparative magnitudes might be. In this situation any solution is likely to be almost entirely *ad hoc*. The approach we follow here is to assume that the measurement

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[7] Negative estimates reflect a basic inconsistency between the annual surveys and the monthly transactions data that cannot easily be reconciled. In some instances, the true position may in fact be negative if foreign investors hold short positions in the security in question. Short *sales* of securities can, and presumably are, included in the net transactions data, but short *positions* are not collected in the annual surveys. Since short sales cannot be identified in the data, we impose nonnegativity as described.

[8] Equation (5) also implicitly includes ε_t.

errors are uniformly distributed throughout the period between surveys, i.e. that $\varepsilon_t = \varepsilon$ and $\beta_t = \beta$. We then assume what we hope are plausible values for ε and β, and perform some limited sensitivity testing.[9]

Equation (5) describes a path for the position in security S that obeys the law of motion for the position and is equal to the reported survey positions at time 0 and time T. In brief, we extrapolate the time 0 survey position forward using observed flow data and compute the residual vis-à-vis the reported survey at time T. This residual is then distributed across time periods according to each period's share in total net transactions, and each residual share is then discounted by the appropriate inflation rate. The estimates will then match reported surveys by construction, and will be consistent with both endpoints, with the reported monthly transactions, and with measured changes in asset prices.[10]

Figure 4 presents our monthly estimated positions for agency bonds held by all foreigners (cf. Figure 1).[11] As discussed above, the path of the estimated positions coincides with the survey values for years in which surveys were taken. In recent years, as the time between surveys has been reduced, the difference between positions estimated with unadjusted net flows and those estimated with the correction has also tended to fall. Figure 4a shows the same series from 2003, in more detail.

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[9] This approach differs from that of Thomas, Warnock and Wongswan, who do not model the measurement error explicitly and instead assume that it is proportional to gross transactions.

[10] Our overall approach closely follows Thomas, Warnock and Wongswan, but note that equation (11) can be evaluated directly (period by period), without the need for a nonlinear method as in TWW.

[11] Estimates for all foreigners are constructed by applying this methodology to survey values of holdings by all foreigners and using adjusted net transactions by all foreigners. For between-survey dates, these estimates will differ somewhat from the sum of estimated holdings of each individual country for two reasons. First, imposing non-negativity is more likely to bind at the country level than for all foreigners. Thus, constructing total holdings by summing individual country values may result in a somewhat larger estimate because each individual country's estimate is bounded below at zero. The second reason is the significant fraction of securities measured in the surveys for which the country of owner cannot be identified. Most of these securities are unregistered or "bearer" securities. Although bearer securities generally cannot be issued in the United States, U.S. firms can and do issue such securities aboard. Because the owners of these securities need not make themselves known, little or no information is typically available on who these foreign owners are. Such securities are reported in the surveys under "country unknown." Holdings by "country unknown" have been sizable at times, amounting to more than $460 billion or about 40 percent of all foreign holdings of U.S. corporate bonds in June 2002. Because we have no information on what share of transactions in U.S. corporate bonds reflect transactions in bearer securities, we estimate between-survey holdings of "country unknown" by linear interpolation.

Figure 4. Total foreign holdings of U.S. agency bonds
Estimated monthly positions using adjusted net flows

$ billions

— adjusted net flows
— survey-consistent estimated positions
● survey value

Values constructed from periodic surveys of holdings and adjusted monthly net transactions.
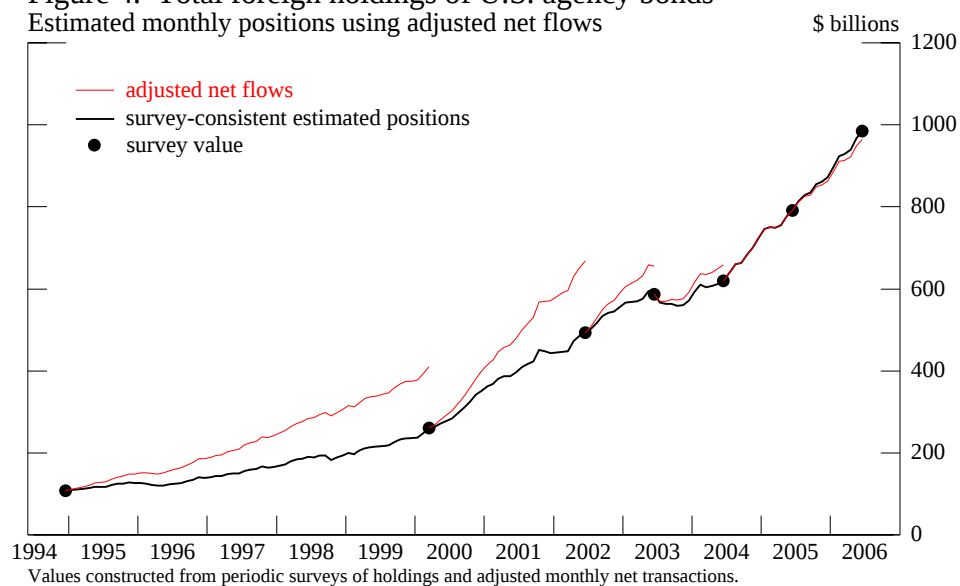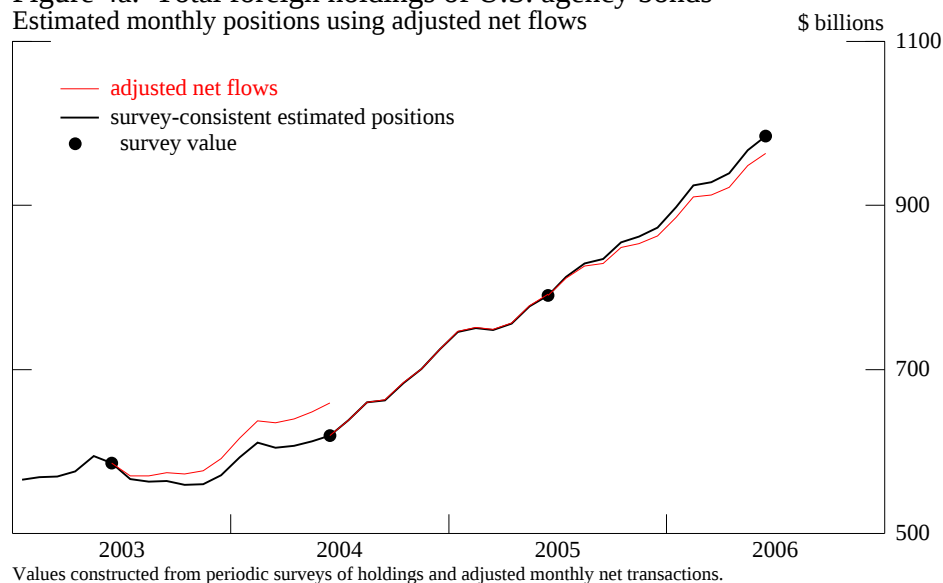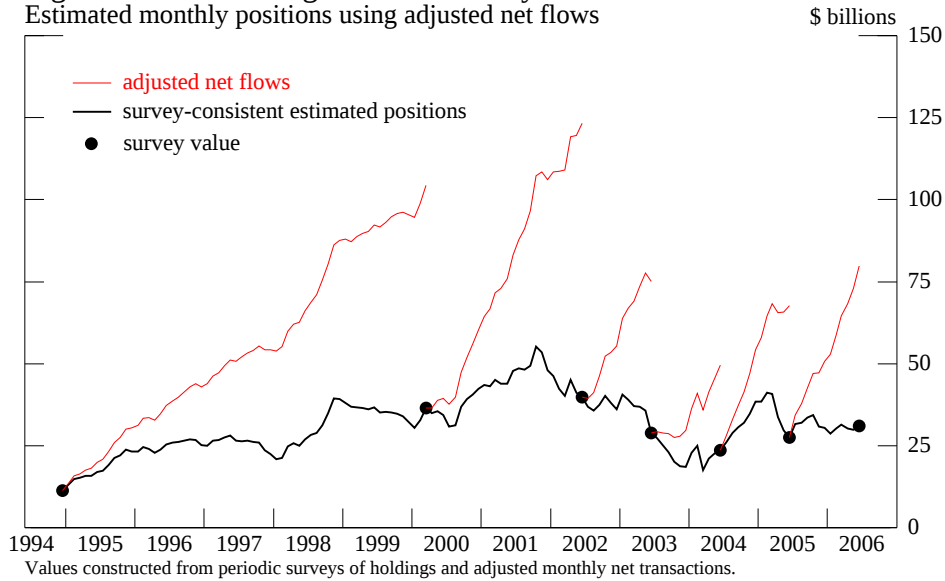
Figure 4a. Total foreign holdings of U.S. agency bonds
Estimated monthly positions using adjusted net flows

$ billions

— adjusted net flows
— survey-consistent estimated positions
● survey value

Values constructed from periodic surveys of holdings and adjusted monthly net transactions.

In contrast, the difference for treasury bonds held by agents in the U.K. is dramatic, as shown in Figure 5. By distributing the gaps across the period between surveys, the large financial center bias is eliminated:

Figure 5. U.K. holdings of U.S. treasury bonds
Estimated monthly positions using adjusted net flows

Values constructed from periodic surveys of holdings and adjusted monthly net transactions.

In constructing these estimates, we assume that both ε and β are equal to .01, implying that the measurement errors are on the order of 1% of monthly transactions and that errors in measuring valuation effects and net flows are of the same magnitude. These assumed values do not have any real empirical basis; rather they are (we believe) plausible values and relatively neutral assumptions that provide plausible results. Figures 6 and 6a illustrate the sensitivity of our estimates to these assumptions. In each figure, we show estimated positions for values of ε and β from -.01 to .02. As shown in the two figures, varying the errors over this range has a modest effect in the early part of our sample, when the period between surveys was two years or more. Since the advent of annual surveys in 2003 the estimated positions are essentially insensitive to changes in the error assumptions over this range.

Figure 6. Total foreign holdings of U.S. agency bonds
Estimated monthly positions with different error parameters

$ billions

e = -.01, b = -.01
e = .01, b = .01
e = .02, b = .02

1994   1995   1996   1997   1998   1999   2000   2001   2002

Values constructed from periodic surveys of holdings and adjusted monthly net transactions.
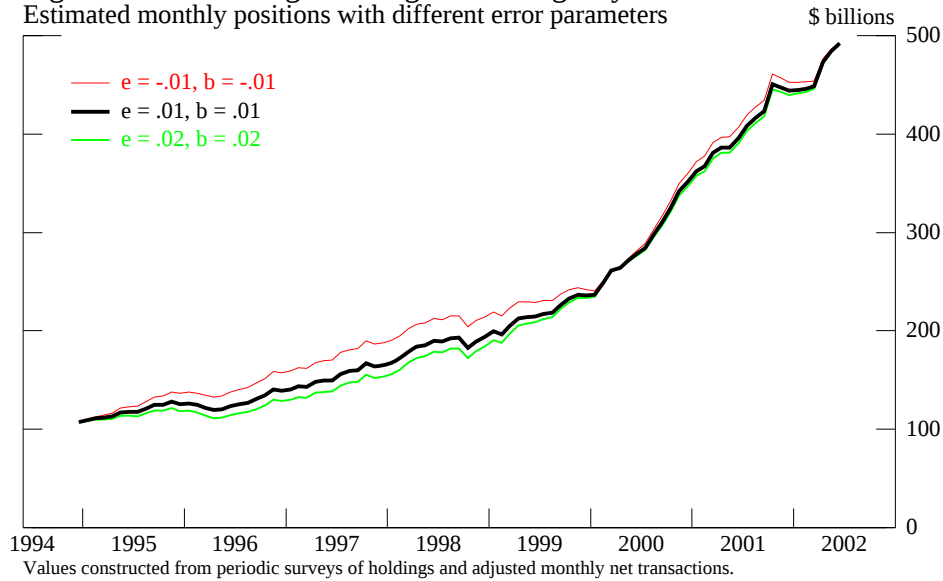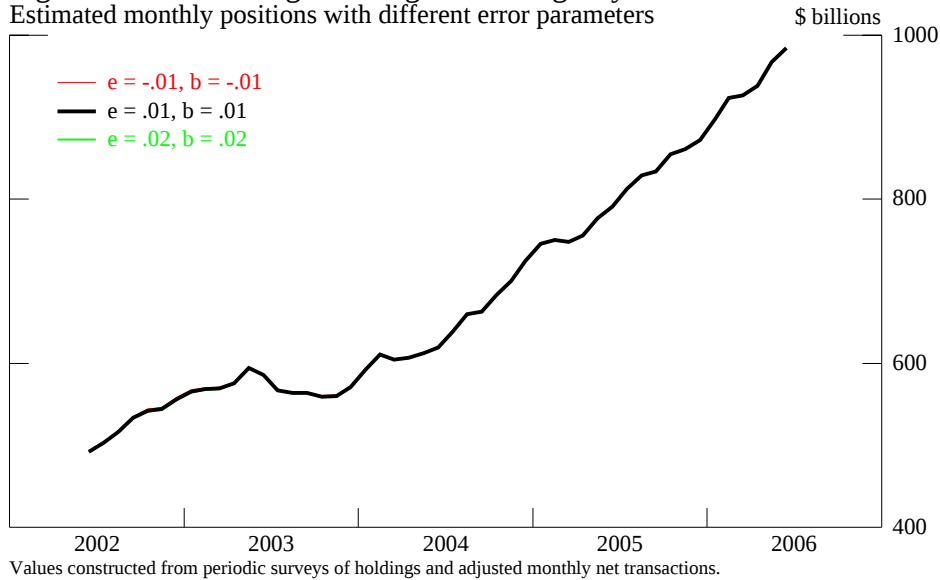
Figure 6a. Total foreign holdings of U.S. agency bonds
Estimated monthly positions with different error parameters

$ billions

e = -.01, b = -.01
e = .01, b = .01
e = .02, b = .02

2002   2003   2004   2005   2006

Values constructed from periodic surveys of holdings and adjusted monthly net transactions.

4. Estimating positions after the last survey

So far we have assumed that the last date of interest happened to be that of a benchmark
survey, so that the problem is confined to constructing position estimates for the period
between two surveys. In this case the total cumulative observation error from one survey
to the next (the "gap") is known, and our problem is merely to distribute that error to the
intermediate observations. In the case where the transactions data extends beyond the last

survey (a case of considerable practical importance) we must in effect forecast the measurement error, or gap, out to the end of the transactions data. This turns out to be a difficult empirical problem, and we do not claim to have found a wholly satisfactory solution to it. The crux of the problem is that while the actual survey gaps appear to be very close to pure noise, they nonetheless seem to contain enough information that simply ignoring them in constructing future position estimates would be a mistake. But as we discuss in the next section, our efforts to estimate even the simplest panel regression model of the gaps were largely unsuccessful.[12]

4 .1 Summary statistics

We begin our statistical analysis by constructing survey gaps for U.S. liabilities for 84 countries, four security types, and seven survey dates, through the survey of June 2005. (We reserve the newly-released June 2006 survey for out-of-sample testing.) We scale the gaps by the estimated position $\hat{S}_t$ to make them comparable across surveys and securities.[13] Table 1 presents summary statistics for the scaled gaps. The units are simple ratios, so that, for example, the average gap for agency bonds positions, averaged across all countries and all surveys, was 2.8 times the estimated position. It is immediately apparent that there are some extremely large outliers in the gaps that will have to be dealt with somehow. This observation is reinforced by the histograms of the gaps by security type (Figure 7).

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[12] As long as we assume that the "naïve" positions (reflecting both the magnitude of the previous survey position and the evolution of net flows and valuation changes) tell us something about the actual "end-of-period" positions, some assumptions have to be made about the about the end-of period gaps. An alternative approach might be to simply forecast the end-of-period position itself, based (for example) on trend growth in the position, and thus ignoring the contributions from net flows and valuation changes. This approach may be appropriate for especially noisy countries such as those with large financial center bias, but seems unappealing for estimating positions more generally.

[13] We scale by the estimated position rather than the actual survey value so that when constructing estimates for current holdings, when we have only the estimated position to work from, the results will be comparable. Because we restrict the estimated positions to be non-negative, this choice also has the result that the minimum the scaled gap can be is -1, the result if the actual survey value is small relative to the estimated position (at the limit, the survey position is zero, and the estimated position is positive). In contrast, there is no upper bound to the maximum scaled gap.
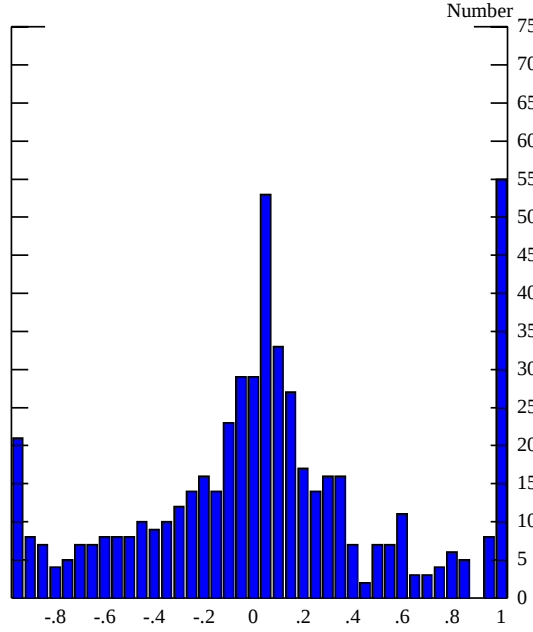
Table 1. Summary statistics for scaled gaps, U.S. liabilities to all foreigners					
By security type and survey date					
	Treasury bonds	Agency bonds	Corporate bonds	Equities	All securities
1989 Survey: mean	1.27	20.76	0.01	0.43	5.52
1989 Survey: minimum	-1.00	-1.00	-1.00	-1.00	-1.00
1989 Survey: maximum	28.73	1547.38	12.34	16.65	1547.38
1989 Survey: std dev	5.57	178.67	1.95	2.31	88.49
1989 Survey: num obs	75	75	76	80	306
1994 Survey: mean	1.90	-0.09	0.13	13.34	4.00
1994 Survey: minimum	-1.00	-1.00	-1.00	-1.00	-1.00
1994 Survey: maximum	114.68	7.55	13.50	936.96	936.96
1994 Survey: std dev	13.59	1.33	1.97	105.65	54.77
1989 Survey: num obs	73	74	73	79	299
2000 Survey: mean	0.14	0.02	-0.10	0.46	0.14
2000 Survey: minimum	-1.00	-1.00	-1.00	-0.97	-1.00
2000 Survey: maximum	6.17	6.88	5.08	33.99	33.99
2000 Survey: std dev	1.11	1.25	1.14	3.93	2.25
2000 Survey: num obs	77	78	72	81	308
2002 Survey: mean	0.18	-0.14	-0.18	0.21	0.02
2002 Survey: minimum	-0.99	-1.00	-1.00	-1.00	-1.00
2002 Survey: maximum	7.30	7.77	3.57	8.51	8.51
2002 Survey: std dev	1.24	1.19	0.70	1.17	1.11
2002 Survey: num obs	79	80	79	81	319
2003 Survey: mean	0.91	-0.14	0.28	0.06	0.28
2003 Survey: minimum	-1.00	-1.00	-1.00	-1.00	-1.00
2003 Survey: maximum	74.95	3.56	42.13	1.72	74.95
2003 Survey: std dev	8.40	0.57	4.76	0.43	4.82
2003 Survey: num obs	80	79	80	82	321
2004 Survey: mean	1.07	0.18	1.90	1.45	1.14
2004 Survey: minimum	-1.00	-1.00	-1.00	-0.55	-1.00
2004 Survey: maximum	73.71	9.56	132.67	82.90	132.67
2004 Survey: std dev	8.24	1.41	14.93	9.26	9.65
2004 Survey: num obs	81	82	79	81	323
2005 Survey: mean	0.08	0.06	-0.03	0.05	0.04
2005 Survey: minimum	-0.88	-1.00	-1.00	-1.00	-1.00
2005 Survey: maximum	1.73	4.36	10.09	2.68	10.09
2005 Survey: std dev	0.53	0.77	1.20	0.47	0.79
2005 Survey: num obs	78	82	81	83	324
All Surveys: mean	0.78	2.82	0.29	2.24	1.55
All Surveys: minimum	-1.00	-1.00	-1.00	-1.00	-1.00
All Surveys: maximum	114.68	1547.38	132.67	936.96	1547.38
All Surveys: std dev	7.06	65.99	6.13	39.67	38.92
All Surveys: num obs	543	550	540	567	2200
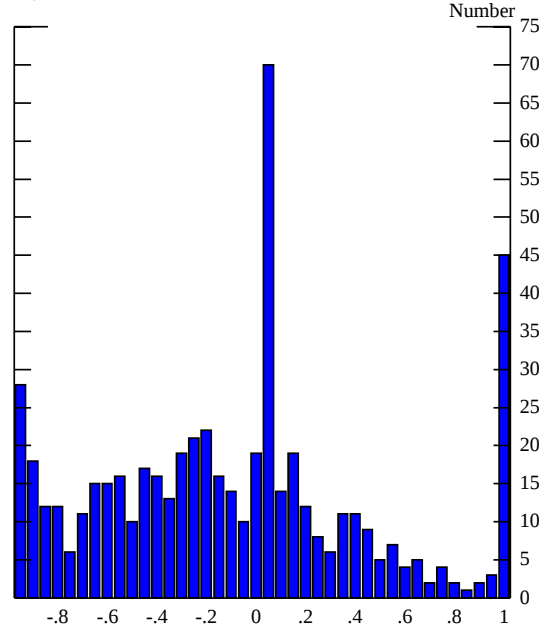
Figure 7. Survey Gap Histograms: US Liabilities

Scaled by estimated position
X-axis numbers are the bottom of each cell
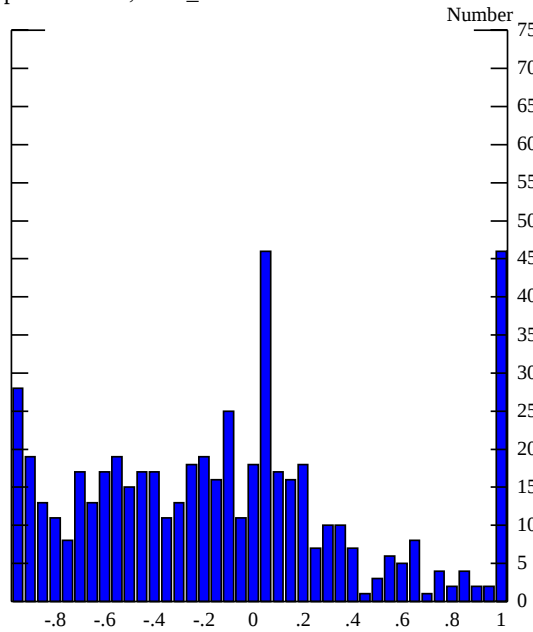
US Treasuries, ALL_SURVEYS
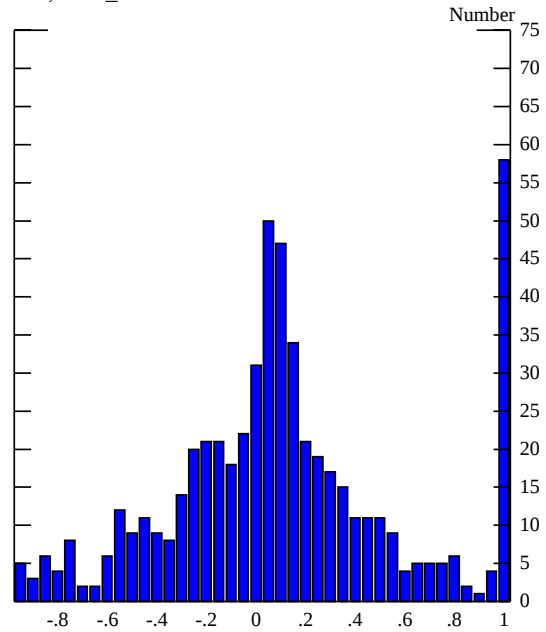
Agency Bonds, ALL_SURVEYS

Corporate Bonds, ALL_SURVEYS

Equities, ALL_SURVEYS

Outliers of this magnitude can potentially have a dramatic effect on any empirical model of the gap, and we found even the simplest rules for estimating the gap to be extremely sensitive to the presence or absence of such values. One approach to handling the problem would be to omit observations that are so far from the mean that the hypothesis that they are drawn from the same distribution can be rejected. Unfortunately, as Figure 7 strongly suggests, the sample distributions are clearly non-normal, and as Table 1 shows, the sample standard deviations are so large that even if the distribution were known, this approach would fail to exclude many extremely large values of the gap.[14]

For now we fall back on a distinctly *ad hoc* approach: we exclude from the sample any observations where the measured survey position is more than twice the magnitude of the estimated position. The rationale is that such cases are clearly unusual and appear to represent something other than the "usual" measurement error. While we must nevertheless take these errors into account somehow, we would like to know if the truncated sample reveals any patterns that would be useful in forecasting. Table 2 shows the summary statistics for the scaled gaps with the outliers removed.

_____

[14] Formal tests for normality confirm this intuition. Another possibility is that the gaps should be scaled by a quantity other than the estimated position that we used. Unfortunately we were unable to identify a scale factor that improved the distribution of the gaps in any significant way.

