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INVESTIGATION OF PROOF OF ONTOLOGICAL FOUNDATIONS OF AN INTERNATIONAL CURRENCY: EVIDENCE FROM THE EVOLUTION OF THE EURO

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Abstract: This paper is not mainly concerned with epistemology. The formalism of international financial linkages, currency unions and monetary stability produce results that are in agreement with theory with great precision. Economic theory now shows how to predict and control the behavior of financial markets and monetary policy including that of the euro experience. Consequently, a broad spectrum of practical monetary innovations addressed the global financial and sovereign debt crises of 2007-2009 and the still lingering Covid-19 crisis. This research will not study extensively how we attain our knowledge of international currencies and what recommendations arise out of theory. We discuss the extent to which an epistemological currency interpretation functions in euro reality and discover its ontological ground. We extend this approach to prove that the absence of a central state and fiscal inconsistencies among others challenges were not an obstacle in the development of the euro. Research results are in good agreement with Mundell's concepts and there is unequivocal evidence that the euro has evolved into a major international currency. Finally, we discuss briefly the extension of our results to potential challenges.

Key words: Euro; EMU; epistemology; currency ontological foundations;

INTRODUCTION

It was pointed out by Nurkse [Nurkse, 1944] earlier on, then by Mundell [Mundell, 1968; Mundell 1971; Mundell 1999] and Mishkin [Mishkin, 2006; Mishkin 2007; Mishkin 2018] much later as well, that size of transaction area, stability of monetary policy, absence of controls, strong central state, size of gold reserves, interest rates and inflation represent major factors of acceptance of a currency. This complements Krugman [Krugman, 1979; Krugman, 1996] who added reserves and currency longevity as additional preconditions of acceptance. Authors, [Sachs, 1994] and J. Stiglitz [Stiglitz, 2015] addressed transition context and J. Shapiro [Shapiro, 1991] considered multinational financial management. While North [North, 1991] developed a general comparative theory of institutions, Sutherland took an institutional avenue in discussing the EMU [Sutherland, 1997; Begg, Fischer & Dornbusch 1994, pp. 606-609; ERM, 2021]. The IMF [IMF, 2009; IMF, 2010], the World Bank [World Bank, 2002; World Bank 2021], EMU [Sutherland, 1997] and

ECB [ECB, 2021] and Eurostat [Eurostat, 2021] all embraced the listed elementary layers of currency theory. We shall determine here both the significance and impact of these observables on the euro. Clearly, it is not necessarily a single euro experience and as effectively shown [Sachs, 1994; Fisher, 2001] it is rational to see various country and currency regimes. We shall apply Bohm's scientific approach [Bohm & Hiley, 1993, pp. 2-5], that distinguishes ontology from epistemology and yet complements it. We show that in most ontological factors, if not all, the euro performed well. We will draw conclusions.

1. ONTOLOGY OF EURO AS AN INTERNATIONAL CURRENCY

1.1. Evidence on the theorem of transaction area size as a factor of acceptance

We begin our proof by comparing GDP, exports and population, as shown in Table1.

Table 1. Comparative international review for 2020 (GDP, exports and population)

Largest world economies	GDP	Share % in world total	Exports of goods&ser.	Share % in world total	Population (millions)	Share% in world total
World	84.578	100.0	22.435	100.0	7.753	100.0
China	14.723	17.41	2.723	12.13	1.402	18.08
USA	20.937	24.75	2.123	9.46	329.5	4.25
EU (27 states)	15.276	18.06	7.135	31.8	447.8	5.77
Eurozone (19)	13.011	15.38	5.915	25.24	342.9	4.42

(Note: In b current US$ Source: World Bank (2021a). https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=XC-CN-US-EU-1W&name_desc=false Access [03.11.2021])

As part of Table 1 proof, eurozone is world single largest export transaction area. Table 2 proves that USD retained its dominant status in OTC FX turnover, while euro is second.

Table 2. OTC foreign exchange turnover by instrument and currency, April 2019

Currency	Total	Spot	Outright	FX swaps	Currency	FX options
USD	5,824,036	1,687,179	883,119	2,905,785	101,895	246,058
EUR	2,129,114	615,509	255,673	1,141,653	26,012	90,267
JPY	1,108,495	360,221	145,256	515,729	24,054	63,234
GBP	843,698	239,765	108,735	444,190	19,071	31,937
AUD	446,511	170,020	52,827	186,332	12,077	25,254
CAD	332,053	121,791	42,963	145,739	7,168	14,392
CHF	327,022	85,683	36,237	194,094	1,961	9,047
CNY	285,030	96,896	35,600	136,851	1,564	14,120
Other	1,894,984	597,818	438,227	734,959	23,170	100,736

(Source: Bank for International Settlements (2019). Daily averages, in M US $ http://www.bis.org/statistics/rpfx19.htm Access [03.11.2021])

To complete proof of transaction theorem Table 3 compares largest stock exchanges.

Table 3. Market Capitalization in B US$ and number of listed companies, September 2021

Rank	Exchange	HQ Location	Market cap. US$b (09/2021)	No. of Listed Companies
1	NYSE	New York	26,002	3,773
2	NASDAQ	New York	22,335	3,522
3	Shanghai Stock	Shanghai	7,754	3,485
4	Euronext	Amsterdam,	7,027	2,559
5	Japan Exchange	Tokyo	6,933	2,517
6	Shenzhen Stock	Shenzhen	5,693	2,434
7	Hong Kong	Hong Kong	5,675	2,005
8	London Stock	London	3,690	1,989

9	National Stock Exchange of India	Mumbai	3,480	1,987
10	TMX- Toronto Stock Exchange	Toronto	3,088	1,961
11	Deutsche Boerse	Frankfurt	2,475	488
	Total Equity Market - Market Capitalization		94,152	Total 26,720

(Source: Federation of World Exchanges (2021). https://www.world-exchanges.org/our-work/statistics Access [08.11.2021])

In Table 3, US based exchanges clearly dominate the first position in terms of market capitalization and number of companies while eurozone competes with Asian exchanges for second or third place. Euronext and Deutsche Boerse, as the largest exchanges in the eurozone, account for 10.1% of this market capitalization and 11.4% of listed companies.

1.2. Evidence on theorem of monetary policy stability as a factor of acceptance

One can understand deeply the meaning and significance of stability of monetary policy by considering the previous meanings of certain words. Thus, the Latin 'stabilitas' meaning firm standing, permanence and unchangeability reflects the view that monetary health is to be regarded as the outcome of a state of right inward immobility in all major components and processes of constituent monetary policies and institutions. Academics disagreed in definitions of institutions. North emphasized that institutions consist of formal rules, informal constraints, norms of behavior, conventions, self-imposed codes of conduct and their enforcement characteristics (1991). ECB monetary policy stability stems from World Bank's definition: "A stable financial system is capable of efficiently allocating resources, assessing and managing financial risks, maintaining employment levels close to the economy's natural rate, and eliminating relative price movements of real or financial assets that will affect monetary stability or employment levels. A financial system is in a range of stability when it dissipates financial imbalances that arise endogenously or because of significant adverse and unforeseen events. In stability, the system will absorb the shocks primarily via self-corrective mechanisms, preventing adverse events from having a disruptive effect on the real economy or on other financial systems." [World Bank, 2021b]. Hence, "prudential regulation is expected to promote systemic stability" [World Bank, 2002, p.79]. There is conclusive proof of ECB's

unconventional recovery and stability package, for the 2009 European sovereign debt crisis, coupled with instruments for the global financial crisis of 2007-2008. It then used quantitative easing instruments [ECB, 2021a] worth € 1 trillion. Similarly, ECB handled the 2020 Covid-19 crisis successfully raising €750 billion on the capital markets, [ECB, 2021b] without major money instability.

Further proof of stability of the ECB's monetary policy derives explicitly from the fact that the first strategy review since 2003 [ECB, 2021c] took place in 2021 [ECB, 2021d]. This derives from the earlier ECB proclaimed culture of stability and confidence. Recognition of monetary challenges, which have evolved in this period, is explicated in the announcement of the next review for 2025, therefore in a much shorter period compared to the previous interval. Price stability is defined as a year-on-year increase in the Harmonized Index of Consumer Prices (HICP) for the euro area as a whole of being below 2%, [ECB, 2021c]. In euro area it dominates the strategy review as the major and fundamental objective of ECB with a 2% inflation target. Primary monetary policy instrument is the group of ECB policy rates (rate on the main refinancing operations, rate on the deposit facility and rate on the marginal lending facility). ECB emphasizes potential monetary transmission adjustments and calibration of monetary policy to address global financial challenges that are evidently different compared to 2003. ECB's measurable indicators of stability include: early identification of important sources of system-wide vulnerabilities, assessment of the potential costs to the real economy, usage of warning models and systemic risk indicators coupled with stress testing, the assessment of contagion risks and developing macrofinancial models and macroprudential policies which both link stability to the performance of the economy and monetary aggregates. ECB approach partly originates from IMF methodologies developed around the outbreak of the previous global financial crisis [IMF, 2008; IMF, 2009] indicating a rise in international monetary harmonization.

