

# Origin and dynamics of Bolivar Republic of Venezuela's Hyperinflation

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## Abstract

La più recente iperinflazione verificatasi nei paesi emergenti è quella del Venezuela, peraltro tuttora in corso. Come in altri episodi di iperinflazione passati quella venezuelana trae origine dal finanziamento monetario di ampi squilibri fiscali. In un paese in cui larga parte delle entrate pubbliche derivano dalle esportazioni di petrolio, tali squilibri sono derivati principalmente dalla caduta del prezzo del petrolio intervenuta nel 2014. La dinamica dell'iperinflazione venezuelana ha presentato regolarità comuni alla gran parte degli altri episodi di questo tipo. Nel corso di essa la domanda di real balances si è prima elevata per poi seguire un path decisamente discendente. Nello stesso tempo, la persistenza dell'inflazione è significativamente diminuita. Questi due processi si sono accompagnati ad una forma di learning nella formazione delle aspettative, divenute nel tempo razionali. In questo contesto la dinamica dei prezzi è stata dapprima più lenta e, poi, più rapida del deprezzamento del tasso di cambio.

[Aggiungere Thier](#)

## 1. Introduction

Hyperinflations are characterized as periods of anomalous price growth. In his classic work, Cagan (1956) defined hyperinflation as occurring when monthly rate of price rises exceeds 50 per cent. According to this definition, in the last twenty-five years only three countries have experienced such episodes: Bulgaria (1997), Zimbabwe (2007), and most recently Venezuela (2016). In this last country hyperinflation is still in progress and in the last part of 2016 it started to become explosive. Official figures on price growth in Venezuela are not available since 2015. However, IMF estimates indicate that the country's annual price growth rate at the end of 2018 was around 800 thousand per cent.

As is well known, two main hypotheses have been put forward to explain the origin of hyperinflations: the fiscal hypothesis and the balance of payments hypothesis. According to the former, hyperinflations are the result of fiscal imbalances and their coverage with money. By contrast, according to the balance

of payments hypothesis, the acceleration of inflation typical of hyperinflation results from a real depreciation of the exchange rate caused by a Balance of Payment (BoP) crisis or a sudden stop.

Entrambe queste ipotesi riconducono l'origine degli episodi di iperinflazione ad uno shock; ciò vale anche per il Venezuela. Infatti, as has happened in other Latin American countries, Venezuelan hyperinflation was preceded by a period of chronic two-figure inflation and, as happens in most cases, la crescita dei prezzi è diventata esplosiva because of a shock. The shock in this case was the fall in the price of oil, whose export constitutes over 90 per cent of Venezuela's total exports, allowing the government to obtain from it a substantial share of its revenue in the form of taxes and royalties. [The marked fall in the price of oil that occurred midway through 2014 determined a decline in government revenue from oil exports. In corrispondenza di ciò è diventato problematico per il governo dare copertura fiscale alla spesa pubblica, il cui ammontare era aumentato significativamente nel 2011 e nel 2012, the two year period to the 2012 presidential elections. Given the difficulties of resorting to further foreign debt because of the reduced confidence in the country's solvency, the Venezuelan government covered the increasing tax deficit by creating money, whose excessive growth led to growing inflation and, from 2016 onwards, generated hyperinflation. **Forse accorcerei questa descrizione ]**

L'iperinflazione venezuelana sembra, dunque, riconducibile all'ipotesi fiscale piuttosto che a quella della bilancia dei pagamenti, anche se è vero che negli anni ad essa precedenti il Venezuela è stato afflitto da ingenti capital outflows. Questi ultimi, tuttavia, sono stati continui e persistenti, non hanno causato, cioè uno shock come accade nel caso di un sudden stop. Conseguentemente, il tasso di cambio ufficiale è stato deprezzato gradualmente con successivi atti del governo.

#### **Cosa si fa nel paper**

Una vasta letteratura ha mostrato che the dynamics of hyperinflation show regularities. Tra queste regolarità la più discussa è senza dubbio quella relativa al trend of money in real terms, first increasing and then decreasing. Cagan (1956) riconduce questo processo al ritardo con cui gli individui adeguano le proprie aspettative rispetto alla realtà. In Cagan, ma anche in molti studiosi che ipotizzano aspettative razionali, *in primis* Sargent and Wallace (1973), demand for money during hyperinflation is discussed by referring to a close economy. Opportunamente, Dornbusch et al. (1990) has observed that, especially when considering a very open economy, as Venezuela, it is appropriate to take into account the foreign sector, and in particular the exchange rate. Accordingly, this contribution follows Abel et al. (1979) and Taylor (1991) in suggesting that during hyperinflation and in a small open economy, money cannot only be replaced by real goods but also by foreign financial assets. **Cosa si fa nel paper**

È plausibile che il grado di sostituibilità della moneta con beni e attività alternative muti nel tempo in relazione alle aspettative.<sup>1</sup> Lo stesso processo di formazione di queste ultime cambia nel tempo. Si recepisce qui l'ipotesi avanzata da diversi studiosi<sup>2</sup> che, in episodi di iperinflazione, gli individui apprendano col tempo a formarsi aspettative razionali.<sup>3</sup> Tale ipotesi helps explain better why in Venezuela at the tipping point from high inflation to marked hyperinflation there was a process of replacing domestic money with foreign money. Di questi aspetti si cerca qui di dare una conferma empirica. In particolare, si cerca di mostrare che quando l'inflazione venezuelana è diventata esplosiva, da un lato si è completato il processo di convergenza towards a steady state rational expectations equilibrium, dall'altro lato, vi è stato un Thiers' effect, that is a "... substitution of the unstable money by stable money ..., that is by specie, or ... by more stable (state) paper money".<sup>4</sup> **Dividere**

The changes in expectations hanno avuto inevitabili riflessi sulla dinamica dei prezzi e sul tasso di cambio. L'interdipendenza tra queste due variabili ha dato luogo ad una spirale che ha drammaticamente aggravato gli squilibri di finanza pubblica, inducendo il governo ad un crescente ricorso alla tassa da inflazione e al signoraggio. Data la pronunciata diminuzione dei real money balances quest'ultimo, a partire dal 2017, è andata riducendosi, collocandosi, quindi, sul lato decrescente della Inflation Tax Laffer Curve (ITLC).

The paper proceeds as follows. Section 2 provides a short survey of the literature on the causes of hyperinflations. In the third section we attempt to explain the origins of Venezuela's hyperinflation and to identify some of the regularities found in most episodes of hyperinflations. The fourth section is divided into three subsections. In the first we test the hypothesis of changes in the formation of individuals' expectations about the inflation rate, in particular from advanced inflation to hyperinflation. In the second subsection we carry out an econometric **test** of the Thiers' Law. The last subsection is devoted to an analysis of the amount of seigniorage. The conclusions provide not only a summary of the questions discussed in the previous sections but also some indications as to the prospects that Venezuela's hyperinflation will end and policy choices designed to ensure this happens. **[controllare]**

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<sup>1</sup> See Bernholz (2003).

<sup>2</sup> See, in particular, Marcet and Nicolini (2003).

<sup>3</sup> See in particular Marcet and Nicolini (2003).

<sup>4</sup> Bernholz (2003; p. 61).

## 2. A glance at the literature on hyperinflation

Hyperinflation phenomena are defined as periods of particularly high inflation. In his seminal 1956 work, drawing on the experience of European countries between 1920 and 1946, Cagan identified the date of the beginning of a hyperinflation as the month in which monthly inflation exceeded 50 per cent and the end as the month in which inflation had been below 50 per cent for at least a year.<sup>5</sup> The explosive character and short duration of hyperinflations means that they differ from the situations of chronic inflation that often beset emerging countries and are characterized by persistence in time and fundamental stability of the level of inflation.<sup>6</sup> This does not change the fact that it is almost always such countries that are afflicted by episodes of hyperinflation.

Explanations for the origins of such episodes basically correspond to two hypotheses: the fiscal hypothesis and the balance of payment hypothesis. The fiscal hypothesis can be traced back to Friedman's assertion that "... inflation is always and everywhere a monetary phenomenon". Working within this context, Cagan (1956) advanced the theory about hyperinflation processes by including expectations in the demand for money and tracing the inflationary spiral back to them with the exogenously given growth of money as the ultimate cause of the process.