Table 2. Summary statistics for scaled gaps: U.S. liabilities to total foreigners, by security type and survey date using truncated data					
By security type and survey date					
	Treasury bonds	Agency bonds	Corporate bonds	Equities	All securities
1989 Survey: mean	0.15	0.13	0.01	0.04	0.09
1989 Survey: minimum	-0.66	-0.66	-0.61	-0.65	-0.66
1989 Survey: maximum	1.99	1.78	1.55	1.43	1.99
1989 Survey: std dev	0.63	0.57	0.53	0.54	0.57
1989 Survey: num obs	60	47	41	67	215
1994 Survey: mean	0.23	0.05	0.08	0.11	0.12
1994 Survey: minimum	-0.65	-0.65	-0.66	-0.66	-0.66
1994 Survey: maximum	1.92	1.64	1.86	1.67	1.92
1994 Survey: std dev	0.56	0.6	0.67	0.49	0.57
1989 Survey: num obs	53	44	49	64	210
2000 Survey: mean	0.12	-0.05	0.04	-0.02	0.02
2000 Survey: minimum	-0.63	-0.65	-0.66	-0.64	-0.66
2000 Survey: maximum	1.96	1.48	1.49	1.96	1.96
2000 Survey: std dev	0.54	0.43	0.62	0.57	0.54
2000 Survey: num obs	60	55	44	66	225
2002 Survey: mean	0.05	-0.11	-0.07	0.11	0.00
2002 Survey: minimum	-0.62	-0.66	-0.64	-0.62	-0.66
2002 Survey: maximum	1.61	1.03	1.70	1.33	1.70
2002 Survey: std dev	0.45	0.43	0.51	0.40	0.45
2002 Survey: num obs	69	57	63	71	260
2003 Survey: mean	-0.01	-0.11	-0.14	0.07	-0.04
2003 Survey: minimum	-0.62	-0.64	-0.66	-0.56	-0.66
2003 Survey: maximum	1.07	1.30	1.62	1.72	1.72
2003 Survey: std dev	0.30	0.33	0.39	0.41	0.37
2003 Survey: num obs	73	70	67	81	291
2004 Survey: mean	0.08	0.04	0.17	0.16	0.11
2004 Survey: minimum	-0.57	-0.62	-0.66	-0.55	-0.66
2004 Survey: maximum	1.63	1.41	1.95	1.41	1.95
2004 Survey: std dev	0.40	0.47	0.51	0.39	0.45
2004 Survey: num obs	67	70	70	75	282
2005 Survey: mean	0.08	0.04	0.17	0.16	0.11
2005 Survey: minimum	-0.57	-0.62	-0.66	-0.55	-0.66
2005 Survey: maximum	1.63	1.41	1.95	1.41	1.95
2005 Survey: std dev	0.40	0.47	0.51	0.39	0.45
2005 Survey: num obs	74	74	72	81	301
All Surveys: mean	0.10	-0.01	0.00	0.07	0.04
All Surveys: minimum	-0.66	-0.66	-0.66	-0.66	-0.66
All Surveys: maximum	1.99	2.00	1.95	1.96	2.00
All Surveys: std dev	0.49	0.48	0.51	0.45	0.48
All Surveys: num obs	456	417	406	505	1784

As would be expected, the standard deviations are much smaller in this sample, although there is still considerable dispersion. A total of 137 observations, out of 2242, were dropped. Comparing by security type, the descriptive statistics indicate that on average, the gaps are somewhat negative for agency bonds (the estimated positions tend to overstate the measured survey positions), slightly positive for Treasuries and stocks, whereas those for corporate bonds tend on average to be zero. For a given security, the gaps also tend to vary in size and sign from year to year.

We also looked for evidence that gaps by country are correlated over time or by security type. Tables 3a and 3b present the correlations over time, for the samples both with and without outliers. For the full sample, there is essentially no correlation at all between one survey year and another. For the truncated sample we observe correlation coefficients on the order of $0.1 - 0.2$, suggesting a very modest degree of persistence in the gaps from one survey to the next.

Table 3a. Correlation matrix for gaps by survey years, 1989 -- 2005 (full sample, 235 observations)							
Survey year	1989	1994	2000	2002	2003	2004	2005
1989	1	-0.006	-0.005	0.053	-0.004	-0.005	-0.026
1994		1	-0.001	0.033	-0.006	-0.009	-0.034
2000			1	-0.002	-0.013	-0.032	0.118
2002				1	-0.018	-0.072	-0.010
2003					1	-0.008	-0.016
2004						1	0.030
2005							1

Table 3b. Correlation matrix for gaps by survey years, 1989 -- 2005 (truncated sample, 194 observations)							
Survey year	1989	1994	2000	2002	2003	2004	2005
1989	1	-0.063	0.155	0.227	-0.039	-0.062	0.140
1994		1	0.106	0.055	-0.059	0.034	-0.023
2000			1	-0.040	0.116	0.129	-0.087
2002				1	0.315	0.073	0.130
2003					1	0.072	-0.023
2004						1	0.177
2005							1

We find a similar pattern for the correlations across securities – essentially nothing for the full sample, and coefficients on the order of 0.1 – 0.2 for the truncated sample. This result suggests, plausibly enough, that there is some slight tendency for large gaps in a given country for one security to be associated with large gaps in the other securities.

Table 4a. Correlation matrix for gaps by security type (full sample, 476 observations)				
	Treasuries	Agencies	Corporates	Equities
Treasury bonds	1	0.026	0.003	0.058
Agency bonds		1	0.416	0.127
Corporate bonds			1	0.003
Equities				1

Table 4b. Correlation matrix for gaps by security type (full sample, 261 observations)				
	Treasuries	Agencies	Corporates	Equities
Treasury bonds	1	0.085	0.093	0.013
Agency bonds		1	0.126	-0.043
Corporate bonds			1	0.123
Equities				1

Finally, we regressed the scaled gaps on dummy variables for security type, survey year, and country-specific dummies. Because gaps may also arise from errors in the valuation adjustments we apply, we also include the security-specific price changes applied in each inter-survey period. Results from applying this regression exercise to the sample trimmed of outliers are presented in Table 5. The regression is able to explain only a small fraction of the observed variation in the scaled gaps: the adjusted R^2 is only .076 and the RMSE comes in at .463: a sizable error for a variable with a mean of .04.[15]

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[15] Discouraging as these results may be, fit is notably better than for the full sample including outliers: conducting the same regression exercise over the full sample generates an adjusted R^2 of -.005 and a RMSE of 40.63.

Table 5a. Regression of scaled survey gaps on survey, security and country dummy variables, and on price changes: summary statistics

Source	SS	df	MS	Number of obs	1784
				F(96, 1687)	2.53
Model	52.064	96	0.5423	Prob > F	0
Residual	361.294	1687	0.2142	R-squared	0.1260
				Adj R-squared	0.0762
Total	413.358	1783	0.2318	Root MSE	0.4628

Table 5b. Regression of scaled survey gaps on survey, security and country dummy variables, and on price changes: estimated coefficients

variable name	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
constant	0.161	0.107	1.50	0.133	-0.049	0.372
dagcy	-0.084	0.039	-2.16	0.031	-0.160	-0.008
dstk	0.016	0.037	0.43	0.669	-0.057	0.089
dcorp	-0.061	0.038	-1.64	0.102	-0.135	0.012
d1994	-0.014	0.059	-0.24	0.809	-0.130	0.101
d2000	-0.043	0.048	-0.90	0.366	-0.137	0.051
d2002	-0.130	0.048	-2.72	0.007	-0.224	-0.036
d2003	-0.152	0.045	-3.35	0.001	-0.241	-0.063
d2004	-0.039	0.067	-0.58	0.562	-0.170	0.093
d2005	-0.092	0.051	-1.81	0.071	-0.192	0.008
ptreas	0.034	0.573	0.06	0.953	-1.090	1.157
pagcy	-0.538	0.704	-0.76	0.445	-1.919	0.843
pcorp	-0.971	0.530	-1.83	0.067	-2.012	0.069
pstk	-0.074	0.030	-2.49	0.013	-0.133	-0.016
Netherlands	0.228	0.131	1.74	0.082	-0.029	0.484
United Kingdom	-0.421	0.134	-3.15	0.002	-0.683	-0.158
Netherlands Antilles	-0.303	0.143	-2.11	0.035	-0.584	-0.022
Hong Kong	-0.217	0.131	-1.66	0.097	-0.474	0.039
(+ other country dummy variables)						

The coefficients for agency and corporate bonds enter with a negative signs (although only the coefficient for agency bonds is significant at the 5 percent level; that for corporate bonds just misses significance at the 10 percent level), providing some statistical confirmation for the observation that on average the estimated positions for agency and corporate bonds tend to overstate the measured survey values for these securities. Of the survey year dummies, we find significant (negative) coefficients for 2002, 2003, and 2005. Most country dummies are not significant; we list a few that are: the U.K. and the

Netherlands Antilles, the Netherlands and Hong Kong (although only at the 10 percent level for the last two). Although point estimates for many of the dummy variables seem sensible, confidence bands around them are large. For the U.K. dummy variable, for example, the 95% confidence interval around the point estimate of -.421 is -.683 to -.158.

Nonetheless, we believe there is some useful information that can be taken away from the regression results. The sizable negative coefficient for the U.K. dummy variable (-.421) indicates that, all else equal, "financial center bias" will lead to an estimated position for the U.K. that overstates the actual survey position by roughly 40 percent. The Netherlands Antilles and Hong Kong also appear to exhibit "financial center bias," while the positive coefficient for the Netherlands indicates that it is a country whose holdings tend to be underestimated. The between-survey price changes for corporate bonds and for equities also enter with significant negative coefficients (only at the 10 percent level for corporate bonds). These results suggest that the prices we impute to foreign holdings of U.S. corporate bonds and U.S. corporate stocks may overstate the actual valuation effects observed for foreign portfolios in these securities: all else equal, price increases will lead to overestimates of the actual survey positions (negative scaled gaps), and price decreases will lead to underestimates. For U.S. stocks, this finding is perhaps not that surprising, given that some of these holdings are actually holdings of mutual funds (including money market mutual funds) and thus may not be appropriately priced by a standard U.S. equity price index. For U.S. corporate bonds, there is no obvious explanation.

4.2 Forecasting the survey gaps

We are left with something of a dilemma: for most countries, there is no clear statistical basis for projecting the survey gaps forward, but for practical purposes we need to make the best forecasts we can. Forecasting the gaps at zero may be appealing on methodological grounds, in the absence of a well-estimated model, but it is clearly unsatisfactory for policy purposes. Even without significant statistical results, we have strong prior beliefs that a large positive or negative gap for, say, the 2002 survey in a given country will not immediately revert to zero in 2003.

We think the best estimates of the gaps will be country and security specific. For example, for U.K. holdings of corporate bonds, we know the gaps are usually large and negative, and we want our forecast of the gap for U.K. bonds holdings to have this property. This suggests using the mean scaled gap for each country and security as the forecast. But as discussed above the gaps are clearly very noisy: there are many outliers, and these can have undue influence on the calculated average gap and thus on the estimated position. In addition, averaging over the entire sample of available surveys ignores more recent developments that may affect the location of transactions (such as the establishment of a new financial center), or that affect reported transactions (such as changes in asset-backed security repayment rates). Such changes may lead to larger or more uniformly positive or negative gaps when observed over the most recent surveys.
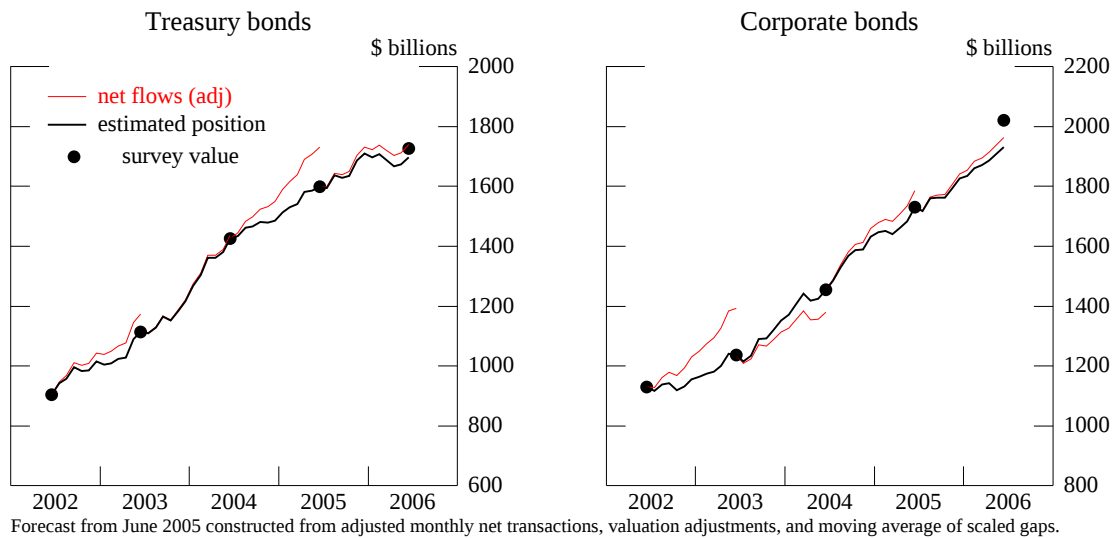
In order to address these concerns we adopt another admittedly ad hoc approach: we use the average of the scaled gaps for the most recent liabilities surveys starting with the first annual survey in 2003. This is also the period for which we have asset-backed repayment estimates for agency and corporate bonds, which may introduce a break in the behavior of the gaps. For our in-sample forecasts of 2006 we use the average of three gaps (2003, 2004, and 2005), and going forward from 2006, four gaps.[16]

We identify outliers by the same criteria we used to exclude observations from the regression exercise above, but rather than omitting them, we bound both positive and negative gaps at twice the magnitude of the estimated position. While it might be conceptually more appealing to discard these observations entirely, this would in some cases leave us with little data to form an average, and it seems better to try to extract some information from these points. Once the end-of-period gap has been determined (and the assumed end-of-period position has been derived), constructing the monthly positions going forward is straightforward. (By an analogous procedure, one can also extend the estimated positions back, from the earliest survey date to the beginning of the transactions data.)

