Liquidity premia: the PPP puzzle's missing piece?

Christopher Olk[1]

Any currency has a different purchasing power in different countries. Price levels, as measured in dollars, diverge internationally. The Minskyan tradition in Post-Keynesian economics explains divergences in the other prices of money (the exchange rate, the interest rate and par) with reference to liquidity premia and currency hierarchy. This theory has not been connected to the phenomenon of diverging price levels, which can be defined as the ratio of exchange rates to purchasing power parity rates. This paper proposes a hypothetical link to fill that gap: Different currencies with different liquidity premia are used as a store of value and international means of payment to different degrees. The resulting divergence between the demand for money in the foreign exchange market and the demand for money in the market for commodities moves the market exchange rate away from a level that would equalize purchasing power rates across countries. Based on a Post-Keynesian analysis of the links between interest rates and exchange rates, I develop an empirical measure for currencies' liquidity premia in the foreign exchange market. I use it to empirically test my hypothesis, which I formalize as a simple regression model. My results suggest that the hypothesized effect is small, but significant. This points to a causal link between currency hierarchy and diverging price levels, which in turn are one driver of ecologically unequal exchange.

Keywords: purchasing power parity, interest rate parity, currency hierarchy, liquidity premia, money view, Post-Keynesian economics, international economics

[1] PhD candidate, Freigeist Research Group „Global monetary relations in the age of offshore finance", Otto Suhr Institute for Political Science, Free University of Berlin. christopher.olk@fu-berlin.de

Introduction

Why do a cup of coffee, a bag of coffee beans, a gigabyte of mobile network connection or a haircut all cost about five times as much in the United Kingdom as it does in India? The difference is not merely one of relative prices of those goods and services, as almost all goods and service are cheaper in India. There is a difference in the *general* level of prices (and wages). Put differently, a US dollar has a higher purchasing power in Bombay, if it is converted to Rupees, than it has in London, if converted to Pounds.

This fact is a bit of a puzzle to orthodox economists, because they would expect the relatively free Anglo-Indian trade to equalize price levels: It would be profitable to buy coffee beans in India and ship them to the UK, assuming a sufficient price elasticity of demand for coffee, low transportation and transaction costs. Any divergence between exchange rates and PPP rates should be eliminated by such arbitrage in the goods markets. The "law of one price" or "purchasing power parity theorem", in its strong version, states that the price level of tradeable goods in terms of USD should be equal across countries without trade restrictions. The empirical failure of this theorem poses a "puzzle" (e.g. Krugman, 1978; Rogoff, 1996) to orthodox economists.

Economists have also proposed solutions to the PPP puzzle based, inter alia, on productivity differentials between tradeable and non-tradeable goods sectors[2], market frictions (Ford & Horioka, 2016), sticky prices (Carvalho et al., 2011), and sticky nominal exchange rates

---

[2] One of the first solutions proposed by prominent neoclassical economists starts from the observation of the 'Penn effect': consumer prices tend to be higher in countries with higher income. This observation is the intuitive basis for the Balassa-Samuelson (BS) model, which argues that the relatively higher productivity in the tradeable goods sector of high-income countries leads to higher price levels than in lower-income countries with less productive export industries, under the assumption that the productivity in the non-tradeable goods sector is equal across both types of countries (Balassa, 1973; Wang et al., 2016).

Specific studies find that BSH does not hold for Eastern Europe in the period 1995-2000 (Égert et al., 2003), that the evidence is weak for China between 2005 and 2015, but that there is some evidence for a "weak" BS effect for 8 African countries between 1960 and 2009: The growth of productivity, if not its cross-country level, is correlated with exchange rate appreciation (Njindan Iyke & Odhiambo, 2017).

There are a number of problems with this argument. First, productivity and trade-ability are not exogenous to exchange rates and price levels. Strong price level divergences create incentives for entrepreneurs to make goods tradeable that previously have not been traded. These mechanisms may be responsible for more and more goods and services becoming "tradeable" over the last decades (xyz).Moreover, capital and labour should move to the production of tradeable goods that are particularly cheap in international terms and thus competitive in world markets, which should dampen the BS effect (Chuah, 2013). It is also empirically challenging to clearly delineate between tradeable and non-tradeable parts of a given value chain – for instance, transport services (MacDonald & Ricci, 2001) or tourists who consume non-tradeable goods (Tubadji & Nijkamp, 2018). Second, structural and political factors are not accounted for, including varying levels of protectionism, different levels of labour organization (Amin, 1977) or structural patterns in the terms of trade between high-income and low-income countries (Choudhri & Schembri, 2010).

(Cheung et al., 2004; Choi & Song, 2022). In these studies, the underlying reasons for "frictions" or "stickiness" are not examined.

The major contribution of Post-Keynesians to exchange rate theory has been to show that exchange rates, especially in the periphery, are not driven by trade in goods but by financial flows (Harvey, 2009; Kaltenbrunner, 2015; see also BIS, 2021). However, economists both in the Post-Keynesian and orthodox camps seem to exclusively study the co-movement of exchange rates and price levels over *time* (e.g. Rabe & Waddle, 2020). So far, neither camp has addressed the startling presence of consistent differences in the size of the deviation between countries.

This paper proposes an additional explanation, complementary to the mechanisms listed above, that can help answer a simple but essential question: What drives the divergence between countries' price levels?

The argument is based on the concept of currency hierarchy, and proposes a novel interpretation of the 'exorbitant privilege' argument. It starts from the observation that countries with currencies that are usually considered as internationally acceptable tend to have higher price levels than countries whose currencies lack such international acceptability. Moreover, this correlation seems to hold regardless of GDP per capita. Existing explanations of price level divergence tend to focus on real factors, such as productivity differentials or barriers to trade arbitrage. The argument of this paper differs from the conventional aapproach in two key ways: First, it adopts the Post-Keynesian understanding of exchange rates as a fundamentally monetary phenomenon, driven by movements of money capital rather than commodities (Harvey, 2009). Second, it recognizes the insight of structuralist Post-Keynesians and international political economy scholars around the concepts of 'currency hierarchy' and 'exorbitant privilege': not all currencies have equal status in the international monetary system: Some high-ranking currencies are demanded as a store of value and a means of paying for goods internationally, while most low-ranking currencies are only demanded as a means of paying for goods domestically. Existing analyses of 'exorbitant privilege' as well as 'currency hierarchy' focus on the impact of this structural difference on interest rates across countries (Bonizzi & Kaltenbrunner, 2020; Conti et al., 2013; de Paula et al., 2017; McCauley, 2015).

At the same time, economists generally agree that a currency's exchange rate depends on the total demand for that currency and its relation to demand for other currencies. In contrast, the

PPP rate depends only on the demand for the currency as a means of payment for to the goods that can be bought with it in domestic markets, and the quantity of those goods.

The central hypothesis of this paper simply is that excess demand for high-ranking currencies pushes their exchange rate above their PPP rate, whereas the lack of such international demand pushes the exchange rate of low-ranking currencies below their PPP rate.

The effect should be strongest for countries whose currencies are used internationally as a store of value in large proportions relative to their GDP, but which are not created offshore to a substantial degree – one salient case being Switzerland.

Obviously, this argument does not imply that other factors besides monetary hierarchy may play a role in explaining the international divergence in the price level of tradeable goods. Otherwise, there could not be different price levels in different countries that use the same currency, such as the members of the Eurozone and the CFA zone (the world's other large monetary union in West and Central Africa). I will merely argue that exchange rate is one determinant of different price levels, and one that can be explained by monetary hierarchy.

If my hypothesis turned out to be true, it would imply that monetary hierarchy and international economic inequality are causally connected. This would support the theory of unequal exchange (e.g. Emmanuel, 1972; Amin, 1974; Kohler, 1998; Dorninger et al., 2021).

The purchasing power parity puzzle

A neoclassical economist who hands 2 dollars over the counter of a coffee stall in India might be surprised when she receives 5 cups of coffee instead of the one cup she expected to receive for that price – at least if she was trained to believe in the purchasing power parity (PPP) theorem.

The neoclassical literature presupposes that exchange rates are determined in the international market for goods and services. The exchange rate that brings these markets to equilibrium is given by the PPP theorem, of which there are two versions: The *absolute* PPP theorem states that the price levels p in two monetary jurisdictions determine the spot market exchange rate S between their currencies (quoted here in the European convention).[3] For instance, the dollar exchange rate of country i depends on its domestic price level, measured by the PPP deflator[4], and the US price level.

$$S_{i/USD} = \frac{p_j}{p_{USD}} \tag{1}$$

The economic logic underlying absolute PPP is based on arbitrage in goods markets: In the absence of transaction or transport costs, there should be an equilibrium where the price of goods and services multiplied with the price of the currency they are quoted in are equalized across the entire world, because arbitrageurs would otherwise trade goods and, for this purpose, demand currencies until exchange rates adjust until the equilibrium is restored. Empirically, absolute PPP simply does not hold, as the orthodox economist will learn at the Indian coffee stall.

The *relative* version of the PPP theorem states merely that changes in the exchange rate occur in tandem with changes in the relative price levels. The exchange rate and the inflation rate π_i are supposed to move in lockstep:

$$S_t = \mathrm{S}_{\mathrm{t}-1}\left(\frac{\pi_i}{\pi_{USD}}\right) \tag{2}$$

[3] Using the USD as base currency. For instance, the EUR/USD rate expresses how many euros one needs to buy one dollar.

[4] Note the hierarchy implicit in the fact that this variable is called "deflator" – since it does in fact act as a deflator, not an inflator, for all but the richest Core countries, which is perhaps why the World Bank uses the more neutral term „PPP conversion factor".

Empirically, this version of the PPP theorem is equally unsuccessful in the short run, and the evidence is mixed at best for the long run (Taylor & Taylor, 2004; Drine & Rault, 2008). In particular, “[Relative] PPP does not seem relevant to characterize the long-run behavior of the real exchange rate […] in African, Asian, Latin American and Central and Eastern European countries“ (Drine & Rault, 2008). While relative PPP continues to be at the heart many long-run models in international economics (Nagayasu, 2021), in spite of its limited empirical merit, absolute PPP was unequivocally rejected by the 1980s.

There is a persistent deviation between the price of a currency in terms of the goods and services that it can buy in domestic markets – its “purchasing power parity rate” – and the price of a currency in terms of other currencies, i.e. its market exchange rate. The gap between these two rates can be called the “price level ratio of PPP conversion factor to market exchange rate” (as the World Bank does), “exchange rate deviation index” (as Reich, 2014, does), or “distortion factor” d_i (Kohler, 1998). It is given by:

$$d_i = \frac{S_{i/US}}{\frac{p_i}{p_{US}}} \tag{3}$$

The value of d_i gives the quantity of dollars that is required to buy a basket of internationally comparable goods in country i, given that such a basket costs USD 1 in the USA. If absolute PPP held without qualification, d_i would equal 1 for all currencies. This is clearly not the case, as Figure 1 reveals.

The unexplained failure of absolute PPP would be theoretically unsatisfying even if the divergence between the theorem and the data were merely random noise. Clearly, that this is not that case – instead, there is a clear pattern, which requires a theoretical explanation. Prima facie, it seems as if the relative price level tends to be higher in rich countries, and lower in poor countries.

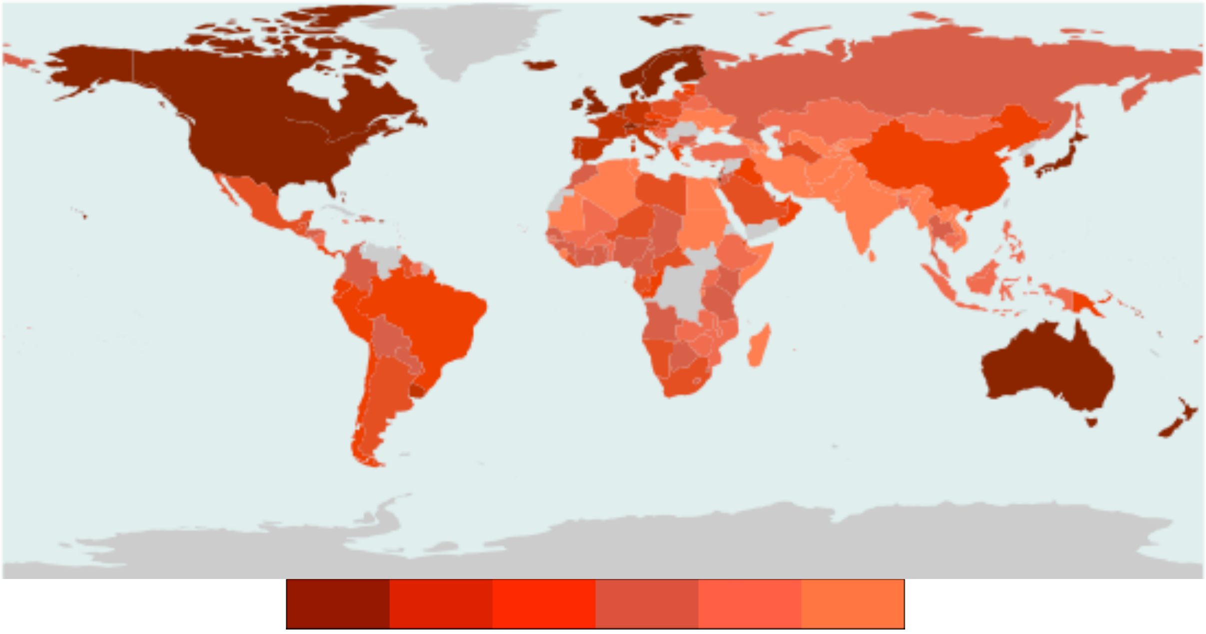

Figure 3. Price level ratio of PPP conversion factor (GDP) to market exchange rate. World Bank (2015).Colours range from 0.2(light red) to 1.2 (dark red).

In addition to these views, not in opposition to them, I will propose another hypothesis: The price level in a country may be determined, among other factors, by the liquidity of its currency. The first step is to acknowledge that exchange rates are not determined in the market for commodities, but in the market for foreign exchange.

Theoretical framework: Minskyan economics

In the Minskyan 'money view' within the broader Post-Keynesian tradition, the price level is but one of the four prices of money: The exchange rate is the price of money in terms of another currency. The purchasing power (the inverse of the price level) is the price of money in terms of commodities. The interest rate is the price of money now in terms of money in the future. Finally, the price of one type of credit money in terms of another type of credit money which is higher or lower in the hierarchy of credit monies (e.g. central bank reserves vs. bank deposits vs. FX swaps) is called "par" (Mehrling, 2018).

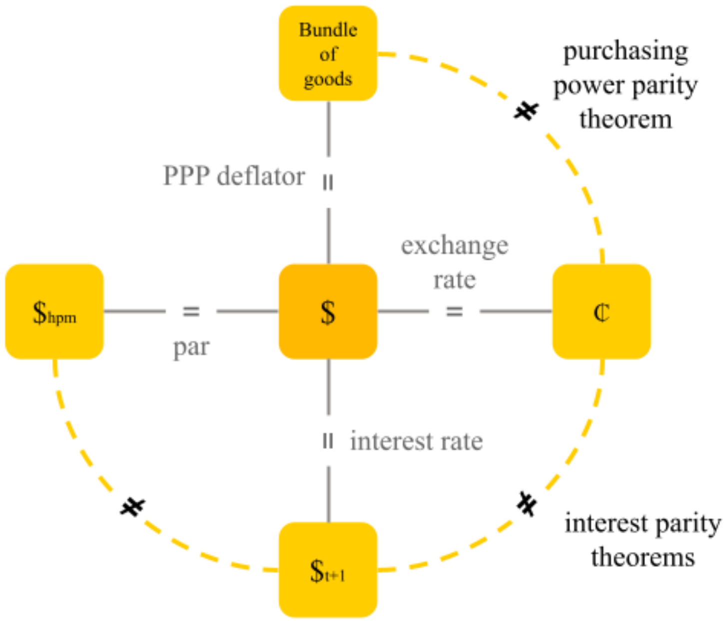

Figure 1. The four prices of money. Own design based on Mehrling (2018, 1st lecture).

Here, ₵ is a fictional currency,[5] $\$_t$ signifies USD in the future and i is the interest rate in the US; $\$_{hpm}$ stands for "high-powered USD", i.e. central bank reserves or cash; and B stands for the bundle of commodities used to calculate the PPP deflator that compares the price levels of different countries.

The four prices of a dollar are by definition equal to one dollar, as expressed in figure 1. This would logically also imply equalities of the four prices to one another. Paradoxically, these are *not* always equal in empirical reality. In particular, the equalities between par, interest rates and exchange rates tend to break during times of financial stress, and they tend to break first in countries who issue currencies that are commonly regarded as lower in the international currency hierarchy.

The equality between a US dollar and its four equivalents holds by definition, but the equalities between them – which are implied logically and, according to neoclassical economics, should be established by arbitrage according to the purchasing power parity and interest parity theorems – do not necessarily hold in practice. For instance, empirical forward rates (i.e., future exchange rates agreed in the present) regularly violate the covered and uncovered interest parity theorems, especially during crises (e.g. Borio et al., 2016; Du et al., 2018; Mehrling, 2018). The reason is that arbitrageurs are constrained by liquidity. Liquidity is actively provided by investors, dealers, banks and central banks by holding currencies on their balance sheets

[5] The ₵ sign is borrowed from the Ghanaian Cedi (GH₵) to stand for any currency.

(Mehrling, 2013). Private actors demand a "liquidity premium" as compensation for doing so, which is reflected in the four prices of each money.

In the Post-Keynesian view, one of the four prices of money, the short-term interest rate, is set by the central bank, according to some tradeoff between the goals of consumer price stability, employment, exchange rate level and external balance of payments.[6] These variables in turn depend on liquidity preferences, and on currency hierarchy: Central banks that issue lower-ranking currencies typically have to set higher interest rates to ensure sufficient demand for their liabilities (de Paula et al., 2017). Liquidity premia directly influence interest rates. They also influence the relationship between par and interest rates, as higher-ranking credit monies tend to bear lower interest rates; and between exchange rates and exchange rates, as the forward rate tends to deviate from covered interest rate parity in times of rising liquidity premia (see below). However, as in Figure 2, there is a missing link in the Minskyan literature where a connection between the exchange rate and the price level could be suspected. Post-Keynesian economists more generally have not attempted to explain the persistent international divergence of price levels, i.e. the failure of the absolute PPP theorem.

This paper seeks to close that gap. Its central argument is that what is true for the other three prices of money is also true for its purchasing power: One of the factors that determines relative purchasing power of a given currency across different countries is the difference between its own liquidity premium and the liquidity premium the currency used in that country, because diverging liquidity premia cause the market exchange rate to diverge from a level that would equalize price levels across countries.

Currency hierarchy and liquidity premia

There is broad agreement among Post-Keynesian economists and international political economy scholars that the international monetary system is characterized by a hierarchy of currencies. Mainstream IPE scholars typically conceptualize 'currency hierarchy' as a divergence in the degree to which different currencies fulfil the three functions of money (unit of account, store of value, and means of exchange) on the international level (e.g. Cohen, 2015).

---

[6] The supply of money is not directly controlled by the central bank, but created endogenously by commercial banks and other financial actors, according to the demand for money by the private sector at the given rate.

In particular, some currencies serve as a means of payment and store of value internationally, while others serve only as a means of payment in the domestic economy. While the liabilities of most central banks may be accepted as a means of payment within the national economy, only a few currencies fulfill that function on the global level.

Economists in the post-Keynesian tradition (e.g. Kaltenbrunner, 2015; Prates, 2020; Bonizzi & Kaltenbrunner, 2020; Reis & de Oliveira, 2021) draw on Keynes' (1973 [1930]; 1964 [1936]: ch. 17) original introduction of the concept of currency hierarchy. They start from the observation that the privilege of issuing the ultimate means of settling international debts – the 'key currency' or 'world money' (Marx, 1976 [1867]: 242) – has always been exclusive to one or a few hegemonic powers. The key currency today is the onshore and offshore US dollar (Murau et al., 2020). The degree to which any currency is internationally acceptable is significantly determined by the degree to which it is ultimately convertible into dollars (Murau et al., 2022).[7]

The result is a pyramidical structure, in which the position of any currency depends on its *liquidity* (Minsky, 1976; Prates, 2020; Svartzman & Althouse, 2020; Aglietta, 2020; Olk, forthcoming). This concept is at the heart of a structuralist or Minskyan or structuralist understanding of international monetary hierarchy[8], as expressed by de Paula et al. (2017): "The key currency, currently the U.S. fiduciary dollar, is placed at the top of the hierarchy because it has the highest degree of liquidity" Similarly, Svartzman & Althouse (2020) suggest that "monetary hierarchies today can be measured by the *relative liquidity* of national

[7] The liquidity of a currency depends in an immediate sense on the willingness of international investors and, more importantly, currency dealers to make markets for them, which requires them to hold assets denominated in that currency and/or to expand their balance sheet by creating assets and liabilities denominated in that currency (Mehrling, 2013). Dealers and investors are not similarly willing to expose themselves to liquidity risk in all currencies, because taking positions in different currencies brings different degrees of liquidity risk. A better explanation is to be found in the emerging "critical microfinance" paradigm, which is closely related to the Minskyan view (Bonizzi & Kaltenbrunner, 2020): what matters for the "moneyness" of a currency is the ability to *convert* it into hegemonic currencies, in particular the USD, quickly and without a loss. This ability in turn depends on the institutional position of the financial system that creates and maintains the currency within the global financial architecture Ultimately, the infrastructural distance of the central bank to the US Fed determines the speed and the cost at which it can access US dollars in order to maintain par between its own high-powered money and the pyramidical credit structure based on it, especially during critical times (Murau et al., 2021): Central banks that enjoy the privilege of a swap line with the Fed or the somewhat lesser privilege of access to the FIMA repo facility will find it easier to get a hold of high-powered dollars in times of crisis, so that they may be able to maintain par even during times when more Peripheral central banks, who need to go through the costly and slow SDR system to acquire dollars, will find themselves unable to maintain par.

[8] Within the Post-Keynesian camp, there is only one other theory related to currency hierarchy, namely that of the German Monetary Keynesians (e.g. Riese, 2001). It is based on the notion of "currency premium", the "ability to store wealth relative to other currencies". This is not equivalent but fairly close to the Minskyan notion of liquidity as an expression of hierarchy; the Minskyan view would add that not only the ability to store wealth but also the riskiness of making markets for a currency matters.

currencies, which corresponds to the willingness of all agents in the system to hold them, and by their use as means of settlement of international debt" (italics added).

A liquid currency is one that is convertible into other currencies in large volumes, quickly and without major price movements, and which can therefore be used to meet outstanding financial obligations. Relatively liquid debt instruments thus provide those who hold them with more 'potential convenience or security' (Keynes 1936: 226) in the face of fundamental uncertainty about the future. Economic agents are therefore willing to hold liquid currencies in relatively larger quantities (Andrade & Prates, 2013; see also Cohen, 2015:21). They also demand a monetary compensation for holding relatively illiquid currencies, the 'liquidity premium'. All liquidity premia tend to increase during periods of heightened uncertainty, but there is also a structural divergence of liquidity premia between currencies: Currencies that have a more limited or costly access to emergency dollar liquidity from the balance sheet of the Federal Reserve, the ultimate issuer of the key currency, are less liquid even in non-crisis times (Murau et al., 2022).

Liquidity premia a wedge into what would otherwise be simple equalities (Minsky, 1976; Mehrling, 2018). The liquidity premium is constantly quantified through these four prices of money and, as it were, hidden in them, but at the same time not reducible to them. The existing literature in the Minskyan tradition acknowledges this both for par[9] and for the interest rate (e.g. Mehrling, 2018). The structuralist-Minskyan interpretation of the forward rate (Kaltenbrunner, 2015; Kregel, 1994) also suggests a connection between liquidity premia and the relationship between interest rates and exchange rate. The contribution of this paper is simply to add that the relatively greater share of more liquid currencies in the total money balances that are hoarded (Andrade & Prates, 2013; Barbosa et al., 2018; Kaltenbrunner, 2015; Lavoie, 2014) has an impact on the divergence between exchange rates and PPP rates.

[9] For instance, bank deposits and central bank reserves trade at par in normal times. However, in a crises (e.g. during a bank run) the liquidity of that money which is lower in the hierarchy (in this case, bank deposits) can fall so much that it breaks the par relationship to high-powered money (in this case, central bank reserves.): Banks will struggle to get hold of reserves and accept a discount to do so. Similarly, it is commonly acknowledged that interest rates compensate for liquidity risk. Otherwise, the shape of the yield curve would be a flat line. In this context, it is interesting that Lavoie (2000, citing Coulbois & Prissert, 1974) suggests that those studies that did find a deviation from CIP have mistakenly used long-term rather than short-term interest rates. He does not make explicit why this would cause the forward rate to deviate, but one possible answer would be that long-term interest rates, in contrast to short-term interest rates, include a liquidity premium.

Hypothesis: alternative link between purchasing power and exchange rate

Empirically, the exchange rate tends to be close to or above the PPP rate (i.e. the price level is high) in countries that issue higher-ranking currencies, while it is lower in all countries with low-ranking currencies. Currency hierarchy, then, seems to have something to do with the PPP puzzle. One attempt to solve it may start from the common assumption that the exchange rate between two currencies is a function of relative demand for them, since most (if not all) of the money supply is created endogenously according to that demand (Harvey, 2009; Kaltenbrunner, 2015; Cesa-Bianchi et al., 2019). Total demand for dollars consists of demand for the purpose of buying goods in the US, plus demand for the purpose of buying third countries' exports invoiced in USD, plus demand for liquid USD-denominated assets as a store of value. The USD/EUR exchange rate then is a function of the sum of these three components of demand for USD, and of the total demand for EUR. In other words, the quantity of money demanded for the purpose of buying third countries' exports depends on the share of the domestic currency in international trade invoicing, and the demand for liquid assets denominated in the currency as a store of value is a function of its interest rate, its expected appreciation and, importantly, its liquidity premium (see section 3.1).[10] Higher-ranking currencies are used to relatively greater extent not only in international trade, but also as a store of value. More generally, agents are willing to hold – and therefore demand – currencies with higher liquidity premia in greater quantity. More liquid currencies should then face international demand above a level that would be sufficient to purchase commodities sold by the country issuing that currency, whereas lower-ranking currencies will face relatively lower demand. This additional demand may not only allow for higher quantities of external liabilities than would otherwise be possible (i.e. the first aspect of "exorbitant privilege"). It may also push the market exchange rate of the higher-ranking (lower-ranking) currency above (below) a hypothetical level that would equalize the price of commodities across countries, i.e. its PPP rate. This hypothesis can not only explain the empirical observation that countries with higher-ranking currencies tend to have higher price levels. It also explains why the effect is particularly pronounced for Switzerland and the UK, small countries with outsized financial sectors whose

[10] Along similar lines, Marx argued that hoarding absorbs the difference between the total supply of money and money in circulation; the remaining demand for "money as treasure" depends on (and at the same time stabilizes) the essential property of money's serving as "general equivalence" (see Brunhoff, 2015 [1976]). It is plausible to conclude that a currency that serves as money on the international level will be demanded for the purpose of hoarding to a relatively greater extent.

currency is internationally used as a store of value in relatively greater proportion to their GDP than those of, say, the US, China or Japan.

PPP rates, in contrast, measure the domestic price level. The price level is usually conceptualized as a function of aggregate demand and supply in domestic good markets (Dutt, 2002), although in the short run it also depends on the price-setting power of different market actors and social classes. Aggregate demand at any given moment can be measured as the quantity of money that people spend at that moment as a means of paying for goods and services, both domestically produced and imported ones. A sudden increase in aggregate demand without a commensurate increase in supply (a highly hypothetical and implausible scenario) would cause inflation – here, Post-Keynesians and monetarists would agree, even if Post-Keynesians would doubt the plausibility of such a scenario and propose a much more detailed and sophisticated mechanism by which increases in demand may or may not translate into inflation or else GDP growth. Consequently, a surge in the demand for a currency in the foreign exchange market will have a direct impact on its exchange rate, but not necessarily a direct impact on the general price level in the countries using that currency.[11] Similarly, a change in the price level need not directly affect the exchange rate.

Aggregate demand in the US is equal only to the first component of demand for dollars, i.e. demand for money as a means of buying domestic goods. There is then a difference in the components of demand for money that determine exchange rates and PPP rates, respectively. An increase in demand for money as a means of paying for domestic goods will have a proportionate (or no) effect on PPP rates and exchange rates[12], but an increase in the demand for other purposes will directly affect exchange rates but not PPP rates, at least not directly.

Although this hypothesis is my own proposition, not drawn from the existing literature, Somel (2003) does give a hint when he argues that “a strong demand for reserve currencies pulls the market value of Peripheral currencies below their purchasing power parities against the reserve currencies“. But this version of the argument cannot explain why, say, Israel or Denmark, certainly not issuers of a reserve currency, have such high price levels. I would suggest a generalization: It is not only the reserve status of a currency, but a high degree of liquidity more generally which causes its exchange rate to rise above its purchasing power.

[11] The question of imported inflation and feed-through mechanisms is beyond the scope of this paper.

[12] In the AS/AD model, a change in aggregate demand will have no effect on the PPP rate if it is fully accommodated by a change in aggregate supply, and no effect on the exchange rate if these changes do not affect the trade balance.

Formal argument

This section will formalize the argument outlined above. We will assume given price levels in two countries, and suggest a mechanism by which the exchange rate may deviate from the PPP rate that would equalize the price levels across countries. This approach can explain not only why absolute PPP fails, but also clarify *how* it fails, and what determines the size of the deviation between PPP and the market exchange rate.

To demonstrate this mathematically, one key assumption behind PPP must first be made explicit, namely the quantity theory of money. The price level is determined according to the 'equation of exchange':

$$MV = pT \tag{4}$$

Where M is the quantity of money, V the velocity of circulation (typically regarded as a constant), and T the number of transactions (typically regarded as a function of output). In the monetarist interpretation, inflation then is merely the effect of exogenous changes in the other variables, in particular the money supply.

For two countries, one of which is assumed to be the US, the PPP theorem can be restated as:

$$\frac{M_i V_i}{p_i T_i} = S_{i/USD} \frac{M_{US} V_{US}}{p_{US} T_{US}} \tag{5}$$

But the vulgar monetarist version of this equation would falsely assumes that the entire quantity of money M is used as a means of payment in transactions. That is not realistic. If the price level is determined by the "quantity of money chasing the quantity of goods", as Friedman put it, we must only look at that part of the total money supply that is actually busy chasing goods, not the part relaxing in deposit accounts.

Marx makes a similar argument: hoarding absorbs the difference between the total supply of money and money in circulation; the remaining demand for "money as treasure" depends on (and at the same time stabilizes) the essential property of money's serving as "general equivalence" (see Brunhoff, 2015 [1976]). For Keynes, money is hoarded out of a "liquidity preference" to ensure flexibility in the face of an uncertain future. Either way, a certain portion of the total money supply will be hoarded rather than spent, and the relative size of this portion varies between currencies.

Therefore, the total quantity of money M can be analytically divided into two parts:

$$M_i = C_i + H_i \quad (6)$$

where C is that part of money that circulates as a means of payment and H is that part which is hoarded as a store of value.[13]

An augmented version of the quantity theory equality would account for the share of the total money supply which actually circulates as a means of payment, but not for the part that is hoarded as a store of value:

$$C_i V_i = p_i T_i \quad (7)$$

Now, what determines the relative size of H_i for two currencies? I will argue that the relative size of H_i as a share of M_i, as compared to H_j of another currency j, will be determined by its relative *liquidity*.

The intuition behind this is simple. In theory, every money functions as a means of payment, a store of value and unit of account. In reality, different currencies fulfill these functions to vastly different degrees. For example, the only reason to hold a currency like the Ghanaian Cedi is to buy goods and services in Ghana; but the reasons for holding Pound sterling, Swiss Franc, or US dollars include the desire to store wealth, to buy commodities exported by third countries, and to protect oneself against liquidity risk. The relative ability of a currency to function as a store of value and to protect its holder against liquidity can be defined as its liquidity premium l_i. It seems to be a plausible hypothesis that this variation depends on the varying degrees of liquidity risk involved in hoarding different currencies. If this is true, the liquidity premium of a given currency should have an effect on the demand for it for the purpose of hoarding. Higher-ranking and more liquid currencies will face international demand over and above a level that would equilibrate goods markets, whereas lower-ranking currencies will face relatively lower demand because they are not held as a store of value. This can be put simply as the statement that the share of Hoarding is a function of

[13] The Cambridge equation, first used by Pigou (1917, p.43), and picked up by Keynes (1923; 1936) accounts for the difference between total income and liquid money balances. It states that $M = kPY$, where k is the proportion of income held as money balances. I chose not to use this equation as the basis of my arguments for reason of exposition, but the two are effectively equivalent, if one assumes that $H = kM$ and $C = (1 - k)M$.

$$H_i = f(l_i) \tag{8}$$

From (6), (7) and (8):

$$(M_i - f(l_i))V_i = p_i T_i \tag{9}$$

On this basis, PPP (as in equation 5) can be rephrased:

$$\frac{p_i T_i}{(M_i - f(l_i))V_i} = S\left(\frac{p_{US} T_{US}}{(M_{US} - f(l_i))V_{US}}\right) \tag{10}$$

Assume for the sake of argument that the total quantity of money, the velocity of circulation and the number of transactions are the same in both countries, and can simply be set to 1. This is a necessary assumption to make a *ceteris paribus* analysis possible.

$$\frac{p_i}{1 - f(l_i)} = S\left(\frac{p_{US}}{1 - f(l_i)}\right) \tag{11}$$

which can be transformed to:

$$\frac{1 - f(l_{US})}{1 - f(l_i)} = S\left(\frac{p_{US}}{p_i}\right) \tag{12}$$

The right hand side now is a reformulation of Kohler's „distortion factor". Inserting (12) into (3) yields:

$$d_i = \frac{1 - f(l_{US})}{1 - f(l_i)} \tag{13}$$

I have just shown in a simple two-country model of an augmented theory of PPP that, when the quantity of money, the number of transactions and the velocity of circulation all are assumed to be the same in two countries, Kohler's distortion factor is a function of the relative returns (or "own rates of interest") of the two country's currencies. The underlying reason is that the exchange rate is determined in foreign exchange markets, whereas the price level is determined in commodity markets. For the exchange rate, the total demand for money matters. For the price level, only that part of the overall quantity of money matters which is not used as a store of wealth, but circulates as a means of payment. Considerations about the liquidity of currency assets will play a decisive role in determining the degree to which a currency will be hoarded, i.e. used for the purpose of storing value.

The assumptions introduced in equation (11) may not be very realistic. However, for my argument to hold it is not required that the number of transactions, the quantity of money and the velocity of circulation are really all the same across countries, but only that they are *statistically orthogonal* (uncorrelated) to $f(l_i)$. Whether this is in fact the case is a purely empirical question. The objective of the next sections will be to arrive at a set of equations that contain only observable variables, so that it can be empirically tested. The first step towards this will require us to dive deeper into the Post-Keynesian theory of exchange rate determination. We need to connect the interest rate to the exchange rate, before we can return to the connection between the exchange rate and the price level.

Liquidity premia, interest rates and forward exchange rates

Post-Keynesian theory acknowledges that the exchange rate is determined in money markets, not commodity markets. Therefore, the interest rate is a better starting point to understanding exchange rate determination than the price level. The forward exchange rate connects the exchange rate to the interest rate (see fig.1), since it is the price of *foreign* currency *tomorrow* in terms of *domestic* currency today. The theoretical connection is given by the interest rate parity theorem, which, in contrast to PPP, is actually used in financial trading (e.g. Hayes & Boyle, 2021). It too goes back to Keynes (1923; see also Kregel, 1994). Like PPP, it comes in two versions: *Uncovered interest parity* (UIP) states that expectations about changes of the future exchange rate between two countries' currencies must be, on average, equal to the interest rate differential between them. The reasoning is a simple portfolio choice argument: an investor would prefer to hold assets denominated in a higher interest currency unless she expects its price to fall. She will hence demand a currency precisely up to the point where it is expected return is equal to its expected depreciation. The theoretical equilibrium then is given by:[14]

$$\frac{1 + i_{USD}}{1 + i_i} = \frac{S^e_{t+1}}{S_t} + \varepsilon \qquad (14)$$

where i_i is the interest rate, S^e_{t+1} is the expected spot rate in the next period, and ε is a normally distributed "white noise" error term with a mean of zero. This implies that expectations need not always be correct, but on average the mistakes are *unbiased*. This is how UIP is usually presented in the literature. However, note that the overarching argument would not logically

[14] Note that I show here the non-approximated equations for UIP and CIP, not the approximated versions that Lavoie (2000) uses. For sufficiently small interest rate differentials, equation (4) can be approximated via the Taylor expansion to $i_{USD} - i_i = S^e_{t+1} - S_t + \varepsilon$, and equation (5) to $F_t - S_t = i_{USD} - i_i + \lambda_i$. I will later make use of this approximation again.

require the assumption that market participants' expectations of future exchange rates are completely unbiased or "rational" or "correct on average" or anything of that sort. It would suffice to assume that the biases and errors expressed in ε are statistically orthogonal to the expected appreciation of individual currencies.

In any case, UIP fails miserably at explaining empirical data (e.g. Lavoie, 2000; Jongen et al., 2008; Mehrling, 2013).[15] Some authors (e.g. Smithin, 1994) have tried to rescue the theorem by inserting a country-specific, time-varying risk premium, with limited empirical success (Jongen & Verschoor, 2008). Lavoie (2000) criticizes these approaches on the basis that, to explain the data, such a risk premium would need to change very quickly over time, which, in his view, would render it economically meaningless. This is worth keeping in mind.

While UIP includes an expectational variable that is not directly observable, the *covered interest parity* (CIP) theorem instead refers to forward contracts, which fix the price of a currency to be paid in the future already in the present. CIP states that the differential between the forward exchange rate and the spot exchange rate interest rate is, in equilibrium, equal to the interest rate differential between two countries:

$$\frac{\mathrm{F_t}}{\mathrm{S_t}} = \left(\frac{1 + i_{USD}}{1 + i_i}\right) + \lambda_i \quad (15)$$

where $\mathrm{F_t}$ is the forward rate and λ_i here is a variable introduced here to account for the empirical failure of equation (15) without it.

If CIP and UIP were to hold simultaneously, then the forward rate would, at least on average, have to be equal to expected future spot rate. This is not the case: while CIP does seem to fit well to empirical data, UIP has little empirical support: the forward premium is not a good predictor of future spot rates (Goodhart et al., 1992).[16] Lavoie (2000) concludes from this that either investors' expectations must be consistently wrong, or the forward rate does in fact not have anything to do with the expected future spot rate. He opts for the latter, and thus rejects UIP, while maintaining CIP.

[15] In particular, currencies with positive interest rate differentials were found to appreciate rather than depreciate, a result also known as the forward premium discount puzzle.

[16] In particular, currencies of countries with positive interest rate differentials were found to appreciate rather than depreciate, a result also known as the forward premium discount puzzle. Some authors (e.g. Smithin, 1994) have tried to rescue UIP by inserting a country-specific, time-varying risk premium, with limited empirical success (Jongen & Verschoor, 2008). Lavoie (2000) criticizes these approaches on the basis that, to explain the data, such a risk premium would need to change very quickly over time, which would render it economically meaningless.

The orthodox interpretation of CIP is again based on any simple no-arbitrage condition: Any deviation from it would give rise to an arbitrage opportunity (known as "carry trade"): For example, by borrowing spot in a currency with a low interest rate and using the proceeds to buy and then lend forward in the high-interest currency, one would reap a risk-free profit. This arbitrage would eventually bring forward rates back into the equilibrium rate (Coulbois & Prissert, 1974).

The Post-Keynesian interpretation of CIP differs from the orthodox analysis. However, there is some internal disagreement within the Post-Keynesian tent here: Kaltenbrunner (2012) provides a detailed account of the disagreement between "Horizontalists" (e.g. Lavoie, 2000) and "Structuralists" (e.g. Kregel, 1994). As Post-Keynesians, both sides generally agree that the interest rate (and not the money supply) is set by the central bank. They also agree that exchange rate expectations are not determined by some kind of rational foresight that would be correct on average, let alone lead to a stable market equilibrium.[17] However, the two camps disagree on the level of autonomy that different central banks have when setting the short-term interest rate in an open macroeconomy, especially for developing and emerging economies (DECs), and during times of crises. Kaltenbrunner favors the Structuralist approach on the grounds that it is better able to explain monetary dynamics in DECs (see also Kaltenbrunner, 2015; de Paula et al. 2017).

The Horizontalist or "Cambist" view (Lavoie, 2000; 2012; Coulbois & Prissert, 1974) posits that the forward rate is simply a mark-up that banks add to the current spot rate given the differential between the domestic and foreign interest rates when they hedge their spot exchange operations in the forward market.[18] CIP (the equality in equation 5) is "determined mechanically" by the cambio operation of banks, "not by demand and supply" for a currency, as it is assumed both in the neoclassical and, as we shall see, in the structuralist interpretation (Lavoie, 2000, p.147). In this view, the forward rate is not a reflection of exchange rate expectations, since these expectations are already reflected in the spot rate. Changes in these expectations are exogenously caused by incoming news about the real economy, but also by sociopsychological factors (Harvey, 2009). The overarching aim of Lavoie's contribution is to

[17] Financial markets are subject to fundamental uncertainty – indeed, they may be understood as an institution whose entire purpose is to deal with uncertainty (after Keynes, 2017[1936]) – and as such will be governed based on a subjective interpretation of data that is determined by a multitude of sociopsychological factors such as social conventions, herd behaviour or feedback trading (Harvey, 2009).

[18] They borrow the currency which they sell and lend the currency which they buy and charge their customers the interest rate differential. This operation will be explained, and criticized, in more detail below.

maintain the horizontalist position that the central bank has full autonomy in setting the short-term interest rate, because it does not engage in quantity rationing but only in price rationing and hence can and will accommodate any level of endogenous demand for money (e.g. Lavoie, 2014; Smithin, 1994). Structuralists argue that it is precisely this assumption which is not realistic for *all* central banks in a world of free capital flows. The reason is simply that not all central banks issue internationally acceptable money.

Empirical evidence against the Cambist view

Lavoie (2000, p.174) claims that CIP generally fits well to empirical data, "sometimes perfectly well".[19] In fact, this claim from 2007 is no longer valid: CIP does *not* always hold true in reality, especially since the 2008 financial crisis (e.g. Borio et al., 2016; Jongen et al., 2008; Mehrling, 2013).

Using data for the spot exchange rate, the forward rate and the policy interest rate[20] from the website *investing.com* for April 2021, I used equation (15) to calculate λ_i. If CIP held „perfectly well", $\lambda_i$would always be equal to 0. This is not the case, as Table 1 illustrates.

Even in the light of this evidence, a proponent of the Cambist view might argue that λ_i is just another error term. But for this to be plausible, that error would have to be uncorrelated to any of the known characteristics of the currency. Empirically, this is not the case: For almost all currencies, the forward rate over the spot rate is *larger* than the interest rate differential, so that λ_i is negative. What is striking is that the exceptions to this rule include the Euro, the Yen, the Swiss Franc, the Pound Sterling, and the Australian Dollar and (by definition) the US Dollar.[21]

[19] He does not provide evidence for this claim, except precisely one anecdotal test of the EUR/CAD rate he once conducted when preparing for a macroeconomics lecture.

[20] Data with the broadest cross-country coverage is available for the short-term interest rate on central bank reserves. Of course, this is not the actual return of most investments, but the yields of different assets denominated in one currency are tightly correlated. Consequently, as a very good predictor of i across different types of assets, the policy interest rate will suffice to compare cross-country differences in liquidity premia. Of course, this proxy would be inadequate if the goal was to predict specific interest rates, but in my analysis data coverage must be prioritized over asset specificity.

[21] The other currencies with a positive residual are the Danish Krone, the Israeli Shekel, the Bulgarian Lev and the Fiji Dollar. The USD, by definition, has a residual of 1.

Albania	-0,003867	**India**	-0,037738	**Qatar**	-0,023802
Argentina	-0,275865	**Indonesia**	-0,034943	**Romania**	-0,032951
Australia	0,000323	**Israel**	0,006996	**Russia**	-0,092693
Bahrain	-0,003396	**Japan**	0,002803	**Serbia**	-0,008664
Bangladesh	-0,037631	**Kazakhstan**	-0,08223	**South Africa**	-0,076165
Brazil	-0,025547	**Kenya**	-0,065043	**Sri Lanka**	-0,041452
Bulgaria	0,007742	**Malawi**	-0,106037	**Switzerland**	0,019417
Canada	-0,000687	**Malaysia**	-0,028574	**Tanzania**	-0,046443
Chile	-0,003103	**Mauritius**	-0,016974	**Tunisia**	-0,148207
China	-0,045952	**Moldova**	-0,043762	**UAE**	-0,013724
Colombia	-0,012169	**Morocco**	-0,030361	**Uganda**	-0,064262
Czech Republic	-0,001351	**Namibia**	-0,07983	**Ukraine**	-0,141295
Denmark	0,008727	**New Zealand**	-0,000734	**United Kingdom**	0,002708
Egypt	-0,177553	**Nigeria**	-0,102027	**United States**	0
Fiji	0,004541	**Oman**	-0,038796	**Viet Nam**	-0,037261
Eurozone	0,008578	**Pakistan**	-0,065003	**Yemen**	-0,030268
Ghana	-0,281435	**Peru**	-0,001909		
Hungary	-0,004785	**Philippines**	-0,018384		

Table 1. Calculation of deviation from CIP λ_i, based on data from investing.com (April 2021).

This is a very good reason to suspect that it must be an expression of the differential liquidity risk associated to different currencies over the maturity of the forward contract. The size of that liquidity risk, and hence the value of λ_i, is structurally determined by monetary hierarchy.[22]

The structuralist interpretation and the liquidity premium

Recall again the simple two-country model where agents can only choose between two currencies to store their wealth in. How will they make this portfolio decision? I posited above that they will decide based on the two currencies' liquidity premium.

The Keynesian theory of portfolio choice (Keynes, 2017 [1936]; Hicks, 1962; Kregel, 1994; de Paula et al., 2017), would actually suggest that the demand for H_i, and hence its relative size must be a function not only of the liquidity premium but of the relative returns r_i or "own rate

[22] This does not imply that it could not also vary over time, depending on other factors. In order to provide strong empirical evidence for this argument, one would have to draw samples at multiple points in time. Since manually copying data from trading websites requires a lot of time and effort, this must be left to a well-funded researcher that can access this data directly, e.g. through a Bloomberg terminal.

of interest”[23] of currency i. This “own rate” has several components, of which the liquidity premium is but one.[24]

It can be expressed, following Keynes’ (2017 [1936], ch.17) as:

$$r = a + i - c + l \tag{16}$$

where a is the expected appreciation (or, if negative, depreciation) of an asset, i its expected yield or quasi-rent, c its carrying cost and l its liquidity premium.

Generally, private agents hold assets because they promise a direct return in the future, either through its interest or due to an expected appreciation. But they do not always only hold those assets that promise the highest return. They also hedge their risk, including the risk of not being able to meet certain obligations in the future, i.e. liquidity risk. They do so by including in their portfolio not only high-yielding assets, but also assets that have a relatively high chance of being accepted as a means of settling debt, and thus function as an insurance against the „survival constraint”. The liquidity premium can therefore explain price differences between two types of assets that otherwise have the same returns: A higher price is the compensation for higher liquidity risk – in other words, the liquidity premium makes up a certain part of the price.

On this basis, de Paula et al. (2017) built a simple model with a liquid “northern” and a less liquid “southern” currency, where

$$l_n > l_s \tag{17}$$

with the foreign exchange market being in (a purely theoretical) equilibrium under the condition that:

$$a_n + i_n - c_n + l_n = a_s + i_s - c_s + l_s \tag{18}$$

This resembles the two-country model that we considered earlier when constructing the hypothesis about the exchange rate’s deviation from PPP.

[23] = the interest rate of an asset measured in quantities of itself. For instance, the „own interest“ of wheat is the increase in the quantity of wheat that a supplier has to offer so that a buyer accepts delivery at a later point in time.

[24] This argument is taken up by structuralists (Minsky, 1976; Dow & Dow, 1989; Kregel, 1994), who argue that the exchange rate is determined by the relative demand for a currency, which is in turn determined by its net return relative to other currencies. In this, they follow closely Keynes’ own writings on the forward market (in the *Tract on Monetary Reform*, 1923) and interpret them as an early development of his arguments on the own rate of return and liquidity preference (presented in ch. 17 of the *General Theory*, 1936).

Carrying costs can be excluded from our analysis right away. For Keynes (2017 [1936], p.195), these are "wastage or costs merely suffered through the passing of time". The carrying costs of near-money assets and short-term financial instruments are very small, if not zero, and, as Kaltenbrunner (2012) suggests, "can thus be safely ignored" [25]. Let us do just that.

We are left with three variables that must explain the divergence between currencies. Consider first the expected appreciation: This is a purely time-varying variable, that logically cannot explain persistent differences between currencies, simply because no currency can appreciate or depreciate for a very long time. We can thus also exclude it from our analysis, which is purely interested in explaining structural cross-country divergence.

Next, the short-term interest rate i. This is the only policy variable in the "own rate of interest", as it is set by the central bank. Structuralists argue that it is this variable that adjusts to changes in the others (Kaltenbrunner 2012, de Paula et al. 2017). In particular, the interest rates adjusts to the remaining variable: the liquidity premium.

The liquidity premium is both time-varying *and* structurally different between currencies, and it can thus explain both the persistent differences between the other variables and their movement over time. In Keynes argument, relating to a closed economy, money has a lower a and i than wheat or houses because its liquidity l is so high. Similarly, structuralists argue, the rate of interest on foreign currencies „includes the price investors and banks are willing to accept to part with the security provided by holding internationally acceptable money" (Kaltenbrunner, 2012, p. 11).[26] "World money" (the USD) will have the highest l of all currencies, and assets denominated in this money can, as it were, "afford" to have a relatively lower i and lower a in equilibrium. In contrast, a currency with a lower liquidity premium relative to other currencies must offer higher yields to investors (see also Kaltenbrunner, 2012). This is where the structuralist view diverges from the horizontalists: If capital flows are not constrained, it follows that the "southern" central bank does not have full autonomy in setting the interest rate, but must set it to a level that compensates both for the different levels of the liquidity premium and for time-varying changes in the liquidity preference schedule of both

[25] De Paula et al. (2017) do include c in their equation, and argue that it depends on the openness of the capital account in a country and the general absence of barriers to capital flows. However, this variable is not a price, neither in terms of "money proper" nor in terms of any assets' own quantity. It can therefore not consistently be included into the liquidity equation itself, but it must be estimated as an additional independent variable..

[26] This implies that central banks do not fully control even the short-term interest rate, as private banks do not just passively accommodate money demand from the real sector, but might raise the price of departing with liquidity (money), i.e. the interest rate, depending on their own liquidity preference schedule and balance sheet considerations (see also Minsky, 1976).

domestic and international investors, as well as for expected exchange rate movements against other currencies, in order to maintain a stable demand for its own currency, so as to preempt major capital flows. Typically, it must control the ratio of interest rates against those of key currencies, prominently the short-term rate in the US. In particular, during a currency crisis, Peripheral central banks might find themselves forced to set high enough interest rates to prevent a sudden stop of capital inflows or an outflow of reserves. Only the Federal Reserve really has full autonomy in setting the interest rate, and only it can fully accommodate a rising demand for money, whereas all other central banks will be constrained by their holdings of international money, i.e. their dollar reserves, and by the degree to which their own liabilities are considered money, i.e. their liquidity premium. In normal times, and among other key currencies, the liquidity premium may be constant and not very relevant, but in times of crises and in developing economies, the liquidity premium matters.

Measuring the liquidity premium in the foreign exchange market

Recall that our goal is to arrive at an empirically observable measure for l_i, in order to test the hypothesis regarding the link between exchange rates and price levels. Connecting equation (18) to CIP yields a method to calculate the difference between the liquidity premia of any currency to the USD. Since all exchange rates will be quoted in USD, a_{USD} is by definition always equal to zero (as the dollar cannot appreciate against the dollar) and can be excluded from equation (18). Doing just that, one arrives at:

$$l_i = i_{USD} + l_{USD} - a_i - i_i \qquad (19)$$

With this equation, one could theoretically calculate the liquidity premium of any currency, given data for all other variables.

But why is l_i a good measure of liquidity? Because it measures the deviation from CIP. Let me explain by illustrating the mechanics of the simple foreign exchange operation that, according to Lavoie (2000) causes CIP to hold. The whole analysis follows closely that of Mehrling (2013; 2018). It agrees with Lavoie that the forward rate is the outcome of banks' cambio operations. However, where Lavoie implies that banks simply add a bid-ask markup on the forward rate, Mehrling explains what determines the size of this markup, and that it is not independent of liquidity considerations. Consider a simple foreign exchange operation in three steps:

Surplus country A	FX dealer	Deficit country B

1	$+\$10$ $due\ from\ B$					$+\$10$ $due\ to\ A$
2			$+10S_0$GH₵	$+\$10\ spot$	$-10S_0$GH₵ $+\$10\ spot$	
3	$-\$10$ $due\ from\ B$ $+\$10\ spot$				$-\$10\ spot$	$-\$10$ $due\ to\ A$

Table 2. Balance sheet operations of a simple FX trade.

Suppose that a deficit agent in country A (for example, Ghana) has to make a payment of USD 10 to a surplus agent in country B (for example, China), but that the deficit agent does not have ten dollars at the moment (step 1). The entire *raison d'être* of foreign exchange markets is to make this payment possible. They achieve this in the following way: The deficit country A sells its domestic currency (Ghanaian Cedis) to an FX dealer (step 2), who creates a new liability denominated in spot USD, to the credit of B, who can then transfer these dollars to A's deposit account (step 3). Now that the payment is made, both A and B are satisfied. But the FX dealer in the middle is still exposed to exchange rate risk: She has a long position in Cedis and a short position in dollars, and if the dollar appreciates against the Cedi, she loses money. The FX dealer can hedge this exchange rate risk by taking opposite positions in the forward market (step 4). In this way, any movement in the exchange rate will affect both sides of her balance sheet equally, and she is hedged against exchange rate risk. Hence, she is a "matched book" or „CIP" dealer.

	Matched book dealer		**Speculative dealer**	
2	$+10S_0$GH₵	$+\$10\ spot$		
4	$+\$10\ forward$	$+10F_0$GH₵	$+10F_0$GH₵	$+\$10\ forward$

Table 3. Balance sheet operations of hedging exchange rate risk.

Someone must take the other side of this transaction, and thereby take on the exchange rate risk.[27] This will be done by a "speculative dealer" or „UIP dealer", who is motivated by the

[27] The following is a disgression that you might wish to skip, since it is not directly relevant to my argument. If so, continue to read on page 24.

expectation that the dollar will depreciate against the Cedi. If he is right and if the future spot exchange does turn out to be lower than the one that he has locked in as the forward rate, he makes a profit from the difference between F_0 and what he expected to be the future spot rate. If he is wrong, he makes a loss. This is why UIP fails empirically: there *must* be a residual ε between the forward rate and the expected future spot rate, because this residual is the profit that compensates the speculative dealer for taking on exchange rate risk:

$$\mathrm{F}_t - S_{t+1}^e = \varepsilon\, S_t \tag{20}$$

By definition, the expected future spot rate is equal to the present spot rate times the expected appreciation rate:

$$S_{t+1}^e = S_t\, a_i \tag{21}$$

Now, if we insert (20) into (19):

$$\mathrm{F}_t - S_t a_i \; = \varepsilon\, S_t \tag{22}$$

And divide both sides by S_t, then we arrive again at UIP, a reformulation of (14):

$$\frac{\mathrm{F}_t}{S_t} = a_i + \varepsilon \tag{23}$$

Summing up, contrary to the horizontalist view, the expected appreciation or depreciation of a currency is priced *not* in the spot rate, but by way of forward contracts. At the same time, going beyond the neoclassical view, there is a liquidity premium ε included in the forward rate. If UIP always held perfectly (i.e. if ε was always equal to zero) then no profit-oriented speculative dealer would make a market in forwards, and the matched-book dealer, who would be unable to hedge her exchange rate risk, would not make an FX market. It becomes clear that ε is not just some kind of more or less random error, but in fact it is a compensation for taking on exchange rate risk. The size of this risk depends on the structural characteristics of a currency, on the time-varying balance of payments, and on the liquidity preferences of traders and investors, i.e. the general uncertainty in the money market. The mean of ε must be positive but very close to zero, because otherwise dealers would either lose more often than they win, or win so much on average that competition would enter to bring down the profit.

Now, let us return to the main argument. Even when the speculative dealer takes on the exchange rate risk, the matched book dealer is still taking another type of risk: She is, after all, borrowing short-term and lending long-term in USD, and accordingly, she has to roll over her spot dollar liability position until the date of maturity of her term dollar asset position. This creates *liquidity risk*, which is counterbalanced by the ability of the matched-book dealer to (1) to borrow dollars, which ability is constrained by her *overall* position in dollars, and (2) to sell her short-term assets against dollars without a loss, which again depends on the willingness of others to hold that currency. But recall that the dealer is at the same time borrowing long-term and lending short-term in a currency with a relatively *lower* liquidity premium. Her overall exposure to dollar-related liquidity will only *partly* be counterbalanced by her holding of Cedis, since those Cedis might not so easily be turned into dollars at any moment. The result will be an overall *positive* exposure to liquidity risk. As a profit-seeking private agent, she will only take on that risk if she is compensated for it, and the amount of compensation will be proportional to her overall exposure to liquidity risk, and so to the relative illiquidity of the currency in question. It follows that the differential between the forward and the spot rate must include her compensation for taking on liquidity risk. These are, according to Mehrling (2013), the mechanics behind CIP: The differential between the foreign term interest rate and the US term interest rate must be sufficient to incentivize private dealers to make a market in foreign exchange, and the foreign interest rate is the variable that adjusts so as to fit the dealer's liquidity preference schedule.

But is the interest rate not set by the central bank? The central banks set overnight rates, not term rates. Term rates are bid up, in the money market, over and above a level that the „expectations hypothesis of the term structure" would suggest, namely that term rates are equal to the expected overnight interest rates of rolling over debt until time $t = n$. The following equation is a version of the expectations hypothesis of the term structure (with a residual l which is, again, equal to the liquidity premium).[28]

$$(1 + i_m)^n + l = (i^e_{t=1})(i^e_{t=2}) \dots (i^e_{t=n}) \qquad (24)$$

CIP therefore can only state that the forward rate over spot rate will be equal to the foreign *long-term* over the domestic *long-term* interest rate i_m of low-credit-risk, near-money assets with the same maturity as the forward contract. This is consistent with the empirical data in all times, except during the height of the 2009 financial crisis (Baba & Packer, 2009; Coulbois & Prissert, 1974; Frenkel & Levich, 1975; Jongen et al., 2008; Taylor, 1987).

[28] The economic meaning of this is simply that investors face higher liquidity risk when lending over long periods of time than when lending over multiple short periods, and hence expect a higher return for long-term lending, so that the long-term rate is not just a multiple of the expected short-term rates up to maturity.

$$\frac{F_t}{S_t} = \left(\frac{1 + i_{m,USD}}{1 + i_{m,i}}\right) \tag{25}$$

However, CIP implies that the forward rate over the spot rate must be greater than the foreign over the domestic *short-term* interest rate i_t, which is set by the central bank. The CIP component of the liquidity premium hence must account for the difference between i_m and i_t. It follows that

$$\frac{F_t}{S_t} = \left(\frac{1 + i_{t,USD}}{1 + i_{t,i}}\right) - l_i + l_{USD} \tag{26}$$

To conclude, let me demonstrate the consistency of Mehrling's argument with that of de Paula et al (2017). Recall that, as Lavoie (2000) shows (see also Feenstra & Taylor, 2014), for sufficiently small i_{USD} (and US policy rates in the last years were sufficiently close to zero), equation (18) can via the Taylor extension be approximated to:

$$\frac{F_t}{S_t} = i_{USD} - i_i + l_{USD} - l_i \tag{27}$$

By integrating (18) and (15) into (6), we have returned to equation (9), except now including ε, the UIP component of the liquidity premium.

$$l_i = i_{USD} + l_{USD} - i_i - a_i - \varepsilon \tag{28}$$

My entire operationaliation of the liquidity premium hence is simply a more thorough (i.e. non-approximate) mathematical formalization of de Paula et al.'s argument (2017).

However, for the empirical analysis, only observable variables must be included in the calculation of the liquidity premium. From (18), we get:

$$l_i = \left(\frac{1 + i_{USD}}{1 + i_i}\right) - \frac{F_t}{S_t} + l_{USD} \tag{29}$$

By setting l_{USD} to 1 in order to normalize the scale on which l_i is measured, we arrive at the final equation to calculate the liquidity premium of a currency:

$$l_i = \left(\frac{1 + i_{USD}}{1 + i_i}\right) - \frac{F_t}{S_t} + 1 \tag{30}$$

Finally, here is an equation that consists only of the CIP component of the liquidity premium, which we want to calculate, and of observable variables. As F_t, I take the price of one year forwards.

This entire analysis still abstracts from four aspects. First, it abstracts from ε and only measures l_i, the CIP component of the liquidity premium. Second, it abstracts from the fact that in practice, rather than the actual exchange of currencies, derivatives (in particular, swaps) are used to hedge exchange and liquidity risk. But this does not make the analysis of the underlying variables any less valid. Third, it also abstracts from the spread between bid and ask quotes, which will be pushed around whenever dealers' relative short and long positions in both the USD and the foreign currency change. Fourth, it abstracts from credit risk. The analysis therefore applies only to the liquidity premia of short-term near-money assets that do not bear significant credit risk.

Empirical evidence

The last step in my argument is to conduct a preliminary empirical test of the postulated relationship between the liquidity premium in the foreign exchange market and the price level.

By integrating (30) and (13) we finally arrive at an equation that can be used to test my main argument empirically.

$$d_i = \frac{1 - f(1)}{1 - f\left(\left(\frac{1 + i_{USD}}{1 + i_i}\right) - \frac{F_t}{S_t} + 1\right)} \tag{31}$$

For the US, we can set $d_{US} = 1$ and $l_{USD} = 1$. Moreover, empirically it was the case that $i_{USD} = 0$ throughout 2021. If we insert these values into equation (31), we get that $1 = 1 - f(1)$, so that we can conclude that $f(1)$ must be equal to zero. Therefore, we can simplify to:

$$d_i = \frac{1}{1 - f\left(\left(\frac{1 + i_{USD}}{1 + i_i}\right) - \frac{F_t}{S_t} + 1\right)} \tag{32}$$

This equation can be operationalized as a simple linear regression, so that the regression coefficient β will estimate the impact of the liquidity premium on the price level:

$$\beta = (1/(1 - f) \tag{33}$$

$$d_i = a + \beta\left(\left(\frac{1 + i_{USD}}{1 + i_i}\right) - \frac{F_t}{S_t} + 1\right) + \epsilon \tag{34}$$

where a is the intercept and ϵ an uncorrelated error term.

Because the income level of a country is such an intuitive determinant of its price level, I also include GNI per capita as a control variable. Y is GNI and N is population. I use data for 2020 from the World Bank.

$$d_i = a + \beta\left(\left(\frac{1 + i_{USD}}{1 + i_i}\right) - \frac{F_t}{S_t} + 1\right) + \gamma\left(\frac{Y}{N}\right) + \epsilon \tag{35}$$

Testing the resulting regression against cross-sectional data yields the following results:

	Estimate	*p-value*
a	-3.042e+00	0.00061 ***
β	2.532e+00	0.00518 **
γ	-3.905e-06	0.15627

Residual standard error: 0.3946 on 46 degrees of freedom (127 observations deleted due to missingness). Multiple R-squared: 0.1907, **adjusted R-squared: 0.1555**.

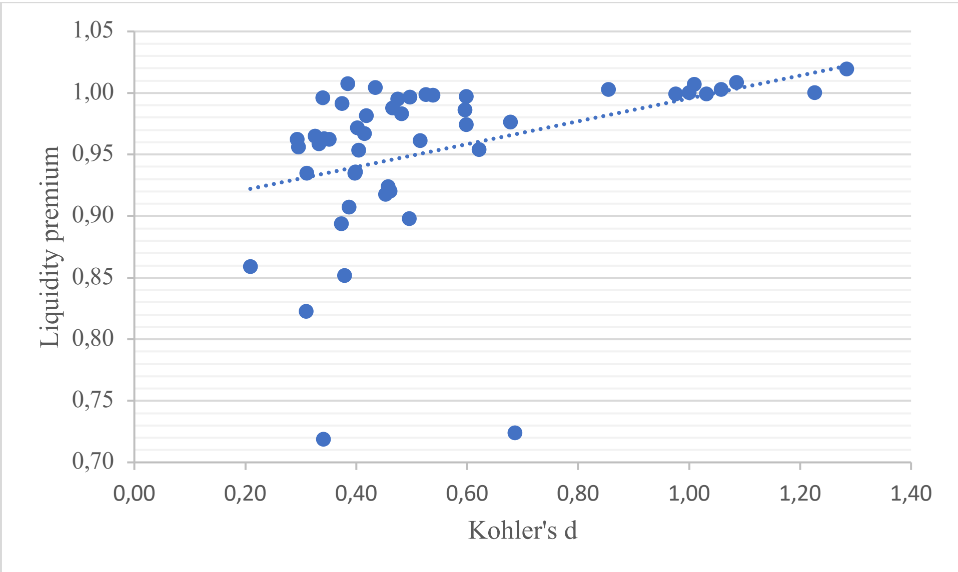

Figure 4. Scatterplot of l_i and d_i, based on data from investing.com and the IMF (2021).

There is evidently a lot of heteroskedasticity, which is also reflected in the low R^2 and the low value of the coefficient β . This implies that the liquidity premium may only have a small effect on the price level, and other factors are more important. However, the impact of liquidity is clearly significant – in fact, more significant than GNI per capita – so that it can be concluded that the liquidity premium does have a small effect on the price level, which is consistent with my theoretical argument.

The same results can also be illustrated by examining some countries' price levels against a qualitative measure of currency hierarchy proposed elsewhere (Olk, forthcoming).

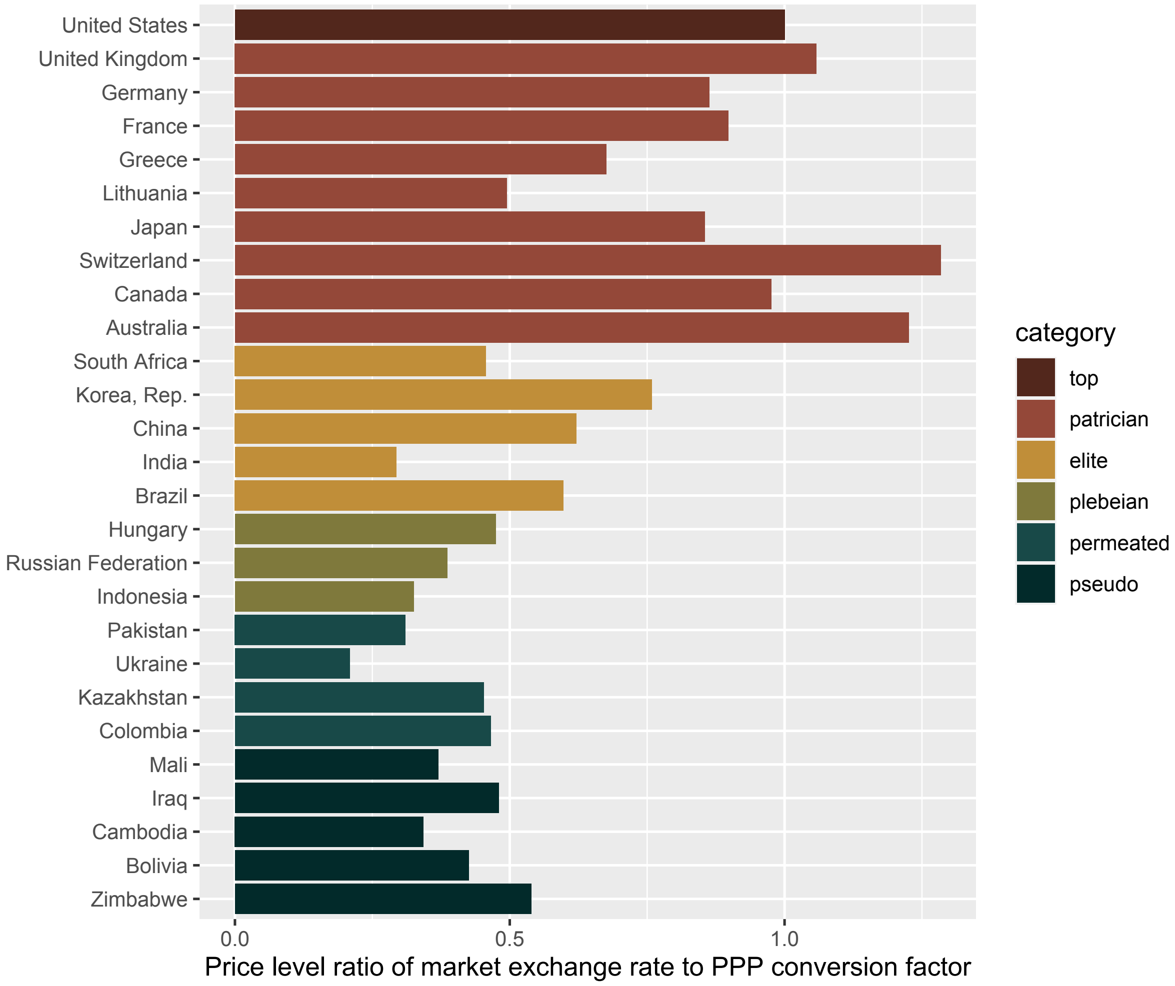

Figure 5. Price level ratio of PPP conversion factor (GDP) to market exchange rate of selected countries, with currency categories (from Olk, forthcoming).

Of course, this little empirical exercise has a number of shortcomings. First, I tested my model only against cross-sectional data and at just one point in time. A panel data approach would be much more potent (but will require funding to get access). Second, other control variables should be included, based on the literature on price level and exchange rate determination. Third, my measure for liquidity premia is just one possible. Other measures for liquidity (e.g. Gabrielsen et al., 2011; Mehrling & Neilson, 2014; Minardi et al., 2006), and perhaps even other aspects of monetary hierarchy, should be included as explanatory variables in further econometric research. Fourth, my model was based on the assumptions that the quantity of money, the velocity of circulation and the number of transactions all are not correlated to the liquidity premium. Further research should include these variables to assess the plausibility of these assumptions.

In addition, the entire theoretical framework abstracts from a wide range of political influences on exchange rates and price levels. For one, exchange rates are never fully determined by market dynamics, but also by central bank policy, especially in the periphery (Mehrling, 2013; de Paula et al., 2017). Moreover, the simple version of this hypotheses abstracts from indirect and possibly complex macroeconomic effects of changes in the components of total money demand on PPP rates and exchange rates.

Finally, one key limitation of the entire approach is that it ignores offshore money creation, which is a significant part of the global monetary system (Binder, 2023) and will have to be accounted for in further research.

It is worth noting here that one other empirical study has found a strong correlation between liquidity premia and exchange rates (Engel & Wu, 2018). The authors use a New Keynesian model whose core properties are quite similar to the simple model that I have presented here, and their results that PPP does hold if they control for changes in the liquidity premia.[29] They measure liquidity premia on the basis of yield curves of government bonds that correspond to those currencies. This is not an optimal operationalization because it does not distinguish between liquidity risk associated to a currency and credit risk associated to a government.

Conclusion: unequal exchange rates

I have argued that one structural cause of price levels' diverging between countries is the hierarchy in the international monetary system. This so because the exchange rate and the price level are determined in two different markets: The exchange rate is determined in the market for foreign exchange. Different currencies have different degrees of liquidity, and hence are able to fulfill the function of storing value to different degrees, the demand for liquid currencies

[29] They measure liquidity on the basis of yield curves of government bonds that correspond to those currencies, an operationalization that resembles a simplified version of my own but is, I would suggest, less robust because it cannot distinguish between liquidity risk and credit risk.

will be greater and their exchange value will rise. The price level of a country, in contrast, is structurally determined by the ratio of that quantity of money which is *not* used as a store of value, but circulates in the economy as a means of payment.

I have formalized this argument mathematically and used a Minskyan interpretation of the forward exchange rate to identify and calculate currencies' liquidity premia in the foreign exchange market. I have then tested my argument by regressing the resulting measure of liquidity against the price level, measured by the deviation between the purchasing power and exchange rate of a currency. My empirical results suggest that the hypothesized effect is small, but significant.

While the Minskyan literature acknowledges that the liquidity premium plays a role in shaping the interest rate, the exchange rate and the par, this essay is the first to argue that it also shapes the price level. This has implications for an area of research that has long been neglected and recently seen somewhat of a revival: the theory of unequal exchange. Scholars working in this area have long explained dependent development with reference to deteriorating terms of trade (e.g. Prebisch, 1962), differences in the wage level (e.g. Amin, 1974; Emmanuel, 1972) or, in a recently emerging promising paradigm of "ecologically unequal exchange", in the valuation of biophysical resources and land (Dorninger et al., 2021; Hornborg, 2003). It is interesting to note that none of these theories has paid significant attention to exchange rates. But obviously, in an international comparison of wage levels, terms of trade or of the valuation of biophysical resources all depend not only on relative prices, but also on nominal exchange rates.[30]

Only Kohler (1998) and Reich (2007) have accounted for the possible role of exchange rate undervaluation[31] for unequal exchange. Several empirical studies (Elmas, 2009; Reich, 2007, 2014; Somel, 2003) in this tradition calculate value trade transfers by the difference between the actual monetary value of exports/imports and their "fair" value measured in PPP rates.[32]

[30] For instance, not only does one joule of energy, one hectare of land, one hour of labour or one ton of gold cost more PPP-adjusted USD if it is exported from Germany than if it is exported from Mexico; it is also logically possible that one can buy x hectares of embodied land for one USD, but that one can buy *more than* x hectares for the amount of Mexican pesos that one receives in exchange for one USD on the FX market. In short, the purchasing power value of Mexican pesos can be greater than their exchange rate value.

[31] Here, orthodox economists may ask: Are not Peripheral currencies overvalued rather than undervalued? From the orthodox perspective, the value of Peripheral currencies often tends to be higher than that which would guarantee a balanced current account. But if exchange rates are not judged against the balance of payments, but against the price level, i.e. purchasing power rate, Peripheral currencies are undervalued.

[32] This method is not uncontroversial: Subasat (2013) argues that studies based on ERDI tend to overestimate unequal exchange, as they ignore the Balassa-Samuelson effect (BSE), which implies that the PPP theorem does not hold because it neglects productivity differences between countries' export sectors. Olk (2021)discusses Subasat's critique in some detail and concludes that the BSE might very well cause the ERDI method to

Marxian scholars of unequal exchange like Koehler (1998) have noted that any devation between exchange rates and PPP rates suffices to cause an unequal exchange of labour (see also Somel, 2003; Reich, 2007; Elmas, 2009; Hickel et al., 2021). An agent who has dollars can buy a higher quantity of a given good from a given peripheral country as soon as she converts her dollars into peripheral currency than what she could buy with them at home. If she can create or access dollars relatively more cheaply than the exporters in the periphery, this monetary privilege enables her to generate an asymmetric net inflow of, as Koehler puts it, *undervalued* embodied resources. Conversely, the international purchasing power of high-ranking currencies is *overvalued* relative to their domestic purchasing power.

So far, theorists of unequal exchange have not tried to explain *why* exchange rates deviate from PPP. This is a gap that my approach fills by connecting it to the literature on currency hierarchy.

overestimate unequal exchange, but not to invalidate the method as such. The BSE can thus explain a certain part of the difference between PPP and exchange rates. Besides, the productivity differences of the BSE could themselves be consequences of prior unequal exchange.

References

Amin, S. (1974). Accumulation and development: A theoretical model. *Review of African Political Economy*, *1*(1), 9–26.

Andrade, R. P., & Prates, D. M. (2013). Exchange rate dynamics in a peripheral monetary economy. *Journal of Post Keynesian Economics*, *35*(3), 399–416. https://doi.org/10.2753/PKE0160-3477350304

Baba, N., & Packer, F. (2009). Interpreting deviations from covered interest parity during the financial market turmoil of 2007–08. *Journal of Banking & Finance*, *33*(11), 1953–1962.

Balassa, B. (1973). Just how misleading are official exchange rate conversions? A comment. *The Economic Journal*, *83*(332), 1258–1267.

Barbosa, L. O. S., Jayme Jr, F. G., & Missio, F. J. (2018). Determinants of the real exchange rate in the long-run for developing and emerging countries: A theoretical and empirical approach. *International Review of Applied Economics*, *32*(1), 62–83.

Birkan, A. Ö. (2015). A Brief Overview of the Theory of Unequal Exchange and its Critiques. *International Journal of Humanities and Social Science*, *5*(4), 9.

Bonizzi, B., & Kaltenbrunner, A. (2020). Critical macro-finance, Post Keynesian monetary theory and emerging economies. *Finance and Society*, *6*(1), 76–86. https://doi.org/10.2218/finsoc.v6i1.4411

Choudhri, E. U., & Schembri, L. L. (2010). Productivity, the Terms of Trade, and the Real Exchange Rate: Balassa-Samuelson Hypothesis Revisited: PRODUCTIVITY AND THE REAL EXCHANGE RATE. *Review of International Economics*, *18*(5), 924–936. https://doi.org/10.1111/j.1467-9396.2010.00917.x

Chuah, K. P. (2013). *Explaining How Real Exchange Rates Move in Growing Economies Using Labor Surplus*.

Cohen, B. J. (2018). *Currency power: Understanding monetary rivalry*. Princeton University Press.

Conti, B. D., Biancarelli, A., & Rossi, P. (2013). *Currency hierarchy, liquidity preference and exchange rates: A Keynesian/minskyan approach*. 22.

Coulbois, P., & Prissert, P. (1974). Forward exchange, short term capital flows and monetary policy. *De Economist*, *122*(4), 283–308.

Cumby, R. E., & Obstfeld, M. (2007). *3. International Interest Rate and Price Level Linkages under Flexible Exchange Rates: A Review of Recent Evidence*. University of Chicago Press.

de Paula, L. F., Fritz, B., & Prates, D. M. (2017). Keynes at the periphery: Currency hierarchy and challenges for economic policy in emerging economies. *Journal of Post Keynesian Economics*, *40*(2), 183–202. https://doi.org/10.1080/01603477.2016.1252267

Dorninger, C., Hornborg, A., Abson, D. J., von Wehrden, H., Schaffartzik, A., Giljum, S., Engler, J.-O., Feller, R. L., Hubacek, K., & Wieland, H. (2021). Global patterns of ecologically unequal exchange: Implications for sustainability in the 21st century. *Ecological Economics*, *179*, 106824. https://doi.org/10.1016/j.ecolecon.2020.106824

Dow, A., & Dow, S. (1989). Endogenous money creation and idle balances. In J. Pheby (Ed.), *New Directions in Post-Keynesian Economics* (pp. 147–164). Edward Elgar. https://books.google.com/books?hl=en&lr=&id=QHXk3RPsivgC&oi=fnd&pg=PA147&dq=Endogenous+money+creation+and+idle+balances&ots=mF0gc16Grr&sig=suPI-DbHntjhUmXvF9gAZDrBLDU

Drine, I., & Rault, C. (2008). Purchasing power parity for developing and developed countries. What can we learn from non-stationary panel data models? *Journal of Economic Surveys*, *22*(4), 752–773. https://doi.org/10.1111/j.1467-6419.2007.00548.x

Égert, B., Drine, I., Lommatzsch, K., & Rault, C. (2003). The Balassa–Samuelson effect in Central and Eastern Europe: Myth or reality? *Journal of Comparative Economics*, *31*(3), 552–572. https://doi.org/10.1016/S0147-5967(03)00051-9

Eichengreen, B. (2019). *Globalizing capital: A history of the international monetary system*. Princeton University Press.

Emmanuel, A. (1972). *Unequal exchange: A study of the imperialism of trade*. Monthly Review Press.

Frenkel, J. A., & Levich, R. M. (1975). Covered interest arbitrage: Unexploited profits? *Journal of Political Economy*, *83*(2), 325–338.

Gabrielsen, A., Marzo, M., & Zagaglia, P. (2011). *Measuring market liquidity: An introductory survey*.

Goodhart, C. A., McMahon, P. C., & Ngama, Y. L. (1992). Does the forward premium/discount help to predict the future change in the exchange rate? *Scottish Journal of Political Economy*, *39*(2), 129–140.

Harvey, J. T. (2009). *Currencies, capital flows and crises: A post Keynesian analysis of exchange rate determination*. Routledge.

Hicks, J. R. (1962). Liquidity. *The Economic Journal*, *72*(288), 787–802.

Hornborg, A. (2003). The Unequal Exchange of Time and Space: Toward a Non-Normative Ecological Theory of Exploitation. *Journal of Ecological Anthropology*, *7*, 8.

Jongen, R., Verschoor, W. F., & Wolff, C. C. (2008). Foreign exchange rate expectations: Survey and synthesis. *Journal of Economic Surveys*, *22*(1), 140–165.

Kaltenbrunner, A. (2015). A post Keynesian framework of exchange rate determination: A Minskyan approach. *Journal of Post Keynesian Economics*, *38*(3), 426–448. https://doi.org/10.1080/01603477.2015.1065678

Keynes, J. M. (1923). *A tract on monetary reform*. London, Macmillan.

Keynes, J. M. (2017). *The General Theory of Employment, Interest and Money*. Wordsworth.

Kregel, J. A. (1994). Money, expectations and relative prices in Keynes' monetary equilibrium. *John Maynard Keynes: Critical Assessments (Second Series), vV London: Routledge*.

Krugman, P. R. (1978). Purchasing power parity and exchange rates: Another look at the evidence. *Journal of International Economics*, *8*(3), 397–407.

Kohler, G. (1998). The Structure of Global Money and World Tables of Unequal Exchange. *Journal of World-Systems Research*, 145–168. https://doi.org/10.5195/jwsr.1998.149

Kvangraven, I. H. