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Splitting Up Dark Matter

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Buenos Aires, Argentina

29 de Noviembre, 2021

Tesis de Maestría en Economía[1] de

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División de la materia oscura

Resumen

Este trabajo ofrece un análisis detallado de una medida alternativa de los flujos de ingresos de las cuentas oficiales denominada " materia oscura ". Nuestro objetivo es ampliar esta área de investigación mediante la división de la materia oscura en dos componentes principales denominados "activos" y "deuda". De esta manera, podremos explicar de manera clara los fundamentos subyacentes de la evolución de los flujos de ingresos para diferentes países. Nuestros principales resultados son que esta nueva perspectiva se encuentra respaldada por trabajos anteriores, ayuda a explicar los flujos de ingresos de los países desde otro punto de vista, y ofrecemos un primer enfoque de los determinantes de las diferencias en los flujos de ingresos entre países.

Palabras Clave: Materia Oscura, imbalances Globales, Inversion Extranjera Directa, Flujos de Ingresos.

Splitting Up Dark Matter

Abstract

This paper offers a detailed analysis of an alternative measure of income flows from officials' accounts denominated "dark matter." We aim to extend this area of investigation by splitting dark matter into two main components denominated "equity" and "portfolio." In this way, we can shed some light on the underlying fundamentals of income flows' evolution for different countries. Once we obtain these components, we proceed to contrast these new measures against the actual data. Our main results are that this new perspective supports previous work, helps explain the income flows for countries from another point of view, and we offer a first approach for the determinants of the differences in income flows across countries.

Keywords: Dark Matter, Global Imbalances, Foreign Direct Investment, Flows of income.

Códigos JEL: F32, F36, F41

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I am very grateful to my family for all their support. To Joaquin Campabadal, Florencia Pucci and Pablo Zarate for their comments. To Osvaldo Meloni and Daniel Heymann for their recommendations. To Javier Garcia Cicco, Walter Sosa Escudero, Amelia Gibbons, Tommy Murphy, and Martin Rossi for all their good advice throughout the master, and finally to my mentor Federico Sturzzenger for always encouraging me to learn beyond his classes and his excellent predisposition on the trajectory of this thesis.

1 Introduction

The Current Account for a given country measures the change in the country´s debt over time. This official account measure acts as a warning that a country is running up foreign liabilities when it gradually accumulates large deficits. Then, if these imbalances are large enough so that they can no be sustainable, they end up requiring significant changes throughout the whole international financial system.

During the 2000s, this topic was of great interest because the United States (US) has been a great source of concern due to its significant imbalances of current account over the years. Some authors [2] had overlooked mainly that the worsening of the US net external position would not continue for an unlimited period so that there would be necessary a significant adjustment to have a relatively smooth regulation process in the country and the world economy attributable to this. Consequently, we should infer that these deficits in the current account are the prelude to substantial interest payments in the future. However, the Net Investment Income of the United States has remained stable and positive over a long time. So a series of puzzles aroused. First, why was the US the largest debtor globally and had not led to a crisis yet? Second, why was the country running up liabilities without any increase in their net factor payments to the rest of the world. Finally, if the United States was a net debtor to others countries (such as the less developed countries), it should have been financing these imbalances. This last did not have sense in practice because capital was flowing away from the less developed countries instead of flowing in.

Prior to that date, no study looked specifically at these puzzles until considerable research was devoted to answering these questions by Ricardo Hausmann and Federico Sturzenegger (H.S.). In a series of papers [3]. They described a framework to gain a better understanding of the mechanisms underlying the measurement of stream flows. The authors suggested different reasons that may generate return differentials on the net foreign assets (mismeasurement of assets and liabilities, debt relief, liquidity, and seignorage). They are not considered in the official statistics of the current account for a country. Thus, they proposed an alternative way of measuring the accumulation of income flows of a country as the capitalized value of the net investment income (NII) discounted at a constant rate. The difference between their new estimations and the official accounts is called "Dark Matter." The evolution of this new indicator is different for each country based on specific and intrinsic characteristics.

This study aims to extend this investigation area by splitting dark matter into two main components "equity" and "debt". This is of interest to assess the stability of net asset position from a detailed perspective for countries worldwide and the current account imbalances from dark matter decomposition. To achieve this goal, we propose two alternative ways for the decomposition of dark matter. As a result, we can determine the importance of each component in the evolution of dark matter, and it will help us learn new insights to explain reasons for return differentials across countries.

In this way, we provide a detailed account of the composition of dark matter for all the countries in the world, and we find that it supports the view proposed by H.S.

[2] See Obstfeld and Rogoff (2007), Roubini and Setser (2005).

[3] See Hausmann and Sturzenegger (2006) Hausmann and Sturzenegger (2007a) Hausmann and Sturzenegger (2007b) Hausmann et al. (2008).

The remainder of this paper is organized as follows. Section 2 provides essential contextual information regarding the concept of dark matter. Section 3 provides a concise analysis of splitting up dark matter. Section 4 provides arguments supporting the evolution of dark matter for a series of countries. Section 5 presents an econometric model to identify critical factors behind the calculation of dark matter equity. Finally, section 6 concludes.

2 Review of Dark Matter and reasons for discrepancies in return differentials

2.1 Determinants of discrepancies in return differentials

The particular case of the United States motivated H.S. to investigate the associations among the puzzles described above and the actual data. They proposed that the assets had return differentials that were not considered in the official accounts. These channels or reasons why a country could exhibit return differentials or yield privileges[4] are four:

First, a country's foreign direct investment (FDI) calculation could be mismeasured because the investment realized by the source country comes with a new product, know-how, expertise, and blueprints that may not be accounted for correctly by firms in the host country accounts. For example, when a company invests in another country, it spillovers intrinsic knowledge raising the yields of that specific goods or services. In other words, this invisible trade is not registered in any account. Otherwise, the value of exports and imports would change disproportionately.

A second channel may subsist from the underlying stability of a country. A country may decide to sell to other countries some of its stability to the rest of the world and charge a price for it, while other countries are willing to diversify some of their instability. This channel is an argument of risk premia that will last in equilibrium [5]. As a result, there exists a differential in returns across countries because the countries with unstable economies want to diversify their assets despite the fact they obtain low returns. In contrast, stable countries could obtain higher returns in other places. An example of this is Switzerland; this country is considered one of the safest in the world, so that people are willing to invest there besides they obtain a low return for it.

A third channel is liquidity and seignorage. The emission and acquisition of liquidity services, such as dollars, pounds, or euros that earn zero interest rates in foreign countries allow the source countries to accumulate the current account deficits without deteriorating their NII. For example, El Salvador is a country that uses U.S. dollars as its official currency. The country needs to export goods and services to the United States to "buy" dollars. For this reason, the United States can incur sizeable current account deficits with no need for payment.

Finally, a fourth reason that may generate a yield differential for developing countries is debt relief; it permits a country to have significant deficits accumulated but never be repaid.

[4] See Gourinchas et al. (2010)
[5] See Frankel (1982)

2.2 Dark Matter

After reviewing the reasons that may originate return differentials, it is reasonable to consider another point of view from that of the official accounts. H.S. proposed a different rule for valuing the stock of net foreign assets that could capture these abnormal returns as the capitalized value of NII, discounted at a constant rate (r):

$$NFA_t^{DM} = \frac{NII_t}{r} \tag{1}$$

This term with a superscript DM denotes the measure of net foreign assets' flows that are not considered in the official statistics.

Also, H.S. define the Current Account DM as:

$$CA_t = NFA_t^{DM} - NFA_{t-1}^{DM} = \frac{NII_t - NII_{t-1}}{r} \tag{2}$$

Finally, dark matter is the difference between this measure of net foreign assets and that obtained from accumulating the current account.

$$DM_t = \frac{NII_t}{r} - NFA_t \tag{3}$$

This concept comes from an analogy to physics that says the world is more stable than it seems due to a dark matter in the universe that nobody can see, but we know it exists. H.S. suggested an analogy that there was a differential in the return of the assets that we can not see, but we know it exists since they generate revenue.

This computation presents the same caveats that the estimation of a ratio-earnings but also presents some advantages. On the one hand, the interest rate chosen should appropriately reflect the expected growth and the opportunity cost of time. The earnings must be relatively stable; also, they must be of good quality and not be capital gains. On the other hand, the potential advantage of applying this methodology to the overall earnings on net foreign assets is that we average over many firms and agents so that the resulting earning flow may be relatively stable (Hausmann et al. (2008)). Also, the authors explain that the interest rate level they chose is not relevant for this story and that similar results would be obtained with an interest rate computed from market rates[6] . In previous research[7], H.S. used the discounting interest rate from an estimation of the typical return on net foreign assets and considered a constant interest rate of 5%.[8]

However, some authors criticized this point of view; for example, in Higgins(2007) [9], they propose an argument that criticizes the measure of dark matter. They find that discounting the net return separately in assets and liabilities at a constant rate, some assets and liabilities are undervalued relative to the official statistics. They denominated this concept "Dark Antimatter," claiming that is evidence against the dark matter. Another example

[6]See Hausmann and Sturzenegger (2006)
[7]See Hausmann and Sturzenegger (2007b)
[8]In this work we will apply the same rate of discount of 5% and in the appendix, we will present data consistent with this result.
[9]See Higgins et al. (2007)

is a discussion of Cedric Tille (Hausmann and Sturzenegger, 2007a). He suggested that the dark matter was not sustainable because its components were temporary and could not last long. Moreover, there are others such as Buiter (2006) and "the America's dark materialist" from The Economist [10]. However, this new approach has proven to be persistent over time; also, with these estimations of dark matter, the global imbalances appear to be stable even in the presence of crises, such as the global financial crisis of 2008.

Finally, we introduce a brief discussion to frame the reader about the relevance of the dark matter indicator concerning sustainability evaluations, a question far from being trivial. In this vein, some questions may arise regarding the contingent nature of the promises reflected in the NII measure. For instance: an economy may record a surplus in return flows observed from holding high-yielding assets, but low probability of compliance (leading to the question of how the corresponding risks are prospectively assessed, which it is set aside in the computation of the dark matter variable if the NII measurement is based on historical values). On the other hand, the return flows observed from dark matter coincide with relevant events. Some evidence of this is shown later in this paper. Therefore, further research is necessary to answer this question, which may be helpful to assess policy issues.

3 Splitting up dark matter

3.1 Description of the splitting up

The review of underlying fundamentals of return differentials in assets for different countries and the introduction of dark matter enable us to present an extension of this concept splitting up dark matter into "equity" and "portfolio". In other words, we can explore with more detail the decomposition of dark matter due to abnormal returns (positive or negative) caused by mismeasurement of FDI (equity) or those caused by Insurance (debt)[11]. This review is of interest because it will allow us to identify critical factors in the difference of the evolution of net foreign assets estimated by dark matter and net foreign assets by official accounts across countries, and over time and learn new insights behind these concepts.

We propose an alternative way to compute dark matter to split it into "equity" and "portfolio". It consists of discounting the Net Investment Income at a constant rate for equity or portfolio. However, we are unable to use the Current Account because it can not be broken up into equity or portfolio, so we consider the accumulation of the Financial Account and the International Investment Position as alternative variables to make these computations.

The Financial Account (F.A.) records transactions that involve financial assets and liabilities and that take place between residents and nonresidents [12]. So that, when we calculate the cumulative Financial Account is similar to the cumulative current account. Both calculations inform us about the external debt of a country. In addition, the International Investment Position is a statistical statement that shows at a specific point time the value of financial assets of residents of an economy that are claims on nonresidents or are gold bullion held as a reserve asset; and the liabilities of residents of an economy to nonresidents. The difference between the assets and liabilities is the net

[10] See https://www.economist.com/finance-and-economics/2006/01/19/americas-dark-materials

[11] Also, a firm could decide to invest in another country with a stable economy as a way of insurance but we will simplify the analysis not considering this situation.

[12] https://www.imf.org/external/pubs/ft/bop/2014/pdf/BPM6_10F.pdf

position in the international investment position (NIP). It represents either a claim on or a net liability to the rest of the world[13] [14].

However, some differences are worthwhile to mention. The net foreign assets calculated by cumulative current account and NIP differ. As showed by Roubini and Setser (2005) or Lane and Milesi-Ferretti (2009) for the case of the United States, the NIP deteriorated at a slower pace than the NFA calculated by the cumulative current account, which is a sign of abnormal returns. So we can expect that in the limit, the cumulative financial account (which does not show significant differences with the cumulative current account) be equal to the NIP. In other words:

$$\lim_{n\to\infty} \sum F.A. = NIP \tag{4}$$

This insight is essential because our estimations of dark matter decomposed could differ, although later on, we will show that both computations are very similar to each other.

In this way, we introduce the computation of dark matter against the net international investment position is given by the following equations:

$$DM_{Total_t} = \frac{NII_t}{r} - NIP_t \tag{5}$$

.

$$DM_{Equity_t} = \frac{NII_{Equity_t}}{r} - NIP_{Equity_t} \tag{6}$$

.

$$DM_{Portfolio_t} = \frac{NII_{Portfolio_t}}{r} - NIP_{Portfolio_t} \tag{7}$$

Where r is a constant rate of discount, NII is the Net Investment Income of a country (or the Primary Income), and NIP is the Net international investment position of a country.

The computation of dark matter against the Financial Account is:

$$DM_{Total_t} = \frac{NII_t}{r} - \sum_{t=1}^{2019} F.A._t \tag{8}$$

.

[13] https://data.imf.org/?sk=7A51304B-6426-40C0-83DD-CA473CA1FD52

[14] You can see the decomposition considered in this article on the primary account, Financial Account and International investment position in the appendix here.

$$DM_{Equity_t} = \frac{NII_{Equity_t}}{r} - \sum_{t=1}^{2019} F.A._{Equity_t} \tag{9}$$

.

$$DM_{Portfolio_t} = \frac{NII_{Portfolio_t}}{r} - \sum_{t=1}^{2019} F.A._{Portfolio_t} \tag{10}$$

.

Where, as before, r is a constant rate of discount, NII is the Net Investment Income of a country (or the Primary Income), and F.A. is the financial account of a country.

Also, this enables us to estimate the Current Account dark matter from two different perspectives:

$$CA^{DM_t} = NFA^{DM}_{NIP_t} - NFA^{DM}_{NIP_{t-1}} \tag{11}$$

and

$$CA^{DM}_t = NFA^{DM}_{F.A._t} - NFA^{DM}_{F.A._{t-1}} \tag{12}$$

Both equations presented above are alternatives to estimate the CA^{DM} based on the estimations introduced in Hausmann et al. (2008). Where NFA_{NIP} and $NFA_{F.A.}$ represent the net foreign assets against the NIP and the financial account, respectively[15].

We take as a period of study 1992-2019. Although our data began in 1982, to get more accurate results, we left ten years at the beginning of each sum for dark matter against F.A. (equation 4).

It is expected that the computation of these variables considering the two approaches is highly correlated. Although, as we mentioned before, these estimations could differ due to the discrepancies between the NIP and the cumulative F.A. For this reason, we plot the correlation of the mean of DM-equity, DM-portfolio and DM-total against NIP and F.A. for each country under the period of study in figures 1, 2 and 3 [16]. We can see in the left panel of each figure that the correlation between these two measures is high. In the right panel, we can see the same picture just taking away the *outliers*. However, the are some caveats with these calculations. For example, we do not have all the data for all countries, such as China, Mainland, or Singapore, for the calculation of dark matter against NIP, and the calculation of dark matter against F.A. is not complete for all the samples. Also, we have more data for the computation of dark matter against F.A. than for dark matter against NIP because of the scarcity of International Investment Position data for most of the countries[17].

[15] We estimate the NFA_{NIP} as $NFA_{NIP} = DM_{NIP}$ - NFA and the $NFA_{F.A.}$ as $NFA_{F.A.} = DM_{F.A.}$ - NFA.
[16] For this computation we consider a constant interest rate of 5 %.
[17] See the appendix for a list of countries included in each group and data sources.

3.2 Descriptive Statistics - Global Imbalances and Outliers

It is important to know if these new estimations are in line with previous work. Therefore, we display some descriptive statistics that enrich our analysis. H.S. shows in Hausmann and Sturzenegger (2007a) that with the computation of dark matter, the flow of net foreign assets of countries is more balanced than with the official statistics (the cumulative Current Account). So that, given our decomposition, we expect that if total dark matter is balanced, also their components will be balanced. In figures 4, 5, 6 and 7 we take our estimations of dark matter decomposed in dark matter equity and portfolio against NIP and F.A., and then we plot a stacked bar chart to display how global imbalances can be seen using this approach. In all figures, we can see that the estimation of the dark matter portfolio is more balanced than the estimation of dark matter equity and both of them appear to be quite symmetric. In other words, for example, if there is a country that is an exporter of dark matter equity, therefore, other countries will be the importer of dark matter equity.

Another exercise we implement consists of applying a fourth-quadrant diagram analysis to verify if our estimations are consistent with our hypothesis. For example, in figures, 8 and 9 the first to fourth quadrant represents surplus in dark matter equity and creditors in NII equity, a deficit in dark matter equity and creditors in NII equity, a deficit in dark matter equity and debtor in NII equity, and surplus in dark matter equity and debtor in NII. To construct these graphs, we take the mean of dark matter equity and NII equity for the period of study for each country. We expect for these two diagrams that countries that are exporters in dark matter equity (or, in other words, countries that have differential returns in their assets due to Direct Investment - equity) to receive payments reflected in their net investment position in equity. On the left panel for each figure, we can see the relationships for all countries, and on the right panels, we can see relationships excluding the countries that are *outliers*. For both of them, we can appreciate a direct relationship between these two measures indicating that our results are consistent and there are almost no countries in the second quadrant (where countries receive payments and dark matter equity is negative), which would indicate that there are no anomalies in our estimations.

We repeat the same exercise for the dark matter portfolio and NII portfolio in figures 10 and 11. We have a similar interpretation of the four quadrants, only replacing equity for portfolio. We expect in these graphs that countries with negative NII portfolio (debtor countries) have differential returns because of "insurance" or "debt relief" and are exporters of dark matter portfolio. We can see that this pattern is followed in both graphs, but there is no clear correlation. In other words, being a dark matter exporter of portfolio does not necessarily imply more returns on the net investment income portfolio. For example, some countries will not be benefited from having more debt because they do not obtain a return differential for their additional debt (for example, the emerging countries), but in general, the negative relationship should be accomplished.

Finally, we can remark the next points from these figures:

- The computation of dark matter equity against F.A. and NIP are pretty similar. Also, the computation of dark matter portfolio against F.A. and NIP are alike.
- As shown in Hausmann and Sturzenegger (2007a) that dark matter is relatively stable, we found out that dark matter equity and portfolio are also relatively stable and symmetric.

- The United States is a net creditor of dark matter for both calculations. The country has positive dark matter equity and portfolio.
- Japan is an *outlier* because it has dark matter equity positive and also has dark matter portfolio positive, but its Net Investment Income portfolio is positive.
- Most countries from Europe, such as France, Germany, Spain, Luxembourg, the United Kingdom, exhibit positive dark matter equity and net investment income equity. Also, most countries from Europe show positive dark matter portfolio and negative Net Investment Income.

4 Dark Matter evolution for a series of countries

In this section, we will explore in-depth the evolution of the net foreign assets and the current account according to official statistics and dark matter for a series of countries at the center of the global agenda. For this reason, understanding the evolution of their income flows is itself interesting. This section shows that events through the years provide convincing evidence in favor of our dark matter estimations. We explain plausible explanations for the evolution of dark matter and its decomposition for the United States, Germany, Japan, and the United Kingdom.

4.1 United States

The case of the United States was the main reason to get involved in dark matter. It is well known that the country has accumulated large imbalances of current account over the years. In figure 12, we can see in the first panel the evolution of the Current Account; it has been accumulating deficits since the 1980s with only a surplus in 1991. In the second panel, we can see the cumulative current account of the U.S. in millions of dollars, and as a share of GDP since 1982, its share is approximated to 60 % of GDP, and its almost minus ten trillion dollars of the accumulated current account in 2019. It is a warning that the country is running up liabilities, and if these imbalances are large enough, it will require significant changes in the financial system. Some authors in the 2000s made pessimistic predictions. For example, Martin Wolf, Roubini, and Obstfeld & Roggof emphasized that these imbalances could incur in significant changes in the financial system leading them to a global crisis, and the US should depreciate its currency so that it could achieve a smooth transition to try to stabilize its Current Account deficit [18]. However, the NII of the United States has remained stable and positive over time (we show this in figure 13) as a share of GDP it remained between 0 and 15%. This fact was a paradox due to increasing current imbalances implies payments to the rest of the world, but the United States was receiving income instead of paying for it [19].

Despite these significant imbalances over time, the United States did not need to depreciate its currency; and it did not lead to a global crisis yet. After applying the methodology explained in this work, we can see in figure 12 that the NFA with dark matter is positive, indicating that the country is a net creditor instead of a debtor (considering both approaches against NIP and F.A.) and its current account with dark matter is more volatile than it would be with official statistics.

[18] See Roubini and Setser (2005) Obstfeld and Rogoff (2007)
[19] H.S. emphasized this in their articles

In figure 14, we can see the difference between NFA^{DM} and the NFA obtained from accumulating the Current Account, the total value, and that obtained from decomposing it in equity and portfolio in millions of dollars and as a share of GDP. It is important to emphasize that in both figures, the evolution of dark matter seems to be quite persistent and increasing over time; also, dark matter equity and portfolio are growing. This result is of interest on its own because it gives us some insight that the United States has a return differential due to their mismeasurement of FDI and because it is a safe country to make investments (characteristics are not taken into account in their official measures). Also, it is an exporter of their income flows and a net creditor when we see dark matter, instead of being a large debtor (as remarked in official accounts).

Finally, to contrast the results in figure 15, we present cumulative current account, the NFA^{DM} and dark matter with its decomposition against NIP and F.A. in million of dollars. We can see that the two approaches are similar, and we can appreciate the significant divergence of the net foreign assets and the official measures.

In addition, we enumerate some evidence that supports our findings based on indicators that complement the explanations of differential returns.

First, we show that if there is some volatility in the world, then the yield of the asset market in the United States will be lower. In figure 16 we plot the VIX INDEX (is a real-time index that measures the level of risk or volatility in market's expectations is also known as the "fear index") and the Treasury Yields Ten Years Rate (the rate for investing in U.S. government security that has a maturity of ten years). Many analysts use this as the "risk-free" rate when valuing the markets or individual security. We expect the return of securities to be lower due to the safety in the United States to invest. In the graph, we can see that when the VIX INDEX increases (meaning significant volatility in the asset market), the yield of bond treasury decreases (acting as a signal that the United States is a safe place to invest). This evidence supports the point of return differentials due to the underlying stability of a country. In this case, the safe country is the United States. It sells some of its stability to the rest of the world. In addition to this point of view, we can see in the plot that despite the fact of the financial crisis of the year 2008, which occurred in The United States, the rate of interest of the bond treasury decreased, meaning that the rest of the world still thought of the United States as a safe place to invest. Also, this supports the point of view of dark matter because this crisis has not interfered in the global imbalances discrepancy.

Second, in figures 9 and 8, we saw that the US is an *outlier* because it receives a favorable stock of NII equity which helps to explain its positive dark matter position equity. Also, we expect a positive relationship between the evolution of dark matter equity and the stock outward and net of FDI. Therefore, we plot the relationship between stock outward of FDI against dark matter equity and the net stock of FDI against dark matter equity in figure 17. We can see this in all panels, except in the third one, that this hypothesis is accomplished. As mentioned before, the reason for the increment in the dark matter was the invisible trade (knowledge and dissemination of ideas).

Third, the United States can issue liabilities in its currency. For this reason, a dollar depreciation could lead to capital gains.

Finally, other countries use dollars as their official currency, such as Panama and El Salvador. For this reason, the US can maintain deficits in the current account without depreciating its value because these countries need to export to obtain dollars.

4.2 Japan

Japan is well known because it has accumulated large current account surpluses, as shown in the top panel of figure 18. The cumulative current account since 1995 has a surplus of 4 billion dollars, and also it reaches almost 60% share of GDP. Given this current account surplus, we expect the country to receive income from the rest of the world. We can see this in figure 19, where the NII increases over time.

However, when we contrast official net foreign assets with those obtained from our new point of view, we can appreciate that the NFA^{DM} against the F.A. is always more significant than the obtained from accumulating the current account and the NFA^{DM} against NIP in some years is lower than the official one. However in general, all of them move with a similar pattern, and the country in the period considered is, on average, a net exporter of dark matter.

In figure 20 we can see the evolution of dark matter and its decomposition in equity and debt. They move similarly, despite the volatility in their values. The decomposition of dark matter in equity and portfolio helps us explore new insights into why the whole dark matter is fluctuates.

On the one hand, we can see that dark matter equity has increased progressively with some fluctuations since 1995. This trend is complemented by the increment of FDI Stock Outward and the Net Stock of FDI simultaneously. We can see this relationship is positive in almost all panels, except in the approach of dark matter equity FA, in figure 22. Also, this supports the hypothesis of increasing invisible trade in Japan, with the consequence of being a net exporter of dark matter.

On the other hand, we can see that the dark matter portfolio is positive and follows a regular pattern. On average, this pattern is positive in the approach against NIP and against F.A., which indicates the safety of investments in Japan. A moment that stands out is 2006. In this year, the dark matter portfolio in all panels experiences a great collapse. Two plausible explanations for this phenomenon are that the interest rates incremented from zero to 0,25% for the first time in six years in 2006 [20], and the financial crisis beginning in 2008 negatively influenced the Japanese markets because financial institutions maybe were not wholly prepared to face the crisis. After this event, the dark matter portfolio took a reverting path with a progressive increment until 2015, when dark matter portfolio imports increased. It is a warning that the country is losing its safety. The most plausible explanation is that the government holds 200% of its GDP in public debt [21].

To sum up, these new measures suggest that NFA^{DM} differs from the official statistics, and Japan in all the periods analyzed, on average, is a net creditor in both dark matter equity and portfolio.

[20] See https://www.theguardian.com/business/2006/jul/15/interestrates.japan
[21] See https://data.worldbank.org/indicator/GC.DOD.TOTL.GD.ZS?locations=JP

4.3 Germany

In this subsection, we explore the evolution of the income flows for Germany. We can see in figure 23 in the top panel the evolution of the current account, and in the bottom panel, the evolution of net foreign assets since 1982. In the '80s, Germany had a superavit of the cumulative current account until the '90s when the country faced two big problems, the unification with Oriental Germany and the introduction of the Euro [22]. These problems guided the country to a loss of competitiveness, which provoked the dissemination of this surplus. Then, since the new millennium, the country had a surplus in its cumulative current account, and it reached almost 100 % of its GDP in 2019. We can see this in figure 24, where the payments of its NII felt in synchrony with the current account and since the 2000's, they are increasing persistently. The evolution in their payments supports the evolution of the current account.

However, when we consider the dark matter net foreign assets, we can appreciate that in the ́90s, the NFA was lower than those remarked in the official statistics, indicating that the country was a net debtor of dark matter in that period. This approach is complemented with the two problems Germany faced those years. Furthermore, in contrast with the official statistics for the last two decades, the NFA^{DM} was higher than the official, and between 2010 and 2014, the country began to be a net debtor of dark matter. The last can be explained due to the external conditions Germany must face, such as the unfavorable exit of the United Kingdom from the European Union, the commercial war between China and the USA, the increasing immigration to the country, and the lower rate of birth of this country in last years.

We can see that the two methodologies of official statistics and dark matter track each other very well, but has been a significant discrepancy in the last six years. While there is a surplus in the cumulative current account, the dark matter falls with negative values. This disparity can be seen in figure 26.

This discrepancy can be explained by looking at the components of dark matter. On the one side, we can observe a positive relationship between dark matter equity and the Stock Outward and Net of FDI, only with the approach of NIP. On the other side, we can see that the whole dark matter is falling due to the dark matter portfolio. This trend can be explained by the unfavorable conditions that Germany must faced over the last years, which gives place to a less trustworthy investment in this country. This pattern can be seen in figure 27.

4.4 United Kingdom

The evolution of dark matter for the United Kingdom constitutes an interesting case. In figure 28, we can see the evolution of the cumulative current account for the United Kingdom. It presents large deficits since 1982, reaching almost 65 % of the GDP in 2019. This means that the country is a net debtor, and we should expect the country to make payments instead of receiving them. However, the NII of the United Kingdom has remained stable and positive until 2006. This surplus of NII meant a strange situation because the country was receiving money when it was a debtor. Later on, the inflow of payments had fluctuations, but the NII payments were not as big as expected

[22] https://nuso.org/articulo/alemania-y-la-crisis-victorias-pirricas/

[23]. This can be seen in figure 29.

However, when we plot the evolution of total dark matter and its decomposition (in figures 30 and 31) we can see an outstanding contrast with official accounts implying that there are return differentials in assets that are not considered in official statistics. When cumulative current account presents large deficits, dark matter estimations show us that the country is a net creditor in the first years, and since then, the country has been a debtor or creditor depending on fluctuations over the last years. We can observe the contrast among all these estimations in figure 31.

Next, we present some plausible reasons why dark matter estimations could differ from official estimations.

First, we see that dark matter equity has a positive relationship with Stock FDI net and outward. This can be seen in figure 32. As mentioned before, the increment in dark matter equity is for the invisible trade hypothesis (knowledge and dissemination of ideas).

Second, the United Kingdom is one of the most important economies in the world. Therefore, it is benefited from a premia for "Insurance."However, in the graphs, we can appreciate that this premium could have decremented for several reasons. Such as the recession of 2008, and the exit of the European Union in 2016. Nevertheless, we can appreciate the United Kingdom's increased dark matter portfolio export in the last years.

To sum up, the United Kingdom is an interesting case of study because it shares some characteristics with the United States case. The country received income despite being a net debtor, and this tendency reversed in 2006. Furthermore, the country, on average, under the period of study, is a net exporter of dark matter and a net exporter of dark matter equity.

5 Econometric model

5.1 Regressions to determine what explains Dark Matter equity

In this section, we try to describe why countries present different values of dark matter equity. From recent literature[24] and the underlying theory of return differentials described in this work, dark matter equity can be explained because of several macroeconomics variables, which results in the risk of facing an omitted variable bias in our model. We will offer a first approximation to test if some variables can explain this fact despite this caveat.

We saw from figures 8 and 9 that the countries with more payments on their net investment income equity tend to have more dark matter equity. Therefore, we can expect that countries with more stock of Foreign Direct Investment outward are more likely to increase dark matter equity. However, given the fact that the countries that have more investment in FDI also receive a significant amount of FDI inward, we propose that countries with more **stock of FDI net** (defined as the difference of FDI outward and FDI outward) are more likely to export dark matter equity.

[23]For example, if the interest rate was five percent, then the payments in 2019 should be of a hundred thousand million dollars. However,the payments are -45051.496 million dollars, almost half.

[24]See for example Ca'Zorzi et al. (2012)

Also, we will add some fundamentals to our estimations. We will add the **balance of trade of goods** and **the balance of trade of services**, whose coefficient signs are ambiguous. On the one hand, we expect that countries export dark matter equity due to invisible trade. On the other hand, a country can export more because other countries invested more in it [25]. For this reason, we do not expect a clear sign for these variables.

Another variable we implement in our model is the **spending on R & D as % of the GDP**. The spending on R & D is a proxy of the capacity of firms to innovate and their higher return of potential income. We expect a positive sign of this indicator, in other words, that countries with more spending on R & D are more likely to export dark matter equity.

An additional variable we implement is **Financial Development Index** [26] as a proxy of the sophistication and internalization of the financial system. We expect that countries with more advanced financial systems to be exporters of dark matter equity.

Finally, we incorporate a proxy for **Trade Integration** measured as the degree of openness relative to GDP (sum of imports and exports normalized by GDP). This kind of variable is used in international trade as a proxy of trade costs. The sign of the coefficient is ambiguous. On the one hand, we expect that a higher level of openness is more likely to attract FDI in the long run ((Donghui et al., 2018); (Patsupathi and Sakthi, 2019)) and then increment the exports of dark matter equity. On the other hand, a higher level of openness is less likely to attract FDI in the long run ((Rathnayaka Mudiyanselage et al., 2021)) because that a higher level of openness does not imply more attraction of FDI. A reason for this relationship could be inefficiencies in the implementation of policies that attract FDI.

On the table 6 we present descriptive statistics of these variables measured in millions of dollars (except for the spending on R&D, the Financial Development Index, and the variable of trade integration). For the regressions, all the variables were normalized by GDP and multiplied by 100 to get percentages.

To sum up, we test whether a model with a limited number of explanatory variables helps to account for the difference in net foreign assets equity based on official statistics and that estimated with dark matter equity. We will apply a fixed-effect model to capture the heterogeneity not observable of each country. All the variables are in millions of dollars, and each of them is divided in the GDP of each country to avoid potential heteroskedasticity problems. We will consider the whole sample of countries for which we have data and different groups [27]. As previously mentioned, the period we will consider is from 1992 to 2019. Next, we present the specification we want to estimate:

[25] For example, we should consider the case of Ireland, this country received a significant amount of FDI from the US from the Apple enterprise (See https://www.thejournal.ie/apple-iphones-irish-economy-2-3963957-Apr2018/) and Ireland's economy improved due to this reason increasing it's GDP.

[26] See (Svirydzenka, 2016) to learn more about the index.

[27] The countries and their different classifications are in the appendix.