In their development of Cagan's analysis, Sargent and Wallace (1973) maintain that the continuous and accelerated growth of money stems from a fiscal imbalance financed by printing money. On the basis of the hypothesis of rational expectations advanced by Sargent and Wallace and the hypothesis of the exclusively monetary coverage of fiscal deficits we have feedback from expected inflation to the creation of money. Given the government's need for seigniorage in real terms, the money supply adapts to expected inflation, and thus it is endogenous.<sup>7</sup>

The financing of fiscal deficits with money and processes of hyperinflation are frequent in times of war.<sup>8</sup> In times of peace, from a perspective of public choice this can be brought back to the need felt by the government to reinforce its support and consolidate its power.<sup>9</sup>

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<sup>5</sup> Fischer et al. (2002) regard as phases of hyperinflation those in which prices exceeded 100 per cent a year.

<sup>6</sup> See Pazos (1972).

<sup>7</sup> See Sargent and Wallace (1973).

<sup>8</sup> See Capie (??).

<sup>9</sup> See Bernholz (2001; 2003) and Breman and Buchanan (1981). The financing of public spending by means of money is consistent with this objective if, in a democracy, the number of individuals damaged by inflation is a minority, or, in the case of the damaged individuals being the majority, if a portion of them can be compensated in some way; and in the case of an autocratic regime, if the leaders are chosen by a selectorate whose members are not damaged by inflation.

In the balance of payments (BoP) hypothesis, on the other hand, hyperinflation can be explained in terms of a balance of payments crisis. Tale crisi può derivare da squilibri tra importazioni e esportazioni oppure da un sudden stop, ovvero da un subitaneo reversal of capital inflows.<sup>10</sup> In quest'ultimo caso un cambiamento di aspettative riveste un ruolo decisivo nel determinare una crisi valutaria. Tale cambiamento può essere indotto da fattori diversi, come l'emergere di una rilevante instabilità politica,<sup>11</sup> o mutamenti nel mercato monetario e finanziario internazionale.<sup>12</sup>

A BoP crisis leads to a marked depreciation in the exchange rate followed by an increase in imported inflation when there are mechanisms di salvaguardia del potere d'acquisto dei salari dovuti, as shown by Liviatan and Piterman (1986) to their indexation o alla forza of trade unions che difendono il potere d'acquisto dei lavoratori.<sup>13</sup> The rapid adaptation of wages to price dynamics produces an inflationary spiral.<sup>14</sup>

Le due ipotesi appena menzionate danno spiegazioni diverse, oltre che delle origini, del modo in which an inflationary spiral develops and thus there are different indications as to which measures to adopt to put an end to hyperinflation.<sup>15</sup> Nell'ipotesi fiscale la spirale inflazionistica deriva dall'interdipendenza tra inflazione, disavanzi fiscali e crescita della moneta. In quella della BoP essa deriva, invece, dall'interazione tra tasso di cambio, crescita dei prezzi e salari.<sup>16</sup>

The truthfulness of the two above-mentioned hypotheses has been subjected to various empirical tests, often based on Granger causality tests designed to establish whether causality runs from exchange-rate changes to money growth or from money growth to exchange-rate changes.<sup>17</sup>

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<sup>10</sup> See, among others, Calvo (2000).

<sup>11</sup> Si veda quanto accaduto in Messico nel 1994.

<sup>12</sup> Un esempio in questo senso è rappresentato dagli effetti dei cambiamenti dell'impostazione della politica monetaria dei paesi avanzati nei primi anni 1980s sui movimenti internazionali di capitali. La mutata direzione di questi ultimi fu all'origine dei sudden stop che colpirono diversi paesi latino-americani e, in alcuni casi, degli episodi di iperinflazione da cui furono interessati.

<sup>13</sup> Su questi aspetti see also Moutiel (1989).

<sup>14</sup> The balance of payments hypothesis does not exclude the idea at all that hyperinflation can result from imbalances in public finances. Indeed, it can happen that a country prefers to finance persistent fiscal deficits not only with money but at least in part with debt held by non-residents. In the case in which at some point this debt is perceived by investors as unsustainable or there is a change in the state of the international financial market, a sudden stop occurs and there is an exchange rate crisis with a consequent acceleration in the domestic rate of inflation.

<sup>15</sup> See Kiguel (1992).

<sup>16</sup> See Dornbusch et al. (1990).

<sup>17</sup> See, among others, Fischer et al. (2002), Moutiel (1989) and Dornbusch et al. (1990).

Fischer et al. (2002) show that the episodes of hyperinflation since the second world war in some cases were brought about by a real depreciation in the exchange rate, in others by the excessive creation of money. Quasi sempre nei paesi emergenti lo shock da cui deriva l'iperinflazione si inserisce in una situazione di inflazione cronica. La transizione da quest'ultima alla crescita esplosiva dei prezzi si associa ad una diminuzione della persistenza del tasso di inflazione. Secondo la gran parte degli studiosi tale processo sarebbe da ricondurre to the shortening of contracts che si registra quando l'inflazione accelera e diventa esplosiva.<sup>18</sup>

Studies on hyperinflations have concentrated not only on their origins but also on their dynamics. In this context frequent empirical regularities have been found. La empirical regularity più nota e discussa regards l'andamento of real monetary balances. During hyperinflation their amount inizialmente increases and subsequently, with the pronunciato rise in the inflation rate, falls. Cagan (1956) explains this fact by hypothesizing the existence of adaptive expectations. In the hypothesis of rational expectations the trend of real balances is explained in two different ways: some scholars maintains perfect foresight but abandon the Cagan money demand function<sup>19</sup> while others assume some imperfections in money markets or a process of learning in the formation of expectations.<sup>20</sup>

In quest'ultimo contesto si ipotizza che gli individui, nella modalità di formazione delle aspettative, convergano verso uno schema di perfect foresight. Questo approccio consente non solo di spiegare l'andamento of the demand for real balances, ma anche le ragioni della cosiddetta Thiers' Law, ovvero del fatto che quando l'iperinflazione è consolidata vi sia massiccia sostituzione della moneta "cattiva" con moneta "buona", in genere valuta estera.<sup>21</sup>

L'elevata inflazione e il Thiers' effect si associano inevitabilmente ad un tendenziale deprezzamento nominale del tasso di cambio.<sup>22</sup> Nominal depreciation of the exchange rate che si associa inevitabilmente agli episodi di iperinflazione has repercussions on the government budget if the government obtains revenue from exports and if the country has foreign debt In particular, in this latter case, as a consequence of the depreciation of the exchange rate the equivalent in national currency of the debt increases as does its service. This reflects negatively not only on the budget balance, but also

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<sup>18</sup> See Sargent (1982) and Kiguel and Liviatan (1989).

<sup>19</sup> See Vasquez (1998) and Sutierrez and Vasquez (2004).

<sup>20</sup> See Marcet and Nicolini (2003) and Adam et al. (2006).

<sup>21</sup> See Bernholz (1989; 2003).

<sup>22</sup> Ciò anche quando un paese adotti politiche di crawling peg allo scopo di contrastare l'inflazione importata.

on the balance of payments. Ne può derivare una situazione di insostenibilità del debito estero.<sup>23</sup> Anche in assenza di debito estero un'elevata inflazione ha negative repercussions on the budget balance because of the Oliveira-Tanzi effect.<sup>24</sup> This leads to a worsening of fiscal imbalances and conduce the government to create additional money, in other words, greater use of seigniorage, thus further driving inflation.<sup>25</sup>

### 3. Hyperinflation in Venezuela: stylized facts

In the past, various countries in Latin America have been affected by chronic inflation. These have been attributed to the extreme political instability of these countries<sup>26</sup> and to the frequent emergence of populist regimes.<sup>27</sup> For much of the 2000s, Venezuela was also afflicted by chronic inflation (Table 1).<sup>28</sup> Come accaduto nel caso di altri paesi dell'America Latina, anche in Venezuela "the chronic fiscal imbalances eventually became an unsurmountable obstacle, and inflation moved away from the fragile high inflation equilibrium into hyperinflation".<sup>29</sup>

At the beginning of 2013 inflation in Venezuela underwent a significant acceleration. Starting in July 2015, annual price growth exceeded 100 per cent. It surpassed the rate of 50 per cent a month in October 2017. By the end of that year the rate of inflation was 2585 per cent.<sup>30</sup> In 2018, according to

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<sup>23</sup> È quanto accaduto a diversi paesi dell'America Latina negli anni 1980s, in particolare all'Argentina, Brasile e Bolivia. Questi paesi, a causa di ingenti deflussi di capitale, di cui si è detto alla nota ? furono interessati da un pronunciato deprezzamento della loro valuta nazionale e, quindi, da un significativo aumento del servizio del debito estero contratto negli anni precedenti.

<sup>24</sup> Quest'ultimo consiste nel fatto che in fasi di inflazione si ha un deterioramento of the real tax proceeds collected by the government. Tale deterioramento è dovuto to the time elapse between il momento in cui il reddito tassabile è prodotto e quello in cui le tasse vengono riscosse.

<sup>25</sup> High inflation can have positive repercussions on the national budget attraverso l'erosione del valore reale del debito interno. Tale effetto è stato particolarmente rilevante dopo le due guerre mondiali nel caso dei paesi avanzati. However, in emerging countries, where debt in national currency is contained, these positive effects are modest and the negative repercussions of hyperinflation on the state budget tend to prevail

<sup>26</sup> See, among others, Paldam (1987).

<sup>27</sup> See, in particular, Dornbusch and Edwards (1991).

<sup>28</sup> On possible explanations for chronic inflation see, among others, Dornbusch (1985) and Kiguel and Neumeier (1992).

<sup>29</sup> See Kiguel and Liviatan (1992; p. 48).

<sup>30</sup> The Venezuela central bank stopped publishing inflation data in 2015. The unofficial data come from estimates provided by IMF and Hanke (??). On this point, see Hanke and Bushnell (2017).

opposition data, the annual rate of price increases in Venezuela had exceeded 80 thousand per cent<sup>31</sup> and, according to others, even a million per cent.<sup>32</sup>

Table 1 – Bolivarian Republic of Venezuela: economic indicators

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Real GDP growth	4.8	-3.3	-1.5	4.2	5.5	1.3	-3.9	-6.2	-16.6	-14.0
Rate of inflation <sup>1</sup>	30.9	25.1	27.2	27.6	20.1	56.1	68.5	180.9	274.4	2585.8
General Government revenue (%GDP) <sup>2</sup>	31.4	24.6	21.2	27.9	25.1	28.1	30.3	19.2	14.7	14.5
General Government expenditure (%GDP)	31.9	29.3	30.2	37.9	37.3	35.0	42.7	35.0	34.1	40.6
Budget balance (%GDP)	-0.3	-4.7	-9.0	-10.0	-12.2	-6.9	-12.4	-25.8	-19.4	-26.1
Central government public debt (%GDP)	14.0	18.2	29.0	25.1	27.5	32.9	28.5	29.6	n.a.	n.a.
- Domestic	4.5	7.5	14.0	11.3	15.6	20.1	19.5	22.2	n.a.	n.a.
- External	9.5	10.7	14.9	13.7	11.9	12.8	9.0	7.3	n.a.	n.a.
Current account capital and financial balance (%GDP)	-22.2	-10.7	-13.6	-20.4	-3.6	-9.2	-4.3	14.6	n.a.	n.a.
Foreign exchange reserves (mln. \$)	33098	21703	13137	9930	9900	6038	7457	6324	3265	1931
M2 growth	28.8	33.2	28.6	32.7	43.6	54.3	66.0	97.7	163.6	
M2 in real terms	191.2	186.8	185.1	219.3	293.8	318.0	312.0	219.6	154.6	70.3
GDP/M2	3.54	3.02	3.45	3.05	2.28	1.86	1.51	1.52	2.70	2.01

Source: IMF - Regional Economic Outlook Database.

The acceleration of the rate of inflation during the course of 2013 appears to have been due to the significant acceleration in the growth of money that started in 2012 (Table 1). This in turn can be seen as due to the expansion of the primary deficit in the public sector, whose impact on GDP rose from 10.0 to 13.8 per cent between 2011 and 2013. In this space of time, in the run-up to the Presidential election of October 2012 Chavez increased public spending to an extraordinary extent, especially on housing infrastructure and social development programmes.<sup>33</sup> The impact of this rose in 2011 by over 7 percentage points as against the previous year (Table 1). However, the increase in public spending was financed only in part by the increase in government revenue due to the rise in the oil price verificatosi

<sup>31</sup> According to Hanke (??).

<sup>32</sup> According to the IMF (??).

<sup>33</sup> See Vera (2015).



nel 2011.<sup>34</sup> For the rest, the government resorted to money creation determinando un'accelerazione del tasso di inflazione. La politica fiscale espansiva consentì al governo di attutire gli effetti della recessione indotta dai riflessi sul commercio estero, e quindi sulle esportazioni di petrolio, dalla crisi globale del 2008.<sup>35</sup> Essa, tuttavia, comportò un sensibile aumento della domanda interna, in particolare dei consumi. Ne derivarono un pronunciato aumento delle importazioni e dei prezzi interni.

Il tasso di inflazione accelerò ulteriormente in modo significativo dopo il 2014. A metà di quell'anno, infatti, the oil price fall. Conseguentemente, the government revenue from oil export diminished consistentemente e con esso il totale del government revenue. In corrispondenza della rigidità della spesa pubblica a ciò è conseguito un sensibile ampliamento del fiscal deficit. More precisely, between 2014 and 2016 the primary deficit in the public sector increased by almost 4 percentage points (Table 1). In corrispondenza dell'accelerazione del tasso d'inflazione, all'ampliamento del disavanzo dello stato ha presumibilmente contribuito anche l'Oliveira-Tanzi effect. È, tuttavia, da ritenere che tale contributo sia stato relativamente contenuto data la modesta incidenza delle imposte dirette sul gettito complessivo dello stato venezuelano. Date le crescenti difficoltà a finanziarsi con debito estero,<sup>36</sup> the government covered the growing fiscal deficit mainly by means of seignorage. Money growth continued to accelerate in 2016 and 2017 (Table 1). The inflation rate skyrocketed since the autumn, and in 2017 esso ha superato il 50 per cento al mese. Trova così, nel caso del Venezuela, ulteriore conferma la tesi avanzata in diversi contributi<sup>37</sup> secondo cui, diversamente da quanto accade nei paesi avanzati, nei paesi emergenti e in via di sviluppo i disavanzi pubblici si accompagnano quasi sempre ad elevata inflazione. Tale regolarità economica è probabilmente riconducibile alla bassa capacità fiscale di questi paesi e al fatto che essi spesso soffrono del cosiddetto original sin.<sup>38</sup>

L'accelerazione del tasso di inflazione intervenuta tra il 2013 e il 2017 si è associata ad un progressivo e costante deprezzamento del bolivar sul mercato parallelo. Per contro, il tasso di cambio ufficiale è stato svalutato solo a intervalli di tempo anche prolungati.<sup>39</sup> Pertanto, esso è stato persistentemente

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<sup>34</sup> Allo scopo di accrescere queste risorse the official exchange rate was devalued in January 2011. See Kulesza (2017).

<sup>35</sup> Il successo di questa manovra conferma quanto sostenuto da Auerbach and Gorodnichenko (2012) in merito all'efficacia della politica fiscale in fasi recessive.

<sup>36</sup> Dovute sia alla caduta of the government revenue on oil exports sia alle cattive relazioni del Venezuela con gli Stati Uniti.

<sup>37</sup> See, among others, Catao and Terrones (2005).

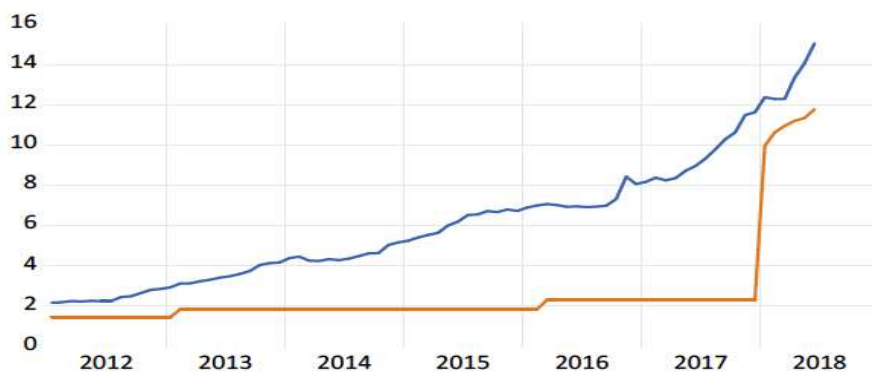
<sup>38</sup> That is the situation in which a country is not able to borrow abroad in its domestic country. See Eichengreen et al. (2002).

