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The impact of dark matter on sustainability of current account imbalance

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Abstract. In this paper, we pay attention to the contribution of conventionally omitted dark matter (DM) on sustainability of current account imbalance. According to the definition of DM in Hausmann and Sturzenegger (2006, 2007), the existence of undervalued foreign assets and liabilities, and this difference are called dark matter. We further discuss its influence on current account imbalance's sustainability under various country backgrounds. Using panel data, our empirical results find that abnormal return and PPP deviation help the convergence rate of current account imbalance toward steady-state to become faster. For the prominent valuation effects and better investment skill of high-income countries and middle-income countries, DM can significantly back up current account imbalance of those countries. Real exchange rate depreciation also aids the persistence of current account imbalance in high-income countries and middle-income countries.

Keywords: dark matter, current account imbalance sustainability, return privilege, abnormal return.

1. Introduction

Existing global imbalance implies that the current account deficit in US is equivalent to the current account surpluses of emerging markets in Asia and oil-exported countries. Although the high current account deficit in US, literature indicates that net investment income in US is positive persistently, contrary to the expectation of current account dynamics. It reflects the prominent valuation effects in US, supporting the sustainability of huge current account deficit. (Gourinchas and Rey, 2007; Cururu et al, 2010)

Particularly, HS (2006, 2007) indicates a specific viewpoint. They pay attention to not only valuation effects, but also "liquidity services", "trading of insurance services" and "knowledge spillover" of US dollar，resulting in unrecorded exports of services in US. That is to say, the former valuation effects and the latter return privilege constitute dark matter.

HS (2006, 2007) refers investment income as a good measure of the appropriate value of net foreign assets. "Measured in this way, the net foreign asset of US seems to be fairly stable in past 20 years, indicating that US seems to be a creditor, not a debtor". They measure the stock of net foreign assets (NFA) as the capitalized value of the net investment income (NII), discounted at a constant rate of interest 5%. The term is called dark matter (DM), reflecting the discrepancy between our measure of net foreign assets and the measure that can be obtained from official figures or from accumulating the current account imbalances. Countries with net investment income larger than what is presumed on the basis of their asset base will have DM assets, while countries where the net investment income is too low will have DM liabilities. DM includes both valuation effects and return privilege, the former may independently of current account flows, and the later allows some countries to obtain abnormal returns (positive or negative) [1].

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[1] The abnormal return allows as follows. First, some poor countries with large current account deficits may gain debt relief, that is running deficit without increasing their payments abroad. Second, stable countries may pay lesser for their liabilities because an extra sense of security of investors, which lets it earn larger net income from foreign asset than what would be expected from its current account surpluses. Third, some countries may run deficits without accumulating liabilities because their currency is used by other

According to HS (2006, 2007), they find the existence of huge DM asset in US, implying the undervaluation of foreign asset. HS (2006, 2007) also indicates that the existence of dark matter liabilities in China, Singapore, Thailand, and Taiwan…etc., representing the undervaluation of foreign liabilities in those countries and the overvaluation of current account surpluses. The explanations in HS (2006, 2007), including that the foreign direct investment (FDI) abroad is undervalued, a vehicle for two income flows are very imperfectly captured in official statistics. First, the valuation effects are associated to the fact that FDI allows for the dissemination of ideas and knowledge. The valuation effects are not picked up because market value adjustment to FDI assets have no visible market prices at best on the basis of the host country characteristics, and these are not likely to be strongly related to the earnings potential of the firm. Second, the return to unrecorded exports of services from headquarters to their affiliates around the world.

Those mentioned above inspires us to explore whether DM help the persistence of a country's current account imbalance? These are "valuation effects from spillover effects in technology and knowledge", "trading of insurance services" and "liquidity services", which are missed and imperfectly captured in official statistics.

In addition, according to Dooley et al. (2004), three major economy and monetary areas are separately, East-Asia countries, U.S., and Europe. U.S. is a centre country; Asia is a trade account; and Europe, Canada and the Latin America are capital account. Asia countries mainly exports to US, especially they adopt following policies. First, the exchange rates in Asia countries peg to US dollar. Second, adopting export-led strategies with undervalued pegged exchange rates. In addition to the two controls described above, Asia countries tax on capital inflows and peg on an undervalued currency in foreign market for intervening. Based on the phenomenon described above, we also consider that policy of exchange rate undervaluation is might to be an important role in global imbalance.

