Economics
The Open-Access, Open-Assessment E-Journal

Discussion Paper
No. 2020-2 | January 08, 2020 | http://www.economics-ejournal.org/economics/discussionpapers/2020-2

The portfolio theory of inflation and policy (in)effectiveness revisited: corroborating evidence

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Abstract
This study revisits and tests empirically the Portfolio Theory of Inflation (PTI), which analyzes how the effectiveness of macroeconomic policy in open and globally financially integrated economies is influenced by global investor decisions (Bossone, *The portfolio theory of inflation and policy (in)effectiveness*, 2019). The PTI shows that when an economy is heavily indebted and is perceived by the market to be poorly credible, investors hold it to a tighter intertemporal budget constraint and policies aimed to stimulate output growth dissipate into domestic currency depreciation and higher inflation, with limited or no impact on output, or with lower output and lower inflation. On the other hand, markets afford highly credible economies much greater space for effective and noninflationary macro policies. The study leads to a very basic advice: policymakers of an internationally highly integrated economy should keep public liabilities (the stock of both central bank money and public debt) at low levels: the larger the liabilities, the higher the degree of surrender of the country's national policy sovereignty to external forces and interests.

JEL E31 E4 E5 E62 F31 G15 H3
Keywords Credibility; exchange rate; financial integration; fiscal and monetary policies; global investor(s); inflation; intertemporal budget constraint; policy effectiveness; public debt

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Citation Biagio Bossone and Andrea Cuccia (2020). The portfolio theory of inflation and policy (in)effectiveness revisited: corroborating evidence. Economics Discussion Papers, No 2020-2, Kiel Institute for the World Economy.
http://www.economics-ejournal.org/economics/discussionpapers/2020-2

Received December 18, 2019 **Accepted as Economics Discussion Paper** January 7, 2020
Published January 8, 2020

THE PORTFOLIO THEORY OF INFLATION AND POLICY (IN)EFFECTIVENESS REVISITED: CORROBORATING EVIDENCE

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> «If a leading presidential candidate in an emerging market lost favor with Wall Street, the banks would pull their money out of the country. Voters then faced a stark choice: Give in to Wall Street or face a severe financial crisis. It was as if Wall Street had more political power than the country's citizens»[1]

1. INTRODUCTION

Why is it that, in Japan, expansionary fiscal and monetary policies of unprecedented duration and intensity have achieved high employment at virtually zero inflation, while considerably lesser stimuli in Turkey have caused the lira to collapse and inflation dangerously to rise? And why is it that over the last decade the US Federal Reserve and Treasury have succeeded in bringing unemployment down to historic record lows without overheating the economy, while in the same period anti-recessionary fiscal and monetary expansion in Mexico only resulted in currency depreciation and higher inflation (Ahumada, 2009 and Angulo-Rodriguez, 2011)? And speculating further: would a country like Italy recover effective sovereignty over macroeconomic policy if it exited the euro?

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[1] Quoted from Stiglitz. J. E., *The End of Neoliberalism and the Rebirth of History*, Project Syndicate, 4 November 2019.

The above questions can be addressed using Portfolio Theory of Inflation (PTI), which this study sets out to revisit and test empirically. The PTI argues that in an open and globally financially integrated economy the effectiveness of macroeconomic policies depends on the level of credibility that financial markets attribute to the economy, in particular its policy authorities and policy stance (Bossone, 2019).[2] Here, "global financial integration" means that the public liabilities of a country are traded in the international financial markets and their prices are determined by investors who i) manage their portfolios taking a global perspective on local investment opportunities (in a sense that will be defined below) and ii) are capable to shift capital in and out of the country swiftly and at negligible transaction costs. Global financial integration causes relevant shares of domestic (private and public) assets and liabilities to be managed as global portfolios.[3]

Consequently, while in a highly credible economy macroeconomic policy shocks would be effective in stimulating output during a recession,[4] if the same shocks were enacted by the policy

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[2] Based on the approach introduced in macroeconomics by Backus and Driffil (1985a, b), following the work of Kreps and Wilson (1982), this study defines "policy credibility" – as referred to a government – as the extent to which economic agents believe the government will carry out the macroeconomic policies it has promised to pursue. Importantly, this notion relates to both the will and ability of the government to deliver on its promise. Market judgments on policy credibility, thus, draw on a country's past policy track record, its resolve to pursue pre-announced policy commitments and targets, and the adherence of its policy framework to what markets consider to be sound financial stability criteria (such as, typically, low inflation, stable asset prices, high liquidity and solvency of financial institutions, low leverage of key sectors, etc.).

[3] The effect of global financial integration would be reinforced by a high incidence of institutional investment over total domestic savings and by a large concentration of domestic wealth, since both features magnify the role of the global investors in the price determination process of the traded liabilities.

[4] This should be of no surprise considering in particular the case of those countries whose currencies offer safe haven at times of high uncertainty. The policy space available to these economies expands especially during those times, when both domestic and foreign investors demand more of the assets denominated in their currencies. In practice the fiscal and monetary authorities of those countries can issue whatever amount of

authorities of a poorly credible and largely indebted economy to counteract, say, a recession or economic stagnation, capital would likely flee the country, the nominal exchange rate of the national currency would depreciate, and domestic inflation would rise, with only limited effects on the economy's real variables. Only to the extent that output were to recede even further (indeed, a possible outcome, as discussed later), would exchange rate devaluation and inflation be dampened.

Said differently: according to the PTI, the integration of a national economy into the global financial markets confers on the latter the power to *create* or to *destroy* the policy space available to the economy, that is, the power to expand or to narrow the boundaries that delimit the use the economy's fiscal and monetary policy instruments until they compromise the sustainability of the government's financial position or the stability of the economy.[5] The amplitude of the boundaries (i.e., the extent of the policy space) depends on how credible global markets believe those policies, and the policymaking institutions behind them, to be against the background of the economy's potential. And since global investors manage their positions intertemporally, the boundaries they set for each economy at each point in time determine the *elasticity* of the economy's intertemporal budget constraint (IBC) and, hence, the economy's degrees of freedom to borrow resources from the future for present uses: when investors deem a country's credibility to be low, the economy is tied to a tighter IBC and the issuance of public sector liabilities (in the form of money or debt under any currency of denomination) aimed to stimulate output growth dissipates instead into domestic currency depreciation and higher inflation.[6] Such "price" dissipation effects would only be dampened

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money and debt obligations they wish since these will be absorbed by the market. The absorption may in fact be such that the new issuances might be accompanied by unchanged or even increasing prices.

[5] In the spirit of this study, as it will become clearer later, reference to the government's financial position or the stability of the economy includes not only the sustainability of public debt but also the internal and external stability of the value of the national currency.

[6] The concepts of credibility and excess liabilities will be clarified in Section 3.

if the tighter IBC were to depress output, an option not to be ruled out and discussed later. On the other hand, if the same expansionary action is undertaken by a highly credible government, a more elastic IBC allows output to expand with no or limited dissipative effects on the economy's nominal variables.

In what follows: Section 2 relates the PTI to the existing relevant literature; Section 3 discusses the central role that global investors play in the context of the PTI; Section 4 provides a formal representation of the PTI and analyzes its main results; Section 5 discusses some peculiar features of the PTI as a theory of inflation in today's global context; Section 6 provides empirical evidence in support of the theory; and Section 7 develops some general reflections on the PTI. Section 8 concludes the study.

2. RELATIONS WITH THE LITERATURE

The pillars underpinning the PTI are i) the portfolio balance approach (PBA) to exchange rate determination, as modified to incorporate intertemporal choices from global investors, and ii) the relationship between policy credibility, exchange rate and inflation. References to the relevant literature on these two pillars are contained in Bossone (2019). The only addition, here, refers to the second pillar and is the work by Ahumada (2009), which shows that fiscal expansion in Mexico leads to real exchange rate depreciation (in spite of an upward trend in interest rates) and explains this finding evoking the so-called country risk view of fiscal policy, whereby fiscal loosening in developing countries may induce risk-averse investors to transfer funds abroad in order to avoid domestic inflationary taxes, exchange rate risk and other potential hazards commonly associated with

unsound public finances. Such capital outflows may, in turn, weaken the domestic currency in real terms even with a higher rate of return on the peso-denominated bonds.[7]

3. FINANCIAL INTEGRATION AND THE ROLE OF GLOBAL INVESTORS

Two critical aspects characterize a globally financially integrated economy: the central role of global investors as resource allocators and the neutrality between the currency denomination of the economy's liabilities.

Global investors

The PTI's core rests on the central role played by the representative "global financial investor" in the national resource allocation process, in lieu of the representative (domestic) household that typically underpins all conventional choice theories. The former, much more than the latter, are sensitive to exchange rate dynamics and take a global view of investment opportunities and risks. Acting as "marginal" investors, global financial investors have the largest influence on the pricing of their trades and determine the prices at which trades are executed, including those of the smaller (domestic) household savers (see Section 4).[8]

To the extent that prices are determined by global investors, asset values are driven by the expected dynamics of international asset prices. This is because, unlike domestic households, global investors do not use domestic inflation rates to gauge the real value of their investment assets, but

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[7] According to the country risk view, increasing budget deficits (especially in developing countries) are usually deemed by international investors as an early warning indicator, that is, as a signal of deterioration in the economy's fundamentals and may originate massive capital outflows that lead to exchange rate depreciation even with increased real interest rates. See Ahumada (cit.) for references to the main proponents of this view.

[8] For a study on the marginal investor and a review of the marginal investor in the finance literature, see Bartholdy and Kate (2004) and references therein, and see more recently Chen and Lei (2015).

consider instead the relative dynamics of the exchange rates across the relevant currencies (or at least what they expect those dynamics to be during the relevant time horizon), which may differ (substantially and persistently) from the underlying purchasing power parities.[9] In such circumstances, domestic inflation rates are determined by the exchange rate dynamics (rather than vice versa): the more open is a country's economy and the more flexible its prices, the greater is the transmission from exchange rate changes to domestic prices (through the ERPT effect).

Also, when faced with the prospects of a country issuing "excess" liabilities,[10] global investors replace at the relevant margin *both* domestic debt *and* money holdings with foreign assets deemed to be safer stores of value.[11] Thus, in poorly credible and largely indebted economies higher inflation can materialize even at positive levels of the output gap, as a reflection of the growth of public liabilities and their impact on the currency's exchange rate.

Neutrality of currency denomination

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[9] Global investors are not consumers, and unlike consumers they are not interested in expressing the real value of their assets in terms of any domestic consumer price index.

[10] The concept of "excess" liabilities may be understood in circumstances such as when public liabilities exceed the value of nominal aggregate output and both grow at the same rate, causing the difference between the two variables to grow indefinitely, beyond the point at which the holders of the liabilities might no longer be willing to absorb them, except perhaps at exorbitant (and yet unsustainable) interest rates. Holders would at some point start diversifying their portfolio into alternative assets, including those denominated in foreign currencies, and indeed very rapidly so in the event that the ratio were anticipated to grow fast. Notice that this would happen independently of increasing inflation expectations, and simply as a result of portfolio rebalancing effects. In fact, as will be explained below, higher inflation (and inflation expectations) could be the consequence, not the causing factor, of such portfolio rebalancing effects.

[11] Of course, domestic agents would still demand the domestic currency for transaction and tax payment purposes, but such demand might not be enough to prevent the currency from depreciating if people move large share of wealth out of it and into alternative assets (including foreign currency denominated ones).

It is often argued that a government that spends its own currency cannot be forced into default in that currency.[12] Yet, although debt contracts are typically stipulated in nominal terms, creditors are keen on making sure that they eventually recover the full real value of their lending (inclusive of the interest income). Repaying lenders in a currency that depreciates, and whose rate of depreciation is not fully compensated, is not a default in legal terms but is economically equivalent to it and lenders want to avert the risk and be compensated for being exposed to it.

Were it not so, there would in principle be a "free lunch" that governments could benefit from by borrowing in a domestic currency that they can print in unlimited amounts. This happens anytime a government is in a position to exploit domestic borrowers, either because they are small, uninformed and with limited investment capacity, or because they operate in segmented or captive domestic capital markets. On the other hand, when national economies are globally financially integrated and their liabilities trade in the international capital markets, global investors evaluate the debt repayment capacity (in real resources) of the borrowers (say, governments), and such capacity is in fact the same whether the contracts are written in domestic or foreign currencies. The fact that a government may print infinite amounts of domestic currency (which it may not do in foreign currencies) does not alter - ex ante - the (real) losses that the investors expect from contracts expressed in different currencies: contract terms would in any case be written so that the investors would be indifferent between the currencies of denomination. That is, the contracts would carry terms and conditions that protect the investors from the risk of default in all cases, whether this originates from the interruption of the debt service or from debt repayment taking place in a depreciating currency. The debtor is the same as well as its capacity to repay (in real terms), and the same is therefore the risk faced by investors.

[12] See, for instance, Vernengo and Pérez Caldentey (2019).

Symmetrically, the government issuing the liabilities would be subject to the same IBC under each of the two options, since the interest rate paid on the liabilities would have to adjust to the underlying risks faced by the investors, and it would be equal under both options. Moreover, the lower the credibility of the issuing government, the higher the risk of currency depreciation and therefore the higher the interest premium required by the investors for wanting to purchase and hold the liabilities.

4. THE PORTFOLIO THEORY OF INFLATION

The economy's model

The PTI originates from the conventional portfolio balance approach to the exchange rate determination, as reframed in the context of optimal intertemporal allocation choices by a representative global investor acting in internationally integrated financial markets and perceived by the markets as the "marginal" investor (see discussion above and further below in this section).

Under global financial integration of the economy, high incidence of institutional investment, and large wealth concentration, the global investor is representative of the relevant investment community that national policy authorities need to consider when taking policy decisions. This is the peculiarity of the PTI, which aims to show the centrality of global financial markets in shaping government IBCs and in determining the (in)effectiveness of their macro policies.

The PTI model consists of two open and globally financially integrated country economies *D* and *F*, where *F* is relatively large vis-à-vis *D* and acts as price setter in the international markets for goods and services. The issuance of government debt bonds B_j in country j, where $j = D, F$, and their market value are tied to the country government's IBC:

(1) $P_t^B B_{j,t} = P_t \sum_{\tau=t}^{\infty} \left(\beta_{j,t}|_{\omega_t}\right)^t (s_{j,t} + \Delta m_{j,t})$ with $0 \leq \beta_j \leq 0$

(2) $B_{j,t} = B_{j,t-1} + \overline{\Delta B}_{j,t} = B_{j,H,t} + \bar{B}_{j,CB,t}$

(3) $P_t = P_{D,t}^{\alpha}(e_t\bar{P}_{F,t})^{1-\alpha}$ with $0 \leq \alpha \leq 1$

(4) $P_{D,t} = \Phi_D L_D^{-1}\left(e_t\bar{P}_{F,t}\right) + \Pi\left(X_{j,t} - X_{j,t}^*\right)$ with $\Pi' > 0$

(5) $\Phi_{D,t} = \Phi(\sigma_{D,t}, \beta_{D,t})$ with $\Phi_1 > 0, \Phi_2 < 0$; $\Phi_D \in (0,1)$

(6) $\Delta B_{j,CB,t} = \Delta M_{j,t} = \mathrm{M}\left(i_t^{B_j} - i_N^{B_j}\right)$ with $\mathrm{M}' > 0$

(7) $i_t^{B_j} = \iota^{-1}(P_t^{B_j})$ with $\iota^{-1\prime} < 0$

(8) $X_{j,t} - X_j^* = \mathrm{X}\left(i_t^{B_j} - i_N^{B_j}, \frac{e_{j,t}}{P_{j,t}}, \overline{\Delta g}_{j,t}\right)$ with $\mathrm{X}_1 < 0, \mathrm{X}_2 > 0, \mathrm{X}_3 > 0$

(9) $\overline{\Delta g}_{j,t} = \frac{\overline{\Delta G}_{j,t}}{P_{D,t}} = \frac{\left(-\bar{S}_{j,t} + i_{t-1}^{B_j} B_{j,t-1}\right)}{P_{D,t}} = \frac{\overline{\Delta B}_{j,t}}{P_{D,t}} = \overline{\Delta b}_{j,t}.$

Eq. (1) is the IBC of country *j*'s government and its central role in the PTI is discussed below; according to it, the current market value of government bonds *B* must equal the present discounted value of future primary surpluses and monetary financings. Specifically *B* is the number of (one-period) nominal (interest-bearing) bonds issued by the government at a contractual value that is equal to 1 unit of money, and P^B is the market value of one unit of bond *B* and is expressed as a ratio to the bond's contractual value;[13] s_t and Δm_t denote, respectively, the real value of the primary surpluses (taxes minus government spending excluding interest) and the real value of central bank money

[13] This ratio generally varies between 0 and a value less than 1. Recently, however, following the Global Financial Crises, there have been cases where the value of the ratio has exceeded 1. These are cases where some assets (typically bonds issued by highly reputed governments) are considered by the markets to be especially safe, and trade at prices above their contractual value, thereby earning negative yields (see *Why do investors buy negative yield bonds?*, Financial Times, April 12, 2006). In such cases, private creditors of the issuing governments are de facto turned into private debtors.

injections; $\beta_{j,t}|_{\omega_t}$ is a time-varying factor, conditional on information set ω_t available to investors at time *t*; it should be understood as a scale factor that *corrects* the value of the IBC in the perception of the markets and reflects the credibility that investors attribute to country *j*'s policy based on the current information available;[14] ceteris paribus, a lower β_j translates into a tighter IBC for *j*'s government and requires larger (and possibly more frontloaded) fiscal efforts to sustain a given debt stock.[15] This factor, thus, defines the "elasticity" of the IBC, as further discussion below.[16] Total public debt, equal to the stock of government bonds (in all denominations) inherited from the

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[14] Credibility factor $\beta_{j,t}|_{\omega_t}$ could indifferently be thought of as either an index that applies to the IBC, scaling down or up its value correspondingly, or as a probability measure that generates an expected value of the IBC, or else as a risk factor that adjusts the value of the IBC.

[15]The information set ω_t comprises all the information that enables investors to assess and determine the policy credibility of a coutry government, and in particular all relevant economic, political and social factors, both internatl and external to the country, which influence the achievability and sustainability of government's specific policy commitments. New factors or events that raise investors' concerns that country *j*'s government might face future challenges (which would eventually induce it to take such actions as defaulting on future obligations, inflating the debt away, or even repudiating it) would be incorporated in a new information set ω_t^1 and cause β_j to fall ($\beta_{j,t}|_{\omega_t'} < \beta_{j,t}|_{\omega_t}$) thus reducing IBC elasticity accordingly. A fall of credibility might result in such a tightening of IBC elasticity that investors would doubt the (economic, social and political) sustainability of the future primary surpluses required by the tightened IBC, until such a point where they might even stop buying and holding the country's debt altogether. This would cause the price of debt to collapse and, correspondingly, interest rates to rise abnormally to a level where fiscal dominance puts pressure on the monetary authorities to monetize and inflate the debt away. The relevant information set would capture also those developments (including, for instance, the evolution of local or global risks) that may induce investors to shift capital from lower-credible to higher-credible countries considered to be safer places for investment or issuers of safer liability instruments. In such instances, due to those developments, the credibility gap between countries (as perceived by the markets) may change and reflect in different relative dynamics of credibility factors $\beta_{j,t}|_{\omega_t}$for different countries over time. The role of the "credibility gap" will be analyzed below in this section and in Appendix 1.

[16] All else equal, different IBC elasticities across countries would be sufficient to make otherwise identical (country issued) bonds – traded internationally – imperfect substitutes of one another.

previous period plus any current new bond issuance, is held by investors *H* and the central bank *CB* of the issuing country (Eq. (2)); both the central bank's holdings of *B* and the new debt issuances are policy variables decided, respectively, by the central bank and government.[17]

In Eq. (1), *P* is the world price deflator used by global investors to gauge at any time the real value of their wealth and is calculated as the weighted geometric mean of the general price level attaining in individual countries, P_D and P_F, with weights given by each country's share of international trade (Eq. (3)), and where P_F is exogenous. Country *D*'s price level P_D is determined – from the cost side – by foreign price level P_F via the nominal exchange rate *e*, the ERTP factor Φ, and lag operator L^{-1} (which reflects the speed of relative price adjustment to foreign price changes) and – from the demand side – by the output gap (Eq. (4)).

According to Eq. (5), ERPT factor Φ raises (structurally) with the openness of the economy and declines with country credibility – higher credibility anchors inflation expectations and counteracts the bad effects on inflation caused by the ERPT effect (see Section 2).

Eq. (6) summarizes the central bank's policy rule whereby the central bank purchases government bonds (by "printing" money *M*) in an attempt to stabilize the interest rate on government bonds around its "neutral" value $i_N^{B_j}$; the latter is the interest rate that is consistent with zero inflation and zero output gap.[18]

Equation (7) reflects the inverse relationship between bond prices and interest rates; reduced form Eq. (8) posits the real output gap to change i) negatively with the deviation of current interest

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[17] The bar over variables indicates that the variables are determined exogenously to the model.

[18] This what Blanchard (2016) has defined the "divine coincidence," that is, the best rate that can be achieved by policy. Obviously, the central bank stabilization effort may succeed only if the total stock of government debt is given or correctly expected. This raises issues of policy coordination between monetary and fiscal policies, which will be only noted in this study but will not be further elaborated.

rate from its neutral level, ii) positively with the real exchange rate (assuming Marshall-Lerner condition), and iii) positively with the fiscal deficit (assuming away full Ricardian equivalence);[19] and Eq. (9) is the debt-financed fiscal deficit expressed in real terms where *S* is the nominal primary surplus.

The representative global investor intermediates financial resources intertemporally and internationally from surplus agents to agents who needs them for investment or consumption-smoothing purposes, with a view to extracting maximum gains (in utility terms) from investing wealth across the assets available in the international markets across an infinite time horizon. Investors treat assets as "vehicles" to the utility associated with the future streams of real resources to which they give access over time. Global investors move financial capital across international markets in real time and at negligible (transaction) costs, based on the relative utility that assets deliver. Representative global investor *H* thus maximizes the intertemporal utility indirectly derived from invested wealth *W*:

(10) $$U(W_H) = Max_W\ E_t\left[\sum_{t=\tau}^{\infty}\left(\beta_{H,j,t}|_{\omega_t}\right)^t u\left(W_{H,t}\right)\right]$$

s. t.

(11) $$W_{H,t} = M_{H,D,t} + M_{H,F,t} + P_t^{B_D}B_{H,D,t} + e_tP_t^{B_F}B_{H,F,t} = y_{H,t} + M_{H,D,t-1} + M_{H,F,t-1} + P_t^{B_D}B_{H,D,t-1}\left(1 + i_{D,t-1}^{B}\right) + e_tP_t^{B_F}B_{H,F,t-1}\left(1 + i_{F,t-1}^{B}\right)$$

(12) $$M_{H,D}, M_{H,F}, B_{H,D}, B_{H,F} \geq 0$$

and transversality condition

(13) $$\sum_{t=0}^{\infty}\left(\beta_{H,t}\right)^t\left(M_{H,D,t} + M_{H,F,t} + P_t^{B_D}B_{H,D,t} + e_tP_t^{B_F}B_{H,F,t} - y_\tau\right) = 0,$$

[19] It should be noted that debt-financed fiscal deficits would also affect the real output gap indirectly and with positive sign via their effect on the interest rate via Eq.'s. (2) and (7)). This effect would be captured under relation i).

where $u(\cdot)$ is a strictly quasi concave, time-separable, and well-behaved utility function; E_t is the expectations operator at time *t;* and y_H is the investor *H*'s income. The solution to the investor *H*'s optimal plan (10)-(13) is provided in Appendix 1.

The Intertemporal Budget Constraint

It is important to wholly understand the central role of the IBC (Eq. (1)) for the PTI. With global integration of financial markets and the global nature of investors, liability issuers must commit intertemporally to generating enough real resources to fulfill their financial obligations to the investors.

The IBC reflects the constraint that, whatever paths or rules government chooses to set for current and future surpluses, the present discounted value of future surpluses must at least be equal to the value of the liabilities outstanding. From the point of view of the investors, the issuing government must prove capable *and* willing to return the full value of its future debt obligations expressed in terms of foreign (reference) currencies and global inflation, and the IBC must hold identically irrespective of the currency of denomination of the liabilities (for the reasons discussed in Section 2).

Regarding the objection that a government enjoying monetary sovereignty does not face an IBC since it can always print all the money needed to pay for its future obligations, the PTI response is that as investors are guided by what they perceive to be weak credibility of the policy regime and institutions of the issuing government, they may bid down the value of the money issued by that government and influence the markets to a point where the demand for money and assets denominated in that money will shrivel, thereby affecting the IBC. Every government – whether it does or it does not issue the currency of the country – faces an IBC. The elasticity of the IBC may vary, even considerably, depending on the investors' attitude toward the country, but an IBC will always be there nonetheless.

A government that consistently proved capable and willing to satisfy Eq. (1) would be perceived as credible by the markets, and vice versa. The stronger its credibility (a high β), the higher the "elasticity" of its IBC and the greater the market's readiness to absorb larger amounts of its liabilities. On the other hand, with weaker credibility (a low β), the prospects of it being capable and willing to raise sufficient future resources to repay its obligations would be perceived as more uncertain by the investors and the IBC would cause bond prices to fall; the further erosion of credibility might even lead investors to no longer buy or hold domestic bonds and to shift their portfolios toward foreign assets.

Eq. (1) epitomizes the essence of the PTI developed in this study, in that the theory reflects the ultimate subjective nature of market perceptions (as expressed in the investors' expectations, conjectures, and conventional beliefs) that are relevant to evaluate the credibility of national economic policies and the confidence than can be placed on the country's policy regime and institutions.[20]

Solving the model represented by the above equations for the domestic price level expressed in logarithmic form (see Appendix 1) yields:

$$(14) \quad \tilde{p}_{D,t} \approx \phi(\cdot) + L^{-1}\{[(\beta_{F,t+1} - \beta_{D,t+1}) + (\tilde{m}_{D,t+1} - \tilde{m}_{F,t+1}) + (\tilde{b}_{D,t+1} - \tilde{b}_{F,t+1}) + (\tilde{\iota}_{t+1}^{B_F} - \tilde{\iota}_{t+1}^{B_D})) + \tilde{p}_{F,t}] + \pi_{D,t}(\cdot)\},$$

[20] More goes into Eq. (1) than the mere evaluation of stock-flow consistency. To see this, consider that, all else equal, the same stock of public debt may correspond to very different spending and tax policies that a government may decide to adopt, with different implications for the fiscal multipliers and the economy's supply side. Different policies would impact differently the growth path of the economy and its capacity to generate future fiscal surpluses, thereby inducing financial markets to assess differently the policy credibility of the authorities and to determine a different elasticity of the government IBC, as earlier defined.

where the tilde indicates the percentage deviation of variables from their steady state (optimal) values. According to Eq. (14), for a given ERPT factor $\phi(\cdot)$ and zero net excess internal demand $\pi(\cdot) = 0$, domestic inflation varies directly with:

i. changes in country credibility gap, as perceived by the market and based on new information and re-evaluation of relevant economic data. Note that credibility affects inflation both directly (via the credibility gap) and indirectly through the pass-through factor (the higher domestic credibility, the lower the pass-through, and the lower the inflation rate);

ii. changes in the relative dynamics of domestic versus foreign (central bank) money stocks;

iii. changes in the relative dynamics of domestic versus foreign debt;

iv. changes in the interest rates differential on government bonds, and

v. changes in the rate of foreign inflation.

Notice that the EPRT term in Eq. (14) has negative sign, except when the pass-through is complete and thus $\phi(\cdot) = ln1 = 0$. With complete pass-through, instantaneous relative price adjustment to foreign prices, and no change in the output gap, changes in the nominal exchange rate feed fully into domestic inflation (relative to foreign).

According to Eq. (14), inflation would be sensitive to whatever public liabilities are deemed to be in "excess" vis-à-vis relevant foreign economies, irrespective of their nature and denomination.

Interestingly, Eq. (14) can be used to show that international economic developments may induce investors to move capital to countries with high credibility (they show a large positive $\left(\beta_{F,t+1} - \beta_{D,t+1}\right)$ differential), and are generally regarded as safe havens). In such situations, the credibility gap might actually widen with the consequence that the IBC of highest-credible countries becomes more elastic, their policy space for expansionary action increases and, all else equal, their rate of inflation declines, while the opposite happens to the lowest-credible countries. Notice in such

cases that the credibility gap widens not because national authorities have necessarily changed their policy commitments, but because the information carried by the new developments induce investors to search for better protection of their resources; this is sufficient for them to strengthen the perception of credibility of these countries vis-à-vis the others.

From an ex-ante perspective, Eq. (14) might provide ambiguous indications depending on how the dynamics of a country's domestic versus foreign liabilities interacts with the interest rate differential on domestic government bonds: a more than proportional increase in the latter would depress the economy's output, strengthen the exchange rate and lower inflation. In addition to the portfolio effect, Eq. (8) and its feedback on prices through Eq. (4) suggest that also a real channel might be at play from the interest rate differential to inflation.

Credibility and macro policies: An evaluation

The model above allows to evaluate the effects of active fiscal and monetary policies of a government essentially by analyzing how policy stimuli are financed and how the government's financing strategy is judged by the financial markets.

Assume country *D*'s largely-indebted government engineers a persistent fiscal stimulus through the issuance of new domestic debt $\overline{\Delta b}_{\tau}^{D} > \overline{\Delta b}_{t}^{D}$, $\tau = t+1, \dots t+n$, for an indefinite number of periods *n*, in an attempt to keep the real output gap down at zero (Eq. (8)). If the government's credibility is low (a low β_D), investors determine an inelastic IBC and require government to commit to attaining larger primary surpluses over the immediate future so as to keep bond prices from falling. In fact, for economies that already suffer from low credibility, the very intention of relaxing macro policies might be perceived by the markets as further weakening credibility, thus tightening the

government IBC.[21] A tight(er) IBC makes the effect of the stimulus small and short-lived, if at all. Moreover, if the government does not (credibly) commit to attaining larger future primary surpluses (that is, $\beta_{D,t}|_{\omega_t^1} < \beta_{D,t}|_{\omega_t}$), based on the new information set ω_t^1), bond prices fall (Eq. (1)) as investors sell domestic bonds for foreign assets, leading to higher interest rates (Eq. (7)) and to a contraction in the supply of money supply engineered by the central bank to accommodate higher rates and stymie currency depreciation. Substituting Eq.'s (1) and (2) into Eq. (7) and the resulting expression into Eq. (8), casting the exchange rate as an implicit function of credibility and the interest rate from Eq. (A5) in Appendix 1, differentiating totally and setting the resulting expression equal to zero, yield

(15) $$\Delta X_{D,t} = X_{D,t} - X_{D,t-1} =$$

$$\mathrm{X}_1 \left\{ \left(\iota^{-1} \left(\frac{P_t \sum_{\tau=t}^{\infty} \left(\boldsymbol{\beta_{D,t}|_{\omega_t^1}} \right)^n (s_{D,t} + \Delta m_{D,t})}{B_{D,t-1} + \overline{\Delta B}_{D,t}} \right) - i_N^{B_D} \right) \Delta i_t^{B_D} + \right.$$

$$\left. \left(\iota^{-1} \left(\frac{P_t \sum_{\tau=t}^{\infty} \left(\boldsymbol{\beta_{D,t}|_{\omega_t^1}} \right)^n (s_{D,t} + \Delta m_{D,t})}{B_{D,t-1} + \overline{\Delta B}_{D,t}} \right) - i_N^{B_D} \right) \boldsymbol{\Delta \beta_{D,t}} \right\} + \mathrm{X}_2 \left(\Delta \frac{e_{D,t}}{P_{D,t}} \boldsymbol{\beta_{D,t}|_{\omega_t^1}} + \frac{e_{D,t}}{P_{D,t}} \boldsymbol{\Delta \beta_{D,t}} \right) + X_3 \, \overline{\Delta b}_{D,t} = 0,$$

which shows that, based on the new information set, country D's credibility could drop to a critical level $\beta_{D,t}|_{\omega_t^1}$ (marked in bold and red in Eq. (15)), which neutralizes the effect on real output of both fiscal stimulus $\overline{\Delta b}_{D,t}$ and real exchange rate depreciation $\Delta \frac{e_{D,t}}{P_{D,t}}$, such that $\Delta X_{D,t} = 0$; yet, the

fiscal stimulus would increase the nominal exchange rate and inflation via Eq. (14). However, in the event that the negative credibility effect the portfolio and output effects (Fig. 1a), the recessionary

[21] An implication of this argument is the asymmetrical treatment by the markets of expansionary versus contractionary policies. Whereas the former may weaken credibility, thereby further limiting the policy space available to policymakers, the letter strengthens credibility and thus enhances government's ability to affect real variables as desired. This issue of policy asymmetry will not be further pursued here.

impact on output (as noted, via Eq. (8) might be such as to eventually lead to an appreciation of the exchange rate and lower inflation.

Consider now the central bank's decision to stimulate the economy by lowering the domestic policy rate (Eq. (7)) and committing to keep it low for a long period by supplying more money through periodic purchases of government bonds. From Eq.'s (1) and (6), the share of domestic bonds held by the central bank increases (at an unchanged level of total outstanding government debt); correspondingly, global investors reallocate their portfolio toward foreign bonds since the marginal utility of the money balances they have received in exchange for selling the bonds to the central banks has declined, as shows Eq. (A5) in Appendix 1.[22] The latter equation also shows that, ceteris paribus, portfolio compositions featuring higher shares of foreign assets relative to domestic assets determine a higher nominal exchange rate. While the nominal exchange rate depreciation may in principle amplify the stimulus, the intensity and duration of its effect ultimately depend on the amplitude and speed of the real exchange rate adjustment process (Eq. (14)).

[22] This is due to the fact that they now hold domestic money balances in excess with respect to optimal balances (see $M_{H,t}^{D*}$ in Eq. (A5), Appendix 1).

FIGURE 1A. FISCAL IMPULSE

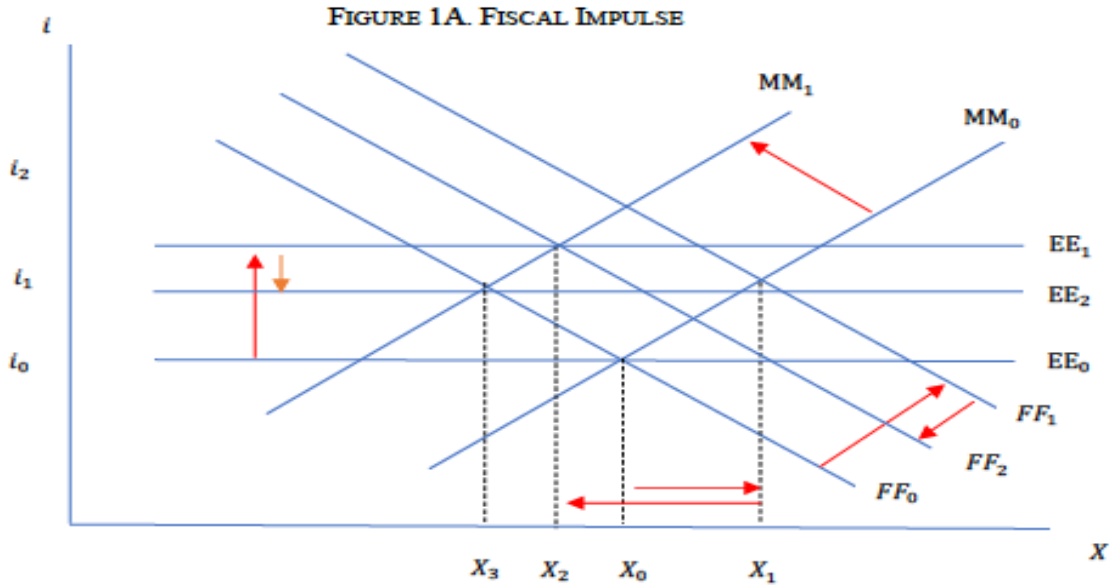
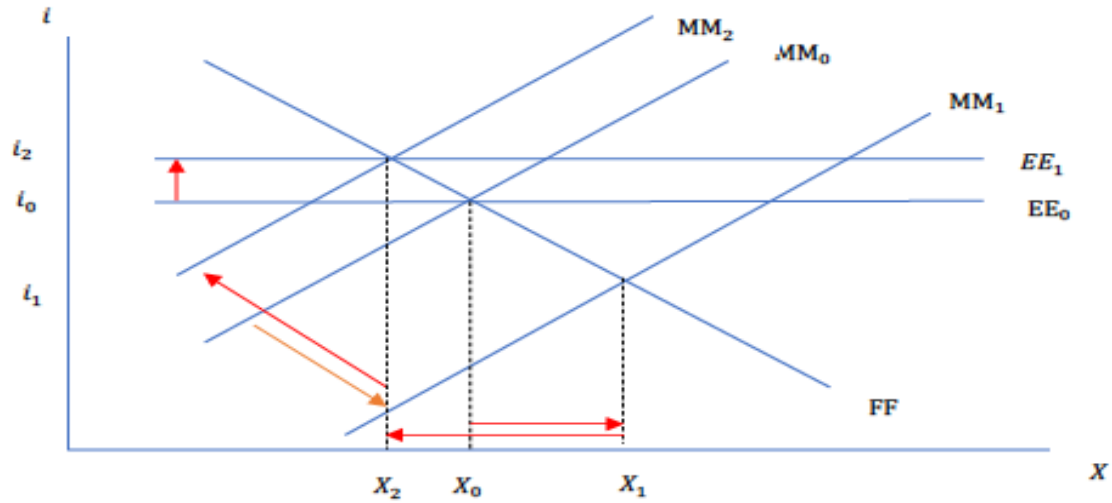


FIGURE 1B. MONETARY IMPULSE



Note: Figures 1a and 1b: the curve MM is the locus of (i, X) pairs at which $\Delta b = 0$; the curve FF is the locus of (i, X) pairs at which $\Delta m = 0$; and the schedule EE is the locus of (i, X) pairs at which $\Delta\left(\frac{e}{P}\right) = 0$. Fig. 1a portrays the case where the expansionary fiscal stimulus $\Delta b > 0$ is more than offset by the effects of the drop in the level of policy credibility as perceived by the market. The fiscal authorities initially shift the FF schedule rightward from $FF_0$to $FF_1$to a higher level of output, which is only partially dampened by a higher interest rate. However, the lack of credibility causes investors to sell off domestic bonds in exchange for foreign assets, and the monetary and fiscal authorities to adjust, respectively, the money and bond supply so as to keep balance in the bond and foreign exchange markets. As a result, the EE and MM schedules shift, respectively, from EE_0 up to $EE_1$and from MM_0 backward to MM_1, and the FF schedule moves somewhat backward to FF_2, all crossing each other at an interest rate that more than offsets the initial stimulus. As noted in the text, the adjustment process might be such as to eventually lead to an appreciation of the exchange rate, lower output and lower inflation, with the schedule EE shifting backward to EE_2. Fig. 1b represents the case where the expansionary output effect of the monetary impulse $\Delta m > 0$ is more than offset by the effects of the drop in the level of policy credibility as perceived by the market. The monetary policy authorities initially shift the MM schedule from MM_0 to MM_1 to a lower interest and exchange rate levels. The lack of credibility, however, causes investors to sell domestic bonds for foreign assets, causing the interest rate to rise and the currency to weaken. The EE schedule shifts upward from EE_0 to EE_1 and the monetary authorities must shrink the money supply as necessary to restore equilibrium in the bond and foreign exchange markets. As a result, the adjustment might be such as to even more than offset the initial stimulus.

Short of the real exchange rate effect, the monetary stimulus is effective only to the extent that the central bank keeps the interest rate low (at or below its neutral level) for long enough. As experienced during the recent crisis, this policy encounters a limit at the zero (or effective) lower bound on the nominal interest rate; yet, until such limiting point is reached, the policy is generally effective.

However, the policy authorities must be mindful of the impact of credibility on the country's IBC. While high credibility raises the effectiveness of monetary policy, low credibility or the erosion of credibility in the eyes of the markets reduces it. This factor is particularly relevant for globally financially integrated and largely indebted countries, especially if their capacity to sustain a low interest rate policy is doubted by the markets. This would be the case if persistently low interest rates rendered the economy's public debt unattractive to investors or if the excess money balances injected by the central bank to purchase (monetize) the outstanding debt were used to buy speculative assets and assets denominated in foreign currencies. In this case, the authorities would have to undo the stimulus and raise the interest rate so as to halt exchange rate depreciation, otherwise depreciation and inflation would go unchecked. Reusing Eq. (15), after setting $\Delta\frac{e_{D,t}}{P_{D,t}} = 0$ and $\overline{\Delta b}_{D,H,t} = 0$, gives

(16) $\Delta X_{D,t} = X_{D,t} - X_{D,t-1} =$

$$\mathrm{X}_1\left\{\left(\iota^{-1}\left(\frac{\sum_{\tau=t}^{\infty}\left(\boldsymbol{\beta_{D,t}}|_{\omega_t^1}\right)^n\left(s_{D,t}+\frac{\overline{\Delta M}_{D,t}}{P_t}\right)}{B_{D,t-1}+\overline{\Delta B}_{D,t}}\right)-i_N^{B_j}\right)\Delta i_t^{B_D}+\left(\iota^{-1}\left(\frac{\sum_{\tau=t}^{\infty}\left(\boldsymbol{\beta_{D,t}}|_{\omega_t^1}\right)^n\left(s_{D,t}+\frac{\overline{\Delta M}_{D,t}}{P_t}\right)}{B_{D,t-1}+\overline{\Delta B}_{D,t}}\right)-i_N^{B_D}\right)\Delta\boldsymbol{\beta_{D,t}}\right\}=0$$

which again shows that, based on the new information set, if country D's credibility drops to a critical level $\beta_{D,t}|_{\omega_t^1}$ (marked in bold and red in Eq. (16)), which neutralizes the effect of monetary stimulus $\overline{\Delta m}_{D,t}$ on the nominal interest rate, $\Delta\iota^{-1}(\cdot) = 0$, and hence on real output, while the largest part of the effect would dissipate into nominal exchange rate depreciation and higher inflation via Eq.

(14).[23] The negative credibility effect might even have a net contractionary impact on output (Fig. 1b).

Finally, if the central bank and government coordinated their acts and engineered a monetary financing of new debt issuance aimed to support fiscal stimulus $\overline{\Delta b}_{D,CB,t} = \overline{\Delta m}_{D,t}$ large enough to keep $i_t^{B_j} - i_N^{B_j} = const$ (a.k.a. "helicopter money"), by totally differentiating Eq. (8) the change in the real output gap would be

$$(17) \quad \Delta X_{D,t} = X_{D,t} - X_{D,t-1} = X_1\left(i_t^{B_D} - i_N^{B_D}\right)\Delta i_t^{B_D} + X_2\left(\frac{e_{D,t}}{P_{D,t}}\right)\Delta\frac{e_{D,t}}{P_{D,t}} + X_3\,\overline{\Delta bm}_{D,t} = X_3\,\overline{\Delta m}_{D,t},$$

since $\Delta i_t^{B_j} = 0$ by construction and $\Delta e_{j,t} = 0$ with full pass-through from Eq. (14). Eq. (17) shows that, by keeping the interest rate differential constant, no negative effects retrofit on real output; as a result, the fiscal-monetary impulse is unencumbered, and the policy program can be calibrated to stabilize real output at full capacity without causing inflationary pressure. [24]If the stimulus were temporary, and the pass-through less than complete, the nominal exchange depreciation that would follow the temporary excess supply of money (Eq. (14)) would amplify the stimulus (Eq. (8)). On the other hand, under a persistent monetary financing of the fiscal deficits, the ongoing excess money creation would affect the nominal exchange rate and the inflation rate, causing credibility to drop, the ERPT effect to increase (Eq. (5)), and the exchange rate and inflation to further rise (Eq. (14)). Thus, while policy coordination may achieve the best result possible, it is not by itself sufficient for the

[23] For full neutralization to be possible, that is, for $\Delta X_{D,t} = 0$, the decline in credibility must offset the impact that the monetary stimulus exerts through the change in the price of bond *B* (represented by the term in parentheses of the expression for $\Delta\iota^{-1}(\cdot)$), so that $\Delta\iota^{-1}(\cdot) = 0$.

[24] This result is consistent with Buiter's (2016) conclusion that *«helicopter money always works»* However, the monetary authorities should always consider the impact of their action on the exchange rate.