<sup>39</sup> Nel ???

sopravalutato in termini reali. Tale sopravalutazione è stata l'esito della politica adopted by the Venezuelan monetary authorities, who used strict foreign exchange controls and currency reserves accumulated in the period of the oil boom to peg the currency to the dollar in an attempt to make it less difficult for citizens to purchase imported goods, in particular food and manufactured products. La sopravalutazione in termini reali del cambio ufficiale, sostenendo le importazioni e penalizzando la competitività delle esportazioni, ha contribuito ad un sensibile peggioramento del saldo della bilancia dei pagamenti. I crescenti disavanzi di quest'ultima sono stati coperti attraverso l'utilizzo delle riserve ufficiali il cui importo si è progressivamente ridotto (Tabella 1).

La riduzione graduale delle riserve ha reso via via più difficile la politica di crawling peg. Conseguentemente nel corso del 2017 il livello del tasso di cambio ufficiale si è significativamente avvicinato a quello del cambio nel mercato parallelo (Figura 2). Al pronunciato deprezzamento del cambio ufficiale si è associato un sensibile aumento del controvalore in bolivar del debito estero. Il ripagamento di quest'ultimo è diventato, pertanto, più oneroso e difficile.

Figure 2 – Parallel and official exchange rate



Legend: — Parallel Exchange Rate; — Official Exchange Rate. Source: IMF database and DolarToday.

### 3.1 Origin and persistence of the hyperinflation

Come si è visto, i dati inducono ad escludere che l'iperinflazione venezuelana derivi da una BoP crisis. Allo scopo di trovare una conferma dell'origine fiscale di questa iperinflazione si è proceduto a test di causality. Inizialmente we run a VAR Granger causality test in cui si considerano three variables: the inflation rate, the change of the real official exchange rate, and a proxy for the real fiscal deficit, represented by the change of the ratio of monetary base to prices.

The data consist of monthly time series from 2013.01 to 2017.12. From the results of the VAR Granger causality test given in col. (1) of Table 2 it emerges that the null hypothesis - the variable of interest does not cause inflation - is rejected in the case of the real fiscal deficit, while it is accepted in the case of the real exchange rate.<sup>40</sup> Thus it can be concluded that price growth is caused by increases in real fiscal deficits and not by the change of the real rate of exchange.

Table 2 – VAR Granger Causality/Block exogeneity Wald test (2013.01-2017.12; included observation 58)

	Inflation		Deficit		Real Official Exchange rate	
	Chi-sq	Prob.	Chi-sq	Prob.	Chi-sq	Prob.
Excluded Variables:						
-Deficit proxy	20.0	0.00	-	-	7.1	0.03
-Real Official Exchange Rate	4.8	0.09	5.5	0.06	-	-
-Inflation Rate	-	-	22.7	0.00	25.4	0.00
-All	25.4	0.00	29.1	0.00	32.8	0.00

Conferma di questi risultati si ha from the computation of the variance decomposition nel sistema VAR prima stimato. This function mostra quanta parte dell'errore di previsione di ciascuna variabile possa essere spiegata da innovazioni nelle variabili considerate.

Table 3 – Variance decomposition among the exchange rate, deficit and inflation

Variable	Months in forecast	Innovations		
		Real Exchange rate	Deficit proxy <sup>a</sup>	Inflation
Inflation	1	0.00	0.00	100.00
	5	1.03	15.08	83.89
	8	0.69	28.17	71.14
	12	0.67	46.45	52.87
Real Exchange rate	1	98.86	0.00	0.14
	5	42.39	16.22	41.39
	8	15.04	37.54	47.42
	12	4.90	57.41	37.69
Deficit proxy <sup>a</sup>	1	0.68	81.86	17.45
	5	0.22	18.56	81.22
	8	0.40	9.75	89.84
	12	0.68	20.70	78.62

Source: Authors' calculations. Legenda: <sup>a</sup>The real deficit is proxied by the change of the ratio between base money and the price level.

<sup>40</sup> The null hypothesis is rejected at a level of probability below 5 per cent.

Table 3 shows that the deficit proxy affects significantly inflation. The independent contribution of the real exchange rate to the growth of prices is negligible.<sup>41</sup> Causality tests thus seem to provide confirmation of the plausibility of the fiscal hypothesis as far as Venezuela's hyperinflation. Moreover, this conclusion is consistent with that proposed in numerous studies<sup>42</sup> on the relationship between fiscal deficits and inflation, according to which this relationship is strong and recurrent in countries marked by high levels of inflation.<sup>43</sup>

The sequence of events illustrata nel paragrafo precedente e the Granger causality tests suggest that underlying Venezuela's hyperinflation was the accumulation of substantial fiscal imbalances. In contrast to what had happened in the 1980s in other Latin American countries affected by sudden stops and balance of payment crises, the origin of Venezuela's hyperinflation does not appear to be explicable in terms of the balance of payments hypothesis. The authorities in Venezuela, at least until the latter part of 2017, used a crawling peg regime, preferring for long periods to have an official exchange rate that appreciated in real terms.

Pertanto, diversamente da quanto contempla l'ipotesi della bilancia dei pagamenti, non vi è stato all'origine dell'accelerazione dei prezzi since early 2013 uno shock del settore estero. Come mostra la Tabella 1, grazie anche ai severi controlli sui movimenti di capitali, a partire dal 2012 le fughe di capitali dal Venezuela sono state relativamente contenute.

L'origine fiscale dell'iperinflazione venezuelana ha inciso anche sulla sua dinamica. Il tasso di crescita dei prezzi è accelerato in modo graduale. Tenendo conto della definizione datane da Cagan, si può dire che il Venezuela sia entrato in iperinflazione solo nell'autunno del 2017. Tuttavia, il turing point da inflazione a iperinflazione è stato preceduto da un periodo di progressiva accelerazione della crescita dei prezzi. In questo periodo si possono individuare quattro fasi: Phase 1 corrisponde agli anni dell'inflazione cronica, that is when the rate of inflation was from approx. 20 per cent to 50 per cent (i.e., the months previous to September 2013); Phase 2, when the rate of inflation rose from 50 to 100 per cent (i.e., between October 2013 and June 2015); Phase 3, when the rate of inflation rose from 100 to 200 per cent (i.e., between July 2015 and February 2016); and Phase 4, when the rate of inflation went over 200 per cent (starting in March 2016).

È lecito attendersi che il processo di accelerazione della crescita dei prezzi scandito da queste fasi si sia accompagnato ad una riduzione del grado di persistenza dell'inflazione. Allo scopo di verificare questa

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<sup>41</sup> Both shocks to the inflation rate and to the deficit proxy exert influence on the real exchange rate. The deficit proxy reacts only to inflation.

<sup>42</sup> See, among others, Dornbusch et al. (1990), Fischer et al. (2002) and Catao and Terrones (2005).

<sup>43</sup> On the other hand, it is weak for countries with low inflation. See Catao and Terrones (2005).

ipotesi si è proceduto ad una verifica empirica. In essa, la persistenza dell'inflazione è stata testata e misurata tramite la risposta dei prezzi ad uno shock degli stessi prezzi. Nella stima si sono utilizzate tre variabili: il livello dei prezzi, the amount of broad money e una proxy del forward premium, data dal differenziale tra il livello del tasso di cambio parallelo e quello del tasso di cambio ufficiale. Seguendo l'approccio di Dureval (1999) si sono stimati due modelli VAR:

- 1) Un primo modello unicamente sulle variazioni prime delle tre variabili precedenti,
- 2) Un secondo che aggiunge alle precedenti il livello delle moneta, in termini reali, e del cambio sfasato di un periodo come termini di error correction rispetto al livello di equilibrio di lungo periodo.

Il campione temporale considerato è quello compreso tra il 2008.1 e il 2017.12. Si è, inoltre, tenuto conto del fatto che, quando si fa riferimento ad un periodo di accelerazione inflazionistica, il livello medio dell'inflazione non può essere considerato fisso.<sup>44</sup> Si sono, pertanto, distinte con dummy, le diverse fasi del processo inflazionistico in Venezuela definite in precedenza.

