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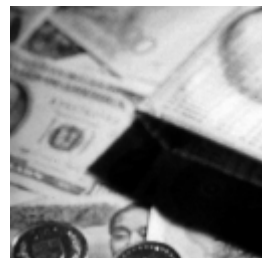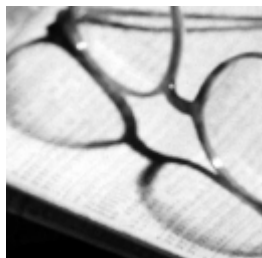
Global imbalances or bad accounting?
The missing dark matter in the wealth of nations[1]

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Abstract

This paper argues that current account statistics may provide a poor indication for the real evolution of a country's net foreign assets. The differences may arise due to mismeasurement of FDI, as well as from unreported trade of insurance or liquidity services across countries. We suggest estimating net foreign assets by capitalizing the service flow and estimating the current account from the changes in this stock of foreign assets. We call *dark matter* the difference between our measure of net foreign assets and that portrayed by official statistics. When apply our estimation to a large set of countries. In particular we find that the US has run no current account deficits over the last two decades, and that global imbalances are relatively small and very stable. The exports of dark matter of the US appear to be fairly steady, casting doubts on the need for a major rebalancing of the global economy.

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I. Motivation

Over the last couple of years the increasing US current account deficit, currently ticking at over 800 billion dollars a year in 2005 alone, has led to significant concerns about the future of the US and the possibility of a major global crisis. It comes after 27 years of unbroken deficits which have totaled over 5 trillion dollars. According to the doomsayers of today, once the massive financing required to keep on paying for such a widening gap dries up, perhaps because foreigners become satiated of owning such a large and rapidly growing amount of American debt, there will be an ugly adjustment in the world economy. The dollar will collapse, triggering a stampede away from American debt, interest rates will shoot up and a sharp global recession will ensue. Martin Wolf (2004) calls this situation an "unsustainable *black hole*" and points that "The U.S. is now on the comfortable path to ruin". Maurice Obstfeld and Kenneth Rogoff (2005) remark that "any sober policymaker or financial market analyst ought to regard the US current account deficit as a sword of Damocles hanging over the global economy". More dramatically, Nouriel Roubini and Brad Setser (2005) warn "The current account deficit will continue to grow on the back of higher and higher payments on U.S. foreign debt even if the trade deficit stabilizes. That is why sustained trade deficits will set off the kind of explosive debt dynamics that lead to financial crises". Figure 1 highlights the large and growing yearly and cumulative current account deficit of the US over the last 25 years which has made the US the largest net debtor in the world.

Obstfeld and Rogoff (2000, 2005a and 2005b) use a two and three country endowment model to estimate a required depreciation of 12 to 14% in their 2000 piece, of between 20 and 40% in their 2004 piece, and of about 33% in their 2005 Brookings Paper[2]. Blanchard, Giavazzi and Sa (2005) use a portfolio model to obtain a required depreciation of 65% in a benchmark specification. Somewhat less dramatically, Gourinchas and Rey (2006), taking account of the specific structure of US assets and liabilities, find a required depreciation for convergence in 5 years to a steady state, of between 18% and 13% depending on the assumed elasticity of net exports.

The increasing unbalanced position of the US presents several theoretical challenges. First, there is the puzzle of why such a large and increasing indebtedness has not led to any visible crisis, and why the world is willing to lend continuously to the US and to do so at surprisingly low interest rates. Or put otherwise, why is the US itself willing to run such large current account imbalances? While some of the recent renditions have chosen to depict the US economy as out of control, with particular attention placed on the low personal savings rate of the typical US consumer, this explanation finds itself at odds with our belief that agents are rational and maximize utility in a way that is consistent with their intertemporal budget constraints. Of course we have no lack of models in which current account crises do occur, but many of the assumptions used in those models, such as currency mismatches, while relatively well suited to emerging economies, are implausible when applied to the US. So we believe the current facts beg the question of whether it is possible that what we see may be an equilibrium or optimal response to underlying fundamentals.

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[2] The later estimates were significantly larger than the original ones if considering that the dollar had already depreciated between 2000 and 2004.

Another popular version is that it is official sources that are keeping demand for US securities *artificially* large. But while this may be true it is also an unsatisfactory answer: why would these governments buy into inevitable capital losses?

A second puzzle arises from the fact that if the US is a large net debtor, someone else is a large net creditor. As we will show below, according to official statistics this large creditor is not Europe (in fact Europe is a debtor as well), but Japan together with the rest of the world. This implies that, over the last decade, the less developed countries in the world have been financing the consumption excesses of the richest countries. This adds a huge puzzle of why capital is flowing away from the less developed world, not just why it does not flow in.

The conceptual and practical problems of the traditional rendition are so large that we are compelled to explore if there is something seriously wrong about this worldview. To motivate our analysis let us start by reviewing some facts. The Bureau of Economic Analysis (BEA) reports that in 1980 the US had about 361 billion dollars of net foreign assets (that is the difference between the foreign assets owned abroad and the local assets owned by foreigners). These assets rendered at the time a net return of about 30 billion dollars. Between 1980 and 2004, the US accumulated a current account deficit of close to 4.5 trillion dollars. It is natural to expect the net foreign assets of the US to fall by that amount, to say, *minus* 4.1 trillion. If the US paid 5 percent on that debt, the net return on its financial position should have moved from a surplus of 30 billion in 1982 to *minus* 210 billion dollars a year in 2004. After all, debtors need to service their debt. But the number for 2004 is, still a *positive* 36 billion, very much like in 1980. According to this basic arithmetic the US has spent 4.5 trillion dollars more than it has earned (which is what the cumulative current account deficit implies) for free.

To respond to the incongruence of the flow and the asset data two answers have been suggested. One notes that the US benefited from about 1.6 trillion dollars of net capital gains so that instead of owing 4.1 trillion, it owes "only" 2.5 trillion (which, at best, cuts the puzzle by less than half, leaving more than a whole other half to be explained)[3]. These capital gains have played an important role in recent years. In fact official numbers show a constant stock of net foreign assets over the 2002-2004 period in spite of increasing current account deficits.

In the US balance of payments statistics direct investment income "is defined on an all inclusive basis, that is, both ordinary and other types of income, including both realized and unrealized capital gains and losses" (see US Department of Commerce, 1990, p. 8). However, BEA acknowledges that these adjustments in practice can be fairly poor: "except for direct investment and its related capital flows, unrealized gains and losses are not reflected in the balance of payments" (US Department of Commerce, 1990, p. 5). For other countries, IMF's practice requires excluding capital gains and losses from current account estimates, even if theoretically they should be included. This provides a more comparable

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[3] The exact computation entails comparing the implied stock of net foreign assets obtained by subtracting the 4.472 trillion dollars of cumulative current account deficits between 1980 and 2004 to the 360.8 billion dollars of US net assets in 1980 with the international investment position in 2004 of 2.542 trillion dollars. The first gives a net asset position of 4.111 trillion which differs by 1.569 trillion from the 2004 official estimate.

and less arbitrary picture of international transactions, but one that over time may differ significantly from economic reality.

The best attempt to overcome some of these problems is the work of Lane and Milesi Ferretti (2001, 2005, 2006) who developed an *External Wealth of Nations Database,* which is an attempt to provide better estimates of net foreign positions. In their initial JIE paper they correct official numbers by adjusting for a series of problems (capital account transfers, debt reductions, exchange rate changes, portfolio equity adjustments, etc). However, to obtain comparability across countries, in that paper FDI was taken at book value. By the time of the 2005, 2006 version of their Wealth of Nations database, a large fraction of countries had started publishing reliable market value estimates of their net stock of FDI, so the latter version relies more heavily on this data. At any rate, this data improves on current statistics but is mostly based on official number so it does not provide a rendition that is really that different from that given by official numbers. Furthermore, because their adjustments of debt assets and liabilities are mostly exchange rate based, even when they find that the US net foreign asset position has been stable in spite of increasing current account deficits in recent years, they conclude that "an important reason why the share of US liabilities in the portfolios of foreign investors has been maintained at a relatively stable level has been the operation of the valuation channel of exchange rate adjustment… it is not a viable long run strategy to rely on such valuation gains to ameliorate a structural reliance on net capital inflows." (Lane and Milesi Ferretti, 2005).

The second answer to the incongruence between flow and stock data stresses the fact that the US earns a higher return on its holdings of foreign assets than it pays to foreigners on its liabilities a point made early on by Lawrence (1990) and more recently by Obstfeld and Rogoff (2005b). The most careful description can be found in Gourinchas and Rey (2006) who attempt a characterization of this differential return by documenting how the gross asset positions of the US economy has shown a trend towards larger shares of risky (equity) assets on the asset side and of less risky securities on the liability side. However, they find that it is mostly the differential return (and mostly in short term liquid assets with relatively minor effects from FDI) and not the composition effect that explains the US net financial income of the US economy.

In spite of finding this return differential to be fairly steady Gourinchas and Rey also conclude on a somber tone. According to them the US has been able to overcome the debt costs of its growing indebtedness but only as a result of a concomitant increase in its unchallenged role as provider of liquidity and safety. Thus they also conclude that "foreign lenders could decide to stop financing the US external deficit and run away from the dollar, either in favor of another currency … or …require a risk premium on US liquid assets whose safety could not be guaranteed any longer. In either case, the repercussions could be quite severe, with a decline in the value of the dollar, higher domestic interest rates and yields, and a global recession".

Both explanations require further analysis. First if it is true that there have been significant capital gains on US foreign assets we need to understand where those large capital gains do really come from. It is unlikely that they come from exchange rate movements, to the extent

that the dollar has gone up and down since the 1980s without any clear trend[4]. So what are the channels by which capital gains take place? Understanding the source is critical to assess the potential sustainability of this revalued stock of capital. On the other hand the traditional rendition that US assets abroad deliver higher rates begs the question of why are US investors abroad so much smarter than foreign investors in the US? After all, are global portfolio investors not free to buy any assets they want? Why would foreigners consistently pick worse assets than American investors?

Cline (2005) provides an excellent analysis of these questions that is a starting point for what we do in this paper. While Cline shares a significant concern for the evolution of US net foreign asset position moving forward, he provides several arguments that suggest why these concerns may be overstated. Not only does he introduce the concept of capitalized net capital income (the present value of net income), which we will use extensively below, to show that "the United States has remained a persistent "economic" net creditor throughout the last three decades", but also applies standard sustainability analysis to analyze the future evolution of the US current account only to find that sustainability is fairly robust. He acknowledges this is the result of the difference between the return on US assets abroad and the return of foreigner's assets in the US, and while he relates this to the risk characteristics of the assets (and shows why it should be fairly insensitive to price or exchange rate changes) he still concludes this differential to be "basically a puzzle". In what follows we will try to argue that there are simple economic reasons that may account for this differential.

The paper is organized as follows. In section II we present a new way of measuring current account imbalances. We will see that our measure for many countries aligns itself very well with the official description but in some cases presents large differences. We call this discrepancy dark matter. In Section III we discuss the factors that explain the existence of dark matter. In particular we show that once dark matter is taken into account the US economy has not been running current account deficits during the last two decades. In Section IV we address the issue of global imbalances. Who are the net exporters and importers of dark matter? How do global imbalances look once dark matter has been taken into account? Section V concludes with some closing thoughts and suggestions for future research.

Section II. Our view

The interest in a concept such as the current account is that it is related to the change in the net asset position of a country. In fact, most textbooks make the assumption that these two concepts are identical and would write an equation such as

$$CA = \Delta NFA,$$

which implies that

$$NFA_t = NFA_{t-1} + \Delta NFA_t = NFA_{t-1} + CA_t.$$

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[4] On this see Cline (2005).

In reality the stock of foreign assets does not evolve strictly according to this rule but rather to

$$NFA_t = NFA_{t-1} + \Delta NFA_t + \varepsilon_t = NFA_{t-1} + CA_t + \varepsilon_t \qquad (1)$$

It is also typical to include a footnote saying that this formulation may be off because of potential valuation changes, but the idea is that these changes should not be very persistent.[5] In fact in the long run it is expected that $\varepsilon=0$.

This is the relationship that is in most analysts' minds, and explains why people worry about large negative external positions. In fact, this is the rationale that we followed in the introduction of this paper, only to find out that it led to a very large inconsistency. The problem comes from the fact that given the standard accounting rules the capital gains can be very substantial and persistent making the relationship between the current account and the change in net foreign assets quite weak.

Thus we propose a different set of accounting rules, a system that rescues the relationship between our definition of the current account and the change in net foreign assets by defining the first as the change in the latter. In short we will assume that $CA = \Delta NFA$ by definition (which is tantamount to making $\varepsilon \equiv 0$).

But to implement this definition we need to adopt a rule for valuing assets. We start by assuming that if an asset consistently pays more than another asset, then it is worth more, even if they both have the same historical cost or "book" or face value. Choosing to value the assets on the basis of their returns is just like valuing a company by calculating its earnings and multiplying by some price-earnings ratio, or valuing a property based on its rental value. As we know from the corporate finance literature for an individual company, the earnings of any given year may give an unreliable measure of its true earning potential, but if we average over an economy and look at trends over a couple of years, this simple methodology delivers reasonable results. Of course, this opens the question as to what exactly this price earning ratio should be and why the discount rate should be the same, even for assets with very large differences in risk characteristics, a point to which we will come back at length below. For the purpose of illustrating the implications let us use here an arbitrary 5% rate, which implies a price-earnings ratio of 20.[6]

With this we can do some quick back of envelope estimations. Japan, for example, has net income from investments (NII) of 86 billion which delivers an estimate of net foreign assets of 1.7 trillion[7]. The US net income on its financial portfolio is 36 billion dollars. This is a 5 percent return on an asset of 720 billion dollars. So we would say that the US is a net creditor for about 720 billion dollars or about 5 percent of its GDP.

With a definition for the value of assets, we can now compute the current account as the change in the value of this net foreign asset position. That is,

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[5] See for example, Caves et al (1996) discussion of "statistical discrepancies" in the payments accounts.
[6] Cline (2005) uses the long term bond rate.
[7] In this exercise and what follows we use net foreign investment income receipts, i.e. netting out net employee compensation which is not a form of capital income. See Buiter (2006).

$$CA_t = \frac{NII_t - NII_{t-1}}{r}$$

This new version of the current account can be easily computed for any country.[8] To return to our previous examples, for Japan, the cumulative official current account between 1980 and 2004 is 2.0 trillion dollars. The difference in the capitalized income flows (our estimation of the cumulative current account) amounts to 1.7 trillion. In the case of Australia the two numbers amount to a deficit of 357 billion and 352 respectively, on so on.