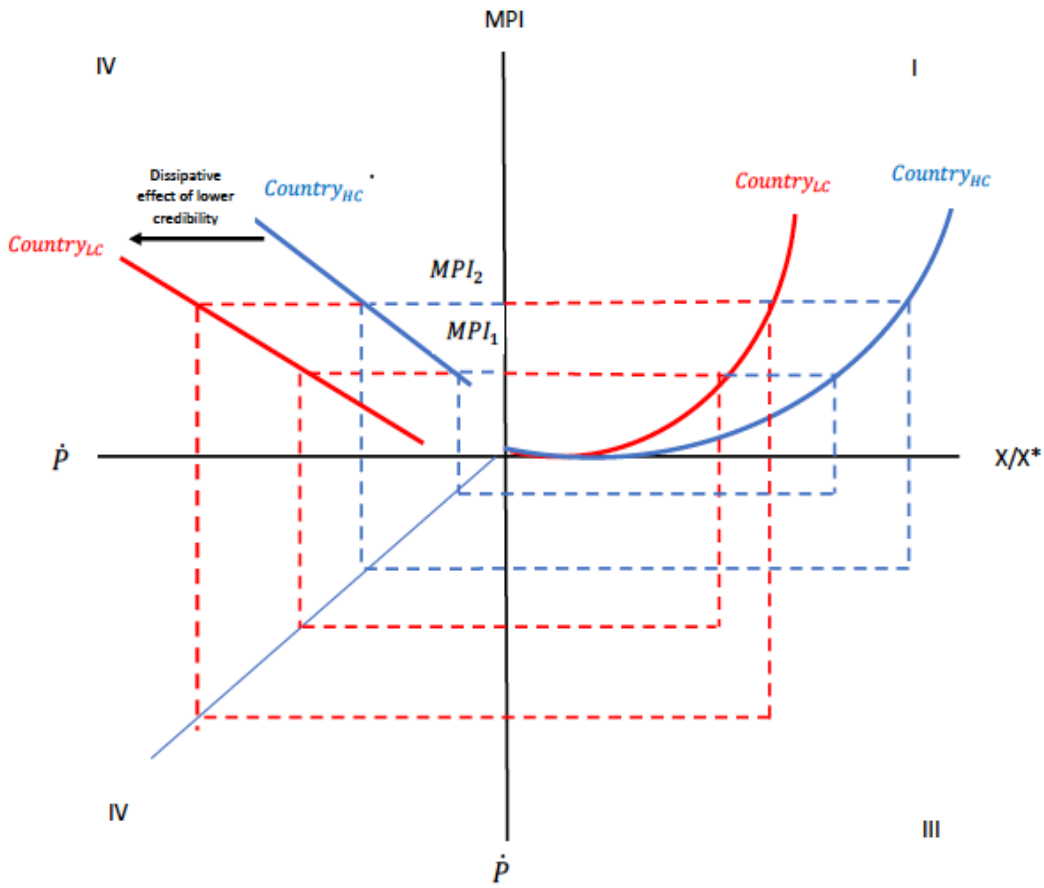
country to gain credibility in the eyes of the market. In fact, the prospects of a persistent excess money creation policy would weaken credibility in the eyes of the markets.

The analysis of the two cases above shows that the effectiveness of macroeconomic policies depends on the level of government policy credibility as perceived by the markets. In particular, at lower level of credibility, the policy space available to the policy authorities for expansionary measures may be very limited, nihil or event negative, even in the context of floating exchange rates.

In particular, Eq.'s (14)-(17) point to the relevance of a) credibility for policy effectiveness and price dynamics in a context where economies are open and globally financially integrated in the global markets, and b) the dissipation of the policy effects into inflation. Policy credibility creates space for active, effective and non-inflationary macro policies. The abuse of such space, however, dissipates the policy effects into exchange rate depreciation and higher inflation. Inflation is the measure of the dissipative effect.

As discussed in Section 5 and supported by evidence in Section 6, there is no mechanical correspondence between changes in government liabilities (money and/or debt), the exchange rate, inflation and real output. The correspondence is country specific as it depends on the country's credibility as perceived by the markets (Fig. 2) and may change depending on the government efforts (or lack thereof) to gain credibility in the eyes of the markets.

FIGURE 2. POLICY SHOCKS AND CREDIBILITY



Note: The responses of real output (as a proportion to potential output) X/X* to policy shocks MPI_1 and MPI_2 are represented by the two schedules charted in quadrant I of Figure 2 for high-credibility $Country_{HC}$ and low-credibility $Country_{LC}$, respectively. As discussed in Section 6, the variable MPI reflects the combined monetary and fiscal policy shocks to aggregate demand. The position of the two schedules indicates the higher effectiveness of policy shocks (in terms of output changes) in the high-credibility country. Symmetrically, policy shocks are relatively less effective (in terms of output changes) in the low-credibility country, where they dissipate instead into higher rates of inflation. The inflation response $\dot{P}$ to changes in MPI are represented by the two schedules charted in quadrant IV of Figure 2 for high-credibility $Country_{HC}$ and low-credibility $Country_{LC}$, respectively. The position of the two schedules indicates the higher dissipation of the policy shocks (in terms of higher inflation) in the low-credibility country. The different colors used for the two countries are used to track their respective output and inflation responses to policy shocks, through the quadrants.

5. KEY FEATURES OF THE PTI

Three features make the PTI especially fit as a theory of inflation in today's global financial context. One is that, according to the PTI, there is nothing mechanical about the transmission channel running from government liabilities to inflation dynamics. The transmission rests fundamentally on the role of financial market expectations, perceptions, and conventional beliefs – as revealed by global investors through their portfolio choices – regarding the policy credibility of a country and the future sustainability of its liabilities. To illustrate the point through an example, a country that would expand its public liabilities to finance new output and employment, all else being equal, could be successful in its attempt (and thus ending up with higher output at low inflation) or unsuccessful (thus ending up with higher inflation and limited or no change in the real variables), depending on how the credibility of the country's authorities and policy institutions as perceived by the market. Whereas the country's liabilities would be deemed to be intertemporally sustainable in a highly credible country, they would be regarded as not sustainable in a poorly credible one, thus leading investors to very different portfolio allocation choices in each case. According to the PTI, in either event the market is central in determining the elasticity of the country's IBC, and while investors may be assumed to act rationally (grounding their portfolio choices on the best knowledge available), the explanatory power of the theory does not require them to be necessarily right in their judgments – the theory simply predicts that whatever investors decide does ultimately determine the outcome of the country' policies.

The second feature is that, according to the PTI, the effect of public liabilities on inflation is not direct but it is mediated by the exchange rate. Investor portfolio choices impact, first, the exchange rate of the domestic currency as a relative price of the assets that are traded internationally and influence domestic inflation once the changes in the exchange rate are transmitted to domestic prices via the passed-through and relative price adjustment mechanisms. In the PTI, therefore, the financial and trade sectors, both domestic and external, interact strongly with each other, reflecting

the degree of integration of the economies into the global (real and financial) markets. The different speeds at which such markets process the information are critical for the transmission of the price signals to proceed from the financial assets to the goods and services exchanged in the economy, and back into the real value of the assets supplied to the markets and those held by the investors. As the model above showed, the PTI does not rule out direct effects of output changes on inflation, and the case was discussed of fiscal expansionary impulses triggering portfolio effects (via Eq. (14)) and real effects (via Eq.'s (8) and (4) that would determine lower output, exchange rate revaluation and lower inflation.

Finally, the PTI is alternative to the conventional "demand-pull" and "cost-push" (structuralist) theories of inflation. According to the PTI, as the name itself of the theory is intended to suggest, inflation originate from the optimal (re)composition of country liabilities within global investor portfolios: changes in domestic prices are the consequence of changes in the *quality* of those liabilities as they are perceived by the marginal investors. If the quality of a country currency or bonds (relative to other country currencies or bonds) is expected to deteriorate, due to their unorderly dynamics, demand for the currency or bonds will decline and a drop in their relative price will follow, causing the price of other assets, commodities and goods to increase.

An important implication of the above features is that the PTI explains how identical policies may attain different outcomes in different countries. For instance, active demand management policies in poorly credible countries may fail to stimulate output and might instead cause inflation to rise (even in the presence of large output gaps) and capital to flee the economy due to an inelastic IBC and unanchored inflation expectations; on the other hand, in highly credible countries with more elastic IBC (as determined by global market preferences) and strongly anchored expectations, the same policy shocks may achieve the desired results in terms of output and real resource use, with limited or no dissipative effect on the exchange rate and inflation.

6. EMPIRICAL ANALYSIS

The PTI was subject to a simple empirical analysis, which revealed some preliminary corroborating evidence. This evidence will have to be further substantiated by deeper future analysis. Given the innovative character of the theory, however, it was thought that sharing such early results would be useful for stimulating a debate on the proposed theory, its basic assumptions, and its predictions. Two testable propositions, deriving from the PTI, were formulated in order to drive the empirical analysis.

PTI testable propositions

Two general propositions, derived from the PTI, were empirically tested. The propositions are:

Proposition 1. *Macroeconomic policy shocks targeted at real output are more effective in credible economies than in less credible economies.*

and

Proposition 2. *Macroeconomic policy shocks targeted at real output do not affect inflation in credible economies, while in less credible economies they may either dissipate into higher inflation or end up in lower output and inflation (depending on the interaction between portfolio and real effects).*

The analysis centered on the following two simple, reduced-form regression equations:

(18) $$ln\Delta RealGDP_{i,c,t} = a_{0,c} + a_{1,c} ln\Delta M0_{i,c,t} + a_{2,c} ln\Delta PB_{i,c,t} + a_{3,c} ln\Delta Debt_{i,c,t} + \sum_{k=1}^{K} a_{3+k,c,} RealGDP_{i,c,t-k} + \varepsilon_{i,c,t}, \quad \varepsilon_{i,c,t} \sim N(0, \sigma_{\varepsilon}),$$

(19) $$Inflation_{i,c,t} = b_{0,c} + b_{1,c} ln\Delta M0_{i,c,t} + b_{2,c} ln\Delta PB_{i,c,t} + b_{3,c} ln\Delta Debt_{i,c,t} + \sum_{k=1}^{K} b_{3+k,c} Inflation_{i,c,t-k} + \theta_{i,c,t}, \quad \theta_{i,c,t} \sim N(0, \sigma_{\theta}).$$

Equations (18) and (19), where variables are all expressed in natural logarithms, regress, respectively, the changes in the economy's real GDP and inflation on the changes in the money

supply $M0$ and budget primary surplus PB as macroeconomic policy shocks,[25] controlling for past changes in the economy's fiscal position proxied by the changes in the stock of public debt (defined as gross nominal debt).[26] Real GDP is defined as $RealGDP = \frac{Nominal\ GDP}{Deflator\ GDP}$ and inflation is defined as $Inflation = lnDeflator\ GDP$.[27][28] Equations (18)-(19) were estimated using the dynamic panel regression model methodology by Arellano and Bond (1991). This methodology was chosen because it allows to: a) gauge the response of output and prices to changes in policies while controlling for permanent unobserved confounding variations; b) exploit the explanatory power of lagged values of the dependent variable (which can be included in the regressions as instruments); and c) eliminate the fixed effects.[29] In both equations, the lagged values of the dependent variables, appearing under the

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[25] $M0$ was chosen since changes in a money aggregate that is controlled by the central bank always reflects its policy stance, whether it uses direct or indirect policy instruments. As for the fiscal policy shocks, we would have preferred using the primary budget surplus data adjusted for the cycle, but the information was unavailable for many of the sampled countries.

[26] Consistent with the PTI predictions (and the two propositions above, in particular) a deterioration in the fiscal position of a poorly credible economy might further detract from the effectiveness of expansionary policy shocks on output.

[27] The use of logarithms allows us to measure the percent changes of the dependent variables with respect to unit percent changes of the independent variables.

[28] The natural logarithms of negative numbers were treated as follows: since $\ln(-x) = \ln(-1 * x)$, then $\ln(-x) = \ln(-1) + \ln(x)$; furthermore, since $\ln(1) = 0$ and $\ln(1) = \ln(-1 * -1) = \ln(-1) + \ln(-1) = 0$, then $\ln(-1) = 0$. Hence, $\ln(-x) = \ln(-1 * x) = \ln(-1) + \ln(x) = \ln(x)$. Finally, in order not to lose the information on the negative changes associated with the negative values of the variables (e.g., drops in output and inflation, or negative policy shocks), the minus sign was pulled out of the argument of the ln function and moved in front of ln function itself.

[29] With the use of the Arellano-Bond methodology, the tests provide a heteroskedastic-consistent estimate of the variance-covariance matrix of the estimators (Cameron and Trivedi, 2009). For this result to obtain, the errors have to be serially uncorrelated. If errors are serially uncorrelated, the null hypothesis is expected to be rejected at order 1 but not at higher orders.

summation sign, were used as instrumental variables. The number of lags is k = 1, K, where K=5 for the GDP variable and K=2 for the inflation variable, based on the estimation performance of alternative lag structures for each equation.

The analysis covers the period 2002-2017. The data sources used are reported in Appendix 2. Equations (18)-(19) were run on two clusters of countries respectively consisting of twelve "high-credibility" (HC) and twelve "low-credibility" (LC) countries, where credibility was proxied by the combined ratings assigned to each country by the three major rating agencies Moody's, Standard & Poor's and Fitch. The criteria for cluster construction and the list of sampled countries are reported in Appendix 2. In Eq.'s (18)-(19), subscripts i = 1, 24 and c = HC, LC stand respectively for sampled countries and country clusters. Propositions 1 and 2 are tested by assessing the inequalities of the prior values of the regression coefficients reported in Table 1.

TABLE 1. REGRESSION ANALYSIS – COEFFICIENT PRIOR VALUES

Dependent Variable	**Independent Variables**		
	Monetary policy shock $ln\Delta M0$	**Fiscal policy shock** $ln\Delta PB$	**Fiscal position** $ln\Delta Debt$
lnRealGDP	$a_{1,HC} > a_{1,LC}$	$-a_{2,HC} > -a_{2,LC}$ where $a_{4,c} < 0$ indicates that increases in the primary balance are contractionary (and vice versa for $a_{4,c} > 0$)	$a_{3,HC} \geq 0 > a_{3,LC}$
Inflation	$b_{1,HC} \leq b_{1,LC}$	$-b_{2,HC} > -b_{2,LC}$, If the portfolio and real effects are not such as to offset exchange rate devaluation (see above discussion of Eq.'s (14), (8) and (4)). $-b_{2,HC} < -b_{2,LC} = 0$ If the portfolio and real effects are such as to more than offset exchange rate devaluation (see above discussion of Eq.'s (14), (8) and (4)).	$b_{3,HC} \leq 0 \leq b_{3,LC}$

Estimation results

From inspecting the main descriptive statistics (means and standard deviations) of the variables included in the regression analysis during the period observed (Tables 2-3), it appears that real GDP dynamics in the HC countries was higher and more variable than in LC countries, while precisely the opposite held for inflation, which in the HC countries stayed close to zero for the whole period. Changes in the primary balance were negative on average for both clusters, suggesting that most countries adopted expansionary fiscal policies. However, while the deterioration of the overall fiscal position (debt) of the HC countries far exceeded (on average) that of the LC countries, the latter made a more active use of monetary policy, as indicated by the average changes in *M0*.

TABLE 2. DESCRIPTIVE STATISTICS – HC CLUSTER

Variable	Obs	Mean	Std. Dev.	Min	Max
ΔrealGDP	192	.5132409	36.40588	-283.4829	310.5293
Δdebt	192	98.92998	290.904	-208.483	1775.196
ΔM0	192	8.81292	22.83452	-8.512943	156.3465
ΔPB	192	-3.396687	100.4466	-940.9615	537.4455
GDPDeflator	192	.0249569	.05514	-.24339	.30543

TABLE 3. DESCRIPTIVE STATISTICS – LC CLUSTER

Variable	Obs	Mean	Std. Dev.	Min	Max
ΔRealGDP	192	.0446246	1.065105	-6.203995	6.308088
Δdebt	192	5.768643	22.29514	-203.7168	77.57293
ΔM0	192	526.3341	6756.585	-4.206501	93562.59
ΔPB	192	-.5471295	5.016117	-27.16381	28.24436
GDPDeflator	192	.1873933	.6143717	-.16761	7.48056

The results of the regression analysis show that in the HC countries, while monetary policy appears to be ineffective, changes in the fiscal position and fiscal policy shocks bear strong direct effects on real GDP, at the 5% significance level (Table 4).[30] On the other hand, macro policies do not have any real output effects in the LC countries (Table 5), where a growing deterioration of the

[30] In the HC countries, a 1 percent change in the stock of public debt leads, on average, to a same sign change in real GDP of almost 0.18%. Conversely, a unit percent change in the fiscal primary balance leads, on average, to an opposite sign change in Real GDP of 0.12%.

fiscal position causes the real GDP even to decrease, at the 1% significance level.[31] These results corroborate PTI Proposition 1. Notice that, based on the test for autocorrelation and at the 5% significance level, the null hypothesis can be rejected at order 1 but not at higher orders.

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                              TABLE 4. REAL GDP-HC CLUSTER
Arellano-Bond dynamic panel-data estimation     Number of obs      =        120
Group variable: ncountry                        Number of groups   =         12
Time variable: year
                                                Obs per group:
                                                              min =         10
                                                              avg =         10
                                                              max =         10

Number of instruments =     95                  Wald chi2(8)       =      68.88
                                                Prob > chi2        =     0.0000
One-step results
                               (Std. Err. adjusted for clustering on ncountry)
------------------------------------------------------------------------------
             |               Robust
 ln_ΔrealGDP |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 ln_ΔrealGDP |
         L1. |  -.3938789   .1149966    -3.43   0.001    -.6192681   -.1684897
         L2. |  -.2252542   .1309701    -1.72   0.085    -.4819508    .0314425
         L3. |  -.2348231   .0731259    -3.21   0.001    -.3781473    -.091499
         L4. |  -.1561704   .0860897    -1.81   0.070    -.3249031    .0125623
         L5. |  -.1983595   .1071038    -1.85   0.064    -.4082791      .01156
             |
    ln_Δdebt |   .1782307   .0722415     2.47   0.014     .0366399    .3198215
     ln_Δm0  |  -.1665915   .1298889    -1.28   0.200    -.4211691    .0879861
      ln_ΔPB |  -.1205763   .0528593    -2.28   0.023    -.2241787   -.0169739
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).ln_ΔrealGDP
        Standard: D.ln_Δdebt D.ln_Δdm0 D.ln_ΔPB


 Arellano-Bond test for zero autocorrelation in first-differenced errors
   +----------------------+
   |Order |  z     Prob > z|
   |------+---------------||
   |   1  |-3.0585  0.0022 |
   |   2  | .89307  0.3718 |
   +----------------------+
    H0: no autocorrelation
```

[31] In the LC countries, a unit percent change in public debt leads, on average, to an opposite sign change in Real GDP of almost 0.46%.

```
                                TABLE 5. REAL GDP-LC CLUSTER
Arellano-Bond dynamic panel-data estimation     Number of obs     =        120
Group variable: ncountry                        Number of groups  =         12
Time variable: year
                                                Obs per group:
                                                              min =         10
                                                              avg =         10
                                                              max =         10

Number of instruments =     95                  Wald chi2(8)      =      49.82
                                                Prob > chi2       =     0.0000
One-step results
                                (Std. Err. adjusted for clustering on ncountry)
------------------------------------------------------------------------------
             |               Robust
 ln_ΔrealGDP |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 ln_ΔrealGDP |
         L1. |  -.1401756   .1069725    -1.31   0.190    -.3498378    .0694866
         L2. |  -.0738178   .1497521    -0.49   0.622    -.3673265    .2196909
         L3. |  -.2029837   .0933589    -2.17   0.030    -.3859638   -.0200036
         L4. |  -.0631034    .137591    -0.46   0.646    -.3327767      .20657
         L5. |   .0306459    .099715     0.31   0.759    -.1647919    .2260836
             |
     ln_Δdebt |  -.4590748   .1450293    -3.17   0.002     -.743327   -.1748226
       ln_Δm0 |   .0513279   .1109136     0.46   0.644    -.1660588    .2687146
       ln_ΔPB |   .1294632   .1824582     0.71   0.478    -.2281482    .4870746
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).ln_ΔrealGDP
        Standard: D.ln_Δdebt D.ln_Δm0 D.ln_ΔPB


Arellano-Bond test for zero autocorrelation in first-differenced errors
  +----------------------+
  |Order |  z     Prob > z|
  |------+----------------|
  |   1  |-2.3185  0.0204 |
  |   2  |-1.7143  0.0865 |
  +----------------------+
   H0: no autocorrelation
```

The policy effectiveness noted in the HC countries is associated with the finding that, at the 1% significance level, growing public indebtedness causes inflation to decrease (Table 6).[32] These results may be heavily affected by the global financial crisis during the period observed, when the strong portfolio preferences worldwide for high-quality public debts has far exceeded their supply, leading output and inflation to decline. On the other hand, macro policies seem not to have any direct effect

[32] Note that in the HC countries, a unit percent change in public debt leads, on average, to an opposite sign change in inflation of almost 0.29%. Macro policies do not affect inflation. Only the coefficient of *M0* is positive at the 10 percent significance level, whereby a unit percent change in monetary policy would lead, on average, to a same-sign change in inflation of about 0.48%.

on inflation in LC countries (Table 7) where the recessionary impact prevails of growing public indebtedness on output. These results are consistent with PTI's Proposition 2. Notice that, based on the test for autocorrelation, the null hypothesis can be rejected at first order, but not at a higher order.

```
                          TABLE 6. INFLATION-HC CLUSTER
Arellano-Bond dynamic panel-data estimation     Number of obs     =        156
Group variable: ncountry                        Number of groups  =         12
Time variable: year
                                                Obs per group:
                                                              min =         13
                                                              avg =         13
                                                              max =         13

Number of instruments =    104                  Wald chi2(5)      =      26.01
                                                Prob > chi2       =     0.0001
One-step results
                                 (Std. Err. adjusted for clustering on ncountry)
------------------------------------------------------------------------------
               |               Robust
ln_GDPDeflator |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
ln_GDPDeflator |
           L1. |   .0186313   .0673879     0.28   0.782    -.1134466    .1507092
           L2. |    .024003   .1539574     0.16   0.876     -.277748    .3257539
               |
      ln_Δdebt |  -.2853967   .1088993    -2.62   0.009    -.4988354    -.071958
        ln_Δm0 |   .4770263   .2620102     1.82   0.069    -.0365042    .9905568
        ln_ΔPB |  -.1315696   .1112065    -1.18   0.237    -.3495303     .086391
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).ln_GDPDeflator
        Standard: D.ln_Δdebt D.ln_Δm0 D.ln_ΔPB
```

```
Arellano-Bond test for zero autocorrelation in first-differenced errors
  +----------------------+
  |Order |  z     Prob > z|
  |------+---------------|
  |   1  |-2.4747  0.0133 |
  |   2  | .81369  0.4158 |
  +----------------------+
   H0: no autocorrelation
```

TABLE 7. INFLATION-LC CLUSTER

```
Arellano-Bond dynamic panel-data estimation     Number of obs     =        156
Group variable: ncountry                        Number of groups  =         12
Time variable: year
                                                Obs per group:
                                                              min =         13
                                                              avg =         13
                                                              max =         13

Number of instruments =    104                  Wald chi2(5)      =     322.14
                                                Prob > chi2       =     0.0000
One-step results
                                 (Std. Err. adjusted for clustering on ncountry)
------------------------------------------------------------------------------
                |               Robust
ln_GDPDeflator |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
----------------+-------------------------------------------------------------
ln_GDPDeflator |
            L1. |   -.243384   .1106132    -2.20   0.028    -.4601818   -.0265862
            L2. |  -.2791298   .0776857    -3.59   0.000    -.4313909   -.1268686
                |
       ln_Δdebt |  -.0963035   .0762441    -1.26   0.207    -.2457392    .0531322
         ln_Δm0 |  -.0135053   .0568943    -0.24   0.812    -.1250162    .0980055
         ln_ΔPB |   .1157682   .0886804     1.31   0.192    -.0580421    .2895785
------------------------------------------------------------------------------
Instruments for differenced equation
        GMM-type: L(2/.).ln_GDPDeflator
        Standard: D.ln_Δdebt D.ln_Δm0 D.ln_ΔPB
```