Nella verifica empirica si è paragonata la risposta dei prezzi ad impulsi sui prezzi nei due modelli VAR su tutto il periodo campionario (la cui risposta viene denominata "all") e su un campione temporale limitato alle fasi 3 e 4, ovvero alle fasi di pronunciata accelerazione del tasso d'inflazione e poi di iperinflazione (la cui risposta ad impulso viene denominata "iper").

Come si vede dalla Figura sotto riportata, la stima della risposta media ad uno shock sui prezzi<sup>45</sup> mostra come nelle fasi di inflazione avanzata e di iperinflazione la persistenza dell'inflazione sia in ogni caso decisamente meno accentuata rispetto alle fasi di inflazione "normali". In particolare nel modello nelle differenze prime nelle fasi di iperinflazione l'effetto di persistenza si riduce al di sotto del 10% già a partire dal quarto mese dopo lo shock, mentre nel complesso del periodo tale soglia viene raggiunta solo 13 mesi dopo. Nel Equilibrium correction model, invece, tale ritardo si riduce di un 1 mese, ma comunque la stima della persistenza risulta costantemente inferiore nei periodi di iperinflazione: in effetti, nei primi 5 mesi dopo lo shock la persistenza risulta pari in media al 38% nei periodi di iperinflazione contro un valore del 53% nel complesso del periodo campionario.

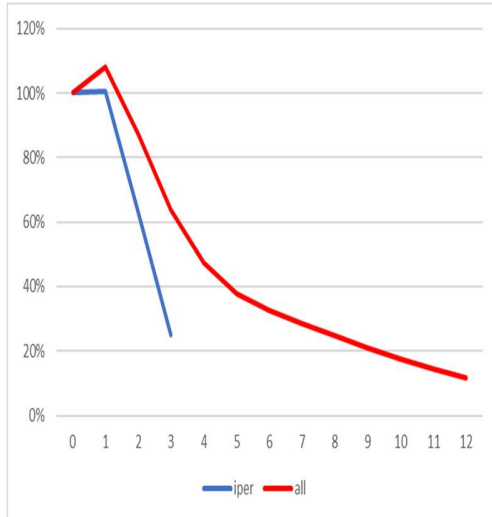
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<sup>44</sup> See, among others, D'Amato et al. (2008).

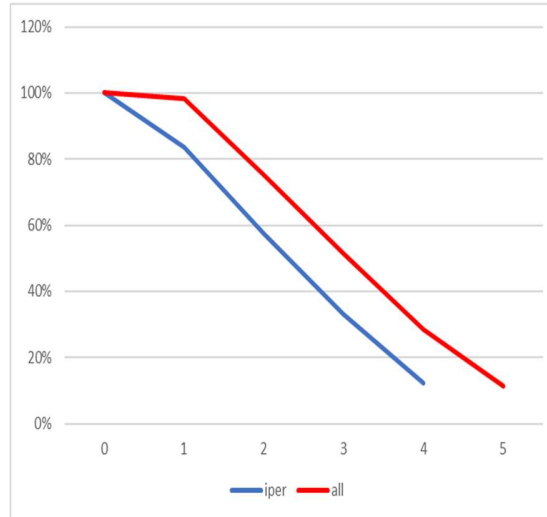
<sup>45</sup> Nel grafico la risposta ad impulso viene riportata fino a quando risulta superiore al 10% dello shock iniziale. In appendice riportiamo anche i relativi intervalli di confidenza che mostrano come la risposta ad impulso divenga non significativa già dal secondo mese dopo lo shock nel caso di iperinflazione, e al quarto nel caso della stima sull'intero periodo campionario.

Figure 1 - Risposta ad impulso (shock iniziale=100%)

Modello in differenze prime  
(a)



Equilibrium Correction Model  
(b)



Come negli altri episodi di iperinflazione, dunque, anche nel caso del Venezuela, la persistenza dell'inflazione si è ridotta in presenza di iperinflazione. Ciò evidenzia una riduzione della rigidità dei prezzi e quindi cambiamenti nei meccanismi di fissazione dei prezzi e dei salari. Tali cambiamenti, come meglio si vedrà nei prossimi paragrafi, sono riconducibili a variazioni sia del quadro istituzionale che del comportamento degli individui, in primis a processi diversi di formazione delle aspettative.

#### 4. Demand for money, expectations and seignorage

As is well known, Cagan (1956) specified a function of demand for money in hyperinflation in which the demand for real money balances depends exclusively on the expected inflation rate. This specification implies the idea of exclusive substitutability between money and real goods. In a context of free circulation of capital or in which controls on capital are not very effective, the currency of a country afflicted by hyperinflation is substitutable also with foreign assets. As we have seen, when this process begins, this produces the so-called Thiers' effect.

The plausibility of this effect in the case of hyperinflation in Venezuela was tested by referring to the contributions by Abel et al. (1979) and, more recently, by Taylor (1991). In these contributions the demand for money is placed in relation not only with the expected rate of inflation but also with the

forward premium on the exchange rate.<sup>46</sup> In this context it is assumed that there is not only a process of substitution between currency and goods, but also between domestic currency and foreign nominal assets. This latter process can be captured by introducing into the equation used by Cagan (1956) not only expected inflation,  $\dot{p}_{t+1}^e$  but also the **forward exchange rate premium**,  $\dot{s}_{t+1}^e$ . In this way, the demand for money in hyperinflation can be written as follows:

$$(1) (m - p)_t = \alpha \dot{p}_{t+1}^e + \beta \dot{s}_{t+1}^e + \zeta_t$$

where  $m$  is the logarithm of money and  $p$  that of the price level and  $\zeta_t$  is a stationary error term. The expected variation in the exchange rate can be interpreted as an indicator of the opportunity cost of holding domestic money rather than foreign currency.

An econometric estimate of equation (1) presupposes the solution of two problems: how to measure the expected rate of inflation and the expected rate of currency depreciation. With regard to the first problem, we do not assume a particular kind of expectations; we simply assume, as in Taylor (1991), that the forecasting error is stationary, that is:

$$(2) \dot{p}_{t+1} = \dot{p}_{t+1}^e + \epsilon_{t+1}$$

where  $\epsilon$  is a stationary process. Therefore, equation (1) becomes:

$$(3) (m - p)_t = \alpha \dot{p}_{t+1} + \beta \dot{s}_{t+1}^e + \eta_t \quad \text{dove } \eta_t = \zeta_t - \alpha \epsilon_{t+1}.$$

The second problem, namely how to measure the expected exchange rate depreciation without having the forward exchange rate for Venezuela, was resolved by using the differential between the parallel and the official exchange rate of the bolivar. In particular, the differential between the parallel exchange rate and the official exchange rate can be considered as a proxy of the premium/discount on current exchange rate. That is to say, we assumed that given a policy of pegging and controls on movement of capital the trend of the parallel exchange rate can capture the expectations of depreciation of the bolivar and, therefore, a component of the cost of holding money in the national currency.

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<sup>46</sup> The exchange rate was used by Frenkel (1976; 1977; 1979) as a rational expectations proxy variable for expected inflation.

For money we used the broad aggregate of money, in other words M2, and for the prices we considered consumer prices, although we are aware that for various goods these are capped and therefore this indicator tends to underestimate Venezuelan inflation.

The period considered in the estimate goes from January 2013 to December 2017. The estimate was not extended to 2018 because of the absence of official data and the uncertain and variable data put forward by international institutions such as the IMF, by ECAL and by the opposition.

The method used in the estimate is cointegration. If, as assumed, the forecasting error in eq. (2) is stationary, the residues of eq. (3) must be  $I(0)$ . Therefore, money, expected inflation and the forward premium must be cointegrated.

The estimate of the cointegrating equation was preceded by unit root tests relative to the different variables used, expressed in logarithms, in other words the broad money,  $m$ , the inflation rate,  $p$ , and the forward premium,  $s^e$ . As is clear from Table 4, on the basis of the ADF and Phillip-Perron tests it can be concluded that all the variables are integrated of order one.

Table 4 – Unit root tests

		ADF test		Phillips-Perron Test	
		t-statistic	Prob.	t-statistic	Prob.
Real Broad Money, $m_t - p_t$	Level	-1.51	0.12	-1.66	0.09
	First difference	-4.05	0.00	-3.88	0.00
Inflation, $\dot{p}_t$	Level	3.37	0.99	4.91	1.00
	First difference	-2.09	0.04	-2.08	0.04
Forward Premium, $s^e$	Level	5.16	1.00	4.52	1.00
	First difference	-1.60	0.10	-5.69	0.00

Legend: the null hypothesis is that the variable has a unit root.