Therefore, we aim to analyze the influence of DM on the current account imbalance's sustainability, either the persistence of current account deficit or current account surpluses? Especially, we do consider the influence of undervalued real exchange rate on the persistence of current account imbalance.

Using panel data, our empirical results find that abnormal return and PPP deviation help the convergence rate of current account imbalance toward steady-state to become faster. For the prominent valuation effects and better investment skill of high-income countries and middle-income countries, dark matter can significantly back up current account imbalance of those countries. Real exchange rate depreciation also aids the persistence of current account imbalance in high-income countries and middle-income countries.

2. Theoretical Framework

According to Meissner and Taylor(2006), NII of a country is larger than expected rate of yield(r) of world, and either rate of yield(r) of domestic foreign assets is higher ($r_A > r$) or rate of yield(r) of domestic foreign liabilities is lower($r_L < r$), comparing to average rate of yield(r) of world. Based on the identity, the changes in net foreign assets of a country can be decomposed as follows,

$$\Delta W = \underbrace{-FA}_{\substack{net.import.of.assets \\ (-financial.account)}} + \underbrace{KG}_{\substack{capital.gains.on \\ external.assets.and.liabilities}} = \underbrace{CA + KA}_{\substack{-FA \\ (BOP.identity)}} + KG$$

$$= \underbrace{TB + (NLIA + NII) + NUT}_{CA.definition} + KA + KG$$

$$= TB + \underbrace{NUT + KA}_{transfers} + \underbrace{NLIA}_{net.labor.income} + \underbrace{(r_A A - r_L L)}_{net.property.income} + \underbrace{(\gamma_A A - \gamma_L L)}_{capital.gains}$$

$$= TB + NUT + NLIA + KA + (\rho_A A - \rho_L L) \quad (1)$$

They are separately NII, trade balance (TB), unilateral transfer (NUT), net labor income abroad (NLIA), net property income abroad, and the capital gains. And the later two terms can be treated as total returns from external wealth; r is yield; γ is capital gain; ρ is total return. Eqs.(1) tells us that the correlation between persistence of current account deficit and net foreign asset, for the persistence of current account shortage

countries, or may earn investment income from unrecorded services that multinationals' headquarters supply to their affiliates around the world.

helping to reduce net foreign asset positions. However, the persistence of current account shortage is not necessary to result in large and negative foreign asset positions, if the valuation effect of this country can offset part of current account deficit (Freud and Warnock, 2005). Messiner and Taylor (2006) and HS (2007) regress NII on net foreign assets for estimating return privileges, treating r as typical yield and fixed effects as estimation of return privilege.

$$\frac{NII_{it}}{GDP_{it}} = r\left[\frac{NFA_{it}}{GDP_{it}}\right] + \alpha_{it} + \varepsilon_{it} \quad (2)$$

Because of the data shortage, HS (2007) simplifies the estimation, and Eqs. (4) is a substitute for Eqs. (2). The changes in net foreign asset positions (B) is as follow,

$$B_t - B_{t-1} = CA_t + KG_t + KA_t + E_t \quad (3)$$

Multiply net foreign asset positions with returns in net foreign asset, resulting in NII, and then divided by GDP, showed as follows,

$$\frac{r(B_t - B_{t-1})}{GDP_t} = \frac{\Delta NII_t}{GDP_t} = r\left[\frac{CA_t}{GDP_t}\right] + r\left[\frac{KG_t + KA_t}{GDP_t}\right] + \frac{rE_t}{GDP_t} \quad (4)$$

For the availability of NII and CA data in many countries, it is easy to estimate Eqs. (4). Assuming the second term in right-hand side of Eqs. (4) as the fixed effects of countries, we estimate in panel data and get,

$$\frac{\Delta NII_{it}}{GDP_{it}} = r\left[\frac{CA_{it}}{GDP_{it}}\right] + \alpha_i + \varepsilon_{it} \quad (5)$$

In Eqs. (5), $\varepsilon_{it} = rE_t / GDP_t$ is the error term and α_i is the return privilege of Meissner and Taylor (2006). According to the estimation of 21 countries in HS (2007), we derive 5% and treat it as a proxy of the typical yield. Following HS (2007), we use 5% to estimate NFA^{DM} . Besides, HS (2007) estimate the return privilege in another way for robust test. Definition of abnormal return between t and t+ j years is as follow,

$$AR_{t,t+j} = \Delta NII_{t,t+j} - 0.05\left(\sum_{i=t-1}^{t+j-1} CA_i\right) \quad (6)$$

Eqs. (6) is the difference of "changes in NII" and "the multiplication of typical yield and net foreign assets". And HS (2007) replace net foreign asset of a country with accumulated current account. Based on Eqs.(5) and (6), we estimate the return privilege in two ways, and discuss the return privileges between Taiwan and other countries. The purposes are twofold. First, debates on the persistence of the return differentials. Second, whether the systematic relationship exists between the return privilege and external imbalance of countries? That is to say, whether the scales of return privilege in countries with current account surpluses and deficit are different? And we compare the empirical result in Taiwan and which of other countries. Based on HS (2007), we discount NII of a country with constant rate (r), and getting NFA_t^{DM} as follow, $NFA_t^{DM} = NII_t / r_t$. The implication of DM describes the difference between the estimation of net foreign assets and official statistics (or accumulated current account). The DM is as follows, $DM_t = NFA_t^{DM} - NFA_t^{OF}$. If the actual NII of a country is larger than inferred NII from NFA, then we find that a country exists "DM assets"; otherwise, if the actual NII of a country is lesser than inferred one, then a country exists "DM liabilities".

$$r \times NFA_t^{DM} = r \times NFA_t^{OF} \quad (7)$$

r is the average rate of return of world, and HS (2006,2007) specify it as 5%. r_t^T and NFA_t^{OF} are separately net rate of return and actual official statistics of NFA, and accumulated current account is often treated as actual NFA.

$$r^T > r \Rightarrow NFA_t^{DM} > NFA_t^{OF} \quad (8)$$

Messiner and Taylor (2006) explains that if the foreign asset of a country, such as US, with the existence of "insurance of assets", "export of knowledge and technology" and "liquidity services", then this country will have higher rates of return, and the undervaluation of NFA. But if foreign assets of a country is not better than other ones, then r^T is equal to r , that is average rate of return in the world. Hence, $NFA_t^{DM} = NFA_t^{OF}$. We conclude Eqs.(7)-(8) as follows,

$$NFA_t^{DM} = \frac{NFA_t^{OF} \times r_t^T}{r} = \frac{NII_t}{r} \quad (9)$$

And the change of net foreign asset positions (ΔNFA_t), that is current account flows, and we can get Eqs. (10) from $NFA_t^{DM} = NII_t / r_t$.

$$\Delta NFA_t^{DM} = CA_t = NFA_t^{DM} - NFA_{t-1}^{DM} = \frac{NII_t - NII_{t-1}}{r} \quad (10)$$

3. Empirical analysis

3.1. Introduction of dark matters in different countries

In this paper, all data comes from the IMF IFS CD-ROM and World Bank, and the time period covers 1980 to 2008. Our sample includes 90 countries in the time period of 1980-2007, and 106 countries in the time period of 1990-2007. According to the classification of World Bank, our sample covers 27 high-income countries, 34 middle-income countries and 19 low-income countries. Based on the definition of HS (2006, 2007), we refer DM in r=0.05, and find that most of low-income and middle-low-income countries, such as Africa and central-south America, having DM assets especially after 1990. And high-income countries distribute in two extremes. US, UK, Austria, Germany and Switzerland have DM assets. However, other high-income countries have DM liabilities, especially Asia countries have DM liabilities after 1990.

The explanations for sketch above are as follows. Existence of DM assets in US, UK, Austria, Germany and Switzerland reflect those countries, whose money adopted by other countries, they can accumulate current account deficit without increasing foreign liability, for the uncounted "trading of insurance services" and "liquidity services" in foreign assets, reflecting incomplete abnormal return of foreign assets.

In addition, low-income countries have DM assets. It represents that the undervaluation of foreign assets and current account balance in those poor countries, implying that their actual current account deficits are not as serious as shown. Most high-income and middle-income countries have DM liabilities, representing the phenomenon of international globalization in decades, and reflecting the uncounted "trading of insurance services" and "liquidity services" of foreign-currency assets from source countries.

3.2. The impact of dark matter on current account imbalance persistence

We adopt CCEP method of Pesarn (2006) to control for the cross-sectional correlation. The empirical result is reported as follows. HS (2007) mentions that the larger abnormal return (AR) a country has, the longer persistence of current account deficit a poor country has. Hence, we expect that negative AR can help current account imbalance to converge to steady-state faster. Besides, the prominent undervaluation of currency (PPP_dev) also can help current account imbalance to converge to steady-state faster. As a result, we expect AR and PPP_dev have negative association with current account imbalance, resulting in converging to steady-state faster.

3.3. The empirical results of Table 2-1

$$\left(\frac{CA}{GDP}\right)_{it} = \alpha_i + \beta\left(\frac{CA}{GDP}\right)_{i,t-1} + \psi_i\left(\frac{DM}{GDP}\right)_{it} + \mu_i PPPdev_{it} + \varepsilon_{it}$$

In this paper, net foreign asset position is replaced by accumulated current account, using accumulated current account to evaluate dark matter of a country. Consistent with HS (2006, 2007), the results in Table 2-1 shows the negative and significant relationship between DM and CA/GDP in full sample and middle-income countries. It represents that the convergence rate of current account imbalance will be slower with the existence of DM assets. The result is also the same with the reality for existence of DM assets in middle-income countries and low-income countries.

In Table 2-1, the positive sign in columns (2), (8) and (10), reflecting the slower convergence rates of current account imbalance in high-income and middle-income countries with dark matter liabilities. The result is consistent with the fact of existence of dark matter liabilities in those high-income and middle-income countries, for the uncounted DM from huge spillover effect of knowledge in FDI from source

countries. In particular, the prominent undervaluation of currency helps current account imbalance of a country to converge to steady-state faster. Results in columns (3), (4), (7), (8), (11) and (12) indicate that the currency undervaluation in all countries, high-income countries and middle-income countries, resulting in the higher speed of adjustment in current account imbalance.

3.4. The empirical results of Table 3-1

$$\left(\frac{CA}{GDP}\right)_{it} = \alpha_i + \beta\left(\frac{CA}{GDP}\right)_{i,t-1} + \psi_i\left(\frac{AR}{GDP}\right)_{it} + \mu_i PPPdev_{it} + \varepsilon_{it}$$

The CCEP estimation shows that abnormal return (AR) has statistically negative relationship with CA/GDP, representing the higher-speed of adjustment of external imbalance in countries with abnormal return. In Table 3-1, the empirical results are as follows.

- **The influence of Abnormal return (AR) on current account imbalance**

After 1990, especially for high-income countries, AR helps current account imbalance in those countries to converge to steady-state in 1 to 4 years, shown in columns (6) and (8). Consistent with the results in Table 3-1, the convergence of current account imbalance towards steady-state for middle-income countries and low-income countries are also affected by AR. In high-income countries and middle-income countries, dark matter has expected relationship with current account imbalance, reflecting the prominent valuation effects and better investment skill in those countries, and can help to back up current account imbalance.

- **The influence of real exchange rate depreciation (PPP dev) on current account imbalance**

With the undervaluation of currency, the current account imbalance converges to steady-state faster. For all countries, high-income countries and middle-income countries, real exchange rate depreciation can help to back up the current account deficit. The currency undervaluation helps the faster adjustment of current account imbalance in all countries, and middle-income countries, with operation in 1 to 4 years, shown separately in columns (3), (4), (11) and (12). For high-income countries, real exchange rate depreciation can help to back up the current account deficit, with operation in 1, 2 and 4 years, shown in columns (6) and (8).

4. Conclusions

Using panel data, our empirical results find that abnormal return and PPP deviation help the faster convergence rate of current account imbalance toward steady-state. For the prominent valuation effects and better investment skill of high-income countries and middle-income countries, DM can significantly back up current account imbalance of those countries. Real exchange rate depreciation also aids the persistence of current account imbalance in high-income countries and middle-income countries.

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Table2_1 [1990]

	Exp	All				High				Middle				Low			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CA/GDP(-1)		0.55† [4.51]	0.33** [3.71]	0.54† [4.02]	0.23** [2.87]	0.75† [13.32]	0.43† [6.91]	0.70† [12.21]	0.39† [5.38]	0.26* [1.67]	0.12 [1.24]	0.24 [1.59]	0.06 [0.94]	0.34† [5.68]	0.31† [2.36]	0.34† [6.80]	0.30** [5.39]
DM1(r=0.05)	(+)		0.02** [2.04]		(-0.01) [-0.73]		0.01 [1.15]		0.01† [3.19]		0.02* [1.82]		0.01 [1.05]		0.003 [0.31]		(-0.02) [-0.99]
PPP dev	(−)			(-0.07)† [-3.52]	(-0.04)** [-2.13]			(-0.06)† [-3.10]	(-0.06)** [-2.51]			(-0.10)** [-2.34]	(-0.06) [-0.90]			(-0.05) [-1.11]	(-0.05) [-1.12]
Number of countries		106				34				52				19			

Table3_1 [1990]

J=1

	Exp	All				High				Middle				Low			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CA/GDP(-1)		0.38† [4.39]	0.30** [3.23]	0.32† [3.51]	0.21** [2.38]	0.75† [9.16]	0.53† [8.53]	0.70† [8.09]	0.47† [6.99]	0.39† [3.16]	0.35** [2.78]	0.35† [2.81]	0.28* [2.27]	0.25† [3.35]	0.25† [3.54]	0.25† [3.39]	0.26† [3.42]
AR1(r=0.05)	(−)		0.10 [0.41]		0.44† [3.17]		-0.34† [-2.70]		(-0.38)† [-3.12]		0.35 [1.33]		0.73† [2.63]		-0.43** [-2.48]		-0.43** [-2.30]
PPP dev	(−)			-0.07† [-3.22]	-0.05** [-2.51]			-0.07† [-2.95]	(-0.06)† [-2.87]			-0.10† [-2.91]	-0.09** [-2.16]			(-0.01) [-0.23]	-0.01 [-0.27]

J=2

	Exp	All				High				Middle				Low			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CA/GDP(-1)		0.32† [3.48]	0.20** [2.01]	0.22** [2.44]	0.14 [1.52]	0.61† [9.40]	0.36† [6.84]	0.54† [6.88]	0.31† [5.02]	0.34** [2.50]	0.29** [2.50]	0.24* [1.83]	0.21* [1.82]	0.24† [2.90]	0.22† [2.94]	0.23† [2.82]	0.22** [2.63]
AR1(r=0.05)	(−)		(-0.01) [-0.02]		0.39** [2.21]		-0.39† [-3.85]		(-0.44)† [-4.20]		0.23 [0.95]		0.59† [2.58]		0.19 [0.61]		0.27 [0.83]
PPP dev	(−)			-0.05† [-2.68]	-0.04** [-2.07]			-0.07† [-3.11]	(-0.04)* [-1.81]			-0.09** [-2.48]	-0.09** [-2.24]			0.02 [0.50]	0.02 [0.47]

J=4

	Exp	All				High				Middle				Low			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CA/GDP(-1)		0.32† [3.12]	0.03 [0.36]	0.18* [1.86]	0.02 [0.18]	0.50† [7.55]	0..21† [3.67]	0.33† [4.33]	0.16** [2.34]	0.36** [2.33]	0.02 [0.19]	0.18 [1.25]	-0.01 [-0.11]	0.21** [2.44]	0.20** [2.07]	0.21** [2.38]	0.19* [1.86]
AR1(r=0.05)	(−)		-0.11 [-1.02]		-0.02 [-0.27]		-0.10 [-0.95]		-0.20** [-2.23]		-0.11 [-0.50]		-0.12 [-0.61]		0.14 [0.46]		0.28 [1.01]
PPP dev	(−)			-0.0	-0.04*			-0.05**	-0.04* [-1.65]			-0.08* [-1.87]	(-0.08)*			0.01 [0.33]	0.04 [0.99]

				5** [-2.44]	* [-2.04]			[-2.06]					[-1.79]				

Note：Robust t statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.