```
Arellano-Bond test for zero autocorrelation in first-differenced errors
  +----------------------+
  |Order |  z     Prob > z|
  |------+---------------|
  |   1  |-2.0696  0.0385 |
  |   2  |-.57174  0.5675 |
  +----------------------+
   H0: no autocorrelation
```

7. Reflections on the PTI

When the stocks of central bank money or public debt grow, somebody has to hold them willingly for their value to be stable. If money or debt are issued by a HC country – especially if the country happens to be the issuer of an international reserve currency – the public wants to hold them, markets make the government's IBC elastic, and the relative price of the stocks is not much perturbed, if at all. In fact, in crisis situations, those stocks might even be in higher demand, from both resident and non-resident agents, and their price would thus increase. At the opposite side, when money or debt are issued by a LC country, the public might not necessarily want to hold them, markets make the government's IBC more rigid, and the relative price of the stocks would thus decline. Now, while a *temporary* increase of both money and debt could be effectively used as a stopgap measure even in LC countries suffering from recession (i.e., the helicopter money case discussed earlier), a *persistent*

debt – such as to finance state deficit spending in an attempt to keep output at full employment – would eventually be unsustainable: especially under strong international financial integration, the perspective of an indefinite growth (and accumulation) of the money and debt stocks would induce portfolio re-compositions away from those stocks and would depress their prices. As the results discussed in the previous section suggest, the economy would move farther afar from its full-employment output level.

In principle, no economy is immune from the "stock" story above, although, as noted, HC countries and especially countries issuing international reserve currencies (typical is the case of the US and Japan) enjoy much greater space than other countries: their IBC is much more elastic and so the critical point (beyond which they would start confronting unsustainability problems) lies much far ahead than for LC countries.[33]

The IBC elasticity would depend not just on domestic circumstances, but very much on global developments as well. For instance, in the case of non-idiosyncratic shocks that would hit the global economy at large, the world demand for assets denominated in international reserve currencies would increase independently of the domestic economic conditions of the issuing countries. Such higher demand would determine an even more elastic IBC for these countries and grant them still larger policy space than under normal circumstances, with opposite exactly holding for less credible countries.

Interestingly, not only the PTI emphasizes the critical role of public liabilities at the core of resource allocation at the country level; it provides a formidable rationale and an effective tool to understand how national public liabilities are influenced by global factors and choices in the context

[33] As noted already (see footnote 5), the concept of sustainability is here understood broadly and encompasses not only the debt repayment capacity of the State, but also the stability of the internal and external value of the national currency.

of highly internationally financial integrated economies. Said differently, in such a context the factors influencing the value of the public liabilities of any country cannot be gauged outside of a global perspective, which the PTI enables to incorporate into the analysis.

8. CONCLUSIONS

This study started from wondering why macro policies can be highly effective in some countries and outright ineffective in others, and to what extent a country stands to benefit from recovering the economic policy sovereignty it had deliberately surrendered by submitting itself to some external constraints (e.g., joining a monetary union). The Portfolio Theory of Inflation (PTI) developed in Bossone (2019), and revisited and preliminarily tested in this study, analyzes how the effectiveness of macroeconomic policy in open and globally financially integrated economies is influenced by global investor decisions, and shows that when an economy is heavily indebted and is perceived by the market to be poorly credible, investors hold it to a tighter intertemporal budget constraint and policies aimed to stimulate output growth dissipate into domestic currency depreciation and higher inflation, with limited or no impact on output. The PTI shows, on the other hand, that markets afford highly credible economies much greater space for active macro policies that can be effective on real output and noninflationary overall. The study has offered some preliminary corroborating evidence.

Three features make the PTI especially fit as a theory of inflation in today's global financial context. One is that, according to the PTI, there is nothing mechanical about the transmission channel running from government liabilities to inflation dynamics: the transmission rests fundamentally on the role of financial market expectations, perceptions, and conventional beliefs – as revealed by global investors through their portfolio choices – regarding the policy credibility of a country and the future sustainability of its liabilities. The second feature is that, according to the PTI, the effect of public liabilities on inflation is not direct but it is mediated by the exchange rate: investor portfolio choices impact, first, the exchange rate of the domestic currency as a relative price of the assets that

are traded internationally and influence domestic inflation once the changes in the exchange rate are transmitted to domestic prices via the passed-through and relative price adjustment mechanisms. However, the PTI does not rule out direct effects of output changes on inflation. Finally, the PTI is alternative to the conventional "demand-pull" and "cost-push" (structuralist) theories of inflation: as its name suggests, inflation follows from the optimal (re)composition of country liabilities within global investor portfolios. Changes in domestic prices are the consequence of changes in the *quality* of those liabilities as they are perceived by the marginal investors.

The PTI predictions and results shown above would lead to draw a very basic and yet extremely powerful piece of policy advice: while integrating a country economy into the global system delivers important economic benefits to its citizens, national policymakers should be careful that the economy's public indebtedness (including external as domestic debt) be always kept at low level and under strict monitoring: the larger the stock of the total public liabilities of an internationally highly integrated economy, the higher its degree of surrender of national policy sovereignty to external forces and interests.

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APPENDIX 1. SOLUTION OF THE ECONOMY'S MODEL

Using the Bellman's equation to solve plan (10)-(13) in the main text,

(A1) $V(y_{H,t}, W_{H,t}) = Max\left[u(W_{H,t}) + \beta V(y_{H,t+1}, W_{H,t+1})\gamma'_{t+1}R'_{t+1}\right]$,

where $R'$is the vector of real income growth rates, real interest rates and loss ratios for all bonds, leads to the Euler equation

(A2) $u'(W_{H,t}) = \left(\beta_{H,t}|_{\omega_t}\right)^n E_t\left[u'(W_{H,t+n})\gamma'_{H,t+n}R'_{t+n}\right]$,

which determines the optimal intertemporal path for wealth *W*. For a given *W* in each period, then, investor *H*'s optimal portfolio corresponds to the optimal intra-date allocation of *W* across the various assets available, and is derived by equating the marginal utilities of *M* and *B* holdings, each weighted with the inverse of its own price:

(A3) $u'(M_{H,D,t}) = u'(M_{H,F,t}) = \frac{1}{P_t^{B_D}}u'(B_{H,D,t}) = \frac{1}{e_t P_t^{B_F}}u'(B_{H,F,t})$.

Solving the model simultaneously for all demand and supply relations, under well-behaved investor preferences and optimal fiscal and monetary policies, and with full ERPT effect, instantaneous relative price adjustment to the exchange rate, and a given price level of country *F*, optimal portfolio allocations $(M^*_{D,H}, M^*_{F,H}, B^*_{D,H}, B^*_{F,H})$ attain at equilibrium asset prices $P_t^{B_{D^*}}, P_t^{B_{F*}} = 1$ (since bonds trade at their contractual value), interest rates $i_{t+n}^{B_{j*}} = i_N^{B_j}$ (equal to their neutral level), and exchange rate e_t^*, where the real output gap is balanced and the domestic and world price levels (expressed in units of the domestic currency) are each equal to $e_t^* P_{F,t}^*$. In fact, the closure of the output gap depends ultimately on the optimality and effectiveness of both fiscal and monetary policies, and optimality calls into question the issue of coordination between fiscal and monetary policies. While policy effectiveness will be discussed in the next subsection, optimality will not be further elaborated in this study.

Assuming $u(W) = \ln(W)$, using Euler equation (15), replacing $M_{H,D}, M_{H,F}, B_{H,D}$, and $B_{H,F}$ with their respective real values all expressed in the domestic currency,[34] simplifying and replacing the solution of Eq. (15) into Eq. (16), yield equilibrium relationship

(A4)

$$\frac{(\beta_{H,D,t|\omega_t})^n(1-p^*_{t+n})^n}{M^*_{H,D,t+n,}} = \frac{(\beta_{H,F,t|\omega_t})^n(1-p^*_{t+n})^n}{e^*_t M^*_{H,F,t+n}} = \frac{(\beta_{H,D,t|\omega_t})^n\left(1+i^{B_{D^*}}_{t+n}\right)^n(1-p^*_{t+n})^n}{B^*_{H,D,t+n}} =$$

$$\frac{(\beta_{H,F,t|\omega_t})^n(1+i^{F*}_{t+n})^n(1-p^*_{t+n})^n}{e^*_t B^*_{H,F,t+n}},$$

where p is the world rate of inflation used by the global investors to gauge the real value of their wealth. Re-expressing Eq. (16) in terms of the equilibrium nominal exchange rate at time t and dropping the subscript H give

(A5) $$e^*_t = \frac{\beta_{F,t|\omega_t}}{\beta_{D,t|\omega_t}} \frac{\left[\frac{1}{M^*_{F,t+1}} + \frac{1}{B^*_{F,t+,1}} E_t\left(1+i^{B_{F*}}_{t+1}\right)\right]}{\left[\frac{1}{M^*_{D,t+1}} + \frac{1}{B^*_{D,t+1}} E_t\left(1+i^{B_{D*}}_{t+1}\right)\right]}.$$

Note from Eq. (A4) that a low β_D relative to β_F causes investors to hold relatively less optimal amounts of domestic money and bonds, and note from Eq. (A5) that a larger "credibility gap" of economy D versus F (proxied by $\frac{\beta_F}{\beta_D} > 1$) determines, ceteris paribus, a higher equilibrium nominal exchange rate e of currency D versus currency F.

.[34] These are given by what these assets can actually buy to their holders at world market prices, that is, $\frac{\beta eM}{P}$ and $\frac{\beta eBP^B}{P}$, where $e = 1$ both for M_D and B_D. For the analysis and formal derivation of the utility of money and other assets, see Bossone (2014).

Finally, transforming Eq.'s (4) and (18) using natural logarithms, substituting Eq. (18) into Eq. (4) in the main text, applying Taylor's expansion to derive the equality $\ln(1+i) \approx i$,[35] and solving for the rate of domestic inflation, yield:

(A6) $\tilde{p}_{D,t} \approx \phi(\cdot) + L^{-1}\{[(\beta_{F,t+1} - \beta_{D,t+1}) + (\tilde{m}_{D,t+1} - \tilde{m}_{F,t+1}) + (\tilde{b}_{D,t+1} - \tilde{b}_{F,t+1}) + (\tilde{\iota}_{t+1}^{B_F} - \tilde{\iota}_{t+1}^{B_D})) + \tilde{p}_{F,t}] + \pi_{D,t}(\cdot)\}$,

which is reported as Eq. (14) in the main text.

[35] From Taylor's expansion, $\ln(1+i) = i - \frac{i^2}{2} + \frac{i^3}{3} - \frac{i^4}{4} + \frac{i^5}{5} - \cdots = \sum_{n=1}^{\infty}(-1)^{n+1}\frac{i}{n}$, $\forall\, i \in (-1,1]$, and $\lim_{n\to\infty}(R_n) = -\frac{i^2}{2} + \frac{i^3}{3} - \frac{i^4}{4} + \frac{i^5}{5} - \cdots = \frac{(-1)^n}{(1+\xi)^{n+1}}\frac{(i)^{n+1}}{(n+1)!} = 0$, $\forall\, \xi \in (0,i)$, and $\forall r \in (-1,1]$. Thus, $\ln(1+i) \approx i$.

APPENDIX 2. DATA SOURCES AND COUNTRY CLUSTERS

Data sources

The data on *GDP* were drawn from the World Bank database (https://data.worldbank.org), the data on general government debt are from the IMF (https://www.imf.org), and the sources and methods for extracting the data for $M0$ are reported below. PB is the government budget surplus (deficit) net of the interest expenses on the public debt, and data were drawn from the IMF database (https://www.imf.org).[36]

Notes on individual country data

As regards the statistics on $M0$, the definition of the aggregate for all sample countries includes coins and notes in circulation and central bank reserves, unless otherwise indicated below.

Angola: $M0$ was defined as currency outside banks. For the period 2002-2006, data were collected from the Angola Statistical Appendix, prepared by IMF in 2007 (https://www.imf.org/en/Publications/CR/Issues/2016/12/31/Angola-Selected-Issues-and-Statistical-Appendix-21424). For 2007-2012 no observations were retrieved. For 2012-2017, the data series ANGOLAMONSUPM0- Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/ANGOLAMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (AOA/USD). Data have been gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries).