Dark matter

To understand how our measure differs from the traditional rendition, let's imagine a country coming that reports a sequence of officially measured net foreign assets equal to

$\{\ldots NFA_{t-1}, NFA_t, NFA_{t+1} \ldots\}$ which earn a rate of return $\tilde{r}_t$ in period t. In our definition we define the current account as the difference in the capitalized value of the net income from investment by a common interest rate r. However assets may be improperly measured by an estimation error μ_t. Thus our measure of the current account can be written as

$$CA_t = \frac{\tilde{r}_t(NFA_t + \mu_t)}{r} - \frac{\tilde{r}_{t-1}(NFA_{t-1} + \mu_{t-1})}{r} \qquad (2)$$

After some simplifications (2) can be written as

$$CA_t \approx CA^o + \frac{\Delta \tilde{r}_t}{r}\frac{(NFA_t + \mu_t)}{r} + (\mu_t - \mu_{t-1}) \qquad (3)$$

Which in turn implies that

$$X^{DM} = CA - CA^o = (\mu_t - \mu_{t-1}) + \frac{\Delta \tilde{r}_t}{r}\frac{(NFA_t + \mu_t)}{r} \qquad (4)$$

which shows that exports of dark matter (X^{DM}) has two basic sources. The first term is the increase in the amount of assets that we know exist, since they generate revenue, but cannot be seen or properly measured. In fact it is this idea that motivates the name dark matter, which is taken from a term used in physics to account for the fact that the world is more stable than you would think if it were held together only by the gravity emanating from visible matter. Equation (4) shows, however, that there is another component of dark matter, arising from the fact that assets of a given country may earn more (or less) than our benchmark return. When this rate changes, our accounting imputes the change in the capitalized value of the change in return as an asset (or liability) for the country thus affecting the value of the current account.

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[8] Our methodology has an antecedent in Cline (2005).

What is the meaning in an accounting sense of using a common interest rate?[9] To illustrate this consider an asset that is held abroad that earns a rate of return r^h which is higher than our fixed and arbitrary benchmark rate of 5%[10] and a liability earning r^l which is lower than our benchmark rate. If A and L represent the market value of the asset and liabilities our accounting would measure assets and liabilities as

$$A^* = \frac{r^h A}{r} > A = \frac{r^h A}{r} + \frac{(r - r^h)A}{r},$$

which implies that

$$A^* = A + \frac{(r^h - r)}{r}A.$$

In other words we add to the value of the asset the second term, the capitalized value of the return differential of this investment. Notice that by capitalizing this we are implicitly assuming that this return differential will persist, something to which we will come back below. In our accounting, the ability to obtain a higher return is an asset, the value of which is equivalent to an export of dark matter.

Likewise, we have that our value for liabilities L^* can be written as

$$L^* = \frac{r^l L}{r} < L = \frac{r^l L}{r} + \frac{(r - r^l)L}{r},$$

which implies that

$$L^* = L - \frac{(r - r^l)L}{L}.$$

If the interest rate paid is lower than our benchmark the second term shows a reduction in liabilities equal to the capitalized value of that interest differential. For example, we interpret the ability of the US to pay lower rates is an asset (a negative liability), the value of which is measured in the second term in the previous equation. This again in our rendition would account for exports of dark matter.

It will be clear by now that our difference with Gourinchas and Rey (2006) is that we capitalize the service flow differential, add it to the stock of net foreign assets and adjust the current account accordingly. It is the fact that we consider this as an asset what makes our description of the current account dynamics so different from the standard renditions. Of course the reader will wonder to what extent these exports of dark matter are sustainable or

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[9] We will differ the economic interpretation of using a constant interest rate until the next section.
[10] None of our results depends on the particular rate chosen. In fact using the US treasury rate we would get basically the same story.

not. If they are not stable or average out to zero, then our accounting will not mean much, nor change significantly the conclusions obtained from conventional analysis. But if these exports of dark matter are consistent and stable then they could lead to a significant update in the interpretation of the facts.

Figure 2a shows a scatter plot that illustrates how the two measures, the current account as measured from changes in the net stock of foreign assets and the official current account track each other for the 94 countries with complete data from 1980 through 2003. Countries along the forty five degree line are countries where our estimates match official statistics. Countries to the right of the forty five degree line are exporters of dark matter, because their net asset stocks has increased by more than indicated by the official current account. Countries to the left of the 45 degree line are importers of dark matter. As can be seen the data shows some important outliers: the US, UK and Switzerland as exporters of dark matter, and Ireland, Italy and Germany as importers. Figure 2b zooms into the central cluster to show that the relationship between the two measures is in general fairly positive. Table 1 provides some plain vanilla regressions to suggest that the correlation is strong. In fact, once the US and the UK are withdrawn from the sample the coefficient relating both measures is exactly 1.00 and highly significant, though this result, as shown in the last column, is mostly driven by Japan.

Figure 2 shows the US as a very large outlier. Figure 3 shows by how much the two measures differ in this case. The cumulative current account deficits according to official statistics, adds up to the 4.5 trillion that the US has overspent between 1980 and 2004. The other line shows the cumulative change in net foreign assets according to our methodology. The fact that the curve shows no meaningful trend (upwards or downward) is simply indicating that the total service flow obtained from foreign assets held by US residents (and thus our measure of the amount of those assets) has virtually not changed. In terms of equation (4) it means that the US has consistently exported dark matter. In fact, the exports of dark matter have been quite similar to the reported deficits making the actual deficit close to zero throughout this period and this is why our measure of cumulative current accounts adds up to virtually zero.

There is a large difference between our view of the US as a net creditor with assets of about 720 billion US dollars and BEA's view of the US as a net debtor with total net debt of 2.5 trillion. The difference between these two equally arbitrary stock measures is the cumulative amount of dark matter. According to our numbers the US owns about 3.1 trillion of unaccounted net foreign assets. Given the size of the discrepancy it is difficult to contest the existence of dark matter. Though we will plunge into methodological discussions right away, it seems clear that no methodological minutiae will reconcile the facts with the statistics.

Figure 4 shows the cumulative exports of dark matter for all countries, both in nominal values and a percentage of GDP and contrasts it with the cumulative official current account. A number in the upper left quadrant implies economies that have compensated their imbalances with exports of dark matter. The US appears here. On the contrary countries in the lower right quadrant, are countries that have imported dark matter in the face of large current account surpluses. When taken as percentage of GDP the upper left quadrant includes countries that have received substantial aid or debt relief (another way of accumulating dark matter), whereas on the lower right quadrant are energy or FDI

champions whose current account surpluses have to some extent been compensated by exports of dark matter. The clear negative relation present in all graphs, which is shown in Table 2 to be statistically significant and large in size, anticipates one of the main implications of our work. To the extent that countries that have surpluses import dark matter and countries with deficits usually export dark matter, global disequilibria must be *smaller* than reported in official numbers. Table 2 indicates that, as a percentage of GDP, a larger cumulative deficit of 1% has led on average to exports of dark matter of about .8% of GDP. This will be the reason why we will find more stability in net foreign positions than that usually derived from official numbers.

The existence of dark matter opens up several important questions. First and foremost what is behind dark matter? What are the economic reasons for its existence? Answering these questions will provide the first clues as to the stability of dark matter and whether we should expect it to be a lasting source for compensating measured imbalances.

The issue of the common discount rate

As stated above, in order to estimate the value of net foreign assets we propose to capitalize the value of a given country's financial income into a stock measure. To do so we need to address the issue of which discount rate should be used and whether bond or equities, domestic or foreign flows should be discounted at the same rate.

We know that assets may have different returns in equilibrium in situations where agents care about risk and markets are incomplete. If the world was populated by risk neutral investors or if there were a complete set of contingent claims, as in our discussion of insurance below, then it is trivial that all assets should be discounted by some risk free rate of return.

Barring that, however, there are two main reasons for why assets in equilibrium may have different ex post returns: surprises and risk premia. Surprises refer to the fact that assets may turn out to have a lower rate of return if faced with expropriation, restructuring or unexpected negative business conditions. Or higher returns if things turn out to be better than expected.

In our computation, surprises are already taken into account because we work with ex post data. Averaging out over a large number of assets and over long period of time it seems implausible to argue that realized returns may differ significantly from expected returns. Buiter (2006) has argued that over short periods this may lead to distortions when using the income flows. We believe this is unlikely to be the case when our results span a period of close to twenty five years which have seen several episodes of financial crises. What Armageddon would still be in store that would imply that the returns used over the last twenty five years incorrectly price the risks observed during this period?.[11][12]

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[11] A more technical but related issue is the fact that income data is computed on an accrual basis. Thus if a country is in default, the interest accrued but not paid will still be imputed to the income flow. While this may lead to some distortions, these apply to a very small set of countries, and only until the issue becomes cleared out. While the numbers are not revised backwards, our final estimation for the stock of assets, and therefore our cumulative current account numbers would still be correct (see Buiter, 2006 on this point).

This leaves the other reason for a differential rate of return: risk premia, which reflects the fact that two assets have a persistent difference in returns. But then, this has to be because they must differ in some other attribute. For example, equities have traditionally earned a premia over bonds that compensate for their higher risk. If we were to discount the earnings of stocks by a risk free rate, this value would exceed market valuation. We can interpret this higher valuation as the fact that whoever buys the equities is selling insurance to whoever sells, the difference between the market value and the value from discounting by the risk free rate is the value of this insurance, very much as the value of an insurance company that sells insurance premia.

As we have done in equation (4) we believe that for the purpose of studying global imbalances it makes sense to call these differences an asset. In fact, while this may sound controversial this is exactly what is done in standard computations of GDP. Said otherwise, many components of GDP are imputed exactly the same way we measure assets in this paper.

A sector where net interest differentials are imputed as income is the banking sector. In fact the contribution of commercial banks into national income and product accounts (NIPAs)[13] is measured exactly this way. In the case of the US, the System of National Accounts (SNA) recommended

"measuring implicit financial services to depositors, using the difference between a risk-free reference rate and the average interest rate paid to depositors, and it recommends measuring the implicit services to borrowers using the difference between the average interest rate paid by borrowers and the reference rate" (Fixler et al, 2003, p. 33)

Fixler *et al* (2003, p 34) explains the logic

"depositors could dispense with the services of a bank entirely and keep their money in securities paying the reference rate of interest. Depositors who forego the opportunity to earn the reference rate in order to obtain the services of a bank choose to pay the implicit price for depositor services equal to the margin between the reference rate and the deposit rate"

Thus in US national accounts, the return differential are used to value such services. We are extending the same principle to international transactions. Thus, when a foreigner decides to invest, say in the US, at a lower rate it is because they value the insurance services provided by this investment. In this case we would say the US is selling insurance abroad, as much as banks sell financial services by paying a low rate on their deposits.

Thus we follow this procedure and discount all our flows at an arbitrary constant interest rate of 5%. In addition to the above this has several additional advantages. First, in the global economy each financial claim appears twice: as an asset in one country and a liability

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[12] There is one case in which this criticism is correct, our data goes through 2004 when the Argentina default had still not been corrected. However, Americans held a relatively small fraction of this debt, so that we expect this not to affect significantly the numbers.

[13] We thank Joe Beaulieu for pointing this out to us.

in another. We should value that claim equally in both countries. Hence, it is important that we use the same interest rate in both countries. It would be problematic if we applied different interest rates for what is in fact the same asset. Second, we choose a constant rate so that changes in our measure of assets depend only on changes in the income flow of the assets and not on variations in the price-earnings ratios. This allows a cleaner visualization of the evolution of flows. In fact, the level of the interest rate we choose is irrelevant for our story and similar results would obtain if we used an interest rate computed from market rates. Third, our interest is not to capture the market price at which assets trade ex ante in markets, but to track the changes in a country's debt service burden. In our methodology if Argentina and Japan have 100 US of debt, but Argentina pays 15% and Japan 1% we would measure these debt burdens as very different, even though market valuations would probably be similar. It would not make sense for us to assume that Argentina will default, when assessing whether its external position is sustainable. For the same reason, if a country has received highly profitable FDI, it is committing to pay more than 5 percent, even if the market discounts equities at a rate higher than debt because of its greater riskiness.

It has been pointed to us (Buiter, 2006, Milesi Ferretti, 2006, Eichengreen, 2006) that our approach may lead to an overestimation of US's foreign assets to the extent that it discounts the flows obtained from riskier investments abroad at the same risk free rate that the US charges on its liabilities. It should be clear by now that by using ex post data we take care of differences in the expected value of the claims. To the extent that the remaining return premium is consistently paid (as is any insurance premium) we choose to consider as an asset the capitalized value of such risk premia countries collect or pay on account of the fact that risk-averse investors are willing to pay for non-diversifiable risks. Figure 5 shows that this differential has been pretty steady over the last 30 years.[14] We are not attempting to provide new estimates for asset values but to assess vulnerabilities. Capitalizing these steady interest rate differential allows to include in the asset estimates the advantage or disadvantage embodied in the differences in the rates of return providing a more coherent picture of actual global imbalances.

Section III. Sources of dark matter

We believe that there are at least three factors that account for the accumulation or decumulation of dark matter. They all involve a persistent return differential between assets and liabilities. This difference in returns may originate in three sources: a return differential for FDI investments, the sale of insurance, and the provision of liquidity services. The first channel involves the notion that FDI investments abroad are a vehicle for the dissemination of ideas, blueprints, knowledge and that they are the vehicle for unaccounted exports through the use by affiliates of a large number of services developed in headquarters. FDI investors purchase assets in order to invest, but also bring with them a blueprint, a product and a business know-how that is usually poorly accounted for. Because of the difficulties in tracking these   operations and cross border use of services, it is likely that numbers underestimate their worth. Countries that are long FDI are probably exporters of services through this channel. The second channel may arise because the underlying stability or

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[14] This graph is computed with FDI at current cost in order to span a larger number of years.

instability of a given economy may allow it either to sell some of this stability to the rest of world or provide the incentive to diversify away some of its instability. Either case is akin to the sale of insurance. The third channel is related to the provision of liquidity services, basically through the use of the dollar or the lower return on deeply liquid financial markets. Let us discuss each of these channels in turn.[15]

Foreign Direct Investment

There are three basic methodologies for estimating FDI investments. The most traditional is the use of book value estimates. While it is the most commonly used, this is a fairly poor measure of the value of investments abroad. In fact the US Department of Commerce (1990) reports that "The international investment position should be interpreted with caution because it is only a rough indicator, not a precise measure. On the one hand, US assets abroad probably are understated because direct investment is carried at book values…" (p. 21). Book value can be improved upon by using the current cost method estimation, which adjusts book value by estimated changes in the value of the underlying investments, usually exchange rate and inflation adjustments. A third alternative is to adjust the values using stock market data, thus approximating market valuations for the underlying assets. As described in Lane and Milesi Ferretti (2006) in recent years a wider range of countries have implemented market valuation methodologies, but book value remains the method of choice for a large number of countries.[16]

The fact that book value may misrepresent the value of firms is well known from the corporate finance literature. And because this is used to construct the series or used to obtain initial values that are then increased by equity prices, this may lead to underestimation. Additionally, to obtain the market value estimate, what is done is to adjust the value of the investment using the increase in the host countries equity markets. But this is debatable. For example if US investments abroad carry the earning potential of US firms, it could be argued, that at least partially they should be updated by the value of US stock markets that better capture this earning potential. As an example, the earning potential of Intel in Costa Rica, is better captured by Intel's stock price than by Costa Rica's equity market. In fact, the profits made by Intel in Costa Rica are reflected in the New York Stock Exchange, but not in San José. The valuation of the S&P500 reflects the markets expectations of the global income of the listed corporations, not just the domestic component.

Let's use the case of the US to find out the amount of underestimation that may arise from using foreign stock markets. According to BEA, at the end of 2004 the US had FDI abroad worth 2.4 trillion at current cost and 3.3 trillion at market value (a ratio of 1.38). However for US firms the difference between market value and book value, as reflected in the S&P

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[15] See also Cooper (2005) who mentions most of these channels.
[16] For the specific case of the US it has been long since the BEA introduced a market value alternative to the original measure, and updated the book value alternative by its improved current cost method. For a careful (and official) description of the two methodologies see Kozlow (2002). The original book value is no longer published though still being reported in the BEA's website.

500 the ratio was 2.99. Applying this ratio to the FDI abroad at historical cost value gives an FDI estimate of six trillion, 2.7 trillion above the market valuation suggested by BEA.[17]

Figure 6, explores this issue in more detail by tracking the evolution of BEA's net foreign position, the net foreign assets according to our capitalization methodology and an alternative version of BEA´s net foreign assets by adjusting the valuation of US FDI abroad by the ratio of market to book value in the US S&P500. The numbers show that both BEA's net foreign assets and the series including the adjustment for FDI behaved very similarly through the early 1990s but they diverge afterwards. Towards the end of the period, the adjusted series delivered a number similar to our methodology showing a virtual balance in the US net foreign asset position.

Caballero et al (2005) suggest that the US together with a few other countries have a superior ability to issue financial claims. They explain the pattern of flows as an equilibrium caused by the fact that emerging some emerging market countries have high growth potential but a low ability to issue financial claims. They thus export their savings and receive FDI from firms that can issue financial claims. We interpreted FDI not only as the possibility of issuing better financial claims on potential output but also of deploying abroad the business ideas that were developed for their home markets. To produce you need not only a plant, equipment, people, but most importantly *ideas*. FDI is a way to exploit a business idea abroad, thus countries that are long FDI, are countries that in general will be net exporters of ideas, the value of which will be embedded in the income flow of their subsidiaries. To the extent that the true value of these ideas is not fully captured by official statistics, countries which are long FDI would tend to show a discrepancy between their income flows and their net foreign assets.

The reason this underestimation may occur is very simple, as much of the productive capacity of subsidiaries abroad depends on the productivity and services provided by headquarters. However, many of these services are not computed as exports from headquarters to their subsidiaries (accounting rules better capture the transfer of goods, but the transfer of services has to be grossly unaccounted for). In reality these are exports from the source country, but that don't get reported as such. Our approach is a way of getting around those missing exports and approximating their value as inferred from the income stream they generate.

Let us illustrate how this channel works with an example. Imagine the construction of a foreign operation the value of which stems mostly from the know how that investors bring along. For the sake of the argument let's assume that the cost of setting the operation is 100 million and that this is what is written down in the books. Imagine also, for the sake of the argument that these resources were borrowed abroad at, say, a 5% rate of return. Once the operation is running it yields 20 cents on the dollar in operational revenue. Once financial costs are taken into account, this investment generates a net income flow of 15 cents on the dollar even though in an accounting sense the net foreign asset position is equal to zero (since the value of foreign direct investment is at book value). By contrast, we would say that the assets abroad in reality are not worth 100 million but four times that (the capitalized value at our 5% rate of the 20 million per year that it earns). Why can this firm earn such a

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[17] We thank Willem Buiter for suggesting this computation to us.

return? Because the investment comes with a substantial amount of know-how, brand value, expertise, better financial structure, and better legal protection, all of which generate earning potential. These are sources of dark matter and explains why US residents (and the UK as will be shown below) can earn more on their assets than they pay on their liabilities and why foreigners cannot do the same.

Table 3 bears on this point by exploring the relation between cumulative exports of dark matter with the stock of FDI for the year 2004. FDI data is taken from Lane and Milesi Ferretti (2006). Table 3a shows the results in nominal dollars whereas Table 3b refers to ratio of GDP. Column (1) in Table 3a shows that countries that export dark matter, tend to have more FDI, as our hypothesis suggest. However, when including FDI liabilities, this result disappears. This is because the US, which has very large FDI liabilities and assets drives the result. Once this outlier is excluded, the result show up strongly and with the expected signs, with FDI assets abroad correlated with more exports of dark matter and FDI at home, correlated with imports of dark matter. Similar results are obtained when looking at dark matter exports as a percentage of GDP in Table 3b. There FDI assets abroad increase dark matter exports and FDI at home decreases dark matter exports with both results strongly significant. The ratio of outwardness of the FDI (ratio of FDI abroad relative to the total) comes in negatively, probably a reflection of diminishing returns to scale in the exports of dark matter.

Insurance

Another possible reason why dark matter may exist is because countries buy and sell insurance services. According to this interpretation countries that are more stable will enjoy a return differential in their favor. Countries that are more unstable, will need to pay for such insurance by borrowing at higher rate or investing abroad at a lower rate. To the extent that the underlying risk properties to the economy remain relatively stable then so will the return differential. And the return differential will be a source of income.

Klingen, Weder and Zettlemeyer (2005) find that emerging market debt has ex-post delivered a rate of return of about 1% above equivalent US securities, and that this return has been relatively stable over long historical periods. This result is consistent with what Gourinchas and Rey (2006) find for the specific case of the US: a 1.56% return effect that is especially significant for short term liquidity assets (other and debt in their category) for the period 1952-2004. This return effect increases to 1.89% during the period 73-2004.

Alternative perspectives for other countries and time periods provide different numbers but all point to the fact that these earning differentials may be substantial, and may last for long periods of time. Barro (2005), for example, develops a model in which the equity premium puzzle in US equity markets is explained by the possibility of unusual but large negative shocks. In his model, the return on bonds falls substantially once these large events become a possibility. His model can be used to explain why the value of insurance provided by the US has increased starting in mid 1990s as a series of international crises followed each other. The common buzz word "flight to quality" somehow captures this effect and explains the significantly lower interest rates paid by the US during this period. In fact, is could be argued that this benefit may have further increased after 9/11 as the US is, even when the most

likely victim of a potential terrorist threat, still the economy that can better deal with the global implications of such threat. Kugler and Weder (2004 and 2005) study these return differentials for Switzerland, a natural provider of insurance services, particularly after WWI. They find that the return differentials have been very strong and persistent.

The most comprehensive analysis of this issue is Meissner and Taylor (2006) who look at the "privilege" in income returns for G7 economies. They find that the US has enjoyed a "privilege" (in the form of higher yields on foreign assets relative to yields paid on external liabilities) of about .5% of GDP from 1981 to 2003 and currently running at close to 1%. Notice that discounting at our 5% rate this is equivalent to assets for about 10% to 20% of US GDP, which brings down US net foreign liabilities by as much, significantly closing the gap between official measures and our own measure of net foreign assets. They find similar privileges for the UK and Japan whereas Canada and Italy pay a negative premia, and France and Germany are relatively neutral.

More importantly Meissner and Taylor look at the experience of the UK in the late XIXth century to find that the UK obtained on average the same privilege over the forty three years prior to WWI (1870-1913), leaving open the question as to what would have happened if WWI had not occurred.

To see this at a more technical level consider a two country world with uncertainty and with a complete set of Arrow-Debreu contingent securities that can be used to hedge risks. We will consider a one period model, with S potential state of natures each with probability $\pi(s)$, and therefore S number of $p(S)$ prices for contingent securities. Global equilibrium requires supply and demand in the S contingent markets to balance, i.e.

$$C(s) + C^*(s) = Y(s) + Y^*(s) \qquad (3)$$

for each state s, where the star refers, as usual, to the foreign country. $C(s)$ refers to consumption in state s and $Y(s)$ is endowment in such a state. With CRRA utility of the standard form $C^{1-\rho}/(1-\rho)$ the standard Euler equation for the maximization of expected utility implies the standard price relation of state contingent claims:

$$\left(\frac{C(s_1)}{C(s_2)}\right)^{-\rho} = \frac{p_1 \pi_2}{p_2 \pi_1} \qquad (4)$$

and likewise for the other country. Substituting the equilibrium conditions (3), in (4), implies the celebrated relations

$$\frac{p_1 \pi_2}{p_2 \pi_1} = \left(\frac{Y^W(s_2)}{Y^W(s_1)}\right)^{\rho} = \left(\frac{C(s_1)}{C(s_2)}\right)^{-\rho} = \left(\frac{C^*(s_1)}{C^*(s_2)}\right)^{-\rho} \qquad (5)$$

where the superscript W indicates world output in that state. Using the standard normalization that $\sum_{s} p(s) = 1$, equation (5) can be used to solve for the equilibrium price of contingent securities

$$p(s) = \frac{\pi_s \left(Y^W(s)\right)^{-\rho}}{\sum_{s} \pi_s \left(Y^W(s)\right)^{-\rho}} .$$

(6)

From (5) it is trivial to conclude that

$$\frac{C(s_1)}{C(s_2)} = \frac{C^*(s_1)}{C^*(s_2)} = \frac{Y^W(s_1)}{Y^W(s_2)}$$

i.e. that the ratio of consumption will be the same in the two countries and proportional to world output. The relative endowment and risk characteristics of such endowment will determine the share of world output going to each country. Define the share of world output going to the home country as μ. This implies

$$\frac{C(s_1)}{Y^W(s_1)} = \frac{C(s_2)}{Y^W(s_2)} = \mu$$

while

$$\frac{C^*(s_1)}{Y^W(s_1)} = \frac{C^*(s_2)}{Y^W(s_2)} = (1-\mu) .$$

The value of μ derives naturally from the budget constraint and equals the share of the country's output relative to world output measured at the Arrow Debreu equilibrium prices. Solving for this value after substituting for the equilibrium prices we find that

$$\mu = \frac{\sum_{s} \pi_s Y(s) \left[Y^W(s)\right]^{-\rho}}{\sum_{s} \pi_s \left[Y^W(s)\right]^{1-\rho}} .$$

(7)

The country share in equation (7) is our object of interest. To the extent that an economy has a more stable output profile, it will be selling insurance to the rest of the world and obtaining an expected payment in return. In short the world would be giving up some income to swap, at actuarially disadvantageous terms, local output for the home economy's output. Equation (5) shows that when there is aggregate uncertainty, prices will not be actuarially fair, i.e. the markets will price in a risk premium to reduce its risk.

To illustrate the concept imagine that the home country (purportedly the US, Japan or the UK in Meissner and Taylor's computation) is more stable than the rest of the world. Without loss of generality and just to illustrate the intuition consider the case in which output is constant across states of nature in the home economy and volatile abroad. In short

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we assume that $Y(s) = \bar{Y}$, for all states at home. Output in the rest of the world, on the other hand is assumed, without any loss of generality to be described by $Y^W(s) = \phi(s)\bar{Y}^W$. We also assume the probability of all states to be the same. In this case we can see that (7) easily simplifies to

$$
\mu = \frac{\bar{Y}}{\bar{Y}^W} \frac{\sum_s [\phi(s)]^{-\rho}}{\sum_s [\phi(s)]^{1-\rho}} \quad . \tag{8}
$$

Notice that if $\rho=0$, which implies linear utility, ie. no risk aversion, μ equals the country's share in world income. On the other hand when $\rho \rightarrow \infty$, which is the case with infinite risk aversion, indifference curves become Leontieff so it is easy to show that

$$
\mu = \frac{\bar{Y}}{\min \phi(s)\bar{Y}^W} , \tag{9}
$$

with intermediate cases in between. Notice that in this extreme case, if the foreign country has output states with extremely low income, then the home economy virtually consumes the whole of world output! The intuition is that with infinite risk aversion the foreign country is willing to give up everything to improve its consumption in its worst scenario. The difference between expected income in autarky and expected income when there is access to international markets is the insurance premium that the country charges every period. In a world of complete securities this payment is fixed and certain, the higher the risk in the world, the higher the payment (and the higher the ex post profile of consumption).

The situation is illustrated in Figure 7. In figure 7a home country has a stable income profile while the rest of the world has a strongly skewed income stream. After trading in Arrow Debreu securities the world economy will operate at the diagonal. Notice that if the probability of both states is not the same, equation (5) indicates that the price of output in the high income state is lower than that of the low income state. So for transferring income to the rest of the world in this state the home economy obtains a compensation that is positive in expected value. This is a way to visualize the insurance premium that creates dark matter.[18] Figure 7b illustrates the case of infinite risk aversion. In this case the horizontal move for the home economy represents the gain in income from its smoothing services.

So the discussion of whether this differential will be stable or not, needs to focus on the fundamentals underlying the reasons why a given economy is expected to be more stable and predictable than others. To the extent that a country has a permanently more stable output this value should be expected to remain, or to grow with the ability of other countries to

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[18] The case of infinite risk aversion implies that the indifference curve becomes flat immediately away from the 45% degree line.

participate in world financial markets. The capitalized value of the flows that compensate for this insurance would appear as dark matter.[19]

Given that Arrow Debreu securities do not exist, one way the exchange of risks takes place is by exchanging debt, as explained above. Consider a country subject to large output shocks and therefore to default risk. These countries may be willing to exchange US debt yielding a steady return in exchange for their risky assets. The difference between the two rates of return includes the compensation for the expected default but also will include an insurance premium for the increased risk. It is this extra premium that will be captured ex post in the factor income data. According to Meissner and Taylor (2006) this amount could, in our estimations, add up to about 10% of US GDP at historically values but has recently been on the rise and may actually reach close to 20% of GDP wiping out most of US foreign debt.

Finally, FDI may be the vehicle for diversifying risk in this manner as well. Countries may buy the more stable US equities or directly invest in the US while the US may use the resources to invest abroad. Foreign operations will carry an "excess" return that will compensate for their instability. This excess return is the compensation for the export of insurance services and will be captured in our framework as dark matter.

Liquidity

Our third source of dark matter is the unaccounted value of the liquidity services provided by some countries. This may come in two ways, one from the fact that some markets, such as that for 30 or 10 year US treasury bonds are very deep. Thus a liquidity premium advantage has been measured on these markets. However, these numbers should already be subsumed in the "privilege estimations" computed by Meissner and Taylor above.

Yet, there is another source of dark matter, which is the use of some currencies as vehicle currencies, which are used as stores of value and media of exchange outside their own frontiers. The value of this stock of assets is the cumulative amount of dark matter exported by a given country.

For example, in the case of the US, these exports amount to anything between 210 billion US dollars and 525 billion dollars[20], which adds anything between 1.8 and 4.4% of current 2004 GDP to the cumulative exports of dark matter. These are exports of dark matter in the form of liquidity services. This concept which involves both seignorage and a negative premium on the dollar-denominated reserve assets constitutes an unmeasured provision of liquidity services which our accounting method would capture as dark matter.

Criticisms of the dark matter methodology

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[19] Shiller (1993), for example, computes the value of claims to output for different countries and finds that the volatility of these claims is lowest for the UK and the US. (see Obstfeld and Rogoff, 1996).
[20] See Buiter (2006).

Since the publication of the first version of this paper several authors have argued with the idea of dark matter, particularly when applied to the US. These include McKelvey (2005), Buiter (2006), Eichengreen (2006), Higgins et al (2006) and Milesi Ferretti (2006). Meissner and Taylor (2006) also discuss the dark matter hypothesis. This controversy comes in spite of the fact that our methodology, as shown in Figure 2 and Table 1 shows a fairly consistent view with traditional statistics, with only the US (and recently the UK) as significant outliers. In our review above we have already discussed many of these criticisms, so we will address here only the main remaining issues, and as the criticisms referred to our application of the methodology to understanding the US current account we may refer to that specific case as well.

One criticism, McKelvey et al (2005) refers to the very large volatility of dark matter export estimates, something that does not bear well with the very stable underlying economic reasons for the existence of dark matter. Shouldn't dark matter be stable? But equation (4) showed that dark matter will be affected by the capitalized value of changes in the actual return, as such small changes can lead to very large swings in our dark matter estimate, As much as in corporate finance, earnings in a particular year, may still provide a poor guide to the income of a particular corporation over the medium term. Even though in our case the income flow is the average of many different individual returns, it is still true that these returns may be affected by macro shocks, thus still exhibiting some volatility. Under this light, our estimates for any particular year should be taken with care, with averages over longer periods being more informative. Trends over twenty five years, as what we have been using in this paper, are relatively stable, as our example of the US illustrates.

Buiter (2006) mentions the potential of a peso problem when analyzing the US current account with dark matter. We have discussed this above, and while we do not provide a formal test, we believe it is unlikely that the last 25 years include bond returns differential that compensates for an event that has not materialized. Meissner and Taylor (2006) show that these return differentials do actually exist, and persist over long periods of time, even through the ups and downs of recurrent crises and our Figure 5 has shown this return differential to be surprisingly stable over the last decades. However one piece of evidence provides some support to the idea that the US may have enjoyed extremely high ex post returns over the last five years that are probably either unsustainable or contain a peso problem. Klingen, Weder and Zettelmeyer (2005) show that the return on emerging markets during the 90s, have been on average unusually high from a historical perspective, a feature that they attribute to very large negative returns in the 1980s. So while over the whole 1970-2000 period returns average out to the normal historical spread for emerging countries, the 90s appear as a period of exceptional high ex post returns. If so, it is unlikely that the US will continue to be able to sell exports of dark matter at the level of 5% of its GDP. In fact, 2005 has seen exports closer to the historical average of 2%.

One issue that has been raised several times (see for example Setser 2006, Eichengeen 2006) is the issue that the divergence between the flow data and the stock data, may stem from tax avoiding strategies. This would imply that profits of US firms are larger than reported and lower the returns obtained abroad. In addition to the fact that this would imply a GDP for the US, larger than actually reported, it is useful to check for the sources of FDI to see if the tax hypothesis stands up the test of the data.

The BEA reports 209 billion dollars of income from foreign direct investments abroad in 2004. Among the low tax jurisdictions, Ireland stands out with 11 billion, Bermuda with 8 billion and UK Caribbean with 6 billion. What role can these play in explaining the story? In fact, for the tax issue to explain the mismatch between asset and flow data on a sustained basis requires that tax dodging should be increasing fast. If it is true that the US runs a current account deficit of 600 billion in a particular year, this implies that there should be 30 billion more in net payments the following year (using our arbitrary 5%). So for this not to show up in the net income from investments, means that tax dodging should have *increased* relative to previous years by that amount. If this reasoning is correct the numbers don't stand up to scrutiny. In 2000 firms had reported income from Bermuda for 6.4 billion, from Ireland of 5.7 and 1.6 billion from the UK Caribbean, so the change is really small relative to what should have been observed given measured imbalances. Mataloni (2000) also checks if reported profitability is sensible to firms with large intrafirm imports, but finds no relationship. While Buiter (2006) has challenged Mataloni's findings it provides complimentary evidence that tax issues are not behind dark matter.

Looking at the empirical evidence for the US

In our cross country studies, the US appears as a clear outlier, with very large exports of dark matter over the last 25 years, thus we take a closer look at this case.

We have argued that there are at least three theoretical reasons for the presence of dark matter in the US: the country is a net provider of knowledge, liquidity and insurance. It is difficult to identify the source of dark matter coming from each source as FDI may operate both as a vehicle for export of know how as well as a means for providing insurance. Debt instruments, in turn, may both be instruments to export insurance but also liquidity services. Our preliminary attempt to reconcile the official data with the income flows seemed feasible. For example adjusting the methodology for estimating the value of the FDI abroad (by using the market to book value of the S&P 500), led to an adjustment to the US net foreign asset position of 23% of 2004 GDP. From Meissner's and Taylor's (2006) estimate we obtained a similar estimate. And Buiter's (2006) seignorage adds anything between 2 and 4%. These measures capture, to a great extent, the same phenomenon, so they cannot be added up, but they show that it is fairly easy to reconcile the two sets of data.

Figure 8 also bears on this point by showing the net income arising from three sources as presented in official figures: net income from foreign direct investment, net payments by the US government and other net private income. The figure shows the rising cost of the interest payments on the growing US public debt, which has been increasingly held by foreigners. In recent years this negative trend has been compensated by an even faster rise in the income generated by FDI.

To get a better idea of how much dark matter is contained in each item, we take each one of the three income flows categories and then scale it up by multiplying by our earnings ratio of 20. We can then calculate the difference in our valuation of each of these assets vis a vis BEA´s valuation and hence the amount of dark matter corresponding to each asset class. This is shown in Figure 9 As can be seen, there is currently dark matter in each asset class but this has not always been the case. While FDI is the largest long-run source, the public

debt shows the biggest turnaround reflecting the low interest rates on US Treasuries of the last few years.

Figure 10 shows the evolution of accumulated stock of dark matter by the US. The stock stands now at over 40 percent of GDP. Since 1980 it has fallen only in 6 years and the largest drop, which took place in 1985, was barely to 1.9% of GDP. In short it would take an unprecedented deterioration of the value of dark matter to even approximate the net asset position that today worries analysts. On average the US has exported about 2% of GDP per year of dark matter with a standard deviation of about half a percentage point[21]. The reasons for the stability of dark matter are several-fold. To the extent that FDI assets abroad continue to rise and to generate excess returns then we should expect to measure a continued export of dark matter. If the ability of the US to provide insurance and liquidity services to the rest of the world is based on size and a more stable economy, to the extent that these features persist into the future and that the world economy continues to integrate in trade and financial assets, the US will increase, not decrease its sales of dark matter. [22]

Section IV. A new look at global imbalances

With a better understanding of what dark matter is, we apply our methodology to the understanding of global imbalances. In order to have a working benchmark Figure 11a presents the official evolution of the net asset position of major global players as a share of each entity's GDP. It shows a world that is increasingly unbalanced with Japan and the rest of the world financing Europe and (more importantly) the US, which appears accumulating a growing external debt. In these graphs the rest of the world is calculated as a residual to make things add up to zero.[23] Figure 11b shows the same picture but this time with data taken from Milesi Ferretti (2006). Again the description is similar to that depicted in official statistics.

Figure 11c presents the alternative view, which we construct by capitalizing the net income that each country makes on its asset position. As can readily be inferred, the world looks quite different once dark matter is taken into account. First and foremost, the US does not appear as a net debtor but as a net creditor and, as mentioned above, its net foreign asset position has remained stable over the last 20 years. Japan, consistent with official data, is a growing creditor, while the European Union and the rest of world are net debtors. Perhaps the most striking feature of Figure 11b is that it shows a world that is surprisingly balanced. Net asset positions of all major regions are fairly small – under 10 percent of GDP – except for Japan which has a surplus of over 30 percent and the rest of world that only recently has increased its indebtedness slightly.

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[21] Even though the exports of dark matter are consistently of about 2%, they show very little autocorrelation across years. A regression gives a coefficient of 2.2 with a tstat of 3.82.
[22] Whether the exports of dark matter will be sufficient to avoid a large adjustment of the US economy is yet to be seen. At current imbalances the historical 2% exports of Dark Matter do not seem to be sufficient to counterbalance a deficit that is running at 6% of GDP
[23] Lane and Milesi Ferretti (2006) argue that discrepancies are running close to 6% of world GDP. Here we are assigning all the discrepancy to the ROW.

Figure 12 shows the evolution of the net foreign asset position of China. It shows first, that China is still a net debtor. However China has reduced its debt considerably in recent years as it has moved its net foreign debt from about 1.2% of world GDP to only 0.4%. This reduction in 0.8% of GDP is in itself large, though the improvement is not as large as is suggested by the official statistics because China remains an important importer of dark matter. In terms of Chinese GDP we report a large increase in debts around 1994 when they reach about 30% of GDP. In recent years the ratio of net indebtedness has fallen to about 10%.

Figure 13 shows Europe´s net foreign assets, again as percent of world GDP. Prior to the launching of the euro both European Union and the Euro countries moved basically in the same fashion. But they have dramatically diverged in recent years, with the UK increasing very significantly its exports of dark matter.

While the above illustrates our measure for some selected countries, of course our analysis allows us to replicate it for any country in the world. This is what was done in Figure 2. [24]

Exporters and importers of Dark Matter

In order to obtain a better intuition of the movements of dark matter Table 4 ranks the exporters of dark matter for the 2000-2004 period. The use of a four year average is motivated by the fact that the volatility in year to year values of the service flow is large and so are exports and imports of dark matter. We also present only those countries with exports or imports of dark matter above 1 billion, i.e. those that to some extent are relevant to explain global imbalances. The table underscores the unique role of the US and the UK in explaining the flows of dark matter. The next country in the list (Mexico) is less than one tenth of the UK number and less than one twentieth of the US number. As was mentioned above the top exporters of dark matter are those countries that provide intermediation of financial services and which transform capital inflows into effective foreign direct investment. The US, the UK, Switzerland, and to a lesser extent Mexico and Korea all play this role (the latter two on a regional basis).

On the import side, nine countries have bought at least 30 billion of dark matter per year over the last five years. This group includes FDI havens such as Ireland and Singapore as well as oil producers (Saudi Arabia and Russia). Both fit our pattern, particularly oil countries for which the increase in the price of oil has increased the income of the assets foreigners hold in these countries thus increasing the value of their liabilities above and beyond what would be captured by their current account deficits measured according to official statistics. Similarly, countries like Ireland and Singapore import significant quantities of dark matter, reflecting the successful returns of FDI in these countries. However the group also includes Japan, Germany, Italy and France even though their imports of dark matter are relatively small relative to their own GDPs.

Section IV. Conclusions and future research

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[24] A complete historical computation can be found in www.utdt.edu/~fsturzen.

In a nut shell our story is very simple. The income generated by a country's financial position is a good measure of the true value of its foreign assets. Once assets are valued accordingly the data seems to indicate that official statistics may provide a distorted picture of current account imbalances. In the specific case of the US we find that a large amount of US net foreign assets are unaccounted for. Since the US has a net income on its foreign asset position it is a net creditor, not a net debtor and its net foreign asset position appears to have been fairly stable over the last 20 years. The difference with the official story probably comes from a combination of mismeasurement, the unaccounted export of know-how carried out by US corporations through their investments abroad, as well as the sale of insurance and liquidity services. The last three factors relate explicitly to characteristics of the US that cannot be easily replicated elsewhere, and explains why the US looks like a consistently smarter investor, making more money on its assets than it pays on its liabilities. Dark matter thus sheds a wholly new light on the discussion of the US role in global imbalances. To the extent that dark matter has kept US net foreign assets relatively stable, the discussion on the instability of global imbalance should focus on the stability of the US economy, its role as a cradle for ideas, or the ability that it commands on liquid assets and prudent macroeconomic policies. But these issues have not be the central issues of the debate, that have focused mostly on domestic savings or on speculating about the willingness of official creditors to finance the measured imbalances.

However, dark matter also sheds a different light on the often discussed savings puzzle. According to the official statistics, the US appears as a profligate consumer with dismal savings. However, these numbers understate the US savings rate by the amount of dark matter it exports and overstates the savings of the rest of the world by the amount of dark matter it imports. To the extent that there are unreported capital gains, these should be included in the current account and in national accounts, increasing the savings rate and national income. In the specific case of the US we find that the economy has been saving significantly more than accounted by official statistics. Exports of dark matter are perceived by households as a source of income, while the stock of dark matter is a source of wealth. The value of this Dark Matter is reflected in the S&P500 and the American consumer is appropriating these benefits in their 401Ks and other asset holdings. Hence, savings are under reported by the amount of dark matter exports (about 5% of GDP since 2000). The result is a consumption level that seems inconsistent with measured statistics but that is normal given actual wealth.

Our computation of dark matter leaves open several interesting areas of research. As a starter, we believe it signals on the importance to improve on the estimates of factor income accounting in the balance of payments and its underlying determinants. With more complete data, it should be feasible to test whether dark matter effectively relates to the know-how embodied in FDI or to the risk properties of the US economy, or the depth of its financial markets, thus testing directly the relevance of each explanation. Alternatively, it would be interesting to look at dark matter by sector and region, to get a better sense of where it is being created and deployed. Likewise while we have somewhat looked into the evolution of dark matter for the US, the stories for other countries are likely to be different and equally interesting. In addition, it should be important to study the stochastic properties of dark matter over time and across countries.

To the extent that current account surpluses have to match deficits somewhere else, studying dark matter in some countries can provide clues for adjustments elsewhere. Oil prices, for example, may be an important driver of investment returns in some countries and thus lead to important transfers of dark matter.

Globalization and financial integration has made asset positions all the more relevant. As the gross stock of assets and liabilities increases valuation adjustments on these assets may overshadow the traditional measure of the current account as drivers of the net asset position. As we've seen, flows of dark matter are a very significant part of the story. As a result traditional measures of current account balances will paint an increasingly distorted picture of reality. In particular, they currently point towards imbalances that are not really there, making analysts predict crises that, for good reason, remain elusive.

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Figure 1. The US Current Account and it´s International Investment Position (in billions of US dollars)
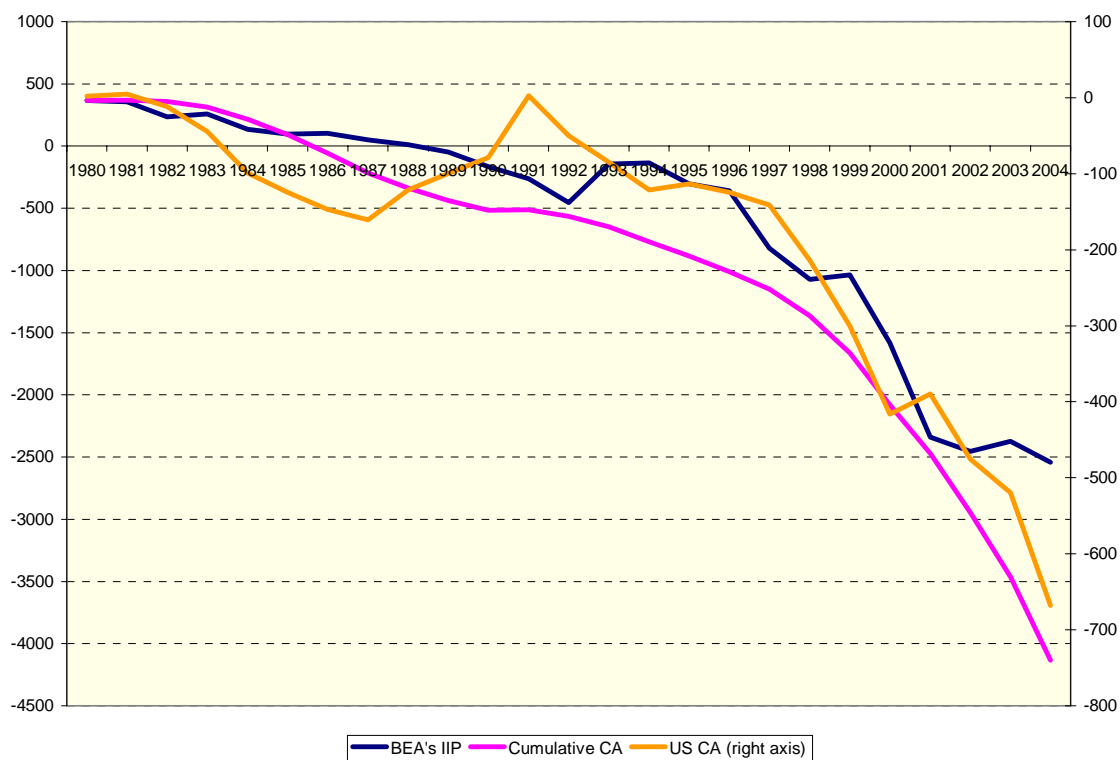
Source: BEA

Figure 2a. Official Current Account and Change in Net Foreign Assets (1980-2003)
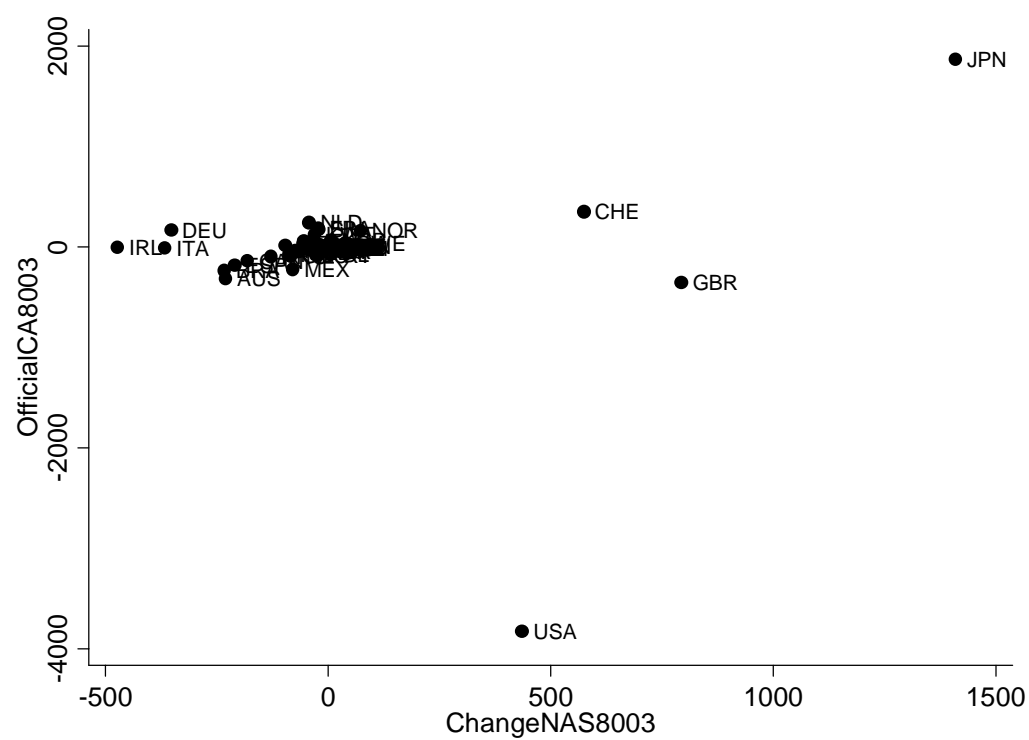
Figure 2b. Official Current Account and Change in Net Foreign Assets (1980-2003)
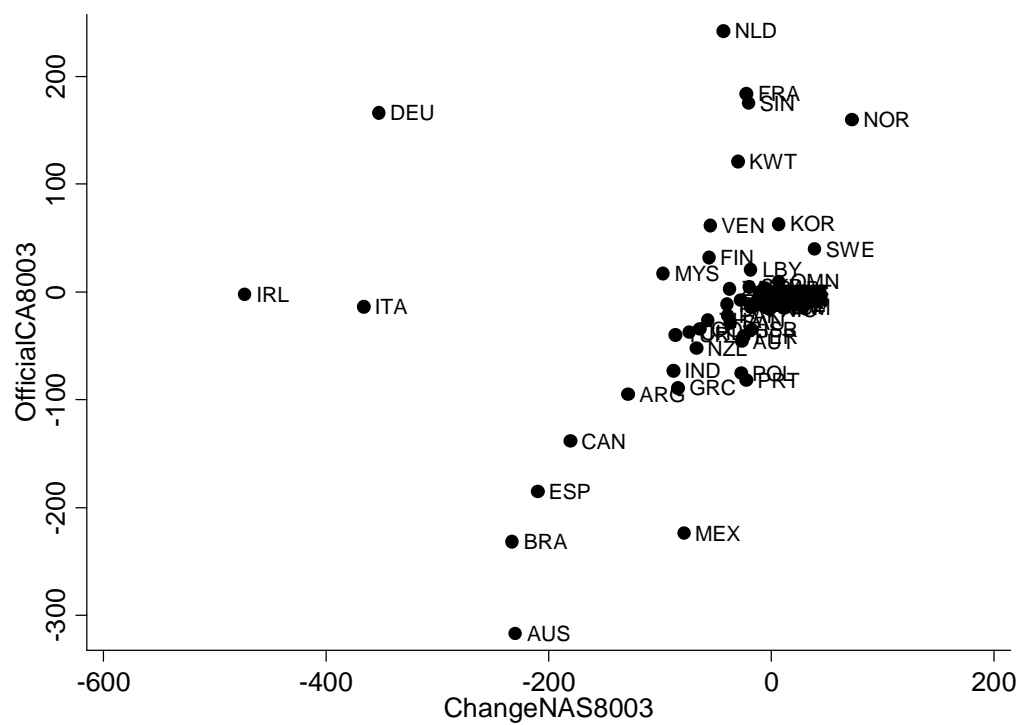
Figure 3. Cumulative Current Accounts with official statistics and with Dark Matter (in billions of dollars)
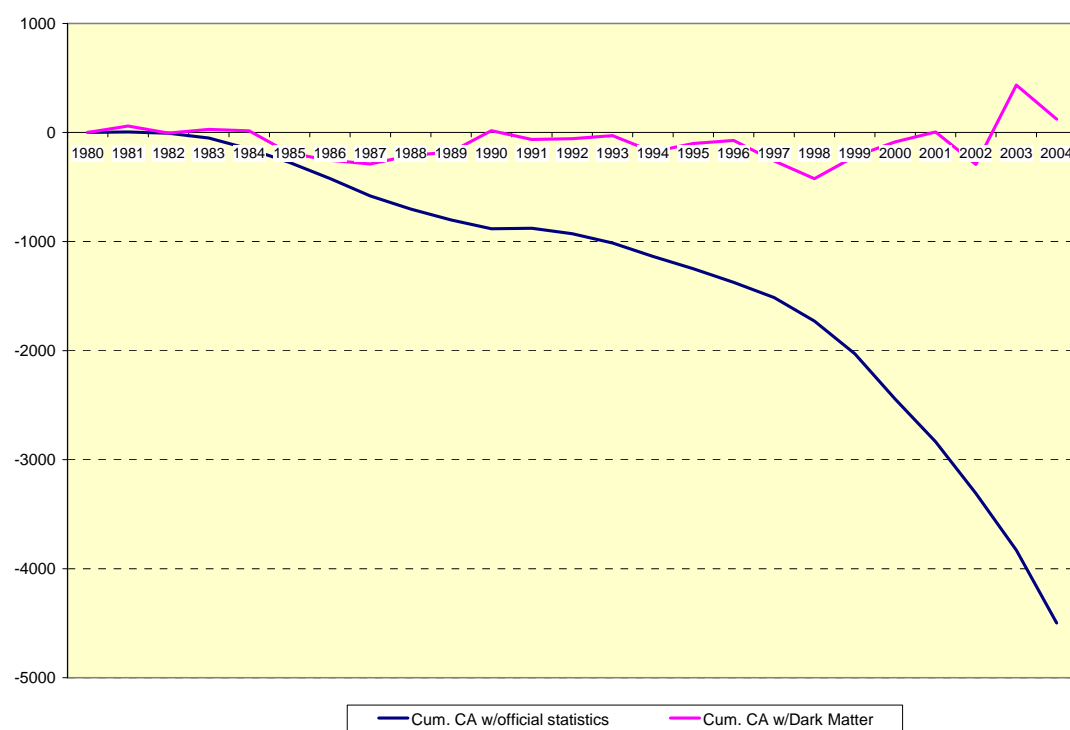
Source: BEA and International Financial Statistics