1.3. Evidence on the theorem of absence of controls as a factor of acceptance

Ontological foundations of the EU single market (free movement of people, goods, services and capital) incorporate cross-border free movement of capital (foreign direct investments investment in real estate and securities, disbursement of loans and personal capital operations). It evolved into an explicitly implementable treaty freedom with the adoption of the Maastricht treaty [Treaty on the Functioning of the European Union, 2021]. The regulatory environment for the free movement of capital incorporates relevant Maastricht Treaty Articles, protocols and declarations and approved temporary policies and decisions. Treaty Article 63 bans all constraints on capital movements and payments limited not to the EU only, but including between EU member countries and nations from exterior to the EU [Treaty on the Functioning of the European Union, 2021]. Contrary to opinions of some economists

[Krugman, 1996] the EU became an international leader in advocating the free flow of capital internationally, proposing reduced or removal of trade barriers inclusive with the development of fairness for investments in which all countries have equal chances of success. This is advocated through multilateral trade agreements and conventions, bilateral investment initiatives and favorable trade agreements and developing meaningful trade and investment negotiations with EU candidate countries and also countries from its Eastern partnership agenda. Since 2014, in line with free movement of capital, the European Commission is planning the EU capital markets union (CMU) in order to develop a genuine single market for capital in the EU. According to the CMU action plan, the European Commission has started working with EU countries to remove any remaining national barriers to the free movement of capital. A technical group exists to discuss barriers to the free movement of capital comprising of delegates from EU countries.

1.4. Exploration of the theorem of strong central state as a factor of acceptance

This is perhaps the most controversial ontological factor of acceptance in the evolution of the euro as an international currency. Contradiction arises in two channels of research: the international regulatory nature of the European Union itself and the ensuing legal character of the eurozone arising out of it. Both issues are highly political and in a state of developmental fluidity in relation to which additional regulations will be agreed. The three-pillar conception of EU institutional evolution has become ubiquitous. The first pillar consists of a single institutional roof, while the second and third still presuppose "cooperation" in the integration of foreign and security policy, internal affairs and justice. In order to define the EU as a strong central state in terms of ontological factors required for an international currency, a single institutional roof on the remaining two pillars would require complete integration. The existing similarities between the order of the union and the national orders of the common states still do not allow us to call the EU a coherent political federal state capable of imposing its influence on the world scene. In the first pillar on economic integration sovereign powers are being moved to the institutions of the Union. However, there still exist differences in labor market regulation and in the fiscal area. This was only partly achieved in the remaining two pillars. Thus, the Union does not yet have the universal jurisdictional characteristic of a central state and cannot create new fields of complete legal competence. On the other hand, although the EU is not a state, it is certainly much more and differently developed versus international organizations established under traditional international law. Their essential similarity is that initially the European Communities were created by agreements that entered into force under international law, which is supposed to supersede national law. Under such a framework the euro area was fully

institutionalized as a monetary union with Eurosystem as the monetary authority consisting of the ECB and the national central banks (NCB) of the 19 member states that are part of the eurozone. The absence of a traditional central state was obviously not an obstacle to achieve stability of monetary policy objectives particularly in relation to inflation and by moving towards institutionally led economic performance [North, 1991].

1.5. Evidence on the theorem of gold reserves size as a factor of acceptance

Gold reserves represent the gold held by a country's central monetary authority and serve as a guarantee to pay off and settle contracts of payment to depositors, note holders, or trading partners. In order to cover costs of inflation and maintain gold reserves governments accumulated gold. Monetary and economic policies relied on its significance. Furthermore, the value of imports and exports from a country is significantly correlated the country's currency [Krugman, 1979] and to gold. If imports exceed exports, the value of the currency declines, and vice versa. In theory, this also implies that a country that exports gold and has a surplus of gold reserves will see an appreciation in the value of its currency. However, mainly the advanced economies used this while developing countries did not benefit much from this solution [Nurkse, 1944]. Finally, gold can also reduce the value of the currency used to purchase it. If transactions are excessively conducted in gold it has an impact on the demand of the local currency and can spur inflation. Many countries, which exercised the gold standard during the 19th and 20th centuries, have since relinquished it but continue to maintain compelling gold reserves. Gold reserves are still very important and governments tend to buy large amounts especially when economic depression begins to rise as a countermeasure against it. According to the World Gold Council, there are roughly 35,553.8 tons of world gold reserves as of November 2021. Currently, a ton of gold is worth about $57.2 million at $1,787 per ounce [World Gold Council, 2021]. The top eleven central banks with the largest gold reserves have remained relatively the same over the past few years. Holders of largest world gold reserves are classified here in Table 4 as follows:

Table 4. World gold reserves in November 2021

	Holder	**Tons**	**% of total foreign reserves**	**Holdings as of**
1	Euro (Incl. ECB)	10,769.0	51.7%	July 2021
2	United States	8,133.5	65.6%	Sep 2021
3	Germany	3,359.1	65.2%	Aug 2021

4	IMF	2,814.0	Not being calculated by IMF	Sep 2021
5	Italy	2,451.8	62.1%	Aug 2021
6	France	2,436.4	57.2%	Aug 2021
7	Russian Federation	2,298.5	21.0%	Sep 2021
8	China, P.R.: Mainland	1,948.3	3.2%	Sep 2021
9	Switzerland	1,040.0	5.3%	Aug 2021
10	Japan	846.0	3.4%	Sep 2021
11	India	744.8	6.5%	Sep 2021
12	Netherlands, The	612.5	54.8%	Aug 2021

(Source: World Gold Council (2021). Access [02.11.2021] https://www.gold.org/goldhub/data/monthly-central-bank-statistics)

Reference to Table 4 shows an exceedingly important result as it extends the definition of an international currency to the euro now with 30% of global gold reserve holdings, which defend the euro. This factor of currency acceptance clearly works to its advantage. We deduce that settlements in one currency of the eurozone also allow economizing in gold and dollars. This result explicitly confirms the factors of acceptance of the more general currency theory in the case of the euro. Indicatively major Asian countries and Switzerland maintain a low share of gold reserves in total foreign reserves and have other strategies.

1.6. Evidence on theorem of interest rates and inflation as factors of acceptance

Fisher was perhaps not the first to introduce notions of interest rates and inflation but his concepts fundamentally initiated their significance laying the foundation for the even more important step of establishing their correlation (Fisher, 1928, p.184; Fisher 1930, p.41, 68, 437). Figures 1-3 show the corridor movement of key ECB interest rates while Figure 4 shows eurozone inflation performance since introduction of the euro (1999-2021).

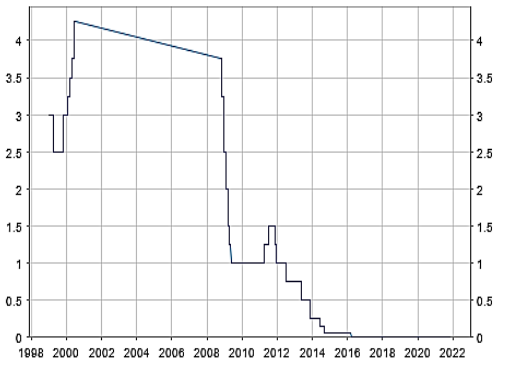

Figure 1. ECB Main refinancing operations key rate. Source: ECB (2021). https://sdw.ecb.europa.eu/ Access [03.11.2021]

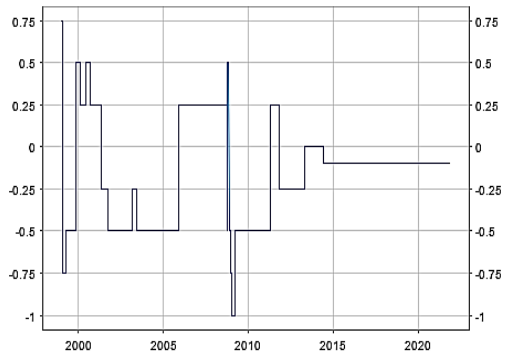

Figure 2.ECB Deposit facility key rate. Source: ECB (2021). https://sdw.ecb.europa.eu/ Access [03.11.2021]