Dark Matter equity against the Net International Investment position:

$$\frac{DMequity_{NIPi,t}}{GDP_{i,t}} = [\frac{FDI_{neti,t}}{GDP_{i,t}}] * \beta_1 + [\frac{BOT_{Goodsi,t}}{GDP_{i,t}}] * \beta_2 + [\frac{BOT_{servicesi,t}}{GDP_{i,t}}] * \beta_3 + [\frac{R\&D_{i,t}}{GDP_{i,t}}] * \beta_4 + [\frac{Financial - Index_{i,t}}{GDP_{i,t}}] * \beta_5 + [\frac{Oppeness - Trade_{i,t}}{GDP_{i,t}}] * \beta_6 + \alpha_i + \mu_t + \varepsilon_{i,t} \quad (13)$$

Dark matter equity against the Financial Account:

$$\frac{DMequity_{F.A.i,t}}{GDP_{i,t}} = [\frac{FDI_{neti,t}}{GDP_{i,t}}] * \beta_1 + [\frac{BOT_{Goodsi,t}}{GDP_{i,t}}] * \beta_2 + [\frac{BOT_{servicesi,t}}{GDP_{i,t}}] * \beta_3 + [\frac{R\&D_{i,t}}{GDP_{i,t}}] * \beta_4 + [\frac{Financial - Index_{i,t}}{GDP_{i,t}}] * \beta_5 + [\frac{Oppeness - Trade_{i,t}}{GDP_{i,t}}] * \beta_6 + \alpha_i + \mu_t + \varepsilon_{i,t} \quad (14)$$

Where $DMequity_{NIP}$ and $DMequity_{F.A.}$ are our measures of dark matter equity against NIP and dark datter equity against F.A., respectively. FDI-net is the difference between the Stock of FDI Outward and Inward. BOT_{Goods} are the net exports of a country in terms of goods, and $BOT_{Services}$ are the net exports of a country in terms of services. R & D is the expenditure of a country in research and development. Financial-index is the Financial Development Index. Openess-Trade is our proxy to trade integration. α_i is a dummy variable for each country; with this variable, we consider time-invariant differences among units. μ_t is a dummy variable for each year; with this variable, we consider time-period effect common to all units. And $\varepsilon_{i,t}$ is the error term.

In table 1 the dependent variable is Dark Matter equity against the Net International Investment Position, with unbalanced panel data. And in table 2 the dependent variable is Dark Matter equity against the Financial Account. We implement robust standard errors, with unbalanced panel data in the regressions, and we estimate these models for different samples: the total sample, Developed countries, emerging countries, frontier countries, and standalone countries.

The following tables display these results:

Table 1: Fixed-Effect Model Dark Matter equity against International Investment position

VARIABLES	(1) All	(2) Developed	(3) Emerging	(4) Frontier	(5) Standalone
Stock Net GDP	0.641***	-0.249	-0.720**	-0.687	0.772**
	(0.056)	(0.150)	(0.336)	(0.753)	(0.266)
BOT Goods GDP	-0.272	-0.834	0.233	-2.901	-0.263
	(1.222)	(0.672)	(0.740)	(3.691)	(4.104)
BOT Serv GDP	1.242	0.017	-2.389**	-4.546	16.674**
	(2.541)	(1.130)	(0.833)	(7.643)	(5.133)
R & D GDP	0.033	0.068	0.124	-0.404	-1.795
	(0.291)	(0.062)	(0.103)	(0.319)	(1.334)
Financial Development	15.676	-2.070	-58.104	124.549	2,182.486
	(62.689)	(36.158)	(49.977)	(358.617)	(1,636.886)
Openness Trade	-2.583***	-0.549*	-0.396**	-2.560	-3.389
	(0.905)	(0.270)	(0.176)	(1.442)	(2.086)
Constant	146.086**	12.809	25.193	196.901*	-588.143
	(56.971)	(25.312)	(17.612)	(90.495)	(592.605)
Observations	1,066	382	284	112	99
R-squared	0.299	0.182	0.284	0.461	0.586
Number of id	84	20	18	12	7
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Fixed-Effect Model Dark Matter equity against Financial Account

VARIABLES	(1) All	(2) Developed	(3) Emerging	(4) Frontier	(5) Standalone
Stock Net GDP	0.823***	0.392***	-0.393	-1.448	0.741
	(0.122)	(0.109)	(0.355)	(1.489)	(0.470)
BOT Goods GDP	-0.150	-0.268	0.223	-1.538	-0.408
	(1.089)	(0.723)	(0.432)	(1.974)	(3.930)
BOT Serv GDP	1.511	0.807	-0.251	-10.051	23.906***
	(2.972)	(1.158)	(1.285)	(9.149)	(6.822)
R & D GDP	-0.252	0.032	0.084	-0.593	-3.186**
	(0.154)	(0.071)	(0.109)	(0.393)	(0.995)
Financial Development	4.119	-25.132	-93.731	52.568	2,257.333
	(58.828)	(46.699)	(58.950)	(345.665)	(1,664.547)
Openness Trade	-1.825	-0.067	-0.366**	-2.846	-5.260
	(1.433)	(0.359)	(0.170)	(1.793)	(3.626)
Constant	135.046	9.321	35.513	275.314*	-473.939
	(90.938)	(41.932)	(22.052)	(136.940)	(524.427)
Observations	1,033	340	283	120	98
R-squared	0.310	0.111	0.233	0.440	0.676
Number of id	86	20	18	13	8
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2 Results of the regressions

The results obtained in tables 1 and 2 provide interesting evidence to determine the sources of dark matter equity.

We find for both regressions considering the total sample that the coefficient of the stock FDI net is statistically significant at 1% of significance, positive, and their magnitudes are alike. This result supports our hypothesis in this work that, in general, for the total sample, the net stock of FDI increases as the dark matter equity augments. Also, the stock FDI net coefficient is statistically significant and positive for the subsample of developed countries in table 2, which is the expected. The mechanism for industrial or developed countries to export dark matter equity when the net stock of FDI increases could be due to invisible trade. In addition, another expected result was that the coefficient of the net stock of FDI for emerging countries to be negative, this evidence is presented in table 1. The intuition behind this is that emerging countries are low on FDI and tend to be importers of dark matter equity. Finally, the coefficient of the stock FDI net is also positive for the sub-sample of Standalone countries.

The coefficient of BOT of Goods is negative in almost all specifications (except for the sub-sample of Emerging countries) for both dependent variables, but it is not statistically significant nonetheless.

The coefficient of BOT of Services is positive for in almost all specifications (except for the sub-sample of Emerging countries and frontier countries) for both dependent variables. This coefficient is statistically significant and negative for the emerging countries on the table 1 this tells us that emerging countries increase their dark matter equity exports when they import services.

The coefficient of Financial Development is positive as expected for the total sample. Also, this coefficient is positive for frontier countries, standalone countries but is negative for developed and emerging countries. Nonetheless, it is not statistically significant in any specification.

The coefficient of Openness Trade is negative for all the specifications and statistically significant for the total sample, developed countries and emerging countries on the table 1, and only statistically significant for emerging countries on the table 2. This result is in line with Rathnayaka Mudiyanselage et al. (2021) and the plausible explanation for the sign of this coefficient is that there could be inefficiencies in the implementation of policies that attract FDI.

5.3 Discussion from previous work

In previous work, H.S. tested for sources of dark matter (See Hausmann and Sturzenegger (2006) and Hausmann and Sturzenegger (2007a)). They show the results from a cross-section analysis and a panel data analysis.

In the cross-section analysis, they used as dependent variable the accumulated stock of dark matter exports between 1980/2003, and the independent variables were some fundamentals such as FDI assets as a share of GDP, FDI liabilities as a share of GDP, an OPEC dummy, the spending on R & D as well as a corporate tax variable, and a HIPC (Heavily Indebted Poor Countries) dummy variable. They found out that the FDI liabilities were statistically

significant for different specifications. In other words, that countries with low FDI to be importers of dark matter. Also, they found out that the FDI assets coefficient was statistically significant only for developed countries. In the panel data analysis they used as a dependent variable dark matter for the period between 1980-2004, and the independent variables were FDI assets and FDI liabilities. The results were in line with that obtained in the cross-section analysis. Their main finding was the significance of the FDI variables, this evidence contrast with the hypothesis of mismeasurement of FDI in the host countries (the invisible trade determinant of discrepancies in return differentials).

This study complements the work presented by H.S. using a different study period, with more data available for all countries and similar explanatory variables. We try to explain dark matter equity sources, and our main result that goes in line with previous work is the coefficient of stock FDI net GDP for the total sample. This result helps illuminate that all countries, in general, can increase dark matter equity if their stock of FDI net augments.

Summarizing, our results show that, in general, the net stock of FDI increases as the dark matter equity augments. This result repeats in developed countries, and it shows a negative sign for emerging countries providing robust evidence of the invisible trade channel.

Further research can extend these results to include the performance of leading commercial partners [28] to account for potential spill-overs, which is beyond the scope of these results. However, we expect that the inclusion of these additional regressors does not affect the main results of this work due that the relevant regressor explaining the mechanism of dark matter equity for invisible trade is the net stock of FDI, and we already incorporated into the model relevant controls of the configuration and performance of economies used in previous work that help explain differences in return (BOT, R&D spending, Financial Development Index, Openness Trade).

6 Conclusion

This work offered a new perspective to visualize income flows by splitting them up into equity and portfolio. We showed that these new measures allow us to see global imbalances from another perspective. While one country is an exporter of dark matter, another one is an importer. Also, we showed that these new metrics are relatively stable over time and that there are no anomalies in their behavior (considering the fourth-quadrant exercise realized). Then, we presented the story of four countries with this new perspective contrasting the data with relevant facts that happened in the last years. Finally, we present the first approach of determinants of these new metrics.

In conclusion, this new approach allows us to see the income flows for different countries in more detail. The estimations align with the underlying theory from previous work and help explain specific facts that can not be seen with official statistics.

For further research, there can be more exercises that can be performed with these new metrics, for example, testing the relevance of these metrics for sustainability evaluations, testing the sources of dark matter portfolio, also generating these new measures for a more granular unit of observation such as provinces or states for each country.

[28] See Heymann and Navajas (1992) for an example of this indicator

It would be valuable to consider the exercises for different interest rate values and test if other fundamentals can help explain further the variability of dark matter from this new approach.

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7 Appendix

7.1 Countries and Source of Data

All countries: Afghanistan, Islamic Rep. of; Albania; Algeria; Angola; Anguilla; Antigua and Barbuda; Argentina; Armenia, Rep. of; Aruba, Kingdom of the Netherlands; Australia; Austria; Azerbaijan, Rep. of; Bahamas, The; Bahrain, Kingdom of; Bangladesh; Barbados; Belarus, Rep. of; Belgium; Belize; Benin; Bermuda; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Brunei Darussalam; Bulgaria; Burkina Faso; Burundi; Cabo Verde; Cambodia; Cameroon; Canada; Cayman Islands; Central African Rep.; Chad; Chile; China, P.R.: Hong Kong; China, P.R.: Macao; China, P.R.: Mainland; Colombia; Comoros, Union of the; Congo, Dem. Rep. of the; Congo, Rep. of; Costa Rica; Croatia, Rep. of; Cyprus; Czech Rep.; Côte d'Ivoire; Denmark; Djibouti; Dominica; Dominican Rep.; Ecuador; Egypt, Arab Rep. of; El Salvador; Eritrea, The State of; Estonia, Rep. of; Eswatini, Kingdom of; Ethiopia, The Federal Dem. Rep. of; Fiji, Rep. of; Finland; France; Gabon; Gambia, The; Georgia; Germany; Ghana; Greece; Grenada; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; Iceland; India; Indonesia; Iran, Islamic Rep. of; Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kazakhstan, Rep. of; Kenya; Kiribati; Korea, Rep. of; Kosovo, Rep. of; Kuwait; Kyrgyz Rep.; Lao People's Dem. Rep.; Latvia; Lebanon; Lesotho, Kingdom of; Liberia; Libya; Lithuania; Luxembourg; Madagascar, Rep. of; Malawi; Malaysia; Maldives; Mali; Malta; Marshall Islands, Rep. of the; Mauritania, Islamic Rep. of; Mauritius; Mexico; Micronesia, Federated States of; Moldova, Rep. of; Mongolia; Montenegro; Montserrat; Morocco; Mozambique, Rep. of; Myanmar; Namibia; Nauru, Rep. of; Nepal; Netherlands, The; New Caledonia; New Zealand; Nicaragua; Niger; Nigeria; North Macedonia, Republic of; Norway; Oman; Pakistan; Palau, Rep. of; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland, Rep. of; Portugal; Romania; Russian Federation; Rwanda; Samoa; Saudi Arabia; Senegal; Serbia, Rep. of; Seychelles; Sierra Leone; Singapore; Slovak Rep.; Slovenia, Rep. of; Solomon Islands; Somalia; South Africa; South Sudan, Rep. of; Spain; Sri Lanka; St. Kitts and Nevis; St. Lucia; St. Vincent and the Grenadines; Sudan; Suriname; Sweden; Switzerland; Syrian Arab Rep.; São Tomé and Príncipe, Dem. Rep. of; Tajikistan, Rep. of; Tanzania, United Rep. of; Thailand; Timor-Leste, Dem. Rep. of; Togo; Tonga; Trinidad and Tobago; Tunisia; Turkey; Tuvalu; Uganda; Ukraine; United Kingdom; United States; Uruguay; Uzbekistan, Rep. of; Vanuatu; Venezuela, Rep. Bolivariana de; West Bank and Gaza; Yemen, Rep. of; Zambia; Zimbabwe.

Developed Countries: Australia; Austria; Belgium; Canada; Denmark; Finland; France; Germany; Greece; Hungary; Israel; Ireland; Italy; Japan; Netherlands, The; New Zealand; Norway; Portugal; Spain; Singapore; Sweden; Switzerland; United Kingdom; United States.

Emerging Countries: Brazil; Chile; China, P.R.: Mainland; Colombia; Czech Rep.; Egypt, Arab Rep. of; Greece; Hungary; India; Indonesia; Korea, Rep. of; Kuwait; Malaysia; Mexico; Poland, Rep. of; Peru; Pakistan; Philippines; Russian Federation; South Africa; Saudi Arabia; Thailand; Turkey.

Frontier Countries: Bahrain, Kingdom of; Benin; Burkina Faso; Croatia, Rep. of; Estonia, Rep. of; Iceland; Jordan; Kazakhstan, Rep. of; Kenya; Lithuania; Mauritius; Morocco; Nigeria; Oman; Romania; Senegal; Serbia, Rep. of; Slovenia, Rep. of; Tunisia; Bangladesh; Sri Lanka.