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[16] When we have data for the 2007 survey, this procedure would imply that we use the average of five survey gaps. We may instead use a moving average of the four most recent gaps, to allow for possible shifts over time.
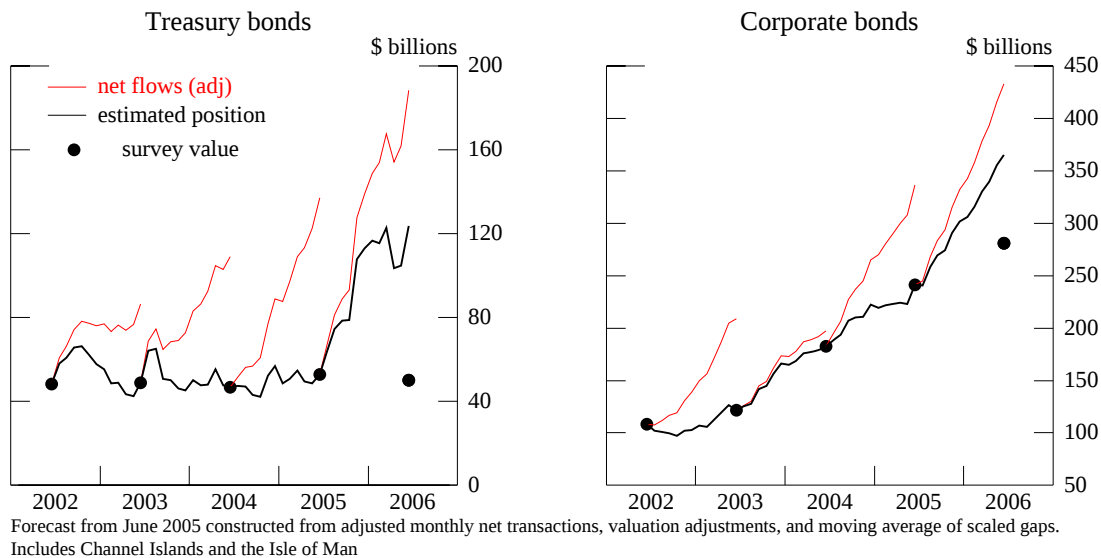
Figure 8 shows estimated positions based on the June 2005 survey for total foreign holdings of U.S. treasuries and corporate bonds in June 2006 made using the procedure just described (the black line) and for comparison, the "naïve" estimates made using flows and valuation changes only (the red lines). Actual holdings as measured in the June 2006 survey are also shown for comparison.

Figure 8. Forecast of total foreign holdings of U.S. long-term securities, June 2006

Forecast from June 2005 constructed from adjusted monthly net transactions, valuation adjustments, and moving average of scaled gaps.
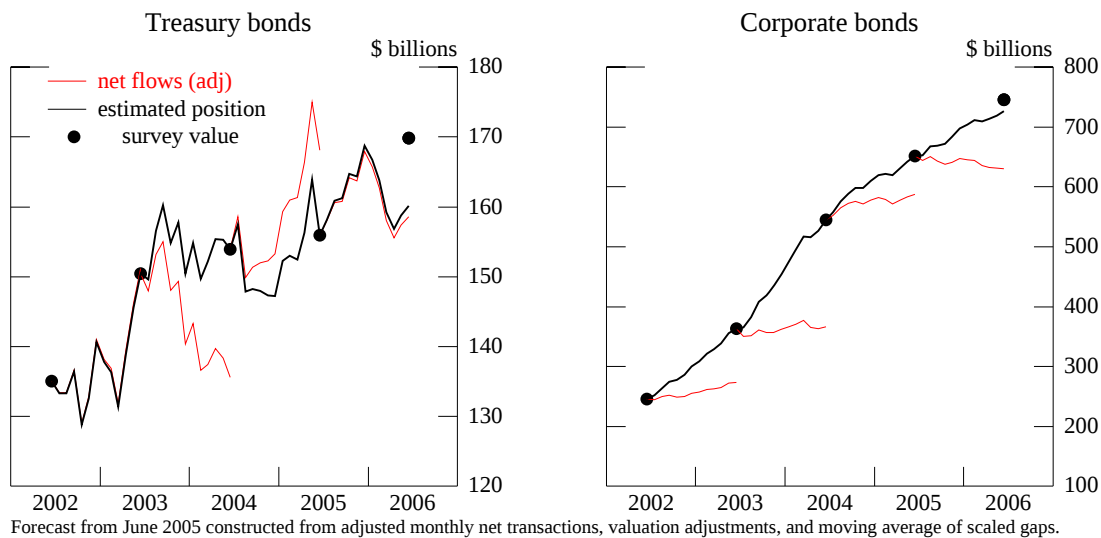
As it happens, the "naïve" estimate derived from applying flows and valuation changes to the 2005 survey value generates a slightly better forecast for June 2006, but such a fortunate outcome cannot be counted on. Furthermore, many individual countries have gaps that are consistently negative or positive, and our procedure takes this somewhat into account. For example, Figure 9 shows that while the forecast positions for the United Kingdom still overestimate the measured survey amounts, they do so by considerably less than the naïve estimates.

Figure 9. Forecast of U.K. holdings of U.S. long-term securities, June 2006

Forecast from June 2005 constructed from adjusted monthly net transactions, valuation adjustments, and moving average of scaled gaps.
Includes Channel Islands and the Isle of Man

Similarly, as shown in Figure 10, we can significantly reduce the degree of underestimation in holdings of corporate bonds in the euro area.

Figure 10. Forecast of euro area holdings of U.S. long-term securities, June 2006

Forecast from June 2005 constructed from adjusted monthly net transactions, valuation adjustments, and moving average of scaled gaps.

4.3. Estimating positions for foreign official investors
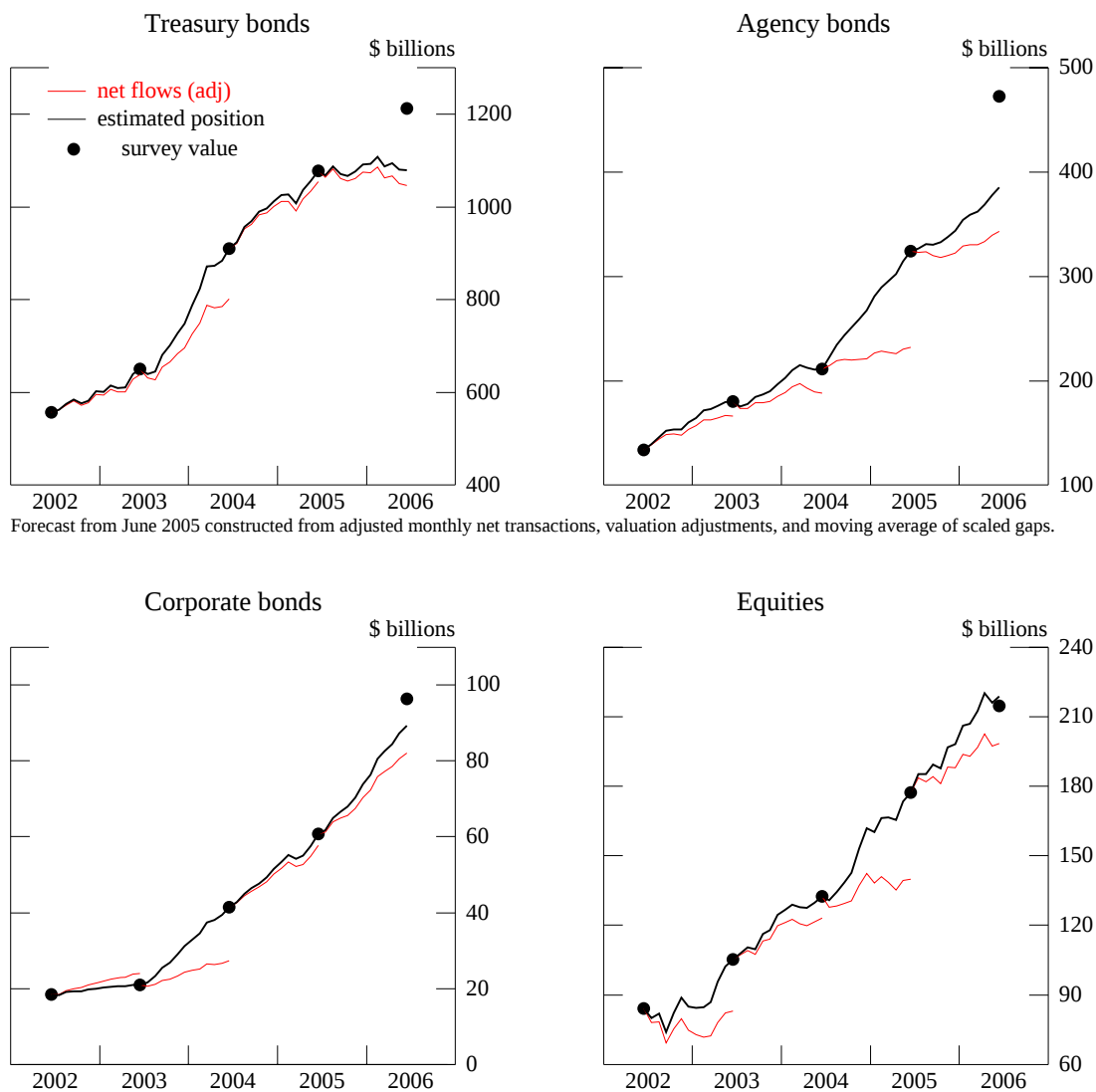
The same approach to generating between-survey position estimates and forecasts by country can be applied to generate position estimates for holdings of U.S. securities by

foreign official institutions. Official investors hold an increasing share of asset-backed securities (especially ABS agency securities), and thus their net transactions should be subject to the same ABS repayment flows.[17] On the other hand, measured official holdings in a new survey typically exceed those expected from summing transactions since the previous survey, even after accounting for valuation changes. This result often occurs because chains of intermediaries can obscure both the type and the country of the foreign holder in the reported transactions data.[18] Figure 11 shows the survey-consistent measures of foreign official holdings of each of the four types of U.S. securities as well as the forecasted value for June 2006. The effect of official net purchases through foreign private intermediaries is especially apparent for official holdings of Treasury and agency bonds since 2002. Although the forecasted values still understate the measured official holdings in June 2006, they do so by less than the "naïve" estimates.

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[17] Foreign official holdings of asset-backed agency securities have grown from $4.3 billion in June 2002 to $117.7 billion in June 2006, and now account for roughly 38 percent of all agency securities held by official institutions, and 30 percent agency ABS held by all foreign investors. Corporate ABS holdings by foreign official investors are much smaller: $29.7 billion in June 2006, or about 5 percent of all foreign holdings of corporate ABS. Estimates of monthly repayment flows on foreign official holdings of agency ABS are available on the TIC website.

[18] Consider the example of a foreign official institution that acquires a U.S. security, such as a Treasury bond, from a private foreign entity on a foreign securities exchange and then has the security moved to be held in custody in the United States at the Federal Reserve Bank of New York (FRBNY). In this case, reported holdings of Treasury securities by foreign official institutions will increase, but no corresponding TIC-reported foreign official purchase will be recorded because the acquisition by the foreign official institution from another foreigner is not a U.S. cross-border transaction: It is a foreign-to-foreign transaction. Because the FRBNY is a reporter on the annual surveys, the increased holdings will then be measured in the next survey. When the private foreigner first acquired the Treasury security, a U.S. cross-border transaction would have been reportable in the TIC system. However, it would not have been recorded as a foreign official purchase, nor would it necessarily have been recorded in the same calendar month or against the same country as was the movement into U.S. custody. For more information, including a comparison of changes in Treasury and agency securities held at the Federal Reserve Bank of New York for official accounts, refer to TIC FAQ number 10, www.treas.gov/tic/faq1.html.