Figure 4a. Exports of Dark Matter vs. Official current account (1980-2003) in US dollars
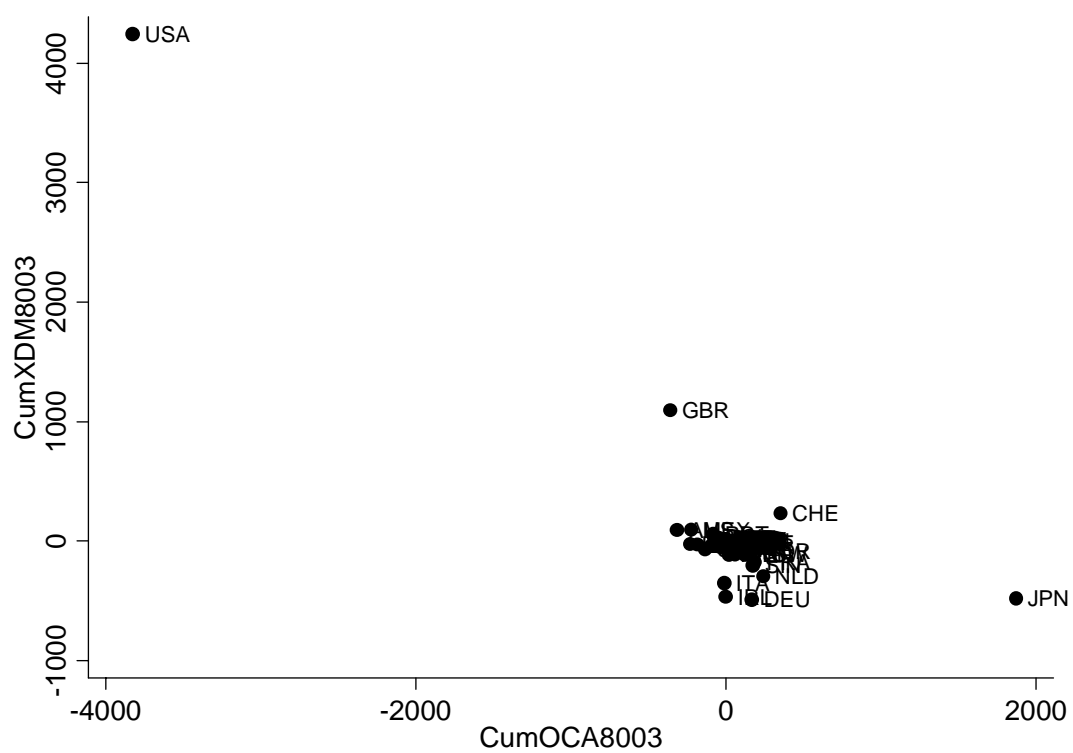
Figure 4a. (cont) Exports of Dark Matter vs. Official current account (1980-2003) in US dollars. Selected countries.
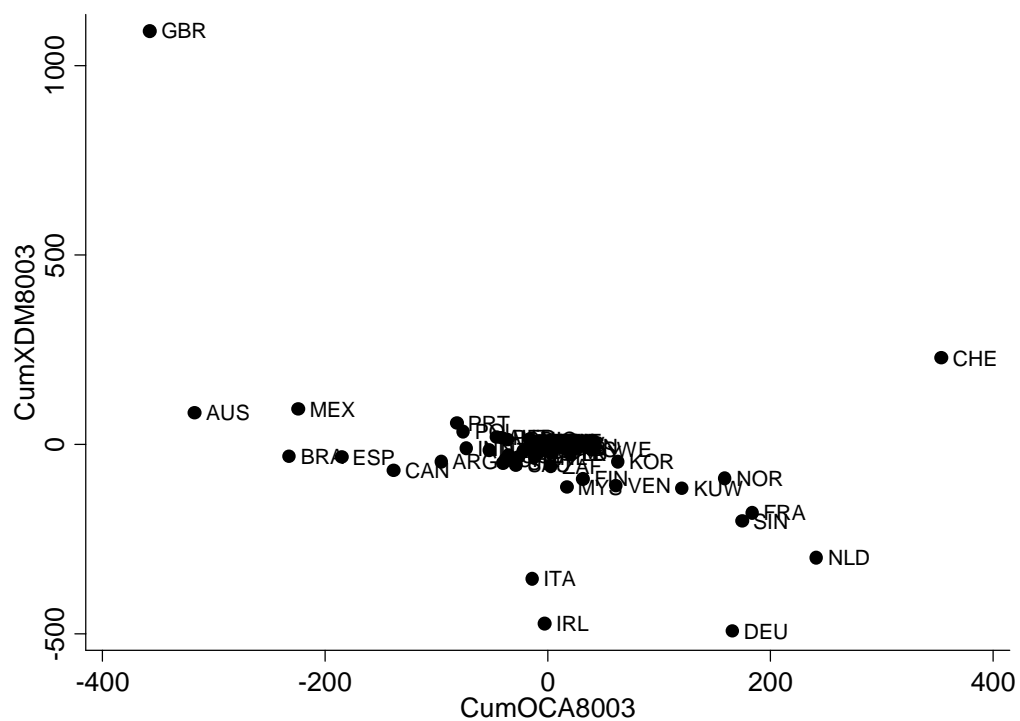
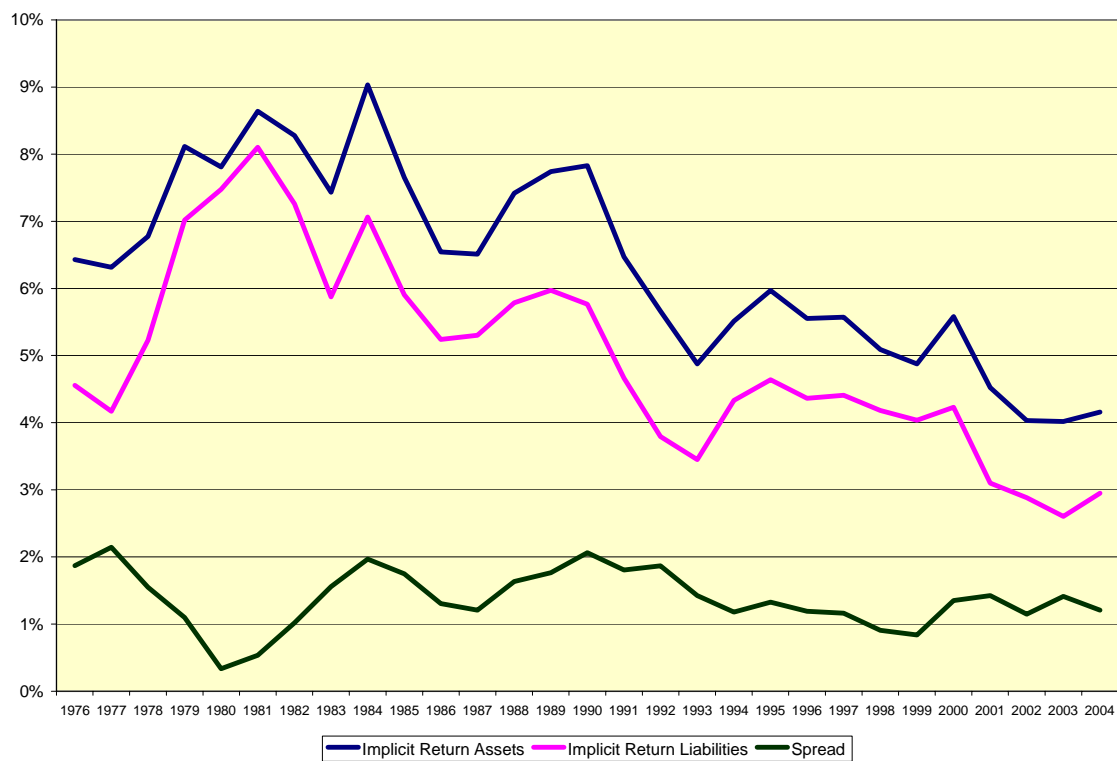**Figure 4b.. Exports of Dark Matter vs. Official current account (1980-2003) as % of each country's GDP**
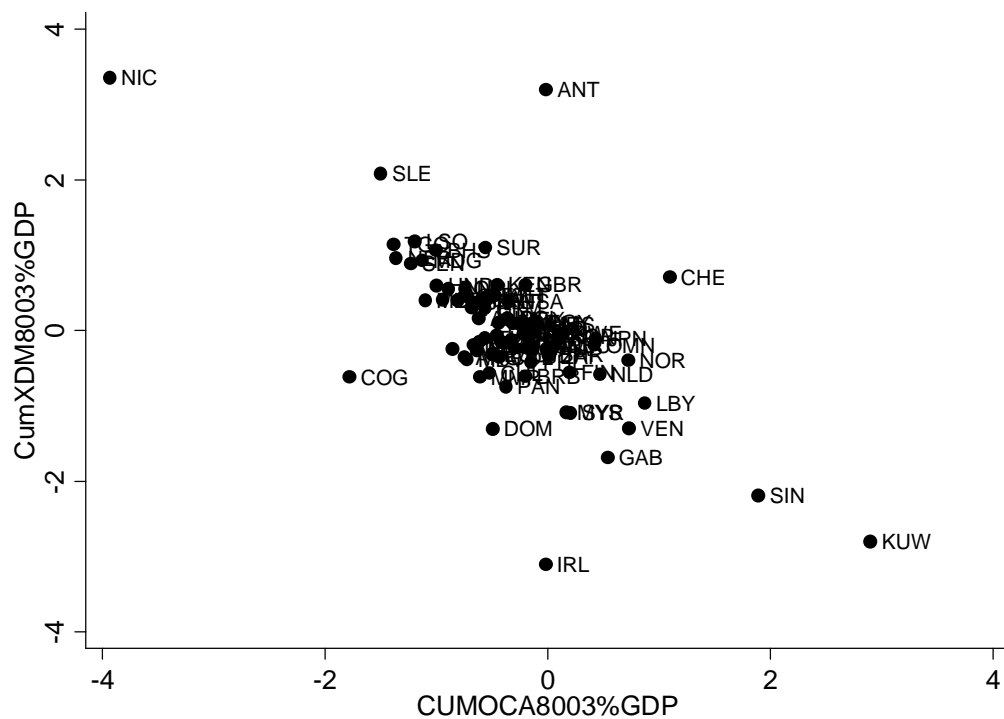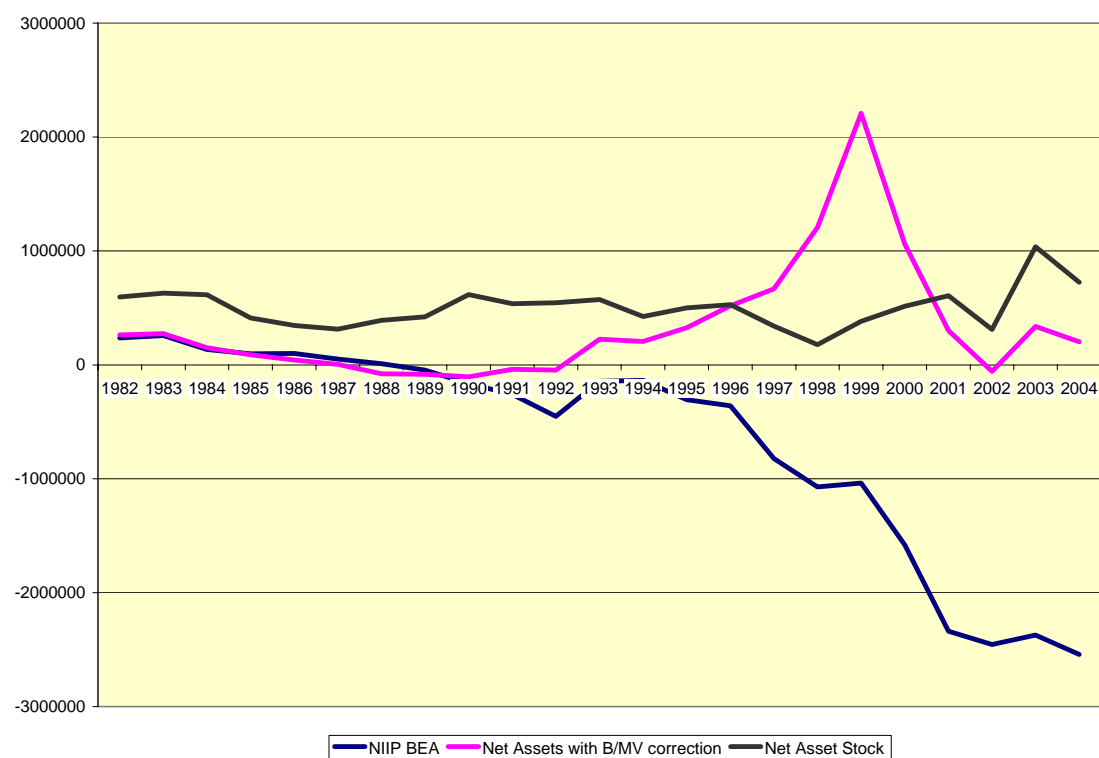
Figure 5. The US interest spread 1976-2004

Source: BEA

Figure 6. Net Asset Position of the US: BEA, Dark Matter and adjusting FDI by US stock market. In nominal US dollars ('000s)