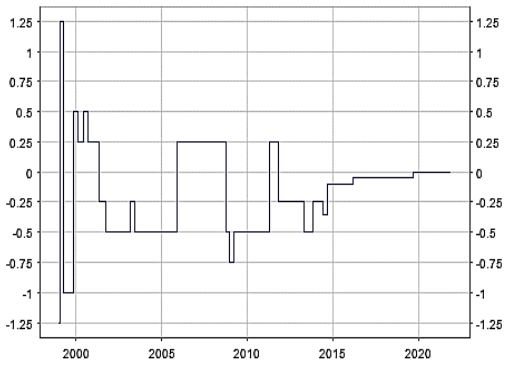

Figure 3.ECB Marginal lending facility key rate. Source: ECB (2021). https://sdw.ecb.europa.eu/ Access [03.11.2021]

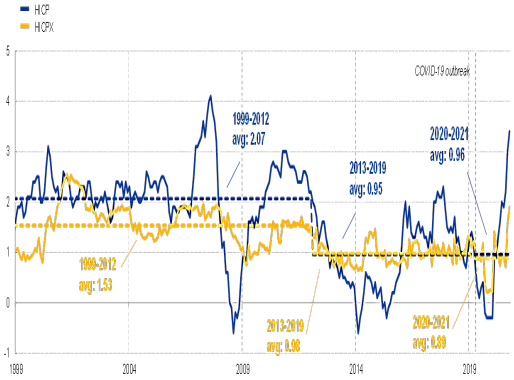

Figure 4. Euro area headline and core HICP inflation. Source: ECB (2021e). [03.11.2021] https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp211007~ab617e7d60.en.html

Reference to Figure 1 shows that the interest rate on the main refinancing operations had a stable downward trend from 2001 through 2009 when it fell very steeply from 3.75% to 1% followed by brief stability until 2011 and by another steep fall from 2012 through 2016. Reference to Figures 2 and 3 shows that both deposit facility and marginal facility moved within predetermined corridors of flexibility

from 2000 through 2012 before gravitating toward zero levels in the remaining performance period. From 2015 the deposit facility became very slightly negative, while the marginal lending facility was negative from 2012 through 2018 (still within corridors). Indeed, all three key ECB rates clearly gravitate towards negative or zero levels from 2014-15. Figure 4 illustrates inflation performance. Reference to Figure 4 shows the main finding that average inflation was well within predetermined corridors throughout the performance period varying between 0.89% and 1.53%. During the whole performance-rating period inflation in the eurozone was in corridor. There were clear short-term spikes after the global financial crisis in 2008 and the Covid-19 epidemic in 2021. Figure 4 proves effectiveness in reducing inflation after the global financial and sovereign debt crises (2007-2009) with V-shaped deflationary spikes in 2009-2010 and 2015. The ECB currently maintains a symmetric mid-term 2% inflation target. In the coming mid-term it remains to be seen if the ECB will succeed in reducing the 4% Covid-19 generated inflation from 2021 to the expected level of 2% [ECB, 2021].

1.7. Evidence of international reserves as a factor of currency acceptance

Data proves the retained leading role of the U.S. dollar in foreign exchange reserves. Table 5 also proves the second most significant position held by the euro.

Table 5. World Currency Composition of Official Foreign Exchange Reserves, M USD

	2018 Q4	2019 Q4	2020 Q4
Total Foreign Exchange Reserves	11,436,228.34	11,826,502.96	12,700,757.73
Allocated Reserves	10,727,332.96	11,076,259.66	11,870,903.60
Claims in U.S. dollars	6,623,400.66	6,725,907.36	7,005,835.16
Claims in euro	2,217,600.97	2,279,470.66	2,521,792.79
Claims in Chinese renminbi	203,084.79	214,460.44	267,518.07
Claims in Japanese yen	556,937.81	652,004.78	715,832.20
Claims in pounds sterling	474,875.71	513,518.25	557,191.73
Claims in Australian dollars	174,463.04	187,881.65	216,113.12
Claims in Canadian dollars	197,216.33	205,988.80	245,770.97
Claims in Swiss francs	14,782.38	16,564.40	20,739.25
Claims in other currencies	264,971.26	280,463.32	320,110.32
Unallocated Reserves	708,895.38	750,243.30	829,854.13

Shares of Allocated Reserves	93.80	93.66	93.47
Shares of U.S. dollars	61.74	60.72	59.02
Shares of euro	20.67	20.58	21.24
Shares of Chinese renminbi	1.89	1.94	2.25
Shares of Japanese yen	5.19	5.89	6.03
Shares of pounds sterling	4.43	4.64	4.69
Shares of Australian dollars	1.63	1.70	1.82
Shares of Canadian dollars	1.84	1.86	2.07
Shares of Swiss francs	0.14	0.15	0.17
Shares of other currencies	2.47	2.53	2.70
Shares of Unallocated Reserves	6.20	6.34	6.53

(Source: IMF (2021). https://data.imf.org/regular.aspx?key=41175 Access [26.06.2021])

1.7.1. Longevity of the currency as a factor of acceptance

Table 5 proves that since official introduction on 1 January 1999 the euro became the second largest reserve currency and second most frequently traded currency after the US dollar. No other currency gained such international prominence in such a short period.

1.8. Final canonical ranking of the euro as international currency

Table 6 investigates detailed currency rankings arising from our previous sections:

Table 6. Comparison of observed major currency area ranks

	Criterion	Scale	Euro zone	US	China	d:€/$	d^2	d:€/ CNY	d^2
1	GDP	1-3	3	1	2	2	4	1	1
2	Exports of goods & services	1-3	1	3	2	2	4	1	1
3	Population	1-3	3	2	1	1	1	2	4
4	OTC FX turnover	1-9	2	1	8	1	1	6	36
5	Stock market capitalization	1-10	3	1	2	2	4	1	1

6	Stock market no. of firms	1-10	3	1	2	2	4	1	1
7	Size of gold reserves	1-12	1	2	8	1	1	7	49
8	Share in currency reserves	1-9	2	1	6	1	1	4	16
-	Number of leading positions	-	2	5	1	-	-	-	-
	Σd^2	-	-	-	-	-	20	-	109
	Key: 1st column based on previous sections. 2nd column is ordinal descending scale is 1 to 3 (lowest);								

(Note: US and China treated as currency areas. For stock markets, Euronext and Deutsche boerse together, Shenzhen and Shanghai Stock Exchanges together. **Source**: Calculations by the author)

We consider Spearman's rank correlation of the euro the US dollar and Chinese renminbi:

$$R = 1 - \frac{6\sum d^2}{n(n^2-1)} \qquad (1)$$

Correlation between the euro and the US dollar, R1 Chinese renminbi, R2 and is

$$\boldsymbol{R_1} = 1 - \frac{6\times 20}{8(64-1)} = 1 - 0.238 = +0.762 \; \boldsymbol{R_2} = 1 - \frac{6\times 109}{8(64-1)} = 1 - 1.297 = -0.297$$

At this stage, we shall only stress the following features of observables in Table 6:

a) With five leading positions the US dollar retains a position of leading currency;
b) Out of eight measurable observables the euro has achieved two leading, two second and four third positions against the US dollar and Chinese renminbi;
c) The value of Spearman's rank correlation coefficient for the euro and the US dollar of +0.762 indicates a very high degree of same direction reciprocity;
d) Spearman's rank correlation coefficient for the euro and Chinese renminbi of
e) -0.297 indicates very weak opposite direction reciprocity, that can be neglected.

CONCLUSION

We should like to point out that we have confirmed our qualitative impression of the role of the euro as an international currency. By an adequate canonical review we have shown that the effects of euro evolution naturally fit into two components: the institutional-legal part and the financial-transaction part. With euro, despite the strangeness of the institutional setup, there is evidently something to it. The fact that all key epistemological observables now known satisfy the criterion of acceptance are then proof of the validity of our postulate. However more questions than answers remain. Indeed, Krugman has implied under what conditions do financial and

monetary policy avenues become contradictory, like through the revival of the ERM 1992-1993 crisis or the Mexican peso crisis of 1994 [Krugman, 1996]. Potential new government asymmetric failures emphasized by Mishkin that produced the Korean financial crisis of 1997 [Mishkin, 2000] with spillover effects are also dangerous issues. Remembering certain fiscal differences in the eurozone, which were in fact addressed by ECB after the global and sovereign debt crises of 2007-2009, could the Argentine 1998-2002 crisis, be repeated? What is the relationship between formal and informal pressures on monetary policy addressed by Fisher who challenged the bipolar exchange regime [Fisher, 2001]? Why do informal financial pressures exert influence on the long-run character of monetary policy? How does a central bank develop not only formal but also the informal restraints on banks and businesses [Mishkin, 2007]? These are only some related epistemological questions that exceed the present scope of our work. Obviously, there is still a long way to go for omnipresent policies, but our study of currency theory provides some signals for its developmental transformation and monetary-financial performance.

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