Figure 11. Forecast of holdings of U.S. long-term securities by foreign officials, June 2006

Treasury bonds

Agency bonds

Corporate bonds

Equities

Forecast from June 2005 constructed from adjusted monthly net transactions, valuation adjustments, and moving average of scaled gaps.
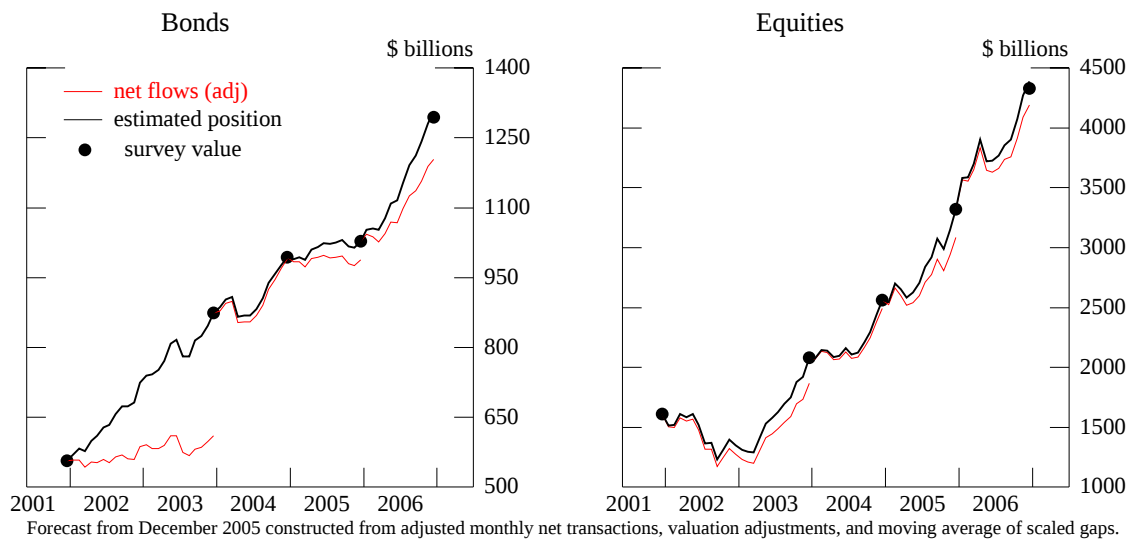
5. Estimating positions on the U.S. claims side

Figure 12 presents estimated positions using the same basic methodology for U.S. claims on foreigners. As we discuss in Appendix B, we allow for country-specific valuation adjustments in constructing our claims estimates and then because our methodology adjusts for financial center (transactions) bias, our estimated holdings will provide a reasonable time series approximation of actual holdings by country of issuer. One difference from our liabilities estimates is that we do construct the aggregate U.S. portfolio of foreign securities
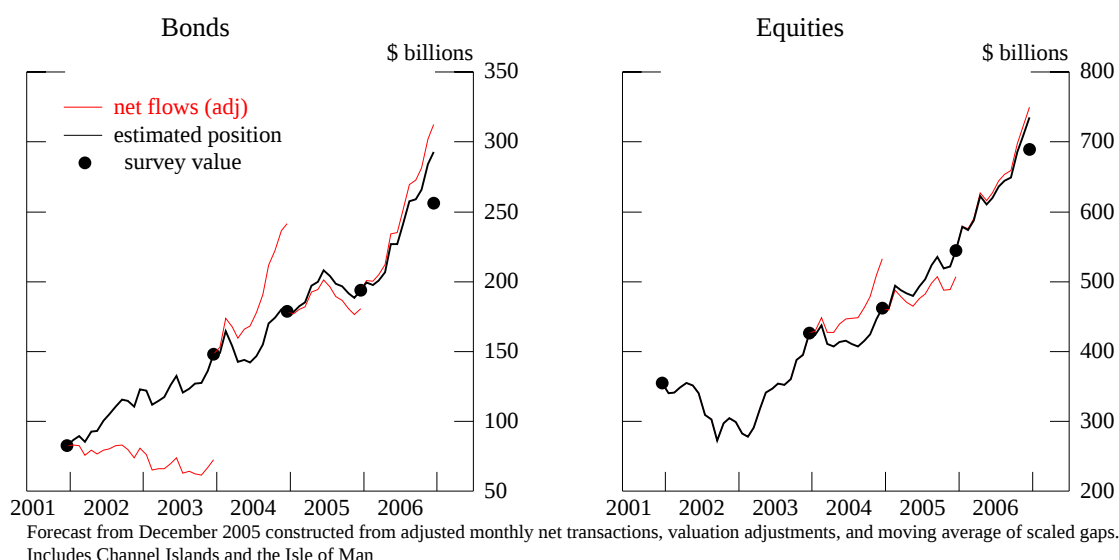
by summing the estimated holdings of securities of each individual country.[19] The advantage to this approach on the claims side is that that because we allow for country-specific valuation effects, the resulting aggregate portfolio is weighted according to the actual countries of issue of the securities that U.S. investors hold. The resulting valuation changes we impute will better approximate the actual price and exchange rate movements realized by U.S. investors than will most global bond or equity indexes: for example, our constructed foreign bond portfolio is roughly 70 percent dollar-denominated, compared with approximately 25 percent for a standard global bond index such as the MSCI World Sovereign bond index. Our approach to estimating positions for U.S. claims after December 2005 is also similar to that for U.S. liabilities, but because claims surveys have only been conducted annually beginning in 2004, the average gap is constructed using only the gaps for 2004 and 2005. Figure 13 shows similar results for U.S. claims on the United Kingdom.

Figure 12. Forecast of total U.S. holdings of foreign long-term securities, December 2006

Forecast from December 2005 constructed from adjusted monthly net transactions, valuation adjustments, and moving average of scaled gaps.

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[19] We do not have a comparable "country unknown" problem for our claims surveys, because the security-level detail allows us to correctly identify the country of issuer even if the security is unregistered. Likewise, the collection of security-level data in our asset surveys means that we do not have the same "custodial bias" that is present in our liabilities surveys.

Figure 13. Forecast of total U.S. holdings of U.K. long-term securities, December 2006

Bonds

Equities

Forecast from December 2005 constructed from adjusted monthly net transactions, valuation adjustments, and moving average of scaled gaps.
Includes Channel Islands and the Isle of Man

6. Decomposing changes between surveys into flows, valuation changes, and other factors

The methodology we have described provides a straightforward way to construct consistent monthly between-survey estimates of securities positions, but it leaves open the question of how to decompose the evolution of the change in position into flows, valuation effects, and other factors: an exercise of considerable interest to analysts attempting to reconcile U.S. cross-border financial flows with the evolution of the cross border holdings such as that presented in the U.S. international investment position (IIP).[20] We identify "flows" as the adjusted net transactions data that include not only the appropriate adjustments for stock swaps and ABS repayments, but also the corrections we make to the flow data to prevent the between-survey positions from becoming negative.[21] We can also get a measure of the size and direction of the valuation effect over the period in question from the difference between the valuation-adjusted position estimate and a flow-only estimate, such as that illustrated in Figure 2. Of course, accounting for these identifiable factors still leaves the observed gap at the end of the period. But because our methodology distributes the gap month by month, we can decompose the change between our estimated positions for any

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[20] In its presentation of the IIP, the Bureau of Economic Analysis decomposes the change in the year-end positions in a similar fashion, separating the annual contributions into financial flows, valuation effects that in turn are separated into price changes and exchange rate changes, and "other factors."
[21] We also bear in mind that our definition of "flows" includes transactions costs.

- 32 -

two periods into the contributions from flows, valuation changes, and the gap. Thus, although our liabilities surveys initially were conducted only once every five years, and more recently are conducted annually but as of end-June, we can decompose the annual changes in our year-end position estimates into flows, valuation effects, and the "gap," similar to the presentation in the IIP. Figures 14 and 15 summarize these changes for total foreign holdings and U.K. holdings of each type of U.S. long-term security.

For total foreign holdings of U.S. debt securities (Figure 14a-c), the estimated change in position in most years is primarily accounted for by financial flows, whereas valuation effects account for the bulk of the change in foreign holdings of U.S. equities, especially in recent years (Figure 14d). The charts also indicate that at times the "gap" can make a sizable contribution. Because the gap itself may arise from flow errors or valuation errors, it may be desirable to attempt to decompose the gap error into the relevant contributing factors. For this purpose, the regression results from Table 3 may provide some guidance, but unfortunately the limited ability of the regression exercise to explain much of the variation and the imprecision with which the coefficients are estimated makes it difficult to draw firm conclusions.

Figure 14a. Foreign holdings of U.S. treasury bonds
Components of change in year-end position
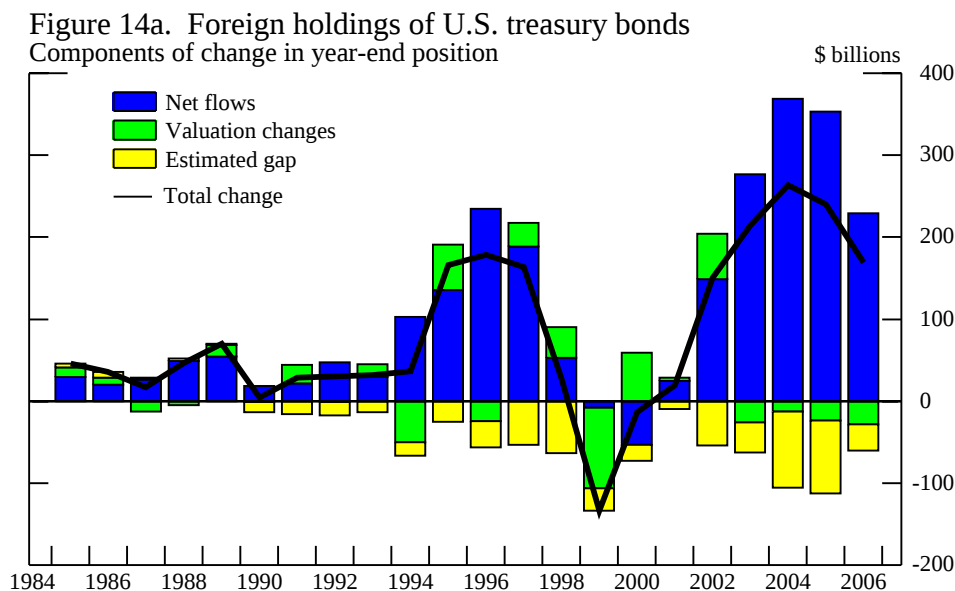
Figure 14b. Foreign holdings of U.S. agency bonds
Components of change in year-end position $ billions

Net flows
Valuation changes
Estimated gap
Total change

1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
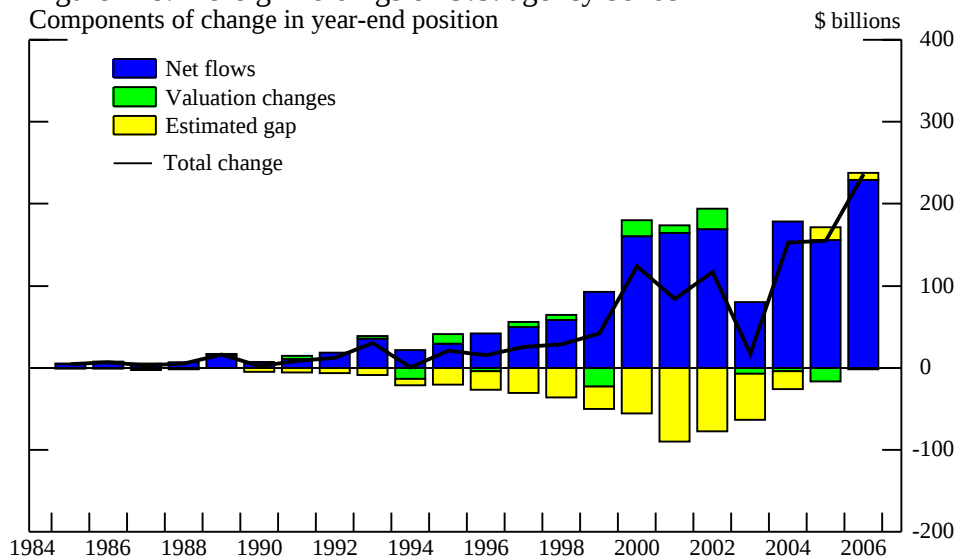
Figure 14c. Foreign holdings of U.S. corporate bonds
Components of change in year-end position $ billions