Argentina: $M0$ data were collected from the Monetary and Financial Framework of the Banco Central de la Republica Argentina

(http://www.bcra.gob.ar/PublicacionesEstadisticas/Cuadros_estandarizados_series_estadisticas_i.asp?prevPage=stat). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (ARS/USD). Data were collected from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

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[36] Additional information on individual country data and sources are reported in Appendix 2. All variables are expressed in US dollars. The variables originally expressed in national currency (e.g., $M0$) were converted in US dollars using the yearly average exchange rates reported by the OECD or the Bank of Italy.

Australia: $M0$ was defined as currency in circulation. Data were collected from the Reserve Bank of Australia (https://www.rba.gov.au/statistics/frequency/fin-agg/2002/). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (AUD/USD). These data were obtained from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Canada: For $M0$ the data series CANADAMONSUPM0- Adj. close was used extracted from Koyfin (https://www.koyfin.com/charts/g/CANADAMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (CAD/USD). These were collected from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Colombia: $M0$ was defined by drawing on data referred to "total monetary base". Data were collected from Banco de la República - Colombia (BRC) (http://www.banrep.gov.co/en/monetary-and-credit-aggregates). $\Delta M0$ values were converted into USD by using the following yearly average exchange rate: Total, National currency units/US dollar (COP/USD). These were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Denmark: For $M0$ the data series DENMARKMONSUPM0 -Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/DENMARKMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (DKK/USD). These were collected from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Egypt: until 2008, $M0$ was defined as the sum of banknote issues, National Investment Bank claims and bank claims. Since 2009, $M0$ was defined as reserve money. Data were collected from the Annual reports of the Central Bank of Egypt

(https://www.cbe.org.eg/en/EconomicResearch/Publications/Pages/AnnualReport.aspx?p=2).

Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (EGP/USD). Data were gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries).

Morocco: $M0$ was defined by drawing on data referred to "Money supply, billion currency units in MAD". These data were collected from Global Economy:
(https://www.theglobaleconomy.com/Morocco/money_supply/). Values were converted into USD by using the following yearly average exchange rate: Total, National currency units/US dollar (MAD/USD). These data were gathered from Fxtop (https://fxtop.com/en/historical-

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New Zealand: For $M0$ the data series NEWZEALANMONSUPM0- Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/NEWZEALANMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (NZD/USD). These data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Norway: For $M0$ the data series NORWAYMONSUPM0 - Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/NORWAYMONSUPM0?view=table). Values have been converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (NOK/USD). These data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Pakistan: until 2005, $M0$ was defined as reserve money. Data were collected from the Pakistan Statistical Appendix, prepared by IMF in 2005 (https://www.imf.org/en/Countries/PAK). Starting from 2006, $M0$ was defined as the sum of banknotes in circulation and deposits of banks and financial institutions. Data were retrieved from the balance sheets of State Bank of Pakistan (http://www.sbp.org.pk/reports/annual/AFS.htm). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (PKR/USD). Data were gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries).

Papua New Guinea: until 2006, $M0$ was defined as the sum of domestic currency deposits and currency in circulation. These data were collected from the Statements of Financial Position of Bank of Papua New Guinea. From 2007, $M0$ was defined as the sum of currency in circulation, deposits from banks & third parties, deposits from Government and Government entities. Data were collected from the Statements of Financial Position of Bank of Papua New Guinea (https://www.bankpng.gov.pg/about-us/annual-reports/). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (PGK/USD). Data were obtained from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries).

Qatar: For $M0$ the data series QATARMONSUPM0 - Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/QATARMONSUPM0?view=table). Values have been converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (QAR/USD). These data were gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/averageRates).

Singapore: For $M0$ the data series SINGAPOREMONSUPM0 - Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/SINGAPOREMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (SGD/USD). These data were collected from the Bank of Italy (https://tassidicambio.bancaditalia.it/averageRates). Data on the primary balance were obtained by drawing on the database of the Department of Statistics Singapore

(https://www.tablebuilder.singstat.gov.sg/publicfacing/createDataTable.action?refId=14555). Data for the years 2001-2004 were collected from The Straits Times (https://graphics.straitstimes.com/STI/STIMEDIA/Interactives/2015/02/budget_singapore_2015/index.html).

South Africa: $M0$ was determined as the sum of notes and coin issued and reserve deposits. Data were collected from financial statements of Reserve Bank of South Africa (liabilities) (https://www.resbank.co.za/Publications/Reports/Pages/Annual-Reports.aspx**).** Values were converted into USD by using the following yearly average exchange rate: Total, National currency units/US dollar (ZAR/USD). Data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Sri Lanka: $M0$ was identified as reserve money. Data were collected from the Central Bank of Sri Lanka (https://www.cbsl.gov.lk/en/statistics/statistical-tables/monetary-sector). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (LKR/USD). Data were gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries).

Sweden: For $M0$ the data series SWEDENMONSUPM0 - Adj. close was used, extracted from Koyfin (https://www.koyfin.com/charts/g/SWEDENMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (SEK/USD). Data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Switzerland: $M0$ was defined as monetary base. Data were collected from the Swiss National Bank (https://data.snb.ch/en/topics/snb#!/chart/snbmobalech). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (CHF/USD). Data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

Turkey: $M0$ was defined as base money, determined as the sum of currency in circulation, liabilities due to banks/domestic banks and required reserves. Data were collected from Central Bank of the Republic of Turkey

(https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Reports/Annual+Reports/). Values were converted into USD by using the following yearly average exchange rate: Total, National currency units/US dollar (TRY/USD). These data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

United Arab Emirates: until 2009, $M0$ was defined as currency outside banks. Data were collected from the Statistical Appendixes prepared by IMF

(https://www.imf.org/en/search#q=United%20Arab%20Emirates%20%3A%20Statistical%20Appendix&sort=relevancy). After 2009, $M0$ was defined UNITEDARAMONSUPM0- Adj. Close. Data were collected from Koyfin (https://www.koyfin.com/charts/g/UNITEDARAMONSUPM0?view=table). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (AED/USD). These data were gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/averageRates).

United Kingdom: $M0$ was defined as the sum of notes and coins. Data are reported as monthly averages of total sterling notes and coins in circulation, excluding commercial banknote issues in Scotland and Northern Ireland. Data were collected from the Bank of England (https://www.bankofengland.co.uk/boeapps/database/fromshowcolumns.asp?Travel=NIxAZxSUx&FromSeries=1&ToSeries=50&DAT=RNG&FD=1&FM=Jan&FY=2010&TD=11&TM=May&TY=2025&FNY=Y&CSVF=TT&html.x=66&html.y=26&SeriesCodes=LPMAVAA&UsingCodes=Y&Filter=N&title=LPMAVAA&VPD=Y). Values were converted into USD by using the following yearly average exchange rates: Total, National currency units/US dollar (GBP/USD). These data were gathered from the OECD (https://data.oecd.org/conversion/exchange-rates.htm).

United States of America: $M0$ was defined as the currency component of M1. Data were collected from the Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org/series/CURRNS).

Uruguay: $M0$ was defined base money (*base monetaria*). Data were collected from Banco Central del Uruguay (http://www.bcu.gub.uy/Estadisticas-e-Indicadores/Paginas/Principales-Agregados-Monetarios.aspx). Values were converted into USD by using the following yearly average exchange rate: Total, National currency units/US dollar (UYU/USD). These data were gathered from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries).

Venezuela: $M0$ was defined as monetary base. Data were collected from the balance sheets of Banco Central de Venezuela (http://www.bcv.org.ve/estadisticas/base-monetaria). Balances were found to be expressed in VEB, the national currency until 2008. From that year, the VEF became the country's legal currency. However, on 20 August 2018, the VES replaced the VEF as national currency at 1 VES = 100000 VEF exchange rate and 1 VEF = 1000 VEB. Values were converted into USD by using the following yearly average exchange rates: until 2008, Total, National currency units/US dollar (VEB/USD); from 2008, following the introduction of the VES as national currency, Total, National currency units/US dollar (VEF/USD). Data were collected from the Bank of Italy (https://tassidicambio.bancaditalia.it/timeSeries). Data on nominal GDP for 2015, 2016, and 2017 were obtained from IMF (https://www.imf.org/external/datamapper/NGDPD@WEO/VEN), and data on the GDP deflator values for the same years were obtained from CEIC (https://www.ceicdata.com/en/indicator/venezuela/gdp-deflator-growth).

Country clusters

Equations (18)-(19) in the text were run on two clusters of countries using panel data covering the period 2002-2017. Two clusters of, respectively, "high-credibility" (HC) and "low-credibility" (LC) countries were formed based on the combined ratings assigned to each country by the three major rating agencies, Moody's, Standard & Poor's, and Fitch (see Table A1 in Appendix 2). The HC cluster was formed by selecting countries with prime or high-grade ratings and comprises 12 countries; the LC cluster was formed by considering the 7 countries rated as highly speculative, substantial risks and extremely speculative or in default. In order to form two cluster of equal size, 5 countries were added to the LC cluster (Colombia, Morocco, South Africa, Turkey, and Uruguay) rated as lower medium grade or non-investment grade speculative.

It should be noted that each country rating may be subject to change over time. Therefore, in principle, the evolution of the ratings of each country should be tracked in an exercise like the one above, instead of just taking one shot at the country ratings at a point in time and consider these ratings to remain unchanged for the whole period observed: a country that today belongs to the LC cluster may not have belonged to the same cluster in the past, or vice versa. Yet, if anything, missing to track the actual country ratings throughout the sampling period makes the estimation more

conservative overall, since, if the two PTI propositions above hold true, the inclusion in a cluster of a country that has not continuously belonged tends to weaken the estimated impact of policy shocks on the dependent variable(s).

TABLE A1. COUNTRY CLUSTERS

Cluster	Moody's	S&P	Fitch
Cluster HC: Prime or High grade			
Australia	Aaa	AAA	AAA
Canada	Aaa	AAA	AAA
Denmark	Aaa	AAA	AAA
New Zealand	Aaa	AA	AA
Norway	Aaa	AAA	AAA
Qatar	Aa3	AA-	AA-
Singapore	Aaa	AAA	AAA
Sweden	Aaa	AAA	AAA
Switzerland	Aaa	AAA	AAA
United Arab Emirates	Aa2	AA	AA
United Kingdom	Aa2	AA	AA
United States	Aaa	AA+	AAA
Cluster LC: Highly speculative, substantial risks, extremely speculative, in default, Lower medium grade, Non-investment grade speculative			
Angola	B3	B-	B
Argentina	B2	B	B
Egypt	B2	B	B+
Pakistan	B3	B-	B-
Papua New Guinea	B2	B	B+
Sri Lanka	B2	B	B
Venezuela	C	B-	RD
Colombia	Baa2	BBB-	BBB
Morocco	Ba1	BBB-	BBB-
South Africa	Baa3	BB	BB+
Turkey	Ba3	B+	BB
Uruguay	Baa2	BBB	BBB-