Source: BEA and author's computation using Global Financial Markets Dataset

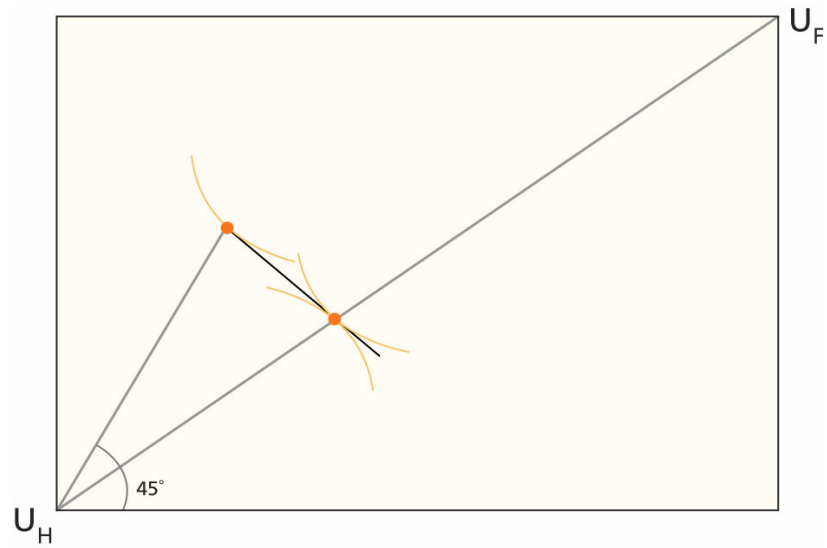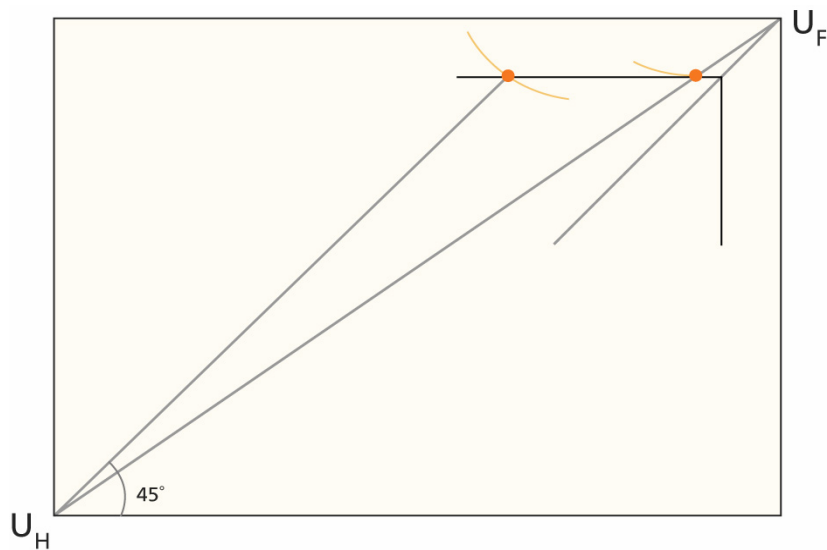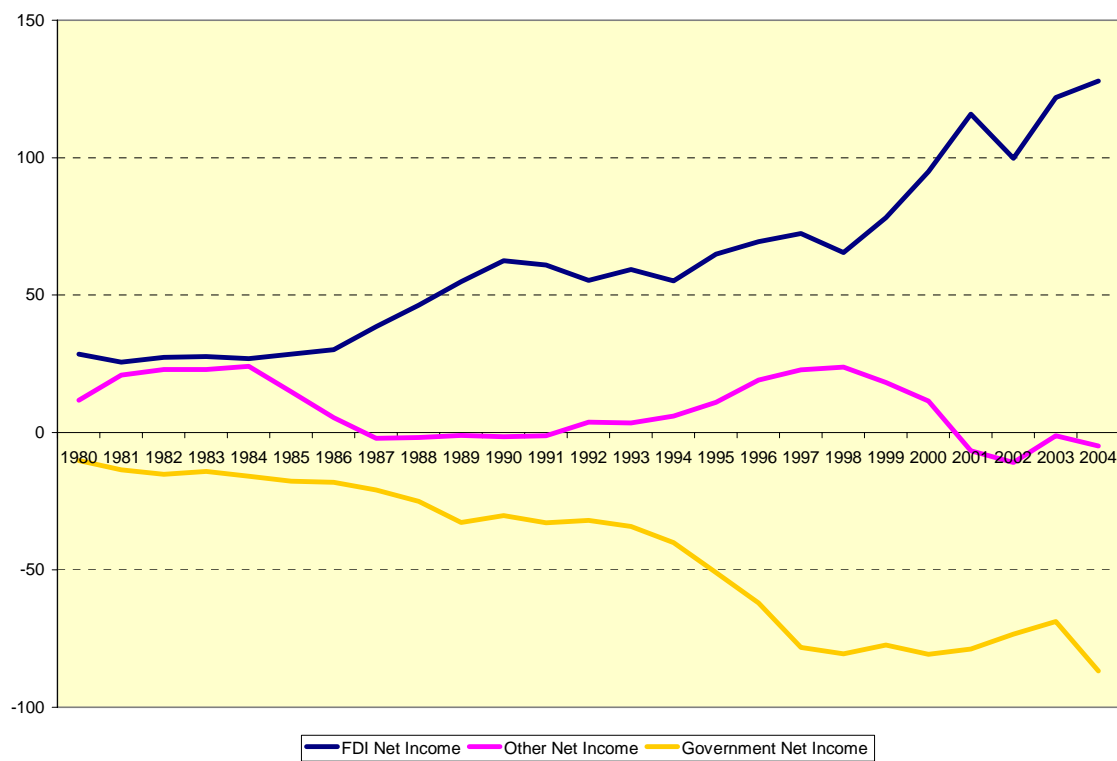**Figure 7a. Trading in Contingent assets**
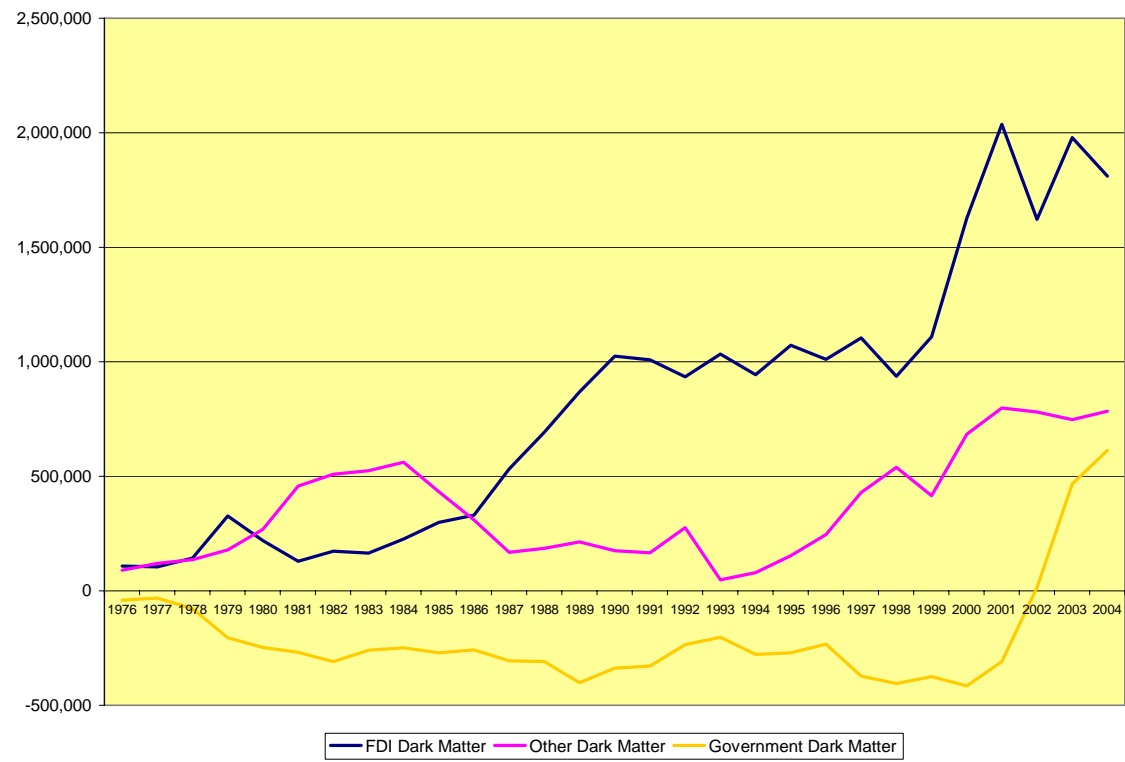

Figure 7b. The infinite risk aversion case

Figure 8. Sources of US Foreign Income
(in billions of US dollars)
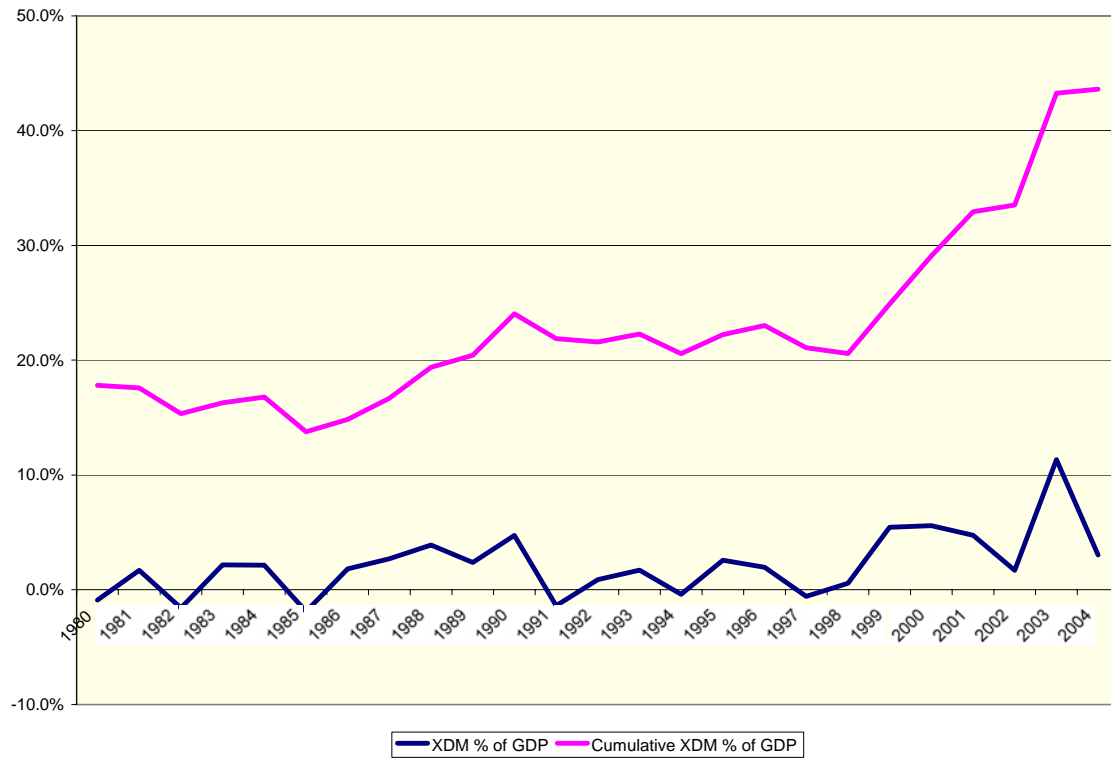

Source: BEA

Figure 9. Dark matter by source
(in millions of dollars)

Source: BEA

Figure 10. US dark matter assets and yearly exports of dark matter (percent of US GDP)

Source: BEA

**Figure 11a. Net Foreign Assets in the World according to Official Figures
(as % of each entity's GDP)**
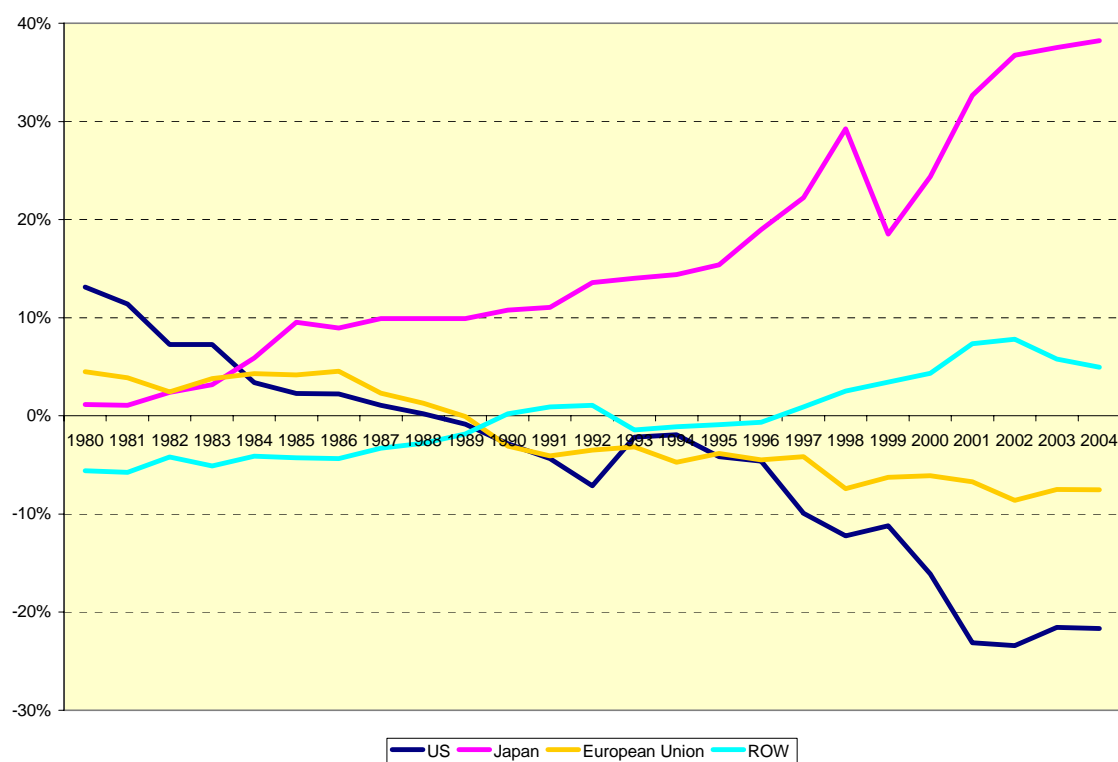
Source: International Financial Statistics

Figure 11b. Net Foreign Assets in the World according to Official Figures. Lane and Milesi Ferretti (2006)
(as % of each entity's GDP)
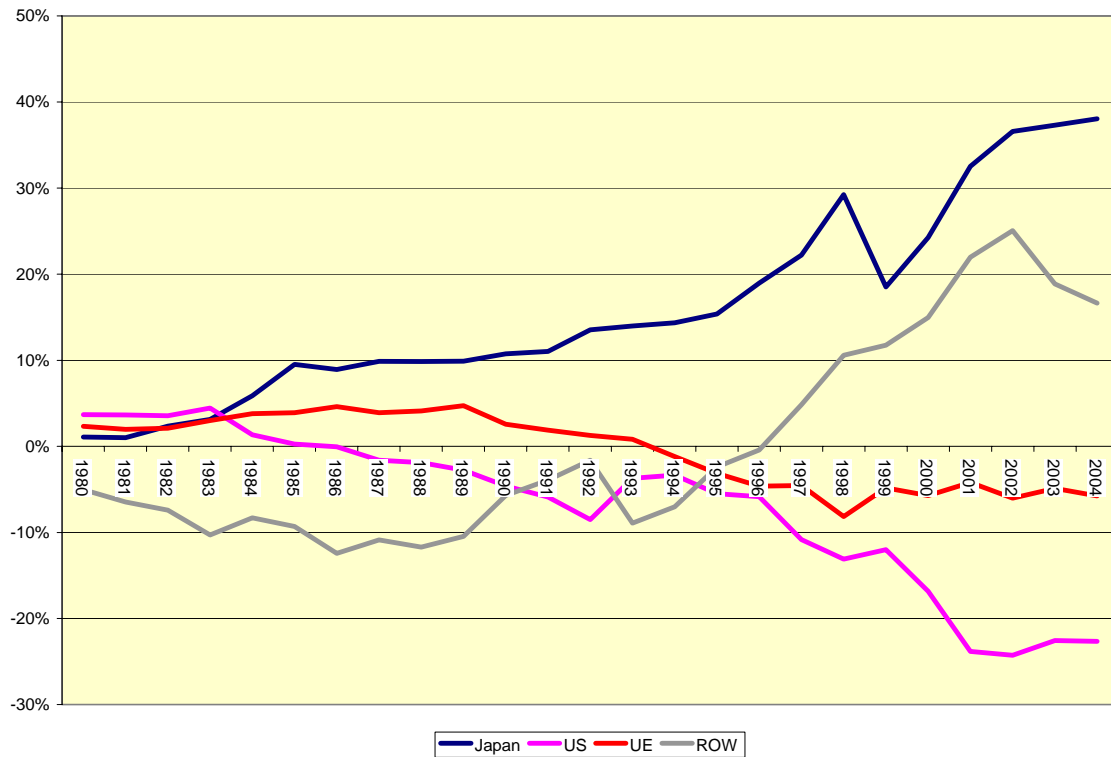
Source: Lane and Milesi Ferretti (2006)