Net flows
Valuation changes
Estimated gap
Total change

1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006
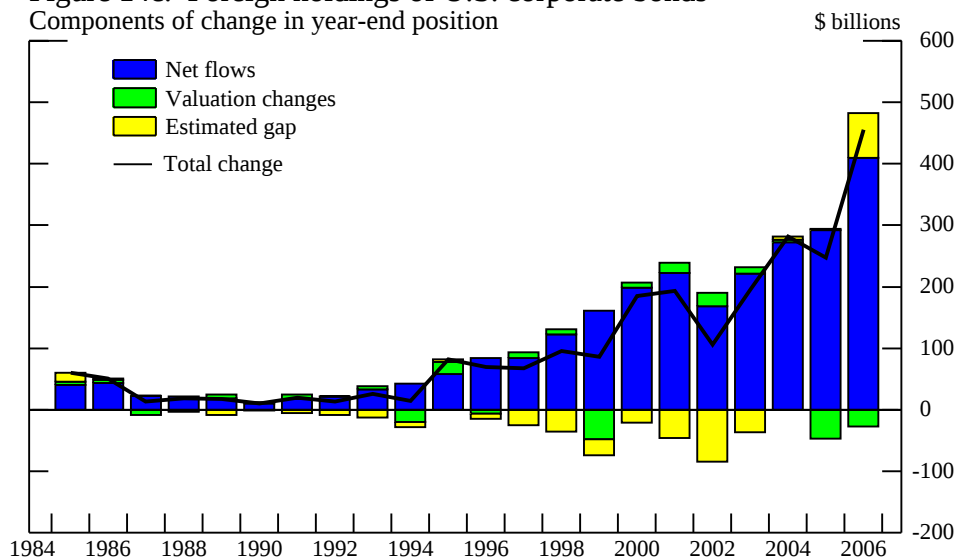
Figure 14d. Foreign holdings of U.S. equities

Components of change in year-end position

$ billions

Legend:
- Net flows
- Valuation changes
- Estimated gap
- Total change
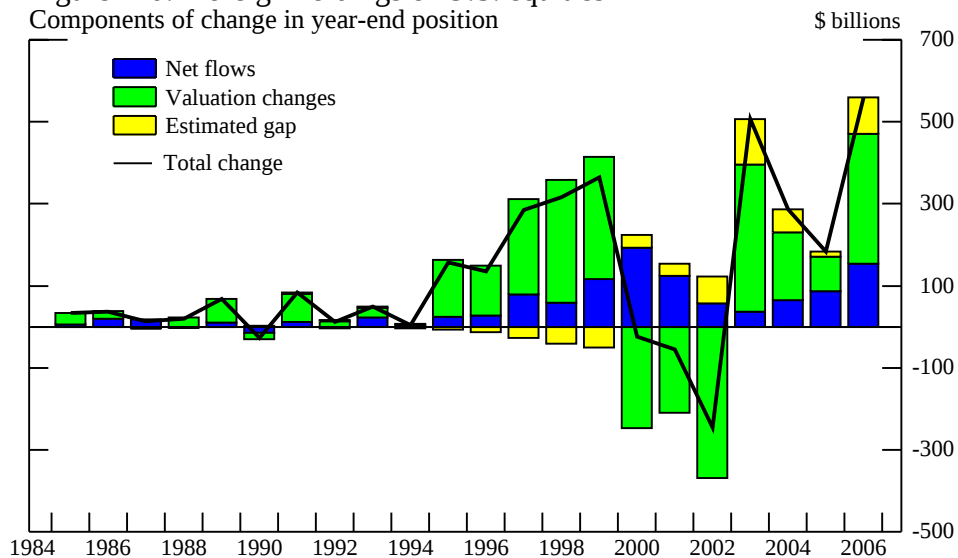
Figure 15a. U.K. holdings of U.S. treasury bonds

Components of change in year-end position

$ billions

Legend:
- Net flows
- Valuation changes
- Estimated gap
- Total change

Includes Channel Islands and the Isle of Man
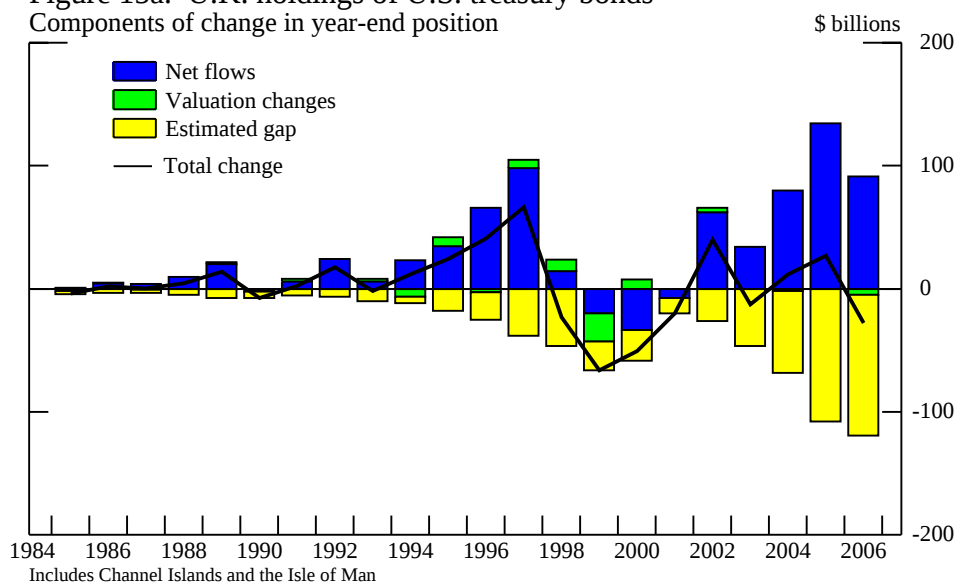
Figure 15b. U.K. holdings of U.S. agency bonds
Components of change in year-end position

$ billions

- Net flows
- Valuation changes
- Estimated gap
- —— Total change

Includes Channel Islands and the Isle of Man
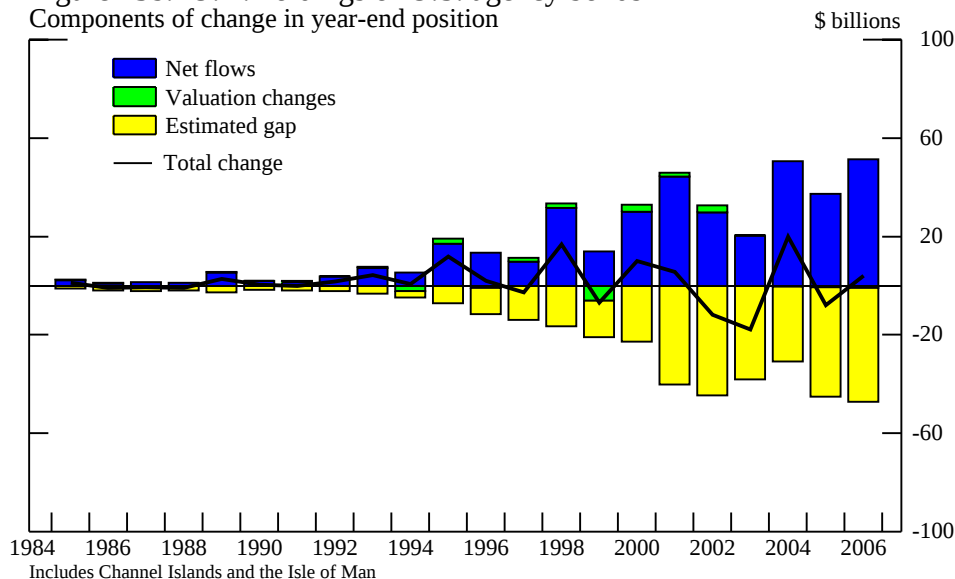
Figure 15c. U.K. holdings of U.S. corporate bonds
Components of change in year-end position

$ billions

- Net flows
- Valuation changes
- Estimated gap
- —— Total change

Includes Channel Islands and the Isle of Man
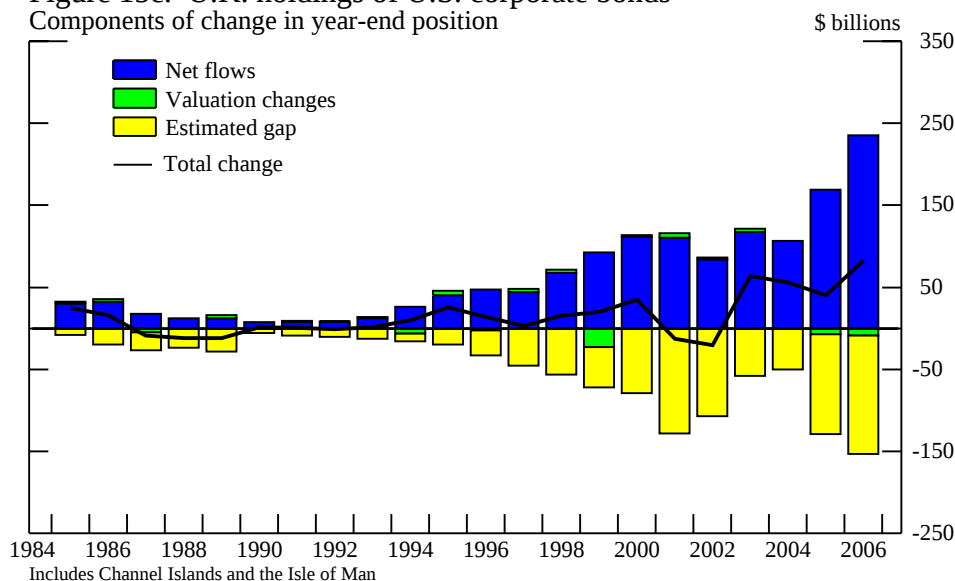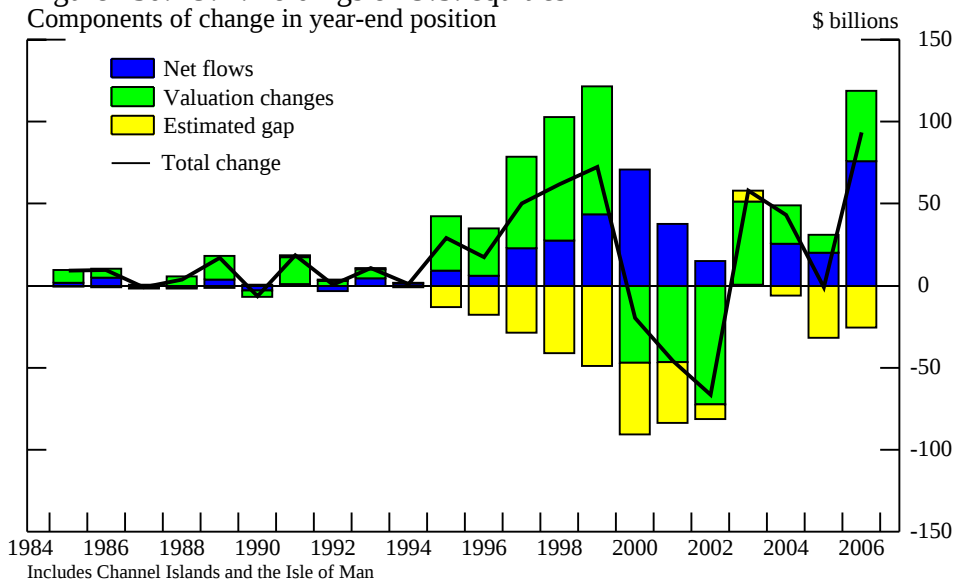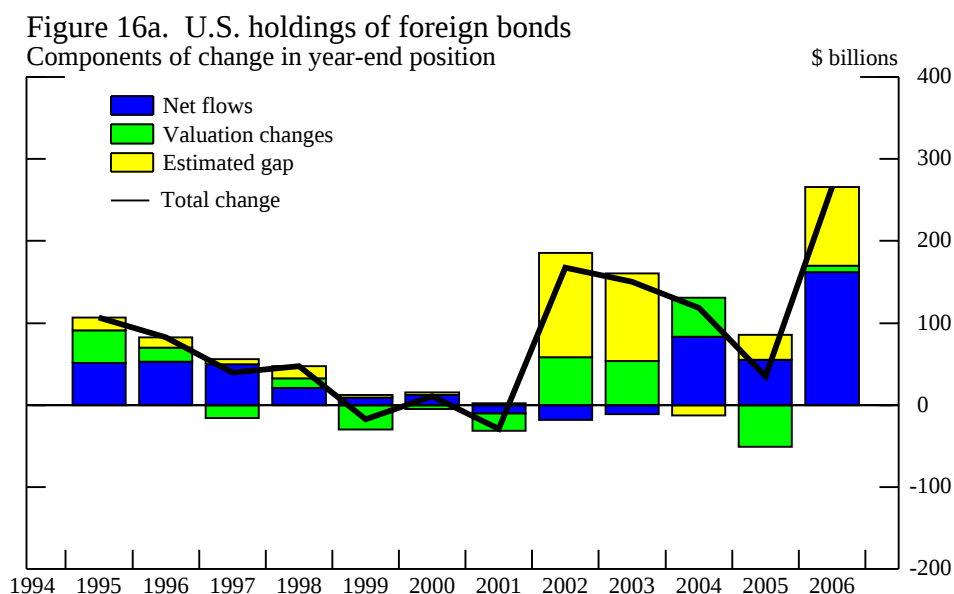
Figure 15d. U.K. holdings of U.S. equities
Components of change in year-end position