Standalone Countries: Argentina; Jamaica; Panama; Bosnia and Herzegovina; Botswana; Bulgaria; Lebanon; Malta; Ukraine; Zimbabwe.[29]

Table 3: Description and sources of variables

Variable Name	Description	Source
CA	Current Account	International Monetary Fund
FDI stock	Foreign Direct Investment stock outward and Inward	UNCTAD
Exports and Imports	Exports and Imports of goods and services	International Monetary Fund
GDP	Current Prices Gross Domestic Product	World Bank
NIP	International Investment Position	International Monetary Fund
R&D	Expenditure on R & D	World Bank
Financial Development Index	Financial Development Index	IMF
Openness Trade	Openness Trade	Own Elaboration, IMF

7.2 Criteria to separate statistics in equity or portfolio

Criteria to assign categories of Financial Account (FA), International Investment Position (IIP) and Net Investment Income (NII) into equity or portfolio

Financial Account	International Investment Position	Net Investment Income
Equity	Equity	Equity
Direct Investment	Direct Investment	Direct Investment
Gross Disposal of non-produced and non-financial assets	(-)	(-)
Portfolio	Portfolio	Portfolio
Portfolio Investment	Portfolio Investment	Portfolio Investment
Other Investment	Other Investment	Other Investment
Reserves and related items	Reserves and related items	Reserve Assets Income
Financial Derivatives	Financial Derivatives	(-)
Capital Transfers	(-)	(-)

7.3 Calculation of the interest rate

As in Hausmann and Sturzenegger (2007a), we calculate the typical return on net foreign assets:

[29]We consider the classification based on the market classifications of the MSCI. These are available for year 2021 in https://www.msci.com/market-classification

$$\frac{\Delta NII_{it}}{GDP_{it}} = r[\frac{CA_{it}}{GDP_{it}}] + \alpha_i + \epsilon_{it}$$

Where " r " represents the typical yield return on net foreign assets. Below we show our results from an unbalanced fixed effects panel regression from a sample of 76 countries (with data available) representative of the different regions of world that the MSCI uses to classify countries in four categories:

Table 4: Typical return on net foreign assets since 1982

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Developed Countries	Emerging Countries	Frontier Countries	Standalone Countries	All Groups
ca_GDP	0.051***	0.074***	0.041	0.068**	0.068***
	(0.018)	(0.010)	(0.029)	(0.021)	(0.012)
Constant	-0.000*	-0.001***	-0.001	0.000	-0.000***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Observations	684	810	664	285	2,443
R-squared	0.026	0.275	0.021	0.017	0.090
Number of id	22	23	21	10	76

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Typical return on net foreign assets since 1992

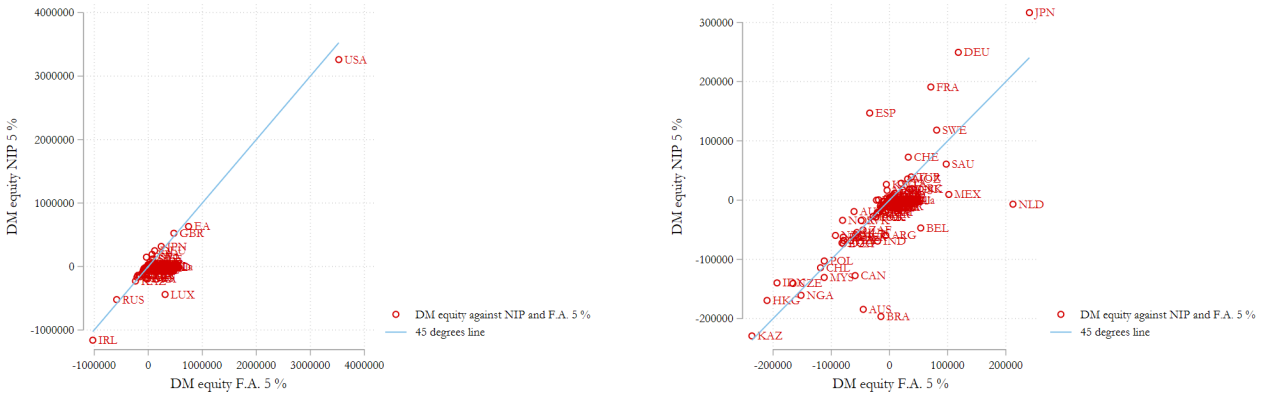
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Developed Countries	Emerging Countries	Frontier Countries	Standalone Countries	All Groups
ca_GDP	0.057*	0.038***	0.046	0.063**	0.047***
	(0.030)	(0.012)	(0.032)	(0.023)	(0.012)
Constant	-0.000	-0.001***	-0.000	-0.000	-0.001***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Observations	538	621	545	238	1,942
R-squared	0.022	0.033	0.025	0.022	0.024
Number of id	22	23	21	10	76

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the results presented in tables 4 and 5 we can see that for different groups and different year, the interest rate takes a lower value from 3,8 % to 7,4 % for this reason we consider a good strategy to take an interest rate of 5% in our estimations.

7.4 Descriptive statistics

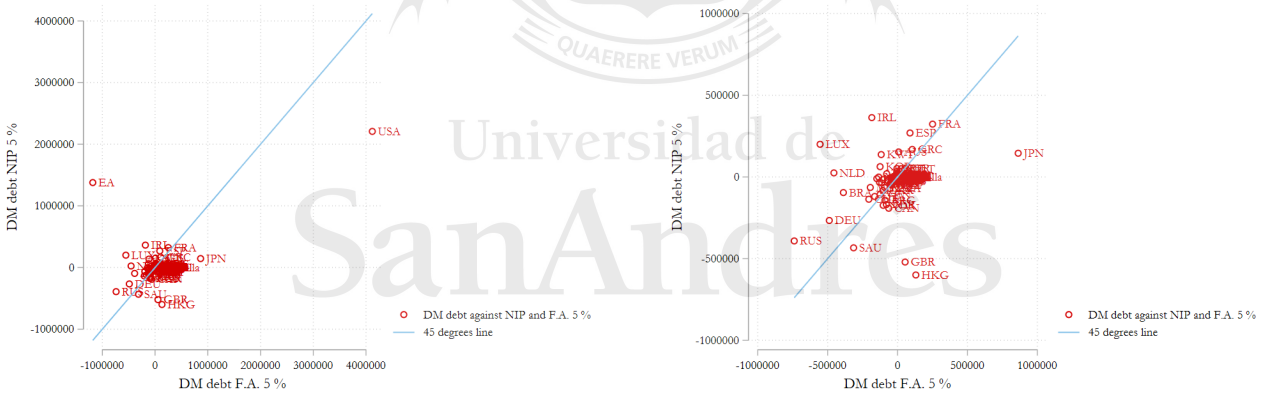
Figure 1: Correlation of dark matter equity against NIP and dark matter equity against F.A. at 5% interest rate (In millions of dollars)



(a) Correlation between DM equity IIP vs DM equity F.A.

(b) Correlation between dark matter equity IIP vs dark matter equity F.A. without outliers

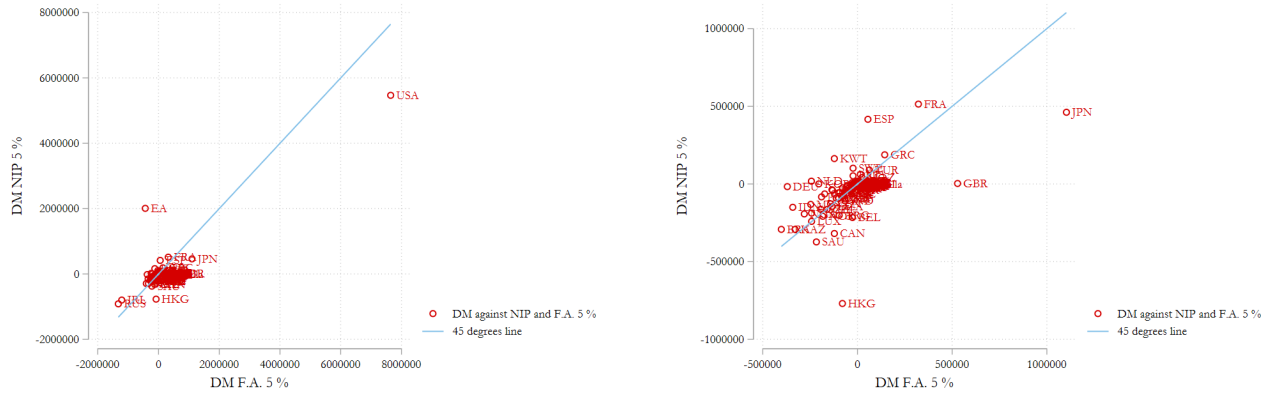
Figure 2: Correlation of dark matter portfolio against NIP and dark matter portfolio against F.A. at 5% interest rate (In millions of dollars)



(a) Correlation between DM debt NIP vs DM debt F.A.

(b) Correlation between DM debt NIP vs DM debt F.A. without outliers

Figure 3: Correlation of dark matter against NIP and dark matter against F.A. at 5% interest rate (In millions of dollars)



(a) Correlation between DM NIP vs dark matter F.A.

(b) Correlation between DM NIP vs DM F.A. without outliers

Figure 4: Stacked Bar chart of Dark Matter equity against NIP at 5% interest rate for all countries in the world (In millions of dollars)

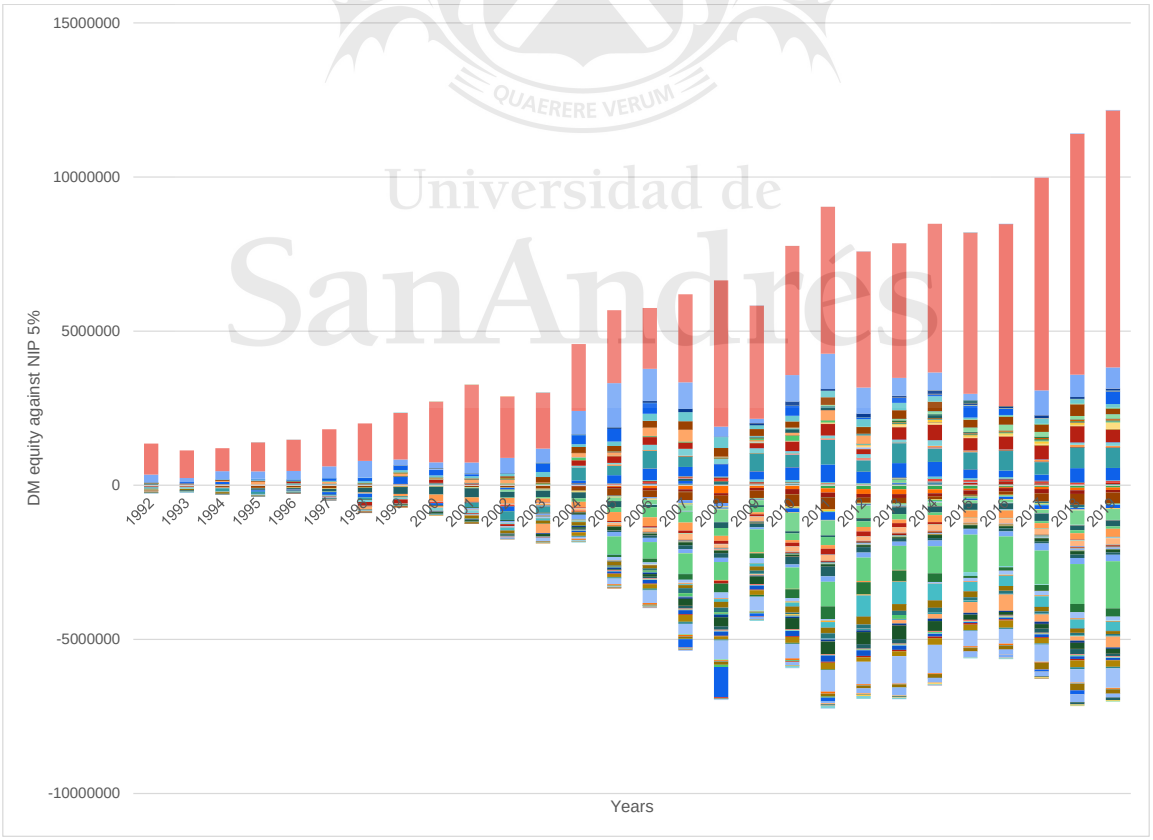


Figure 5: Stacked Bar chart of Dark Matter equity against F.A. at 5% interest rate for all countries in the world (In millions of dollars)

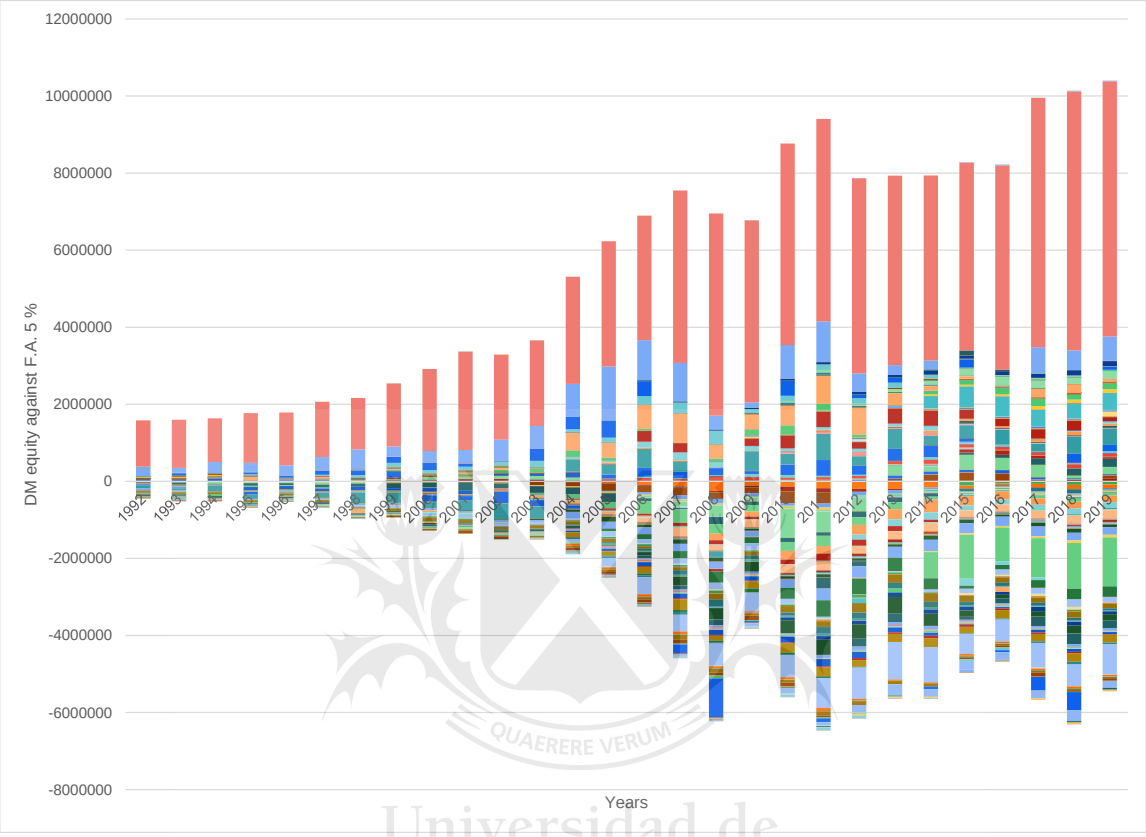


Figure 6: Stacked Bar chart of dark matter portfolio against NIP at 5% interest rate for all countries in the world (In millions of dollars)

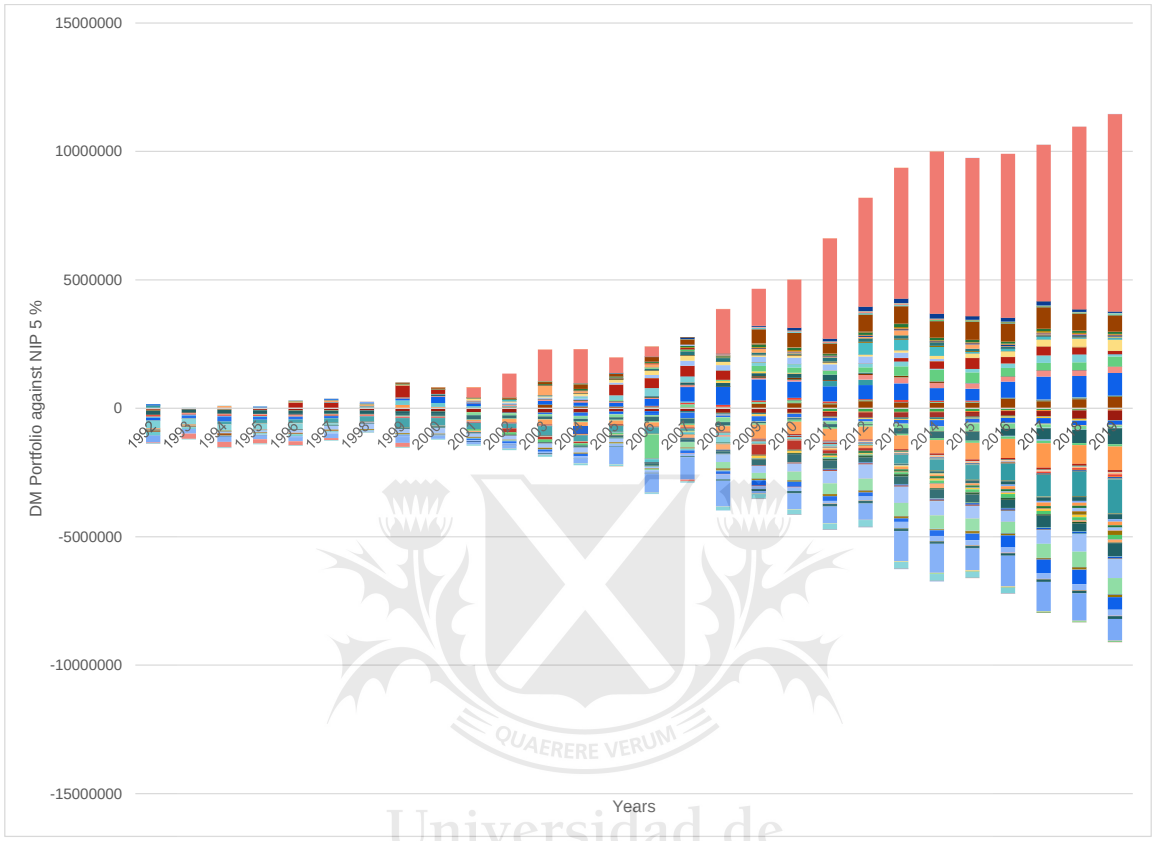


Figure 7: Stacked Bar chart of dark matter portfolio against F.A. at 5% interest rate for all countries in the world (In millions of dollars)

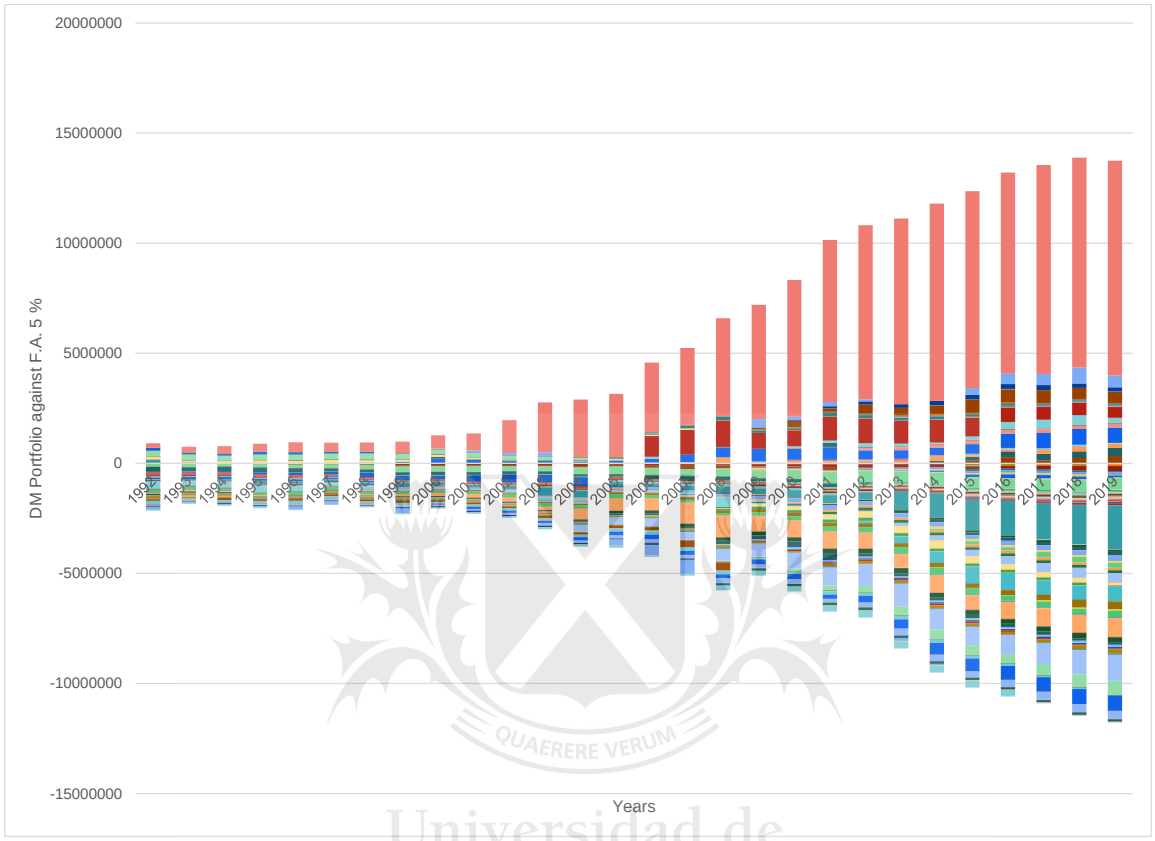
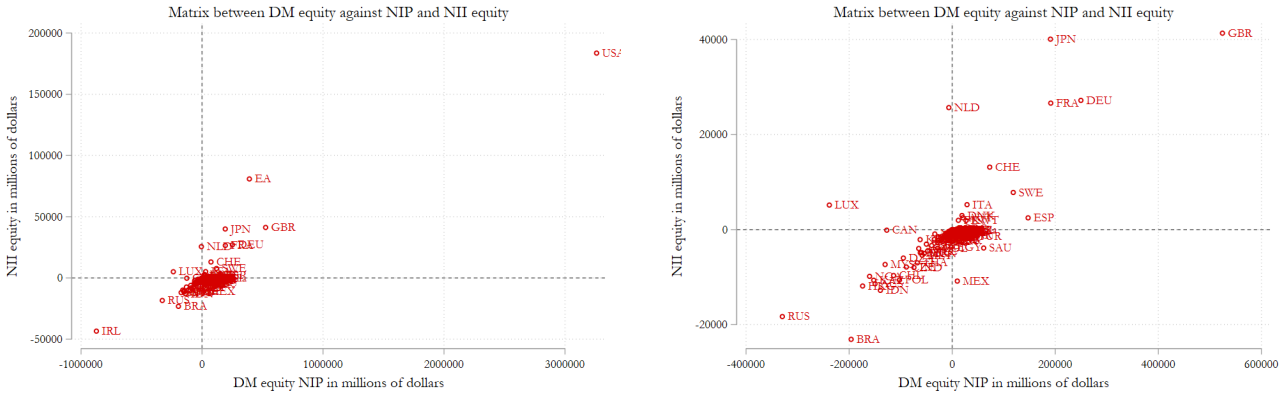


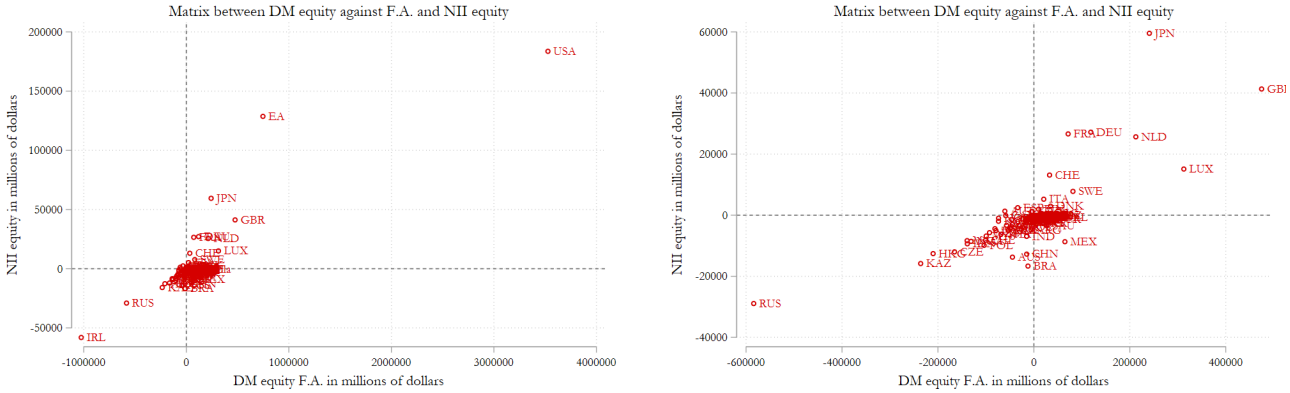
Figure 8: Matrix of Net Investment Income equity and Dark Matter equity against NIP at 5% interest rate (In millions of dollars)



(a) Matrix with all countries.

(b) Matrix without outliers.

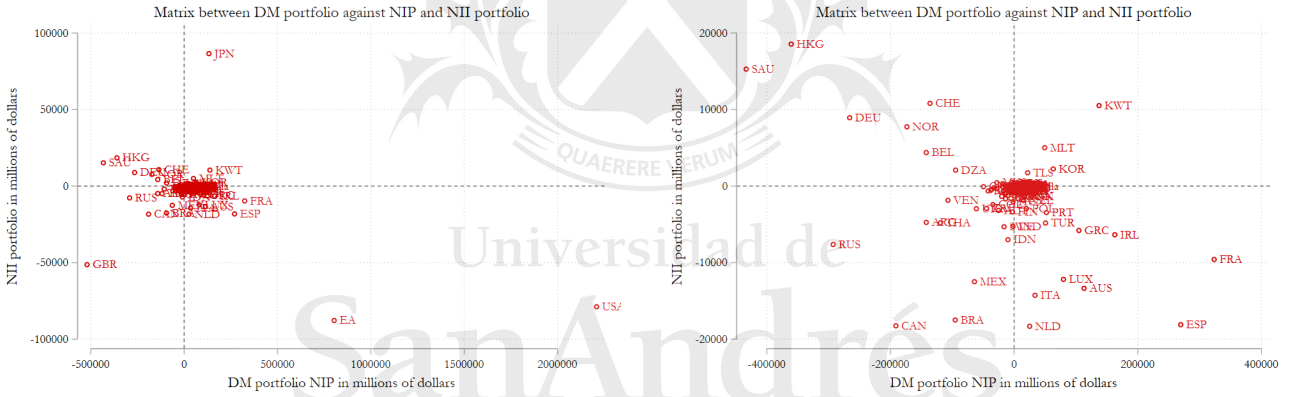
Figure 9: Matrix of Net Investment Income equity and Dark Matter equity against F.A. at 5% interest rate (In millions of dollars)



(a) Matrix with all countries.

(b) Matrix without outliers.

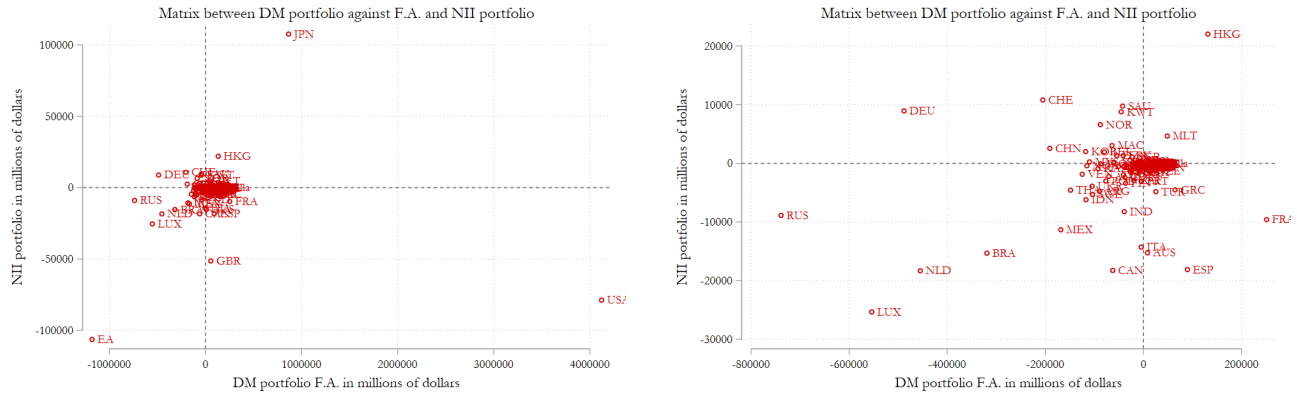
Figure 10: Matrix of Net Investment Income portfolio and dark matter portfolio against NIP at 5% interest rate (In millions of dollars)



(a) Matrix with all countries.

(b) Matrix without outliers.

Figure 11: Matrix of Net Investment Income portfolio and Dark Matter portfolio against F.A. at 5% interest rate (In millions of dollars)



(a) Matrix with all countries.

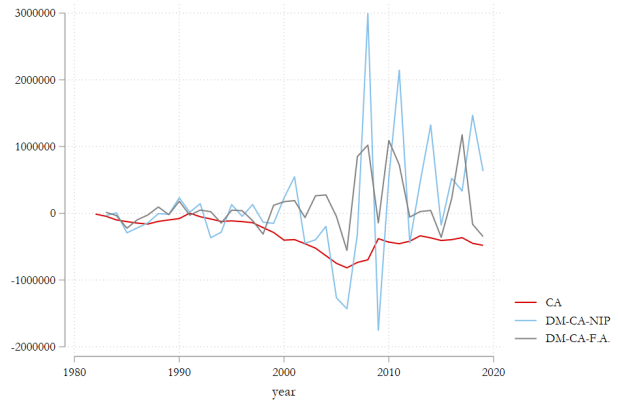
(b) Matrix without outliers.

Table 6: Descriptive statistics of variables used in the regression

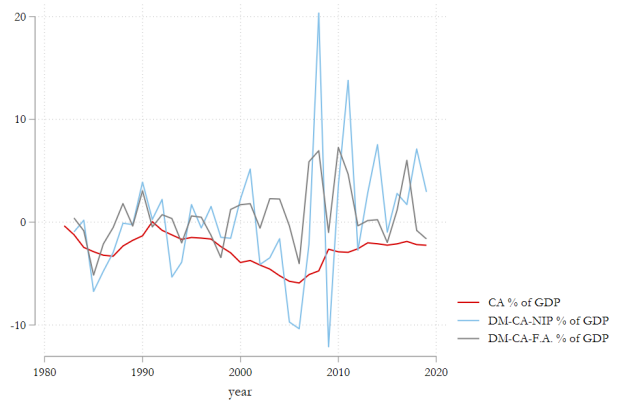
Variables	P25	P50	P75	Mean	SD	Min.	Max.	Obs
DM equity NIP 5%	-16,180.8	-999	1,138.3	18,723	385,349.6	-1,525,147.6	8,334,090	3,348
DM equity F.A. 5%	-10,021.2	-303.2	966.1	19,455	358,121.9	-1,268,289.3	6,724,241	3,882
FDI stock net	-6,319.1	-594.2	0	393	125,435.2	-1,766,263.1	1,793,061.1	7,085
BOT_{goods}	-980.6	-27.16	0	634	46,871.7	-880,302	576,191.1	8,018
$BOT_{services}$	-197.6	0	235	576	15,599.6	-292,168.4	300,363	8,018
RD_{GDP}	0.26	0.63	2	1	1	0.01	4.95	1,372
Financial development index	0.10	0.19	0	0	0.21	0	1	6,726
Openness Trade	0.35	0.62	1	1	0.57	0	8.85	6,761
GDP	3,072.50	13,788	89,547	243,200	1,113,134.46	13	21,433,230	6,724

7.5 Graphs for the United States

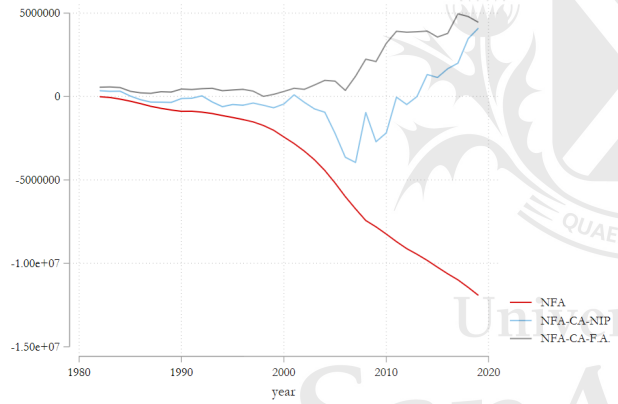
Figure 12: Evolution of CA and NFA according official statistics and estimations of Dark Matter CA and NFA for USA



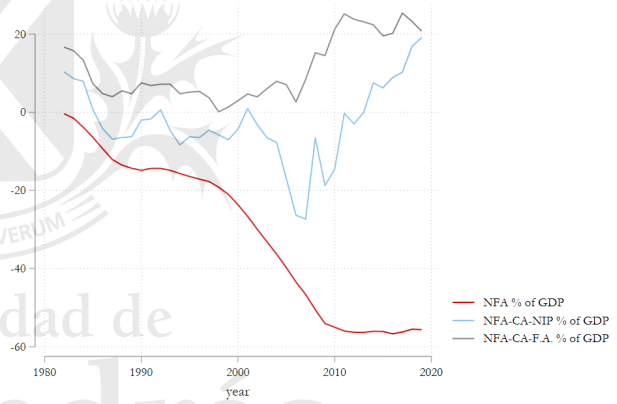
(a) CA in millions of dollars



(b) CA as % of GDP



(c) NFA millions of dollars



(d) NFA as % of GDP

Figure 13: Net Investment Income of United States in million of dollars and as a % of GDP

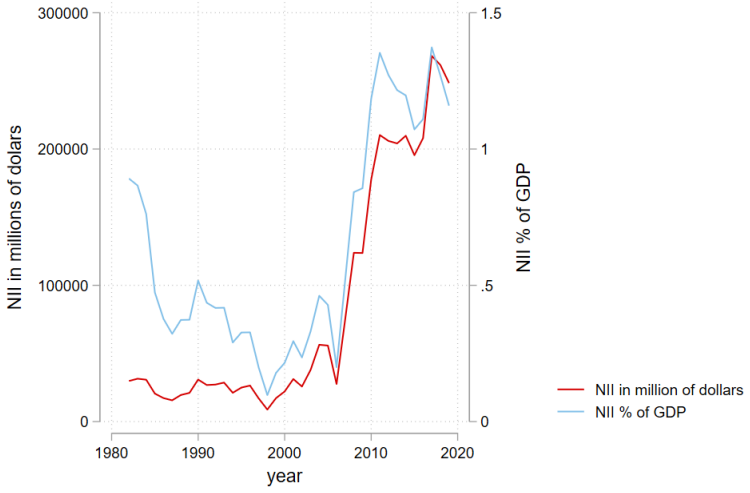
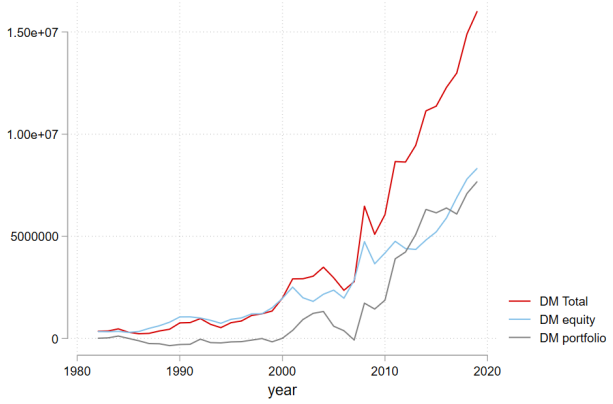
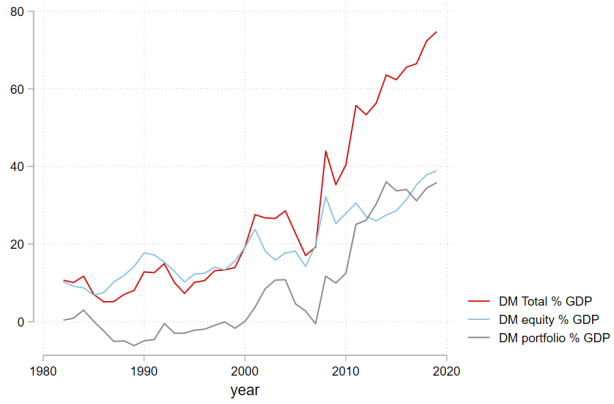


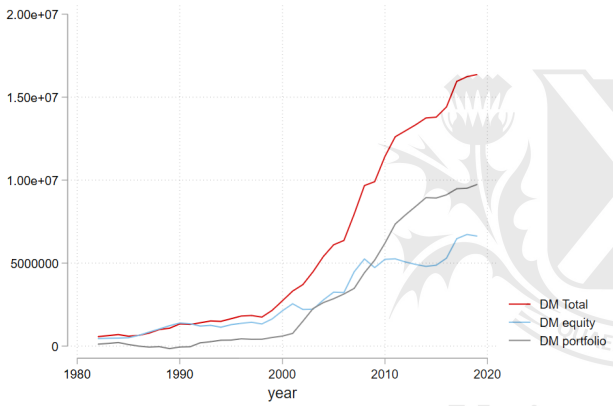
Figure 14: Evolution of Dark Matter and their decomposition in million of dollars and as % of GDP for USA



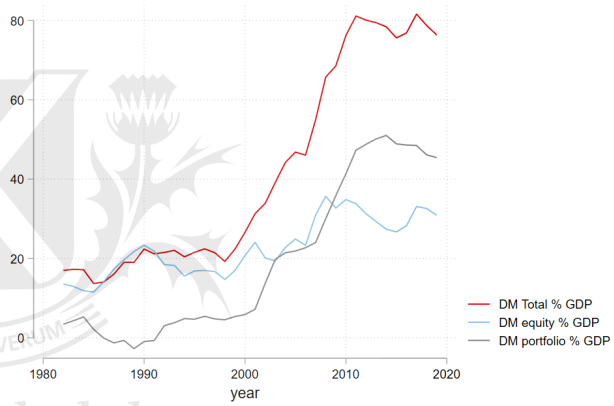
(a) DM NIP and decomposition in millions of dollars



(b) DM NIP and decomposition as % of GDP

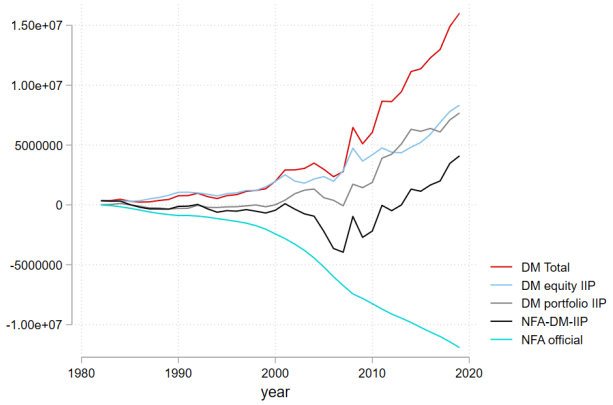


(c) DM F.A. and decomposition millions of dollars

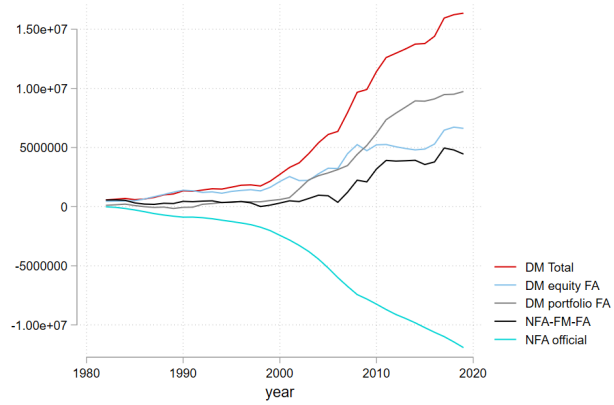


(d) DM F.A. and decomposition as % of GDP

Figure 15: Contrast of measures DM NIP and F.A. for USA



(a) DM and NFA in millions of dollars



(b) DM and NFA as % of GDP

Figure 16: VIX INDEX and Treasury Yields Ten Years Index using monthly data (VIX INDEX is the red line and TYT is the black line)

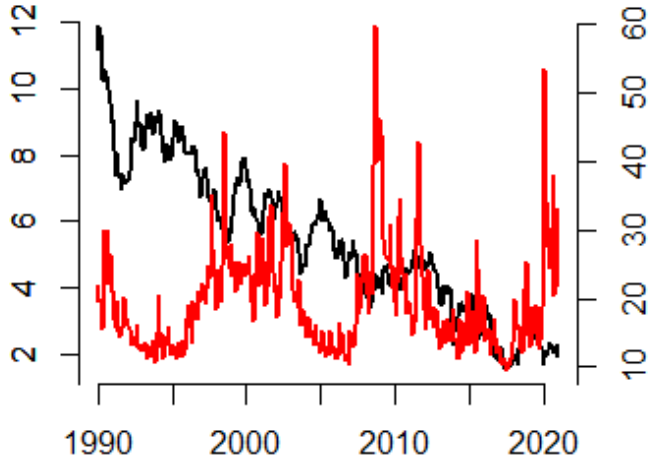
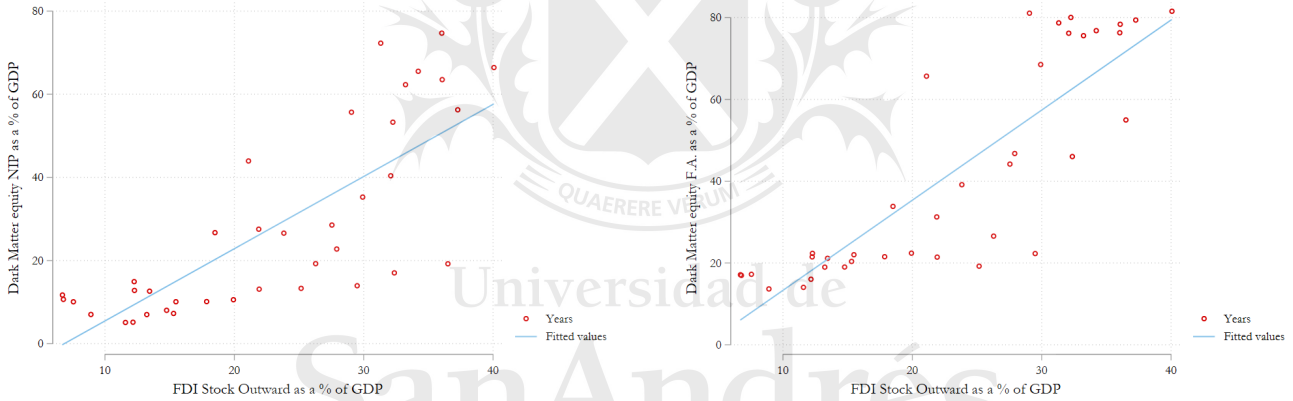
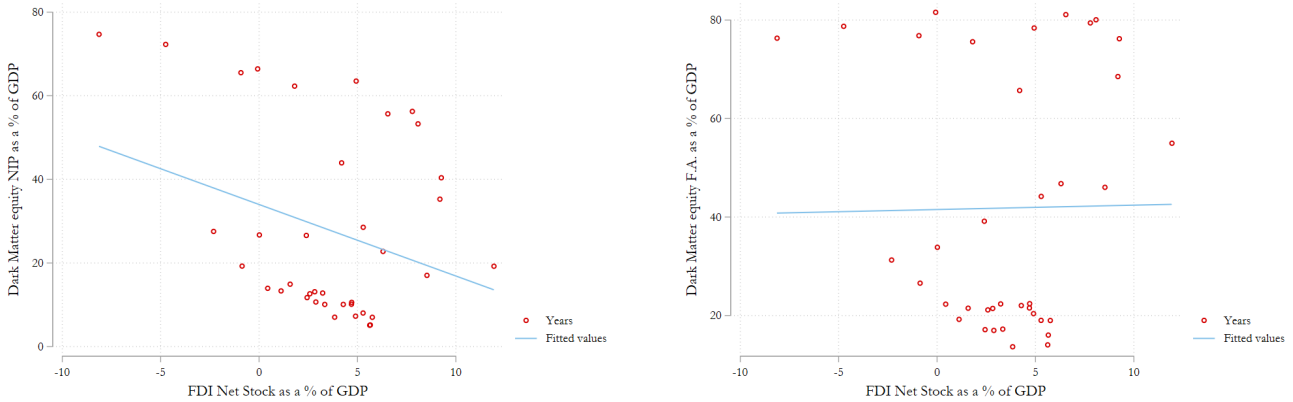


Figure 17: Scatter Plot analysis of Dark Matter equity and FDI Stock % of GDP for USA



(a) Scatter Plot between Dark Matter equity NIP and FDI Stock Outward as a % of GDP

(b) Scatter Plot between Dark Matter equity F.A. and FDI Stock Outward as % of GDP

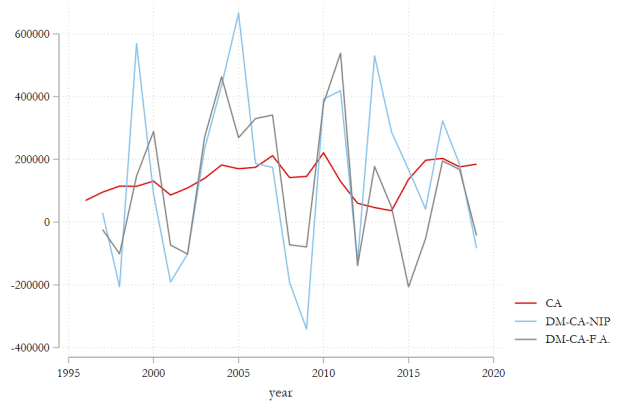


(c) Scatter Plot between Dark Matter equity NIP and FDI Net Stock as % of GDP

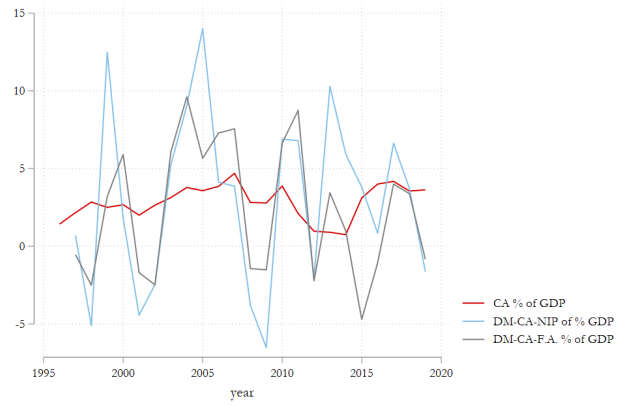
(d) Scatter Plot between Dark Matter equity F.A. and FDI Net Stock as % of GDP

7.6 Graphs for Japan

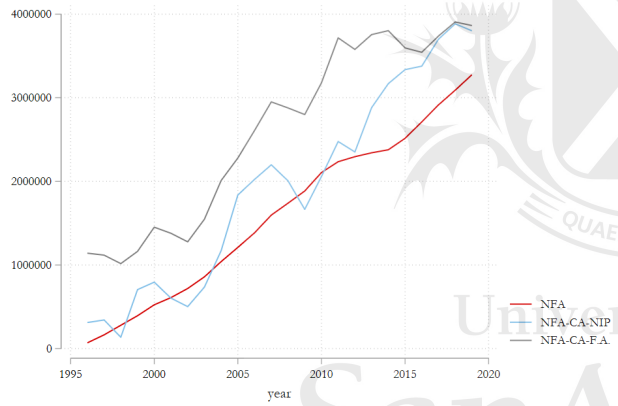
Figure 18: Evolution of CA and NFA according official statistics and estimations of Dark Matter CA and NFA for Japan



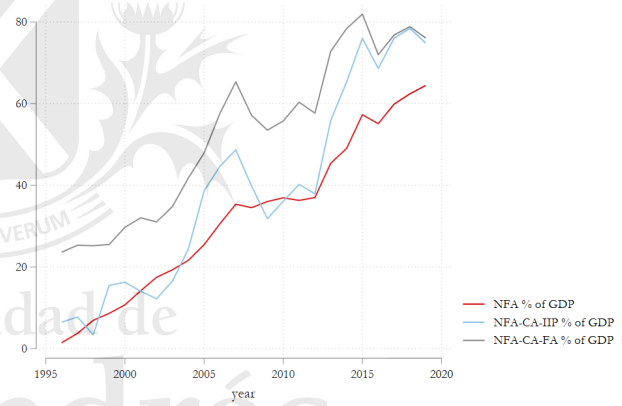
(a) CA in millions of dollars



(b) CA as % of GDP



(c) NFA millions of dollars



(d) NFA as % of GDP

Figure 19: Net Investment Income of Japan in million of dollars and as a % of GDP

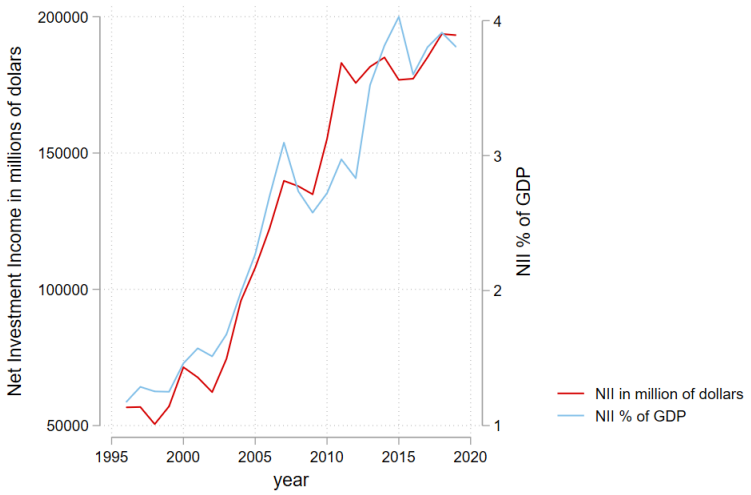
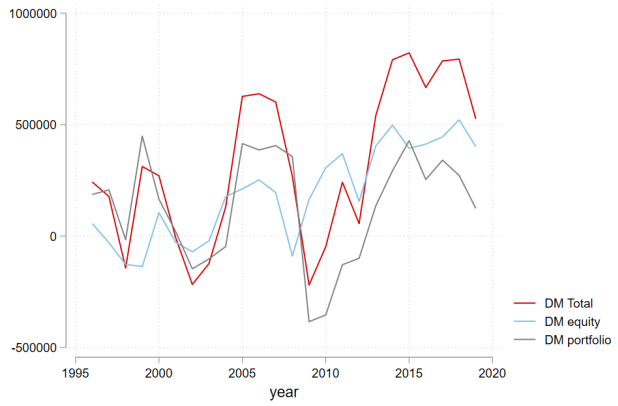
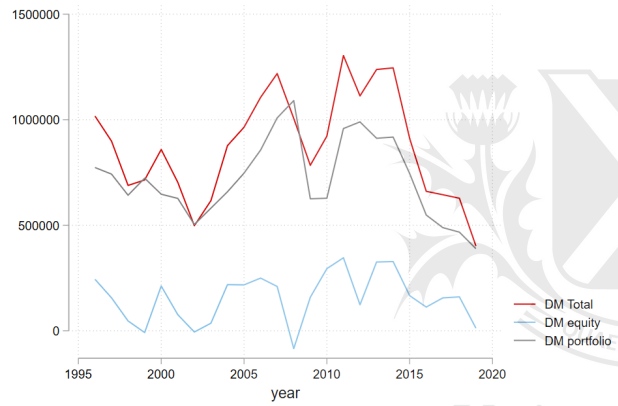


Figure 20: Evolution of Dark Matter and their decomposition in million of dollars and as % of GDP for Japan

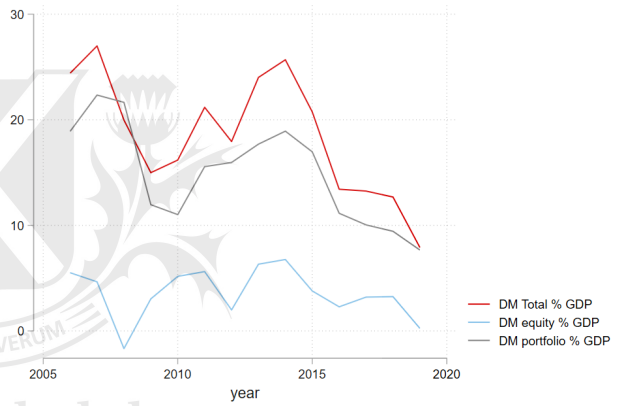


(a) DM NIP and decomposition in millions of dollars

(b) DM NIP and decomposition as % of GDP

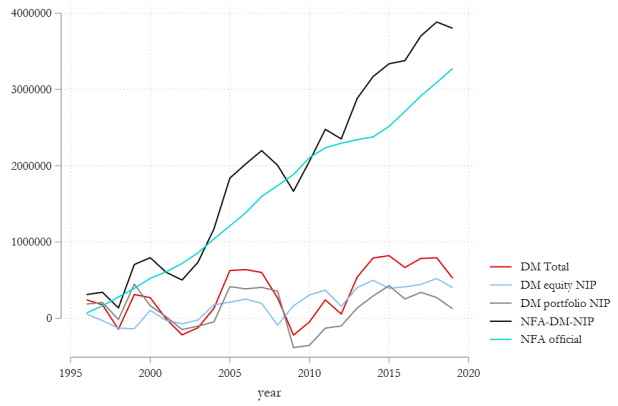


(c) DM F.A. and decomposition in millions of dollars

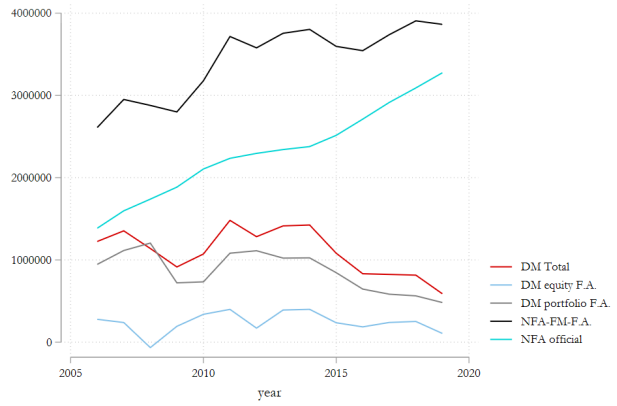


(d) DM F.A. and decomposition as % of GDP

Figure 21: Contrast of measures DM NIP and F.A. for Japan

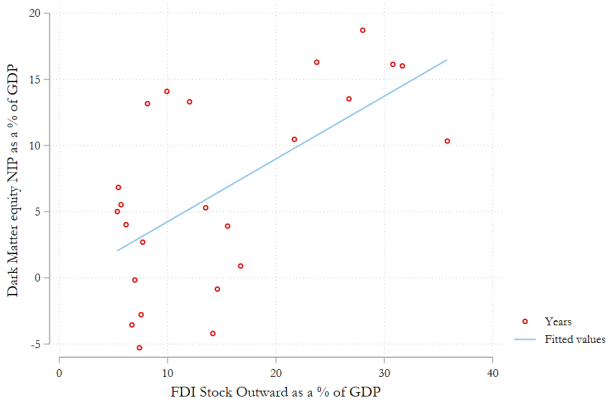


(a) DM and NFA in millions of dollars

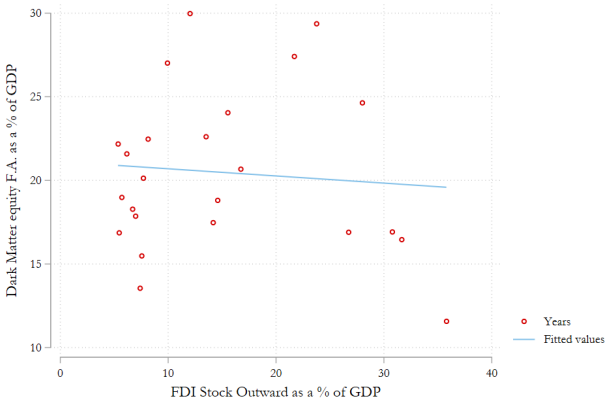


(b) DM and NFA as % of GDP

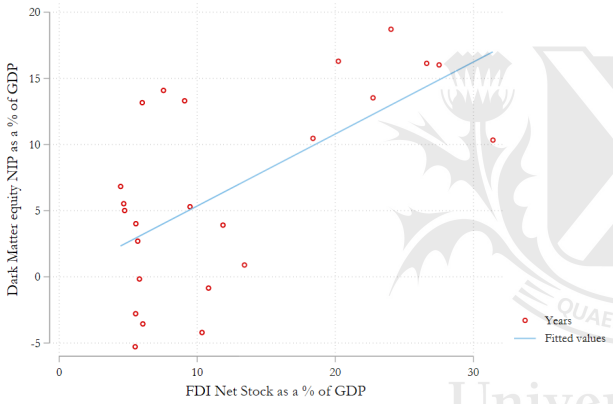
Figure 22: Scatter Plot analysis of Dark Matter equity and FDI Stock % of GDP for Japan



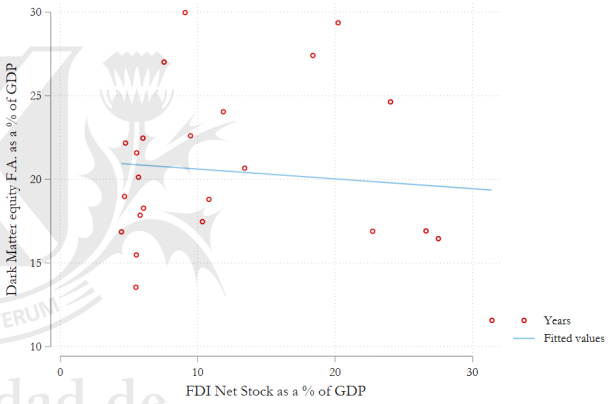
(a) Scatter Plot between Dark Matter equity NIP and FDI Stock Outward as a % of GDP



(b) Scatter Plot between Dark Matter equity F.A. and FDI Stock Outward as % of GDP



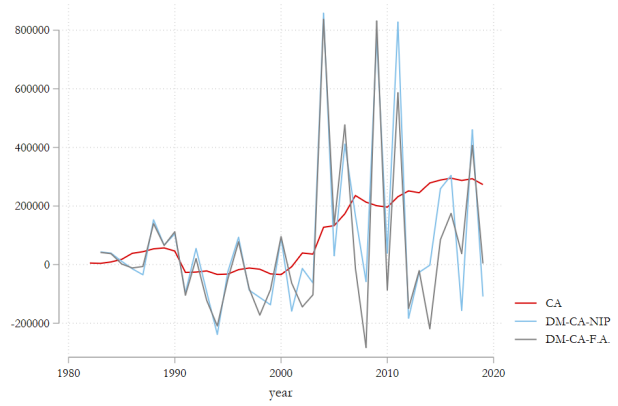
(c) Scatter Plot between Dark Matter equity NIP and FDI Net Stock as % of GDP



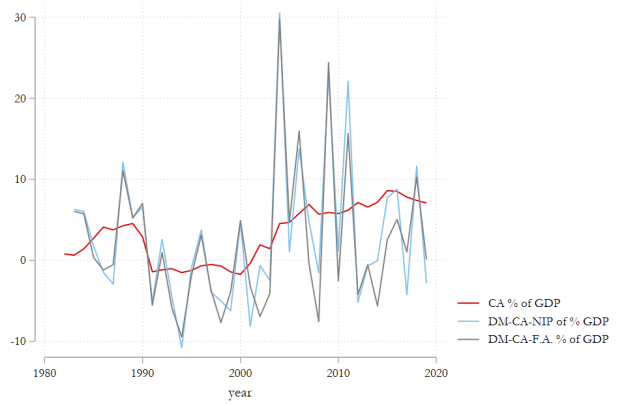
(d) Scatter Plot between Dark Matter equity F.A. and FDI Net Stock as % of GDP

7.7 Graphs for Germany

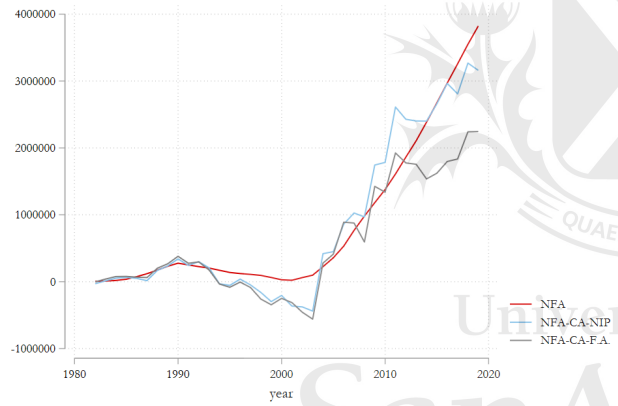
Figure 23: Evolution of CA and NFA according official statistics and estimations of Dark Matter CA and NFA for Germany



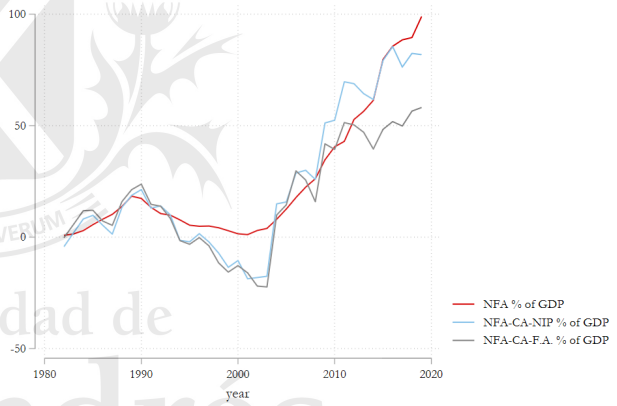
(a) CA in millions of dollars



(b) CA as % of GDP



(c) NFA millions of dollars



(d) NFA as % of GDP

Figure 24: Net Investment Income of Germany in million of dollars and as a % of GDP

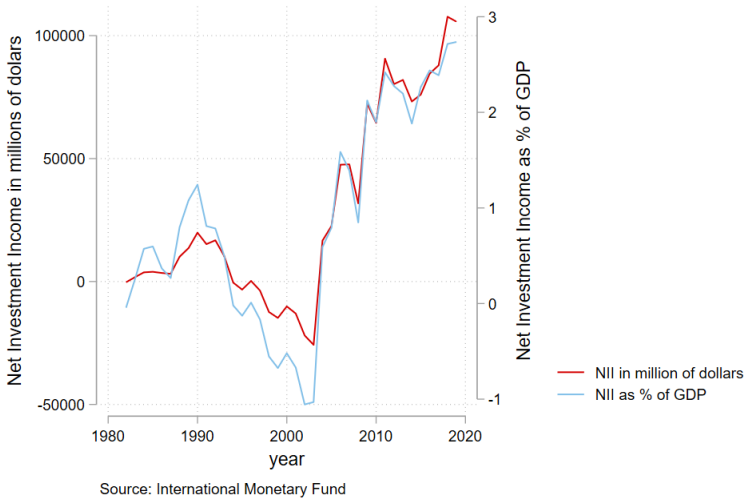
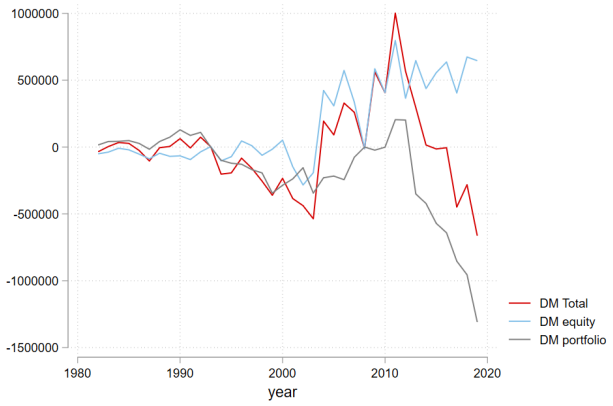
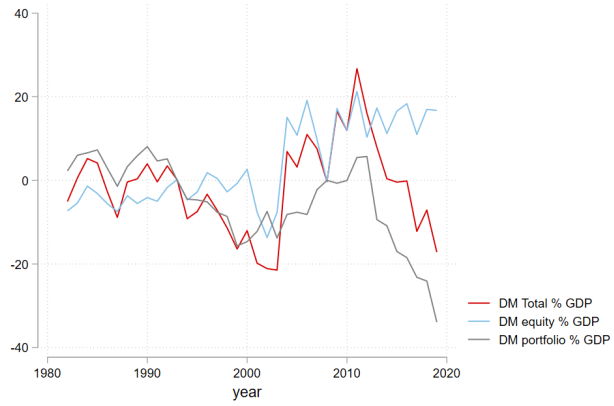


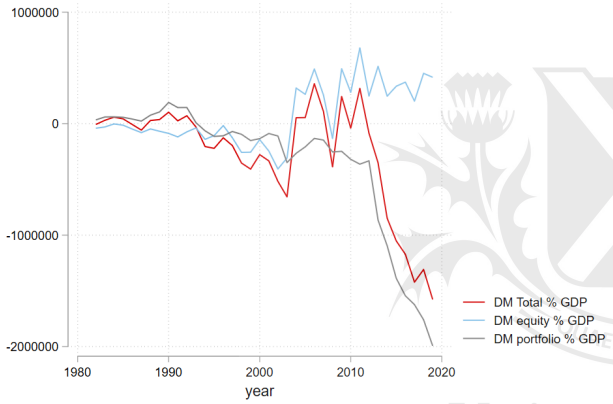
Figure 25: Evolution of Dark Matter and their decomposition in million of dollars and as % of GDP for Germany



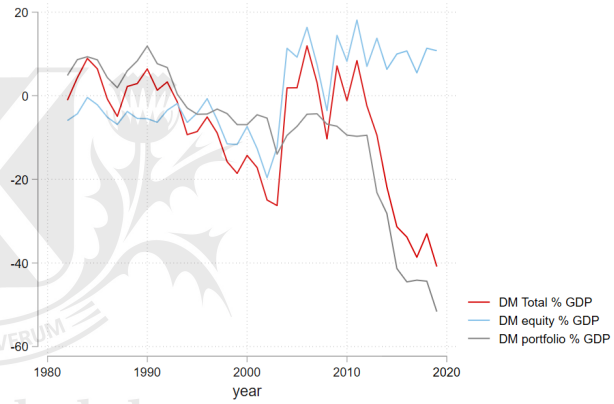
(a) DM NIP and decomposition in millions of dollars



(b) DM NIP and decomposition as % of GDP

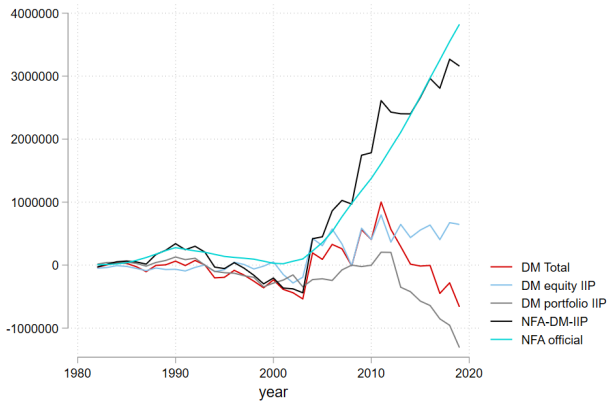


(c) DM F.A. and decomposition in millions of dollars

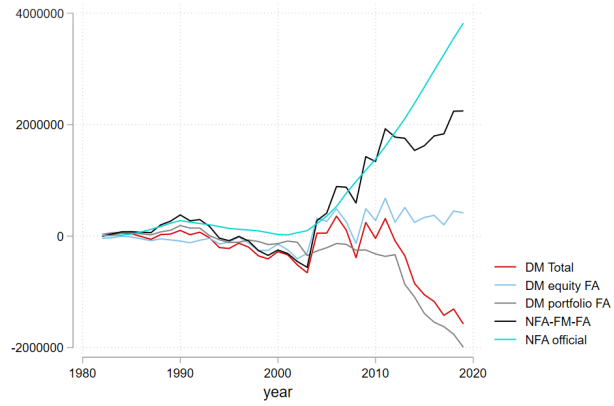


(d) DM F.A. and decomposition as % of GDP

Figure 26: Contrast of measures DM NIP and F.A. for Germany

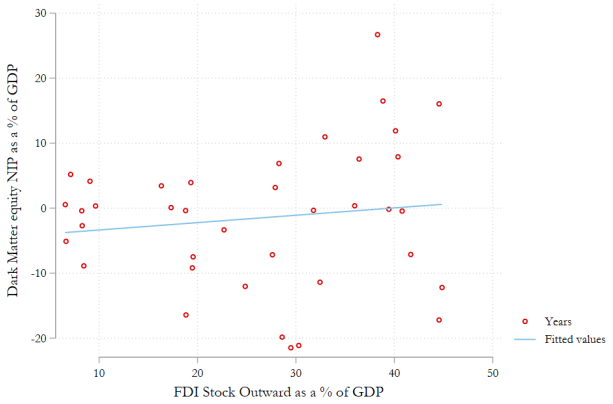


(a) DM and NFA in millions of dollars



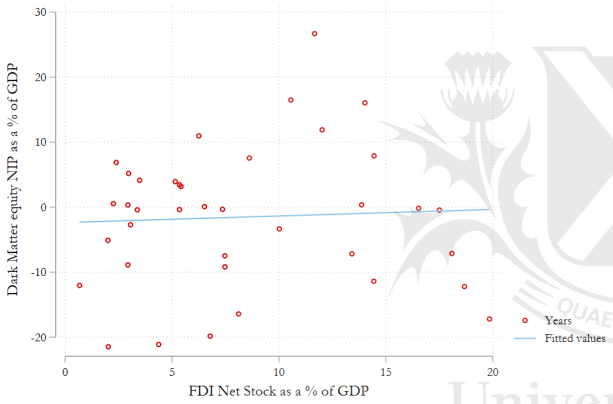
(b) DM and NFA as % of GDP

Figure 27: Scatter Plot analysis of Dark Matter equity and FDI Stock % of GDP for Germany