Figure 11c. Net Foreign Assets taking into account Dark Matter
(as % of each entity's GDP)
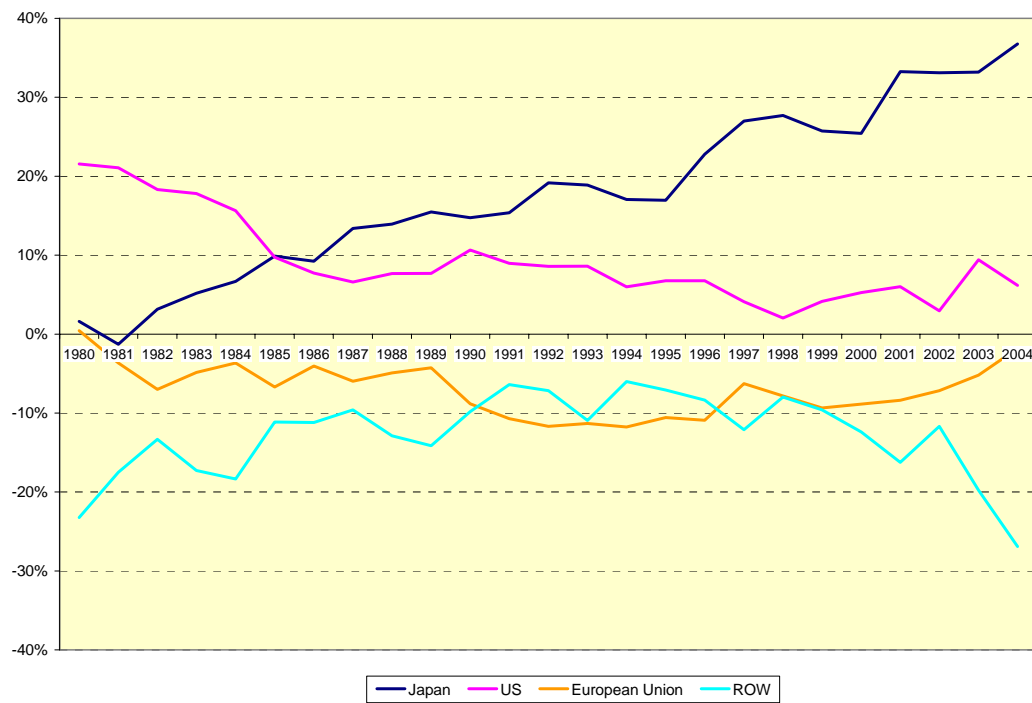
Source: authors´ computations on International Financial Statistics data

Figure 12. China's net foreign assets
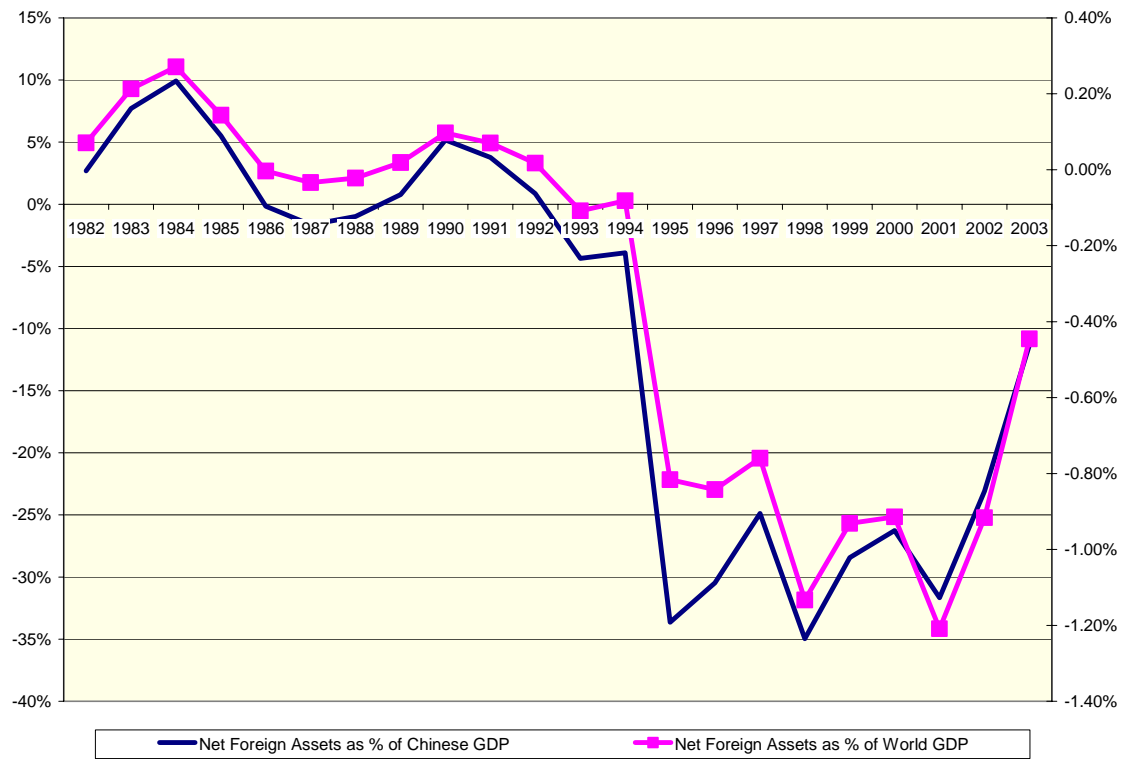
Source: authors´ computations on International Financial Statistics data

**Figure 13. European Union and Eurozone net foreign assets
(as % of world GDP)**

Source: authors´ computations on International Financial Statistics data

Table 1.Dependent variable: Official Current Account

	Full Sample	Excl. US	Excl. US & UK	Excl. US & UK & JPN
Change in NAS	0.27	0.74	1.00	0.38
	(1.21)	(9.19)	(16.01)	(5.06)
Constant	-29.73	15.93	30.54	5.91
	(-0.64)	(0.99)	(2.68)	(0.73)
R-squared	0.01	0.48	0.74	0.22

T-stats in parenthesis

Table 2.Dependent variable: Exports of Dark Matter

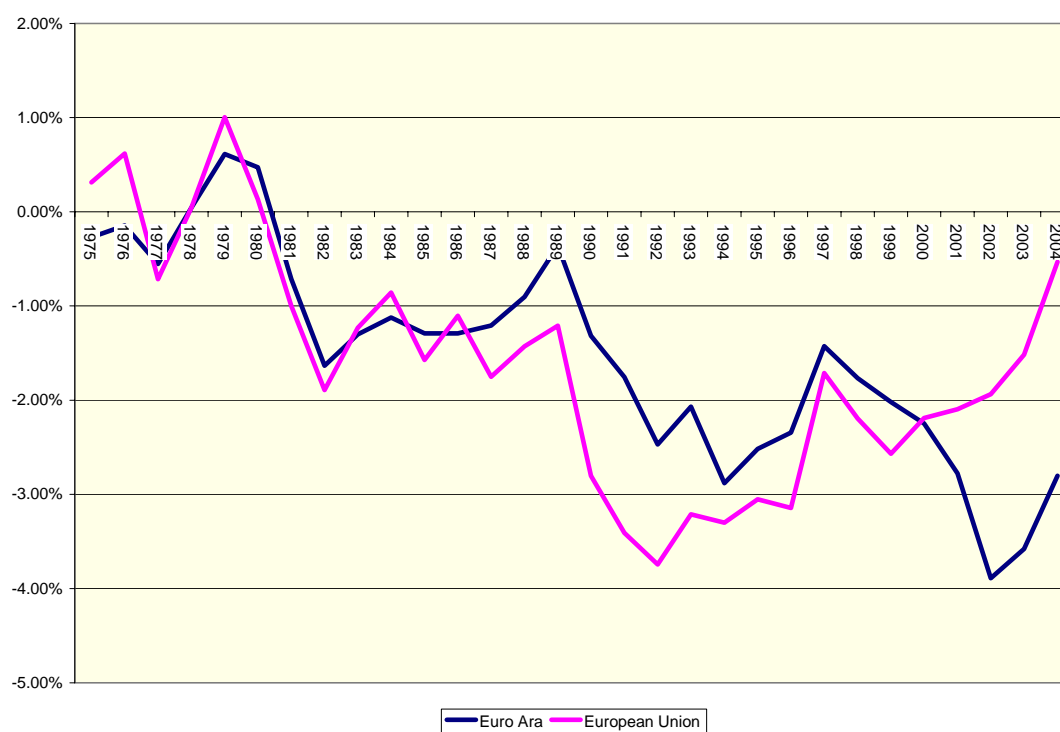|	In US Dollars			In % of GDP
	Full Sample	Excl. US	Excl. US & UK	Full Sample
Cumulative Official CA	-0.94	-0.35	-0.26	-0.79
	(19.51)	(-4.90)	(-5.41)	(-8.13)
Constant	-3.43	-18.46	-31.57	-0.28
	(-0.15)	(-1.17)	(-3.02)	(-3.42)
R-squared	0.82	0.22	0.26	0.43
# of Observations	87	86	85	87

T-stats in parenthesis

Table 3a. Relating dark matter exports to FDI Stocks (2004) in US dollars

	CumXDM	CumXDM	CumXDM w/o US	CumXDM industrial w/o US
FDI Assets	1.09	-0.44	1.17	1.46
	(11.18)	(-1.08)	(4.78)	(3.02)
FDI Liabilities		1.89	-1.64	-1.98
		(3.80)	(-4.52)	(-2.64)
Constant	-96637	-116275	-1453	-40623
	(-2.57)	(-3.31)	(-0.07)	(-0.51)
R-squared	0.62	0.68	0.24	0.32
# of observations	78	78	77	23

Table 3b. Relating dark matter exports to FDI Stocks (2004) in % of GDP

	CumXDM in % of GDP	CumXDM in % of GDP industrial	CumXDM in % of GDP	CumXDM in % of GDP industrial
FDI Assets	0.16	0.56	1.81	2.41
	(0.42)	(1.19)	(3.52)	(4.15)
FDI Liabilities	-1.1	-1.73	-1.9	-3.49
	(-3.45)	(-4.75)	(-5.52)	(-6.76)
Outwardness			-1.95	-4.44
			(-4.24)	(-4.04)
Constant	0.21	0.38	0.69	2.62
	(1.71)	(1.82)	(4.37)	(4.55)
R-squared	0.17	0.55	0.33	0.75
# of observations	78	24	78	24

Table 4. Exporters and Importers of Dark Matter 2000-2003
(average values for this period)

	DMX in US dollars	GDP in US Dollars	DMX in % of GDP		DMX in US dollars	GDP in US Dollars	DMX in % of GDP
UNITED STATES	613.8	10359.0	5.9%	CROATIA	-3.7	22.5	-16.4%
UNITED KINGDOM	240.1	1560.0	15.4%	PERU	-4.0	56.0	-7.1%
MEXICO	24.2	623.0	3.9%	DENMARK	-4.2	175.8	-2.4%
SWITZERLAND	18.5	274.1	6.8%	PAKISTAN	-4.2	64.0	-6.6%
KOREA	17.3	536.8	3.2%	KAZAKHSTAN	-4.8	24.0	-20.0%
BRAZIL	14.4	518.7	2.8%	TURKEY	-5.5	195.8	-2.8%
AUSTRIA	10.3	210.2	4.9%	PHILIPPINES	-5.6	74.7	-7.6%
PORTUGAL	10.1	121.2	8.3%	EGYPT	-5.7	90.9	-6.3%
INDONESIA	6.4	192.1	3.3%	LUXEMBOURG	-5.9	22.0	-26.8%
SPAIN	6.2	662.9	0.9%	SOUTH AFRICA	-6.5	131.9	-4.9%
SWEDEN	6.1	251.3	2.4%	GREECE	-6.7	134.7	-4.9%
COSTA RICA	5.7	16.7	34.2%	POLAND	-7.4	188.3	-3.9%
AUSTRALIA	4.6	411.9	1.1%	CHINA,P.R.:HONG KONG	-8.3	161.2	-5.1%
BOSNIA & HERZEGOVINA	1.0	5.6	18.3%	CZECH REPUBLIC	-9.3	70.2	-13.2%
AZERBAIJAN, REP. OF	-1.1	6.1	-18.6%	COLOMBIA	-9.8	81.7	-12.0%
SLOVENIA	-1.2	22.1	-5.4%	LIBYA	-10.1	26.9	-37.7%
BAHRAIN, KINGDOM OF	-1.4	8.4	-16.9%	NORWAY	-10.5	187.3	-5.6%
UKRAINE	-1.4	40.4	-3.5%	MALAYSIA	-10.8	94.3	-11.5%
CANADA	-1.5	762.8	-0.2%	CHILE	-11.0	70.8	-15.5%
GABON	-1.5	5.2	-28.8%	VENEZUELA, REP. BOL.	-13.0	104.3	-12.5%
ANGOLA	-1.6	10.7	-14.6%	FINLAND	-15.0	134.0	-11.2%
NEW ZEALAND	-1.6	60.2	-2.6%	KUWAIT	-17.9	37.0	-48.5%
ESTONIA	-1.7	6.9	-24.4%	ITALY	-32.5	1207.7	-2.7%
YEMEN, REPUBLIC OF	-1.7	10.1	-17.3%	SINGAPORE	-33.2	89.8	-37.0%
HUNGARY	-1.9	61.5	-3.1%	NETHERLANDS	-34.0	422.6	-8.0%
THAILAND	-2.4	127.0	-1.9%	SAUDI ARABIA	-37.0	193.9	-19.1%
SYRIAN ARAB REPUBLIC	-2.4	20.2	-11.7%	GERMANY	-40.9	2032.5	-2.0%
DOMINICAN REPUBLIC	-2.4	19.9	-12.3%	JAPAN	-44.9	4298.8	-1.0%
INDIA	-2.7	500.2	-0.5%	IRELAND	-52.5	118.0	-44.5%
MYANMAR	-2.8	9.0	-31.7%	RUSSIA	-61.7	335.4	-18.4%
SUDAN	-3.1	14.7	-20.8%	FRANCE	-62.7	1460.3	-4.3%
ARGENTINA	-3.4	195.4	-1.8%				

Source: authors´ computations on International Financial Statistics data