Where we identify significant individual country dummy variables (such as for the U.K.),
these regression results indicate systematic but country-specific problems with the flow
data: we interpret this result for the U.K. as the financial center bias that leads to
systematic overestimates for U.K. holdings. Thus, in Figures 15a-15d for changes in the
U.K. position estimates, the large negative gap contributions about offset the positive flow
contributions, leaving the total change in position (denoted by the solid line) showing a
much smaller annual change. The overall gaps we observe for the total of all countries are
a bit more problematic to sort out. The negative coefficients for agency and corporate
bonds in the regression exercise correspond to the relatively persistent negative gap
contributions for changes in foreign holdings of these securities. These gaps may in part
reflect the imprecision with which we can adjust for ABS repayments (and the fact that
such ABS repayment flows are not available prior to 2002), and thus these gaps may
plausibly offset some of the flow changes for these securities as well. The significant
(negative) survey year dummies for 2002, 2003, and 2005 may suggest that there were
particular problems with those year's measured survey values, but may also indicate
changes in reporting of the flow data. In practice, each year's survey data are used by the
compilers of the data to cross-check reporting on the flow data, and when the survey results
point to a particular problem with the flow data, reporting instructions may be clarified for

data going forward.[22] As we noted above, the negative price coefficients for corporate bonds and for stocks suggest that we may over-estimate the valuation changes that apply to these securities, and may in part account for the tendency for the gap contributions to partially offset the valuation contributions for these securities. However, we reiterate that the confidence with which we can assign such contributions to the gaps is limited, and necessarily will be a judgmental exercise.[23]

Figure 16 repeats the decomposition exercise for U.S. holdings of foreign securities (because the claims surveys only begin in 1994, we can provide this decomposition only from 1995). A few observations stand out. First, for U.S. holdings of foreign equity,

Figure 16a. U.S. holdings of foreign bonds
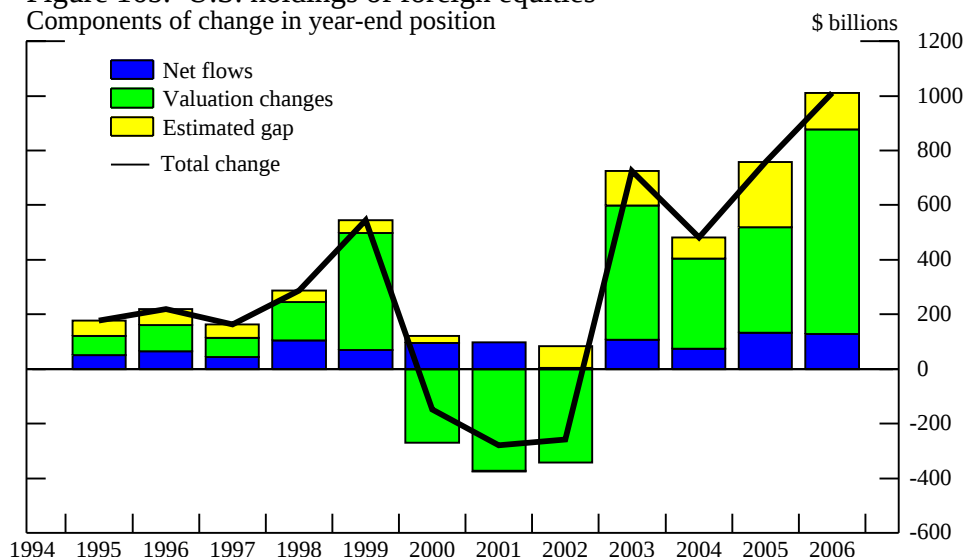
valuation effects make a very sizable contribution, reflecting both the effects of foreign equity price changes (in home currencies) as well as effects of the exchange value of the dollar, with the appreciation of the dollar contributing to the negative valuation effects in

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[22] Because the more recent liabilities surveys are conducted as end-June, the effect of a negative coefficient for the 2002 survey would show up as contributing to the negative gap contributions for both 2001 and 2002, and likewise that for the 2003 survey will contribute to the gaps for both 2002 and 2003.
[23] And in fact although the BEA does allow much of the "gap" arising from the results of a new survey to show up in the estimated "other" factors in their presentation of changes underlying the IIP, they also make some judgmental allocations of the gap to adjust financial flows and valuation changes.

2000 and 2001, and dollar depreciation mitigating the negative price contribution in 2002

and contributing to the positive valuation effects in 2003 and 2004. Second, the gap

Figure 16b. U.S. holdings of foreign equities
Components of change in year-end position

contributions are almost uniformly positive and at times have been quite large. For

example, in 2002 and 2003, the gaps explain most of the total change in U.S. holdings of

foreign bonds (Figure 16a). Whereas the reported flow data for 2002 and 2003 indicated

that U.S. investors on net sold foreign bonds over this two-year period while positive

valuation effects provided some offset, holdings of foreign bonds as reported in the

December 2003 survey were considerably larger than could plausibly be explained by these

factors. Subsequent investigation indicated that this miss was primarily the result of

underreporting of foreign bonds newly issued in the United States, suggesting that in this

case the gap at least in part should be attributed to missed flows.[24] In general, the fairly

persistent positive gaps for estimates of U.S. claims may reflect a greater difficulty in

measuring U.S. cross-border acquisitions of foreign securities, as well as the inherent

difficulty in making accurate valuation adjustments for the sizable, diverse portfolio of

foreign securities held by U.S. investors.

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[24] In the international financial transactions accounts, the BEA reports U.S. net *purchases* of foreign bonds of roughly $30 billion in each of 2002 and 2003, indicating that they did make a judgmental allocation of at least part of the gap to the net flow contribution.

7. Conclusions and further research

Using an approach based on Thomas, Warnock and Wongswan, we provide monthly estimates of U.S. cross-border securities positions combining periodic comprehensive surveys of holdings with the monthly TIC cross-border securities transactions data. We extend the dataset used in earlier work, make somewhat more comprehensive adjustments to the transactions data and enhancements to prices used to make valuation adjustments, and clarify the calculations involved. Although we are unable to identify a satisfactory statistical method for extrapolating estimates beyond the most recent survey values, we arrive at a seemingly workable *ad hoc* approach for updating estimates through the current transactions data.

Our explorations suggest that further improvements could be made to our valuation adjustments, especially for those applied to foreign holdings of U.S. equities and U.S. corporate bonds. Such improvements not only would improve our ability to estimate holdings for dates beyond the last survey, but would also enhance our understanding of the returns foreigners earn on their portfolio investments in the United States relative to the returns U.S. investors earn abroad, an issue of considerable current interest.

In future work we also hope to further explore further the statistical basis for estimation, possibly using bootstrapping or nonparametric methods and accounting for other factors such as trading volume to better explain observed gap errors. Additionally, we hope to extend our statistical analysis to the U.S. claims data to better understand the sources of the persistent positive errors in estimating U.S. holdings of foreign securities.

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Appendix A

Adjusting for sales of asset-backed securities, stock swaps and transactions costs

Asset-backed Securities

As discussed in Bertaut, Griever, and Tryon (2006), an important adjustment to estimates of foreign holdings of U.S. debt securities is to account for repayments of principal on asset-backed debt securities (ABS).[25] Although foreign purchases and sales of agency and corporate ABS are included in the monthly TIC transactions data, the periodic repayments of principal prior to redemption are not reported, because these repayment streams do not pass through the brokers and dealers primarily responsible for reporting securities transactions. Thus, using the as-reported data on agency and corporate debt transactions without accounting for these repayments will tend to overstate foreign net acquisitions of asset-backed debt securities, because the monthly data will include any new purchases of ABS made to offset principal paydowns, but not the paydowns themselves. The estimated adjustments for ABS repayments can be sizable: for 2005, these estimates reduce net purchases of U.S. government agency bonds by nearly $63 billion and net purchases of corporate bonds by nearly $81 billion.

To adjust the transactions data for ABS repayments flows, we use the estimates of monthly ABS paydowns calculated by the Federal Reserve Bank of New York and available on the TIC website. Repayment rates are derived from the underlying security-by-security data from the U.S. liabilities surveys, reported monthly repayment rates by Fannie Mae and Freddie Mac (for agency ABS), and individual security factor values from Bloomberg Online Data services (for corporate ABS). These estimates are available from July 2002 forward on the TIC web site at http://www.treas.gov/tic/; for agency bonds, estimates of ABS repayment flows for securities held by foreign official institutions are also provided.

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[25] Asset-backed securities are securities backed by pools of assets, such as residential home mortgages, which give the security owners claims against the cash flows generated by the underlying assets. Unlike most other debt securities, ABS typically repay both principal and interest on a regular basis, reducing the principal outstanding with each payment cycle. Foreign-held asset-backed agency securities are largely mortgage-backed securities issued by the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Association (Freddie Mac). Corporate asset-backed securities include mortgage-backed securities issued by non-government corporations as well securities backed by pools of assets such as auto loans and credit card receivables.

Details of the methodology are also available on this site.[26] Although asset-backed principal repayments are potentially a concern on the asset side as well as the liabilities side, it does not appear that such repayment flows are a serious omission at present. Although holdings of ABS securities have grown from less than 4 percent as of December 2001 to more than 12 percent as of December 2005, many of these foreign ABS securities replace repaid principal, and thus monthly net purchases are not likely to be overstated to the same degree.

Stock swaps

Another important omission in the TIC data, noted by Thomas, Warnock and Wongswan, is that the TIC S data fail to capture U.S. acquisitions of foreign stock and foreign acquisitions of U.S. stock that arise from stock swaps associated with corporate mergers or takeovers. When a foreign company acquires a U.S. company and the deal is financed in part through a stock swap, U.S. residents who held stock in the target company become holders of foreign equity. Likewise, if a U.S. company acquires a foreign company, a stock swap can increase foreign holdings of U.S. equity. These stock swaps are omitted from the TIC data, but they are reported in the BEA's quarterly balance of payments statistics. Although merger activity has tapered off in recent years, stock swaps previously were an important source of financing for U.S. acquisitions of foreign equity. For example, in 2000, U.S. residents acquired $13 billion in foreign equity through net purchases but $80 billion through stock swaps associated with foreign acquisitions of U.S. companies.

Following Thomas, Warnock and Wongswan, we adjust net transactions of both U.S. and foreign equity to account for acquisitions of equity resulting from stock swaps. Data on the financing of corporate mergers and takeovers from Security Data Corporation are used to distribute BEA's quarterly statistics of stock swaps by month, and these monthly estimates

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[26] It should be noted that the published ABS repayment flow estimates are subject to revision as information from a new liabilities survey becomes available. For example, if the new survey indicates that foreign ABS holdings are a larger share of agency or corporate securities than in the previous survey, foreign holdings of ABS in both the inter-survey period and in months following the survey are likewise presumed to be larger, generating larger ABS repayment flows.

are available on the TIC website.[27] The published estimates are reported for all foreign acquisitions of U.S. equity and for all U.S. acquisitions of U.S. equity that are the result of stock swaps. We use the same Security Data Corporation financing information which details the country of incorporation of both target and acquiring companies to distribute the stock swap estimates by country.

Transactions Costs

Because the TIC S data include transactions costs in any cross-border financial transaction, using the as-reported transactions data can introduce an additional source of error in constructing position estimates. For example, if a foreign resident purchases $10,000 in U.S. securities with a brokerage fee of 1 basis point, the total dollar amount remitted by the foreign purchaser – and thus reported on the TIC S – will be $10,001, although foreign holdings of U.S. securities will increase by only $10,000 (assuming no valuation changes). However, this source of error is likely to be fairly small compared to the omission of stock swaps and ABS repayment flows. Although the volume of U.S. cross-border transactions has increased dramatically, the fees and commissions on transactions in U.S. securities have also declined significantly in recent years, and thus the current fraction of net purchases accounted for by transactions costs is likely to be quite small. Our methodology allows us to ignore transactions costs in constructing position estimates by incorporating them with the transactions measurement error.

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[27] These monthly estimates from January 2000 forward are available at www.treas.gov/tic/swapstk.html; in adjusting for stock swaps in our estimates, we include additional estimates of swaps back to the mid-1980s.

Appendix B

Adjusting for Valuation Changes

We use information from the detailed surveys of holdings to determine appropriate price indexes to apply to account for valuation changes. For U.S. Treasury securities, the choice of an appropriate index is fairly straightforward, because foreign holdings of U.S. Treasuries are reasonably well represented by a standard index of Treasury securities. Similarly, we us a standard U.S. equity price index to account for valuation changes to foreign holdings of U.S. equities, although this pricing choice may overstate the extent of valuation changes because the definition of "equity" also includes mutual funds.[28] For U.S. agency bonds and corporate bonds, we account for the growing role of asset-backed securities in foreign portfolios by creating weighted average indexes of ABS and conventional agency debt and of ABS and conventional corporate debt, where the weights are derived from the proportions of ABS and conventional debt as reported in the surveys.[29] For U.S. corporate debt, we further account for the proportion of debt that is issued in foreign currency: As of June 2005, roughly 25 percent of U.S. corporate debt was denominated in foreign currency, largely in euro. Our conventional debt index itself is a weighted average of foreign currency and dollar-denominated U.S. corporate debt, where the foreign currency component is constructed from indexes of euro-, sterling-, and yen-issue corporate bonds.