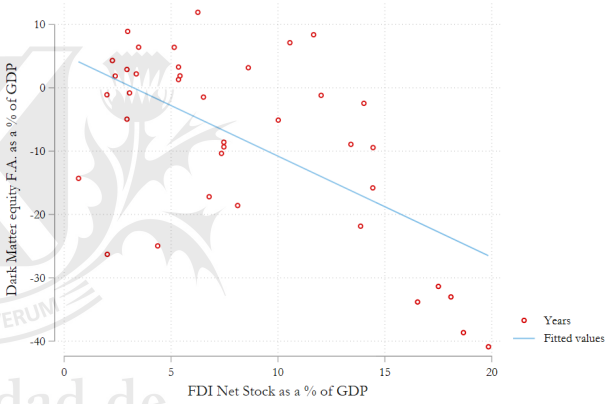


(a) Scatter Plot between Dark Matter equity NIP and FDI Stock Outward as a % of GDP

(b) Scatter Plot between Dark Matter equity F.A. and FDI Stock Outward as % of GDP



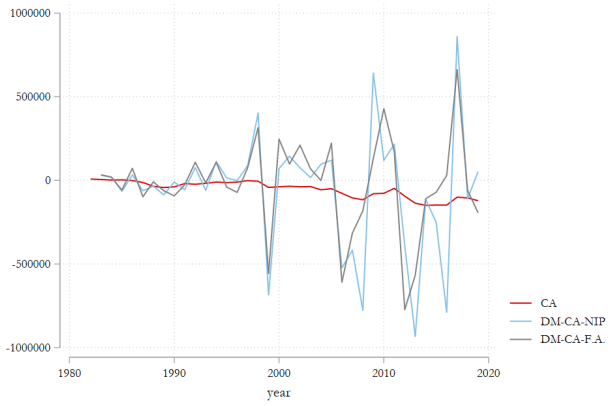
(c) Scatter Plot between Dark Matter equity NIP and FDI Net Stock as % of GDP



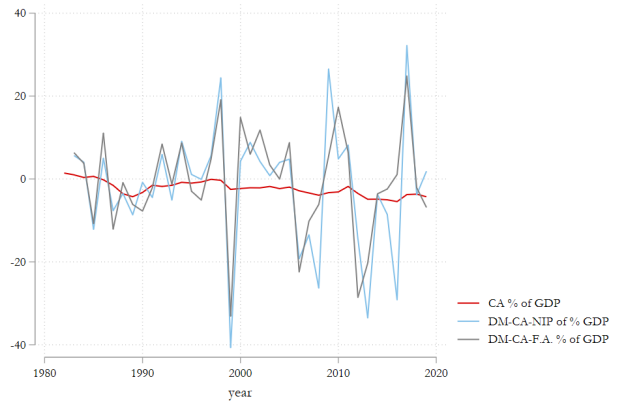
(d) Scatter Plot between Dark Matter equity F.A. and FDI Net Stock as % of GDP

7.8 Graphs for the United Kingdom

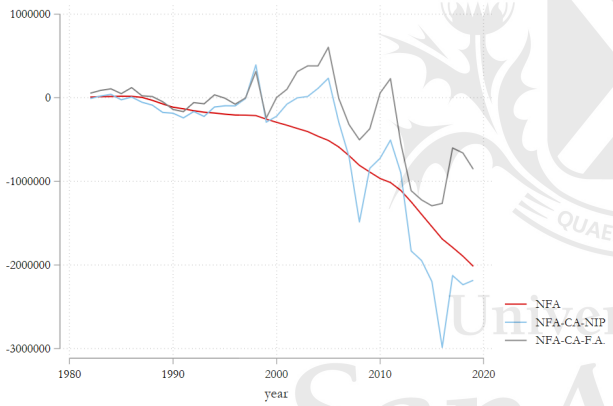
Figure 28: Evolution of CA and NFA according official statistics and estimations of Dark Matter CA and NFA for the United Kingdom



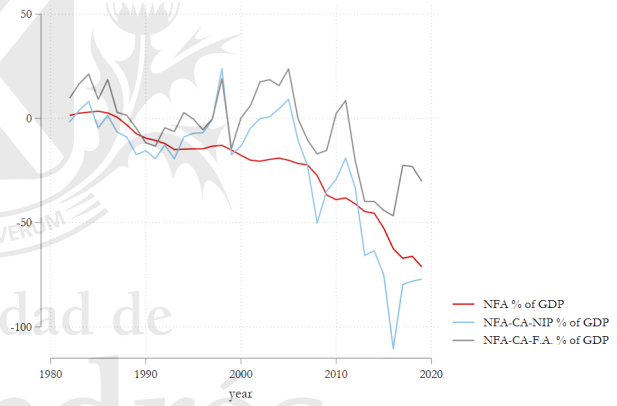
(a) CA in millions of dollars



(b) CA as % of GDP



(c) NFA millions of dollars



(d) NFA as % of GDP

Figure 29: Net Investment Income of the United Kingdom in million of dollars and as a % of GDP

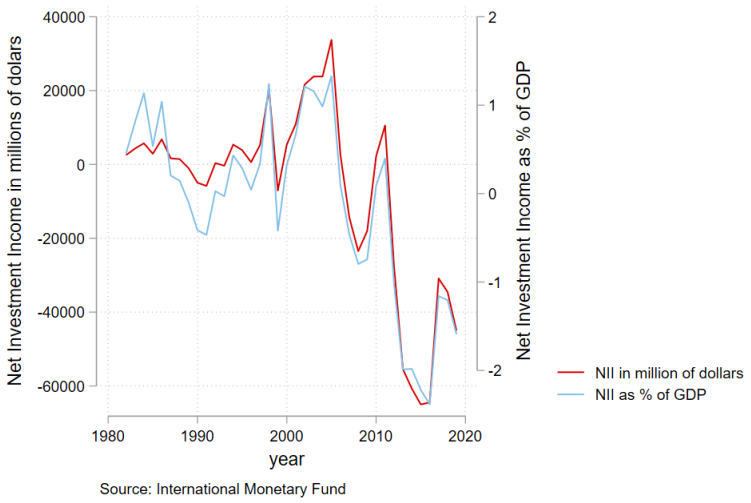
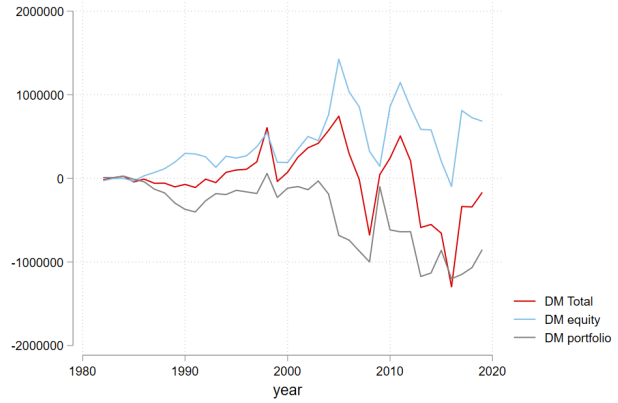
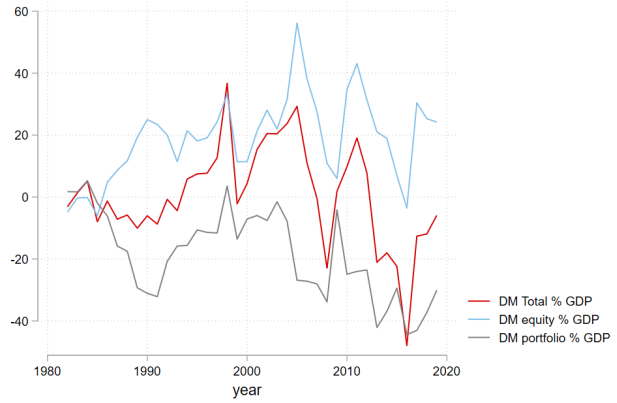


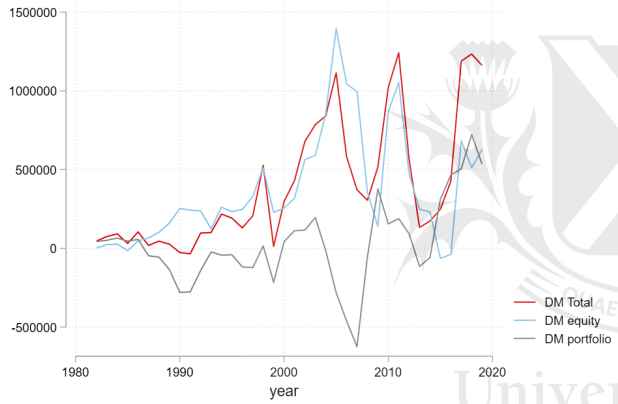
Figure 30: Evolution of Dark Matter and their decomposition in million of dollars and as % of GDP for the United Kingdom



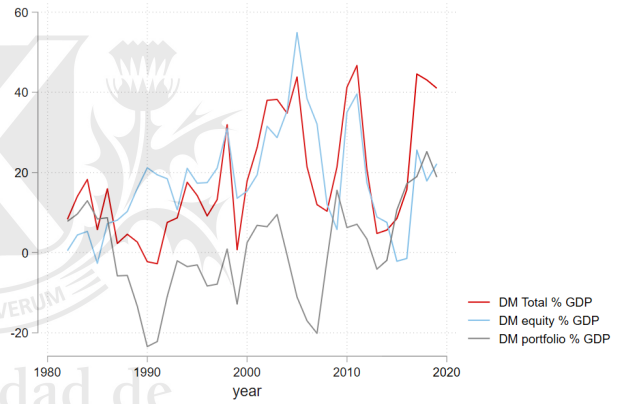
(a) DM IIP and decomposition in millions of dollars



(b) DM IIP and decomposition as % of GDP

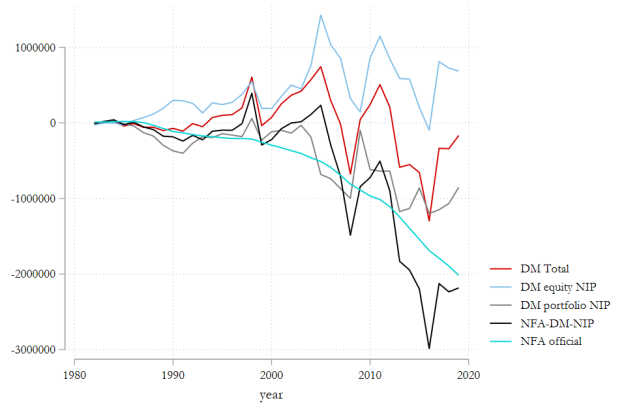


(c) DM FA and decomposition in millions of dollars

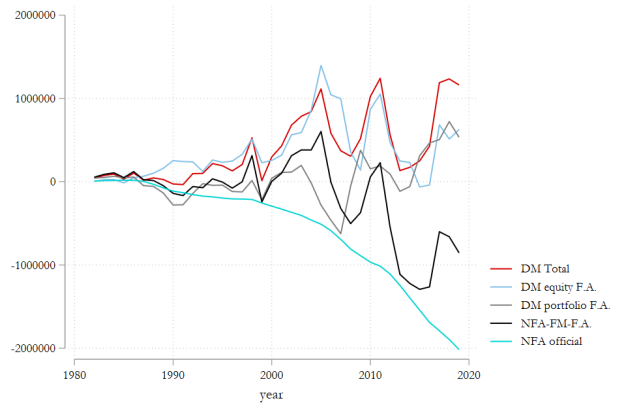


(d) DM FA and decomposition as % of GDP

Figure 31: Contrast of measures in million of dollars with DM NIP and F.A. for the United Kingdom

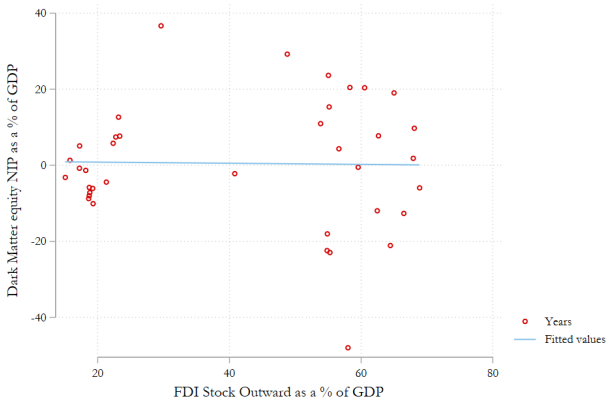


(a) CA in millions of dollars

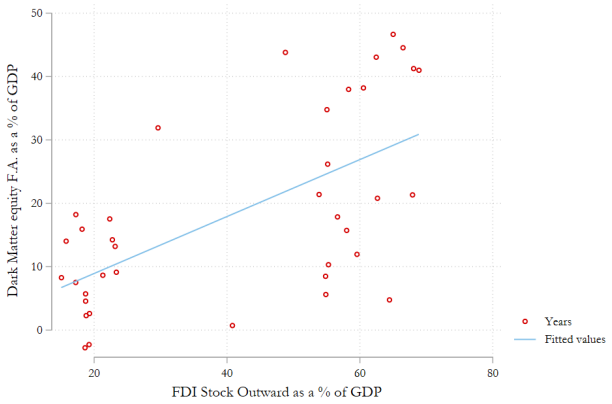


(b) CA as % of GDP

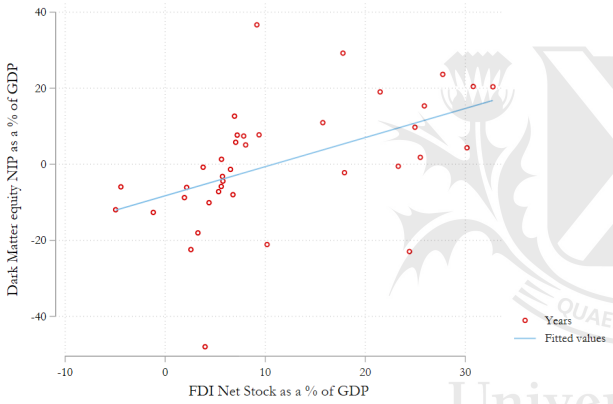
Figure 32: Scatter Plot analysis of Dark Matter equity and FDI Stock % of GDP for the United Kingdom



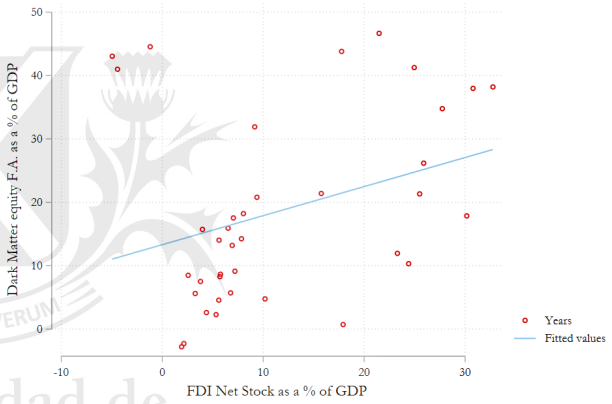
(a) Scatter Plot between Dark Matter equity NIP and FDI Stock Outward as a % of GDP



(b) Scatter Plot between Dark Matter equity F.A. and FDI Stock Outward as % of GDP



(c) Scatter Plot between Dark Matter equity NIP and FDI Net Stock as % of GDP



(d) Scatter Plot between Dark Matter equity F.A. and FDI Net Stock as % of GDP