We then proceeded to the cointegration estimates by DOLS. In this estimate we take account of the four phases che hanno caratterizzato l'accelerazione dell'inflazione venezuelana illustrate in precedenza e individuate con le dummy: Phase 1, Phase 2, Phase 3 and Phase 4. This allows us to verify if and how in the different phases the change in behaviour of private individuals might have changed in relation to their expectations of exchange rate depreciation and, thus to gauge the importance of the Thiers' effect. The results of the cointegrating regressions are given in Table 5.

The first column estimates a Cagan-type regression in which demand for real money depends solely on the expected rate of inflation. As expected, this latter variable proves significant and has a negative sign.



Nevertheless, on the basis both of the Engle-Granger and the Phillips-Ouliaris test, real money and inflation are not cointegrated (Table 6).

The degree of cointegration between these variables improves if the forward premium proxied in the way previously illustrated is taken into account, that is to say, by estimating eq. (3). The results of this estimate, given in the second column of Table 5, show that the forward premium has a negative influence on demand for money. Ciò significa che quando vi sono attese di apprezzamento del tasso di cambio la domanda di moneta aumenta, e diminuisce, invece, in corrispondenza di attese di deprezzamento. In column (3) we take into account of the different phases of the acceleration of inflation. Col. (3) shows that the expected exchange rate has a negative influence on demand for money only when the inflation rate is above 100 per cent. Once the phases of inflation are taken into account the equation passes all the cointegration tests. Moreover, as highlighted by the coefficient of this variable in Phases 3 and 4, the Thiers' effect tends to be accentuated when the inflation rate is high. In column (4) the non-significant variables from column 3 have been eliminated. This represents a further improvement in the cointegration tests.

Table 5 – Cointegration analysis: Dependent variable Real money

	Col. (1)	Col. (2)	Col. (3)	Col. (4)	Col. (5)
Constant	1.572*** (0.074)	1.772*** (0.113)	1.556*** (0.080)	1.488*** (0.021)	1.512*** (0.024)
$\dot{p}_t$	-5.075*** (0.757)	-3.405** (1.363)	-1.090*** (0.400)	-1.240*** (0.391)	-1.894*** (0.420)
$\dot{s}_t^e$		-0.093* (0.050)			
$\dot{s}_t^e$ *Phase1			-0.083 (0.062)		
$\dot{s}_t^e$ *Phase2			-0.021 (0.032)		
$\dot{s}_t^e$ *Phase3			-0.056** (0.022)	-0.040*** (0.010)	-0.041*** (0.011)
$\dot{s}_t^e$ *Phase4			-0.140*** (0.022)	-0.123*** (0.009)	-0.118*** (0.011)
Adj. R2	0.80	0.85	0.99	0.98	
Sample period	2013M1-2017M12				
No. Obs	60				
Estimation method	DOLS	DOLS	DOLS	DOLS	VEC

Legend: Standard errors in ().

Table 6 – Engle Granger and Phillip Ouliaris Cointegration tests

	Col. (1)	Col. (2)	Col. (3)	Col. (4)
Engle Granger tau-statistics <sup>1</sup>	-1.44	-2.187	-5.66***	-5.28***
Engle Granger z-statistics <sup>1</sup>	-10.47	-9.629	-174.92***	-125.60***
Phillip-Ouliaris tau-statistics <sup>1</sup>	-1.22	??	-4.65*	-4.41**
Phillip-Ouliaris z-statistics <sup>1</sup>	-5.07	??	-31.61*	-29.58**

Legend: <sup>1</sup>Null hypothesis: Series are not cointegrated; Rejected at \*\*\* 1%; \*\* 5 %; \* 10 % level.

In column 5 we proceeded to a robustness test of the obtained results by changing the method of estimation using, instead of DOLS, the Vector Error Correction (VECM) method. At the preliminary stage we tested the number of cointegration vectors using the Johansen and Juselius method (Table 7). The trace test and the Maximum Eigenvalues test lend support to the thesis that there is only one cointegration vector. The estimate for this vector is given in column 5 of Table 5 and yields results similar to those in column 4, thus confirming the Thiers' Law.

Table 7 – Johansen Cointegration Tests (col. 5 of Table 5)

No. of cointegrating vectors:	Trace test	Maximum Eigenvalues test
None	66.81***	34.71***
At most one	32.09	18.04

Legend: Null hypothesis: No. of cointegrating relations. Rejected at \*\*\* 1%; \*\* 5 %; \* 10 % level.

The empirical facts outlined above show that Thiers' law works only in phases 3 and 4, when inflation reaches particularly high levels.<sup>47</sup> The question then arises whether this presupposes not only higher expectations of exchange rate depreciation but also changes in the behaviour of individuals due to improvements in the process of forming expectations. Therefore, in the next subsection, we will proceed to test this hypothesis.

#### 4.1 Demand for money and evaluation of expectations

As rightly observed by Dornbusch et al. (1990; p. 7) "... in a forward-looking model of inflation, an increase in the growth rate of nominal money immediately raises both the price level and the rate of

<sup>47</sup> Scrive opportunamente Bernholz (1989; p. 485): "... Gresham's law works at an earlier period of the inflation process ....Thier's law will only operate later, when the increase of the now flexible exchange rate and of the rate of inflation lower the real demand for the inflating money".

inflation".<sup>48</sup> In a context of this type real balances should decline instantly, but this does not correspond to the facts. On the other hand, it is difficult to accept the idea implicit in the adaptive expectations hypothesis that individuals over time make the same mistakes without correcting themselves. What appears more probable is the hypothesis put forward by some scholars that with time individuals learn to eliminate the systematic mistakes of their predictions.<sup>49</sup> In this context the stationary rational expectations equilibria constitute the benchmark for a learning process.<sup>50</sup> This hypothesis implies a modification in time of the way in which individuals form expectations.

In order to establish whether this hypothesis applies to Venezuela's hyperinflation we follow the procedure proposed by Beladi et al. (1993) to test whether price expectations are adaptive or rational. By applying this method starting from our preferred specification, namely the demand function at the basis of col. (4) of Table 5, as shown in Appendix A, we derive the price equation and the restrictions implied by the rational expectations (RE) and the adaptive expectations (AE) assumptions. The price equation under rational expectations for the entire sample period of estimate, that is 2013.01-2017.12, is the following:

$$(4) p_t = \alpha_0 + \alpha_1 p_{t-1} + \alpha_2 m_{t-1} + \alpha_3 \dot{s}_{t-1}^e * Phase3 + \alpha_4 \dot{s}_{t-1}^e * Phase4 + \varepsilon_t$$

As shown in the Appendix, the AE formulation of the price equation, besides the explanatory variables of the RE formulation, has some additional variables, and is specified in this way:

$$(5) p_t = \beta_0 + \beta_1 p_{t-1} + \beta_2 m_{t-1} + \beta_3 (m_t - m_{t-1}) + \beta_4 \dot{s}_{t-1}^e * Phase3 + \beta_5 \dot{s}_{t-1}^e * Phase4 + \beta_6 (\dot{s}_t^e - \dot{s}_{t-1}^e) * Phase3 + \beta_7 (\dot{s}_t^e - \dot{s}_{t-1}^e) * Phase4 + \varepsilon_t$$

The validity conditions of the RE formulation and the AE formulation are given in the following table.<sup>51</sup>

Table 6 – Correctness conditions of the AE and RE formulation

RE	AE
$p_{t-1} > 1$	$p_{t-1} < 1$
$p_{t-1} + m_{t-1} = 1$	$p_{t-1} + m_{t-1} = 1$

<sup>48</sup> Osservazioni simili sono avanzate da Bernholz and Gersbach (1992).

<sup>49</sup> See Marcat and Nicolini (2003) and Evans and Honkapohia (2001; 2003), Marimon (1997), and Sargent (1993). A survey di these contributions can be found in Bullard (1991).

<sup>50</sup> See Sargent (1993).

<sup>51</sup> Their mathematical derivation is given in Appendix 1.

	$m_t - m_{t-1}$ significant If $\hat{s}_{t-1}^e * Phase3$ and $\hat{s}_{t-1}^e * Phase4$ are significant, also those of the monthly changes of these variables must be significant
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Initially, the period taken as a reference in the estimate is the same as that used in the estimate of the demand for money in Table 5, in other words, the period from 2013-01 to 2017-12. The estimation method used in the RE specification is OLS while in the estimates of the AE price equation, to avoid problems of correlation between the variable  $m_t$  and the error term we used TSLS. More precisely, firstly we estimated the value of  $\hat{m}_t$ ,<sup>52</sup> and secondly we estimated eq. (5). The results are reported in Table 7.

The results in col. (1) show that for the entire period the AE formulation cannot be considered correct since the  $p_{t-1}$  coefficient is greater than 1 even if  $(\hat{m}_t - m_{t-1})$  is significant; inoltre, il test di Wald non accetta la condizione che la somma dei coefficienti di  $m_{t-1}$  e  $p_{t-1}$  sia pari a 1. Col. (4) shows that also the RE hypothesis is not valid for the entire period. None of the correctness conditions of RE is respected.

We then proceeded to an analysis of the stability of the estimates relative to the entire period based on recursive estimates (one-step forecast test). From this emerges an instability point in 2015.01. When we repeat the analysis for the 2015.01-2017.12 period a further instability point emerges in 2016.04. This suggests that the process of forming expectations changed over time.

We then proceeded to split the sample and estimate the AE formulation for the period 2013.01-2014.12, that is, up to the first instability point. The estimate, given in col. (2), confirms all the correctness conditions of the AE given in Table 6.

Table 7 – Regression results for AE vs RE specification

	AE specification			RE specification	
	(1)	(2)	(3)	(4)	(5)
	2013.01- 2017.12	2013.01- 2014.12	2016.03- 2017.12	2013.01- 2017.12	2016.03- 2017.12
c	-0.149	-0.267*	-0.944	-0.701***	0.347

<sup>52</sup> This value is obtained by the following estimate:  $\hat{m}_t = 0.04(0.07) + 1.32(0.12)m_{t-1} - 0.45(0.18)m_{t-2} + 0.19(0.20)m_{t-3} - 0.07(0.13)m_{t-4} + 0.17(0.18)p_{t-1} - 0.42(0.37)p_{t-2} + 0.92(0.37)p_{t-3} - 0.65(0.20)p_{t-4} - 0.004(0.004)\hat{s}_{t-1}^e * Phase3 + 0.03(??)\hat{s}_{t-1}^e * Phase4$ .

	(0.171)	(0.146)	(0.568)	(0.195)	(0.669)
$\rho_{t-1}$	1.324*** (0.089)	0.793*** (0.142)	1.257*** (0.093)	0.946*** (0.081)	1.120*** (0.139)
$m_{t-1}$	-0.239*** (0.091)	0.213 (0.134)	-0.082 (0.155)	0.146* (0.086)	-0.216 (0.215)
$\hat{m}_t - m_{t-1}$	-0.492*** (0.085)	0.324** (0.154)	-0.548*** (0.113)	-	
$\hat{s}_{t-1}^e * Phase3$	-0.026*** (0.007)	-	-	-0.003 (0.007)	
$\hat{s}_{t-1}^e * Phase4$	-0.013 (0.010)	-	-0.024 (0.054)	0.002 (0.012)	0.138*** (0.046)
$\Delta \hat{s}_{t-1}^e * Phase3$	0.187 (0.116)	-	-		
$\Delta \hat{s}_{t-1}^e * Phase4$	0.092*** (0.028)	-	0.032 (0.036)		
R2-adj	0.999	0.997	0.999	0.999	0.998
S.E.	0.040	0.010	0.033	0.053	0.052
Wald test Chi-sq. for	31.34	0.34	58.35	22.75	1.11
$M_{t-1} + P_{t-1} = 1$	[0.0]	[0.55]	[0.0]	[0.0]	[0.29]
	TOLS	TOLS	TOLS	OLS	OLS

Note: SE in (); \*\*\*, \*\*, \* significant at 1%, 5%, 10%; probabilities in [].

The estimates for the period 2015.01-2016.03 (not reported) show that during this period the correctness conditions are not respected either for the AE or RE hypotheses. Taking into account the second instability point, we proceeded to estimate the AE and RE equations for the sample 2016.03-2017.12. The results of this estimate, given in col. (3) and (5) of Table 7, show that the correctness conditions of the AE hypothesis are not respected while they are respected those of the RE hypothesis. The empirical facts outlined above confirm the hypothesis that during the hyperinflation in Venezuela the process of forming expectations has been modified, converging towards a rational forward-looking schema.

#### 4.2. Inflation tax and Seignorage

**Questo cappello è poco chiaro** [The traditional models of hyperinflation based on Cagan (1956) imply the existence of an inflation tax Laffer curve (ITLC). However, in this curve there are two stationary rational equilibria:<sup>53</sup> that is to say, there are two rates of inflation, one low and the other high, to which

<sup>53</sup> See Sargent and Wallace (1987).

corresponds the same amount of seigniorage.<sup>54</sup> Equilibrium with high inflation is stable, that with low inflation is unstable. It follows that also when there is a low level of seigniorage the dynamic of inflation converges towards the high inflation steady state equilibrium. This implies that the theoretical models based on the rational expectations hypothesis are affected by what Bruno and Fischer (1990) call an inflation trap. They are not a way of anticipating a process of hyperinflation. As shown by Evans and Yarrow (1981) and by Bernholz and Gersbach (1992), this can occur only if money in real terms does not decrease more than the rate of inflation increases.

The inflation trap problem that is typical of models à la Cagan with rational expectations has triggered an intense debate.<sup>55</sup> Within this debate the schemas that presuppose a learning process in the formation of expectations help explain how the quantity of seigniorage first increases and then with the convergence of expectations towards forms of rational forward-looking decline gradually.<sup>56</sup> ] Indicando con  $BM_t$  la base monetaria al tempo  $t$  si ha che il signoraggio è pari a:<sup>57</sup>

$$(5) S_t = \frac{BM_t - BM_{t-1}}{P_t}$$

Definendo the real monetary base as  $Bm_t = \frac{BM_t}{P_t}$  eq. (5) can be written as  $S_t = Bm_t - Bm_{t-1} \frac{P_{t-1}}{P_t}$ . Tenendo conto che Obstfeld (??) definisce inflation as  $\dot{p}_t = \frac{P_t - P_{t-1}}{P_t}$ , we have that  $\frac{P_{t-1}}{P_t} = 1 - \dot{p}_t$ . Substituting the latter into eq. (5) we get:

$$(6) S_t = \dot{p}_t Bm_{t-1} + (Bm_t - Bm_{t-1})$$

Eq. (6) shows the existence of two distinct sources of seigniorage. The first source is represented by  $\dot{p}_t Bm_{t-1}$ , that is to say, by the inflation rate that private individuals pay the government for holding a monetary base, in other words, money in circulation and bank reserves. The second source of seigniorage stems from the desire on the part of private individuals to hold monetary base, albeit when there is a considerable increase in prices.

<sup>54</sup> See Bruno and Fischer (1990) and Easterly et al. (1995).

<sup>55</sup> See, among others, Kiguel (1989) and Bruno (1989).

<sup>56</sup> See Marcat and Nicolini (2003) and Adam et al. (2006). A different approach which makes it possible to overcome the problem of the inflation trap is characteristic precisely of contributions which, while preserving the rational expectations hypothesis, discard Cagan's theoretical model by anticipating a different function of demand for money (Vasquez, 1998; Gutierrez and Vasquez, 2004; Barbosa et al.; 2006).

<sup>57</sup> For the measure of seigniorage here we adopt that proposed by Obstfeld (2012).

Keeping account of eq. (6), we made an estimate of the amount of seigniorage in Venezuela during this phase of hyperinflation. Table 8 below shows that seigniorage in the period from 2013 to 2016 increased considerably. Tuttavia, nel 2017 esso appare in diminuzione.

Table 8 –Seigniorage in Venezuela in the period 2010-2017

	$(Bm_t - Bm_{t-1})$	Inflation tax $(\dot{p}_t Bm_{t-1})$	Seigniorage $S = \dot{p}_t Bm_{t-1} + (Bm_t -$	Average inflation $\dot{p}_t$
2012	4008	2057	6066	?
2013	1085	4909	5994	?
2014	205	7179	7384	?
2015	-4699	12068	7369	?
2016	-1459	13884	12425	?
2017	-4041	13715	9674	?

Legenda:  $Bm_t$  is the monetary base in real terms and  $\dot{p}_t = \frac{P_t - P_{t-1}}{P_t}$ .

Dall'equazione riportata alla colonna (4) della Tabella 5 possiamo calcolare il tasso di inflazione mensile che consentirebbe al governo di massimizzare il signoraggio. Dato il coefficiente della variabile *Inflation*, tale tasso è pari a 1/1.24, ovvero all'80.6 per cento. Dal momento che nel 2017 il tasso di inflazione mensile effettivo del Venezuela risulta superiore a questo livello, si può concludere che esso giace sul tratto discendente della ITLC. Dornbusch et al. (1990) riconducono questo fatto, riscontrabile anche in altri episodi di iperinflazioni, a ragioni politiche, più precisamente alle difficoltà politiche di dar corso a stabilizzazioni.<sup>58</sup> Oltre a ciò, tuttavia, occorre tenere anche conto del fatto che l'elevata inflazione erode il debito pubblico interno, riducendone il valore reale e, quindi, la spesa reale per il suo ammortamento.<sup>59</sup> Ciò vale anche per il Venezuela, nonostante il fatto che, come mostra la Tabella 1, l'incidenza del debito pubblico domestico sul PIL sia stata sempre relativamente contenuta.

<sup>58</sup> See Alesina and Drazen (1990).

<sup>59</sup> See Reinhart and Santos (2015).

## Conclusions

The causes of Venezuela's current hyperinflation can be traced back to the considerable fiscal imbalances caused by a significant expansion in public spending in the two-year period leading up to the presidential elections in 2012 and a marked fall in the **yield** from oil exports starting from mid-2014. These imbalances were predominantly covered by money creation. The excessive money supply gave rise first to an acceleration of the rate of inflation and later, from 2016 onwards, to an explosive increase in prices.

In its initial phase the dynamic of growing inflation in Venezuela was associated with growth in real money and later, upon the emergence of hyperinflation, with its tendential decline. This dynamic can be explained in terms of the emergence, when inflation became explosive, of the substitutability of domestic money both with real goods and foreign financial assets. Thus, also in the case of Venezuela, as with most episodes of hyperinflation, we have evidence of what Bernholz called the Thiers' effect. This effect is to be attributed not only to growing expectations of a depreciation of the exchange rate but also to changes in the formation of individuals' expectations. The use of econometric tests validated this hypothesis and provides evidence of a learning process and of the gradual convergence towards forward-looking expectations.

The adjustment of expectations had inevitable repercussions on the inflation persistence and seigniorage. After the turning point of inflation to hyperinflation, as in most episodes of this kind, persistence decreased. At the same time, the revenue from the inflation tax started to slow down. Although the Venezuelan government's possibilities of obtaining resources by means of inflation seemed to shrink, today it is still difficult to predict when stabilization programmes can be adopted. The nature of these programmes has been extensively discussed.<sup>60</sup> As shown by other episodes of hyperinflation, their success is based on the adoption of forms of fixed exchange rates, on the rebalancing of public finances and on a credible commitment on the part of the central bank not to finance public deficits with money. However, policy measures of this type are inevitably linked to a change in the political equilibrium of the country.

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<sup>60</sup> See Sargent (1982) and Dornbusch and Fischer (1986). See also the empirical evidences found by Bernholz and Kugler (2009).



## Appendix A – Model specification and test procedure to test the hypothesis of rational expectation vs adaptive expectation

The estimates given in Table (3) do not assume a particular kind of expectation. The only assumption made regarding price expectation was that the forecasting error be stationary. To test whether expectations were rational or adaptive, we modify the Beladi et al. (1993) model to take into account the fact that the demand for money also depends on the exchange rate.

The demand function at the basis of col. (4) of Table 5 is the following:

$$(A1) \quad m_t - p_t = a_0 - a_1(p_{t+1}^e - p_t) - a_2\dot{s}_{t+1}^e * Phase3 - a_3\dot{s}_{t+1}^e * Phase4$$

where  $\dot{s}_{t+1}^e$  is the forward exchange rate premium. Rearranging eq. (A1) yields:

$$(A2) \quad p_t = -a_0(1 - \delta) + (1 - \delta)(a_2\dot{s}_{t+1}^e * Phase3 + a_3\dot{s}_{t+1}^e * Phase4) + (1 - \delta)m_t + \delta p_{t+1}^e$$

$$\text{where } \delta = \frac{a_1}{1+a_1}.$$

Under rational expectation:

$$(A3) \quad p_{t+1} = p_{t+1}^e + \varepsilon_{t+1}$$

where  $\varepsilon_{t+1}$  is a serially uncorrelated disturbance with zero mean and constant variance. Solving for  $p_{t+1}^e$  and substituting it in eq. (A2) we get:

$$(A4) \quad p_t = \frac{1}{\delta}p_{t-1} - (1 - \frac{1}{\delta})a_0 + (1 - \frac{1}{\delta})(a_2\dot{s}_t^e * Phase3 + a_3\dot{s}_t^e * Phase4) + (1 - \frac{1}{\delta})m_{t-1} + \varepsilon_t$$

Eq. (A4) represents the price level equation under the hypothesis of rational expectation. Under RE the coefficient of  $p_{t-1}$  should be greater than 1, and the sum of the coefficients of  $p_{t-1}$  and  $m_{t-1}$  should be equal to 1.

Under adaptive expectations:

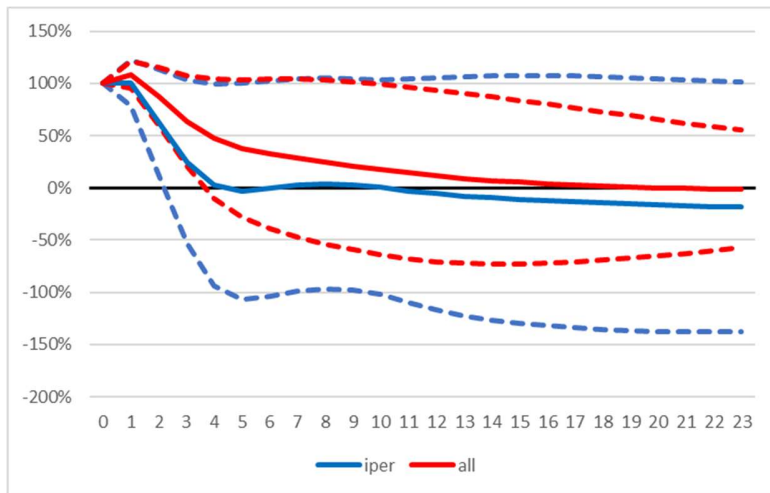
$$(A5) \quad p_{t+1}^e - p_t^e = b(p_t - p_t^e) + e_t,$$

where  $e_t$  is the white noise error term with zero mean and constant variance. From eq. (A2) get  $p_{t+1}^e$ , and then lagging it one period to get  $p_t^e$ . Substituting  $p_{t+1}^e$  and  $p_t^e$  into eq. (A5) we get:

$$(A6) \quad p_t = \frac{1}{1-b\delta} \{-a_0b(1 - \delta) + (1 - b)p_{t-1} + (1 - \delta)(m_t - m_{t-1}) + b(1 - \delta)m_{t-1} + a_2(1 - \delta)(\dot{s}_{t+1}^e * Phase3 - \dot{s}_t^e * Phase3) + a_3(1 - \delta)(\dot{s}_{t+1}^e * Phase4 - \dot{s}_t^e * Phase4) + a_2b(1 - \delta)\dot{s}_t^e * Phase3 + a_3b(1 - \delta)\dot{s}_t^e * Phase4\}$$

Eq. (A6) represents the price level equation under the hypothesis of adaptive expectation. Under AE the term  $(m_t - m_{t-1})$  should be significant, the coefficient of  $p_{t-1}$  should be less than 1, and the sum of the coefficients of  $p_{t-1}$  and  $m_{t-1}$  should be equal to 1. Moreover, if  $\dot{s}_{t+1}^e * Phase3$  and  $\dot{s}_{t+1}^e * Phase4$  are significant,  $(\dot{s}_{t+1}^e * Phase3 - \dot{s}_t^e * Phase3)$  and  $(\dot{s}_{t+1}^e * Phase4 - \dot{s}_t^e * Phase4)$  should also be significant.

## Appendix B –



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