Accounting for valuation effects for U.S. holdings of foreign securities is considerably more complex, because the U.S. portfolio of foreign stocks and bonds includes securities issued by many different countries, which greatly compounds the estimation problem. To

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[28] Roughly 10 percent of U.S. liabilities classified as equities are foreign holdings of U.S. mutual funds. While many of the funds themselves are equity funds, others are hybrid funds, bond funds, or money market funds.

[29] Detail on ABS and non-ABS securities are first reported in the June 2002 survey. At that time, ABS accounted for 25 percent of long-term agency debt held by foreigners and 15 percent of long-term corporate debt held by foreigners. These weights increased to 28 and 19 percent, respectively, in 2004, to 33 and 26 percent in 2005, and to 39 and 29 percent in 2006. We linearly interpolate the weights between survey values. For estimates of holdings before June 2002, we use standard indexes of conventional agency and corporate debt.

estimate valuation changes for foreign securities, we usually use individual country equity or bond price indexes, taking into account the currency composition of U.S. holdings.[30]

Pricing holdings of securities issued by offshore financial centers – such as Bermuda and the Cayman Islands – provides a special challenge, because there are no appropriate country equity or bond price indexes to apply. U.S. holdings of securities issued in offshore centers, especially those in the Caribbean, in large part consist of equity or debt of companies established or reincorporated in these locations.[31] Securities issued in offshore financial centers may also be issued by entities controlled by onshore corporations, including "special-purpose vehicles" (SPVs).[32] U.S. holdings of financial center equity tend to be highly concentrated in the shares of a few corporations, most of which are issued in dollars and trade primarily on U.S. exchanges, rather than the exchange of the country of incorporation. Where U.S. holdings of financial center equity are heavily concentrated in shares of a few specific corporations, we construct customized indexes of equity based on the prices of the shares held by U.S. investors.

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[30] A surprisingly large portion (more than 75 percent in December 2005) of U.S. holdings of foreign bonds are dollar-denominated, including 89 percent of bonds issued in Luxembourg, 84 percent of Australian bonds, 83 percent of U.K. bonds, and between 71 percent and 77 percent of Canadian, Dutch, and Irish bonds. We use weighted averages of local currency bond indexes and Eurodollar bond indexes to estimate valuation changes for holdings of bonds issued by most industrial countries. For debt issued by emerging market countries, we use country-specific weighted averages of EMBI+ indexes and local-currency bond indexes. Although the majority of emerging market debt held by U.S. investors is dollar-denominated, the share of local-currency debt has picked up in recent years.

[31] For balance of payments purposes and thus within the TIC system, an institution is considered to be resident in the country in which it is incorporated or otherwise legally created. Thus, when these entities issue securities, they will be attributed to the country of the offshore financial center rather than to the country of the onshore parent corporation, even though the onshore parent corporation may be understood to be the ultimate obligor. In addition, some companies have reincorporated from their country of origin to offshore financial centers for tax purposes. Although the reincorporation probably has little or no effect on their locus of activity, securities issued by these companies will now be attributed to the country of reincorporation. Equity issued in financial centers accounts for a growing percentage of the U.S. portfolio of foreign assets: In 1997, U.S. holdings of equity issued by Caribbean offshore financial centers amounted to $48 billion, or roughly 4 percent of foreign equity held by U.S. investors. By the end of 2004, these amounts had grown to $277 billion, or nearly 11 percent of foreign equity held.

[32] A special-purpose vehicle is a legal entity that may be created in an offshore financial center (OFC) to engage in financial activities in a more favorable tax environment. An onshore corporation establishes an SPV in an offshore center to engage in a specific activity, such as the issuance of asset-backed securities. The onshore corporation may assign a set of assets to the offshore SPV (for example, a portfolio of mortgages, loans, or credit card receivables). The SPV then offers a variety of securities to investors based on the underlying assets. The SPV, and hence the onshore parent, benefit from the favorable tax treatment in the OFC.

Holdings of long-term debt issued in offshore financial centers present a different challenge. In this case, U.S. holdings consist largely of debt securities issued through SPVs, especially those established in the Cayman Islands. The growth of securities issued through such entities accounts for much of the increase in Cayman Island debt held by U.S. investors: Such debt amounted to about 2 percent of U.S. investors' holdings of foreign bonds in 1997 but grew to nearly 12 percent by 2005. The majority of these bonds are U.S. dollar-denominated, and an increasing share is asset-backed: asset-backed securities accounted for nearly 60 percent of U.S. residents' holdings of Cayman Island bonds in 2005. We estimate valuation changes in Caribbean financial center long-term debt by applying weighted averages of world sovereign, U.S. corporate, and U.S. corporate asset-backed securities indexes.

Appendix C

Allocation of the residual measurement error across months between surveys

Beginning with an initial survey position, an estimate of the position at a future date t can be calculated as

$$\text{(A1)} \qquad \hat{S}_t = S_0(1 + \hat{\pi}_{0,t}) + \sum_{i=1}^{t} \hat{N}_i(1 + \hat{\pi}_{i,t})$$

where S_0 is the latest survey value for a given country, security, and holder; $\hat{S}_t$ is the estimated position at time $t > 0$, $\{\hat{N}_i\}$ is the sequence of net flows from time 1 to t, and $\hat{\pi}_{i,t}$ is the rate of increase in the price of security S over the period i to t, with $\pi_{i,i} = 0$.

In this case, only S_0 is actually known; $\hat{N}_i$ and $\hat{\pi}_{i,t}$ are observed with error and $\hat{S}_t$ is an estimate. When $t = T$, the date of the next survey, S_T is known, and we can define the "gap" between the actual and the estimated survey positions:

$$\text{(A2)} \qquad G_T = S_T - \hat{S}_T$$

We define the measurement errors in security prices (ε_t) as

$$\text{(A3)} \qquad (1 + \pi_t) = (1 + \hat{\pi}_t)(1 + \varepsilon_t)$$

where ε_t is the multiplicative error in observing the true monthly valuation change, π_t. We correct net transactions for transactions costs and other errors:

$$\text{(A4)} \qquad N_t = (1 + \beta_t)\hat{N}_t$$

where β_t includes both effects in multiplicative form. (We assume that both transactions costs and other measurement errors are equal percentages of both purchases and sales, so that β_t may be applied directly to net transactions.) The laws of motion for S_t and $\hat{S}_t$ are

$$\text{(A5)} \qquad S_t = S_{t-1}(1 + \pi_t) + N_t$$

$$\hat{S}_t = \hat{S}_{t-1}(1 + \hat{\pi}_t) + \hat{N}_t$$

Using (A3) — (A5) we define the gap between the (unobserved) actual position and the observed position at time t as

$$(A6) \qquad G_t \equiv S_t - \hat{S}_t$$

$$= S_{t-1}(1+\pi_t) + N_t - \hat{S}_{t-1}(1+\hat{\pi}_t) - \hat{N}_t$$

$$= S_{t-1}(1+\hat{\pi}_t)(1+\varepsilon_t) + (1+\beta_t)\hat{N}_t - \hat{S}_{t-1}(1+\hat{\pi}_t) - \hat{N}_t$$

$$= \hat{S}_{t-1}(1+\hat{\pi}_t)\varepsilon_t + \beta_t\hat{N}_t + G_{t-1}(1+\hat{\pi}_t)(1+\varepsilon_t)$$

Recursively substituting for G, we have

$$(A7) \qquad G_t = \sum_{i=1}^{t}\left[\hat{S}_{i-1}(1+\hat{\pi}_i)\varepsilon_i + \beta_i\hat{N}_i\right]\prod_{j=i+1}^{t}(1+\hat{\pi}_j)(1+\varepsilon_j)$$

Note that for $t = T$ the summation is from 1 to T:

$$(A8) \qquad G_T = \sum_{t=1}^{T}\left[\hat{S}_{t-1}(1+\hat{\pi}_t)\varepsilon_t + \beta_t\hat{N}_t\right]\prod_{i=t+1}^{T}(1+\hat{\pi}_i)(1+\varepsilon_i)$$

and the period t contribution to the total end of period gap can be defined as the t-th element in the summation in (A8), or:[33]

$$(A9) \qquad g_t \equiv \left[\hat{S}_{t-1}(1+\hat{\pi}_t)\varepsilon_t + \beta_t\hat{N}_t\right]\prod_{i=t+1}^{T}(1+\hat{\pi}_i)(1+\varepsilon_i)$$

The ratio of (A9) to (A8) is the share of period t in the total gap at time T:

$$(A10) \qquad \lambda_t = \frac{g_t}{G_T} = \frac{\left[\hat{S}_{t-1}(1+\hat{\pi}_t)\varepsilon_t + \beta_t\hat{N}_t\right]\prod_{i=t+1}^{T}(1+\hat{\pi}_i)(1+\varepsilon_i)}{\sum_{t=1}^{T}\left[\hat{S}_{t-1}(1+\hat{\pi}_t)\varepsilon_t + \beta_t\hat{N}_t\right]\prod_{i=t+1}^{T}(1+\hat{\pi}_i)(1+\varepsilon_i)}$$

The quantity $\lambda_t G_T$ is the amount of the end-of-period gap attributable to month t.[34]
adjusting for the valuation change between t and T gives us the quantity to be added to the measured position at time t. Our final estimated position $\tilde{S}_t$ is the observed position ($\hat{S}_t$) plus the allocated share of the gap:

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[33] The decomposition of G_T in (A9) and (A10) is not unique, because of the interaction between ε_i and ε_j, $i \neq j$ in the product on the right-hand side. These interactive effects could plausibly be assigned either to g_i or to g_j. However, this definition is intuitively appealing – it represents the direct effect of the time t measurement errors on the time T gap when they have been revalued at time T.

[34] Obviously, the definition of λ_t in (10) requires $G_T \neq 0$. If this condition is not met, there is no gap, no measurement error, and we do not need to define the weights λ_t at all.

$$\text{(A11)} \qquad \tilde{S}_t = \tilde{S}_{t-1}(1+\hat{\pi}_t) + \hat{N}_t + \frac{\lambda_t G_T}{\displaystyle\prod_{i=t}^{T}(1+\hat{\pi}_i)(1+\varepsilon_i)}$$

By evaluating (A11) at t = T, it is straightforward to show that $\tilde{S}_T = S_T$, and since (A11) is the law of motion for $\tilde{S}_T$, the sequence $\tilde{S}_T$ is "survey consistent" in the sense of Thomas, Warnock, and Wongswan (2004).

Appendix D

Estimated positions in downloadable format

We provide time series of monthly estimates of foreign holdings of U.S. securities and U.S. holdings of foreign securities, along with the basic decomposition into monthly flows, valuation changes, and estimated gap contributions as described in section 6. Estimates are available by security type and country for the dates December 1984-June 2006 (foreign holdings of US securities) and December 1994-December 2006 (US holdings of foreign securities). We report estimated positions for between-survey values only, and leave the decision of how to forecast future values to the user's discretion.

The time series are stored in three comma-delimited text files:

      ticdata.liabilities.ftot.txt

      ticdata.liabilities.foi.txt

      ticdata.claims.txt

where 'ftot' and 'foi' denote total foreign holdings and holdings by foreign official institutions. The three files are combined into a zip file

http://www.federalreserve.gov/pubs/ifdp/2007/910/ticdata.zip

In each file the time series are arranged in columns; the rows are ordered by country code and by date. The first row contains the column names, as follows:

ticdata.liabilities.ftot.txt

date (mm/dd/yyyy)
country code (ccccc)
country name

ftot_*_survey_pos	reported survey values
ftot_*_adj_net_flow	adjusted monthly net flows
ftot_*_adj_val_chg	estimated monthly valuation changes
ftot_*_monthly_gap	estimated monthly gap contributions
ftot_*_est_pos	estimated positions

where

* =	agcy	U.S. agency bonds
	corp	U.S. corporate bonds
	stk	U.S. stocks
	treas	U.S. treasury bonds

ticdata.liabilities.foi.txt is similar, with the obvious substitution of foi for ftot. (Note that only data for the total of all foreign official holders is available). The claims file is for total claims for two security types, stocks (stk) and bonds (bond):

ticdata.claims.txt

date (mm/dd/yyyy)
country code (ccccc)
country name

us_*_survey_pos	reported survey values
us_*_adj_net_flow	adjusted monthly net flows
us_*_adj_val_chg	estimated monthly valuation changes
us_*_monthly_gap	estimated monthly gap contributions
us_*_est_pos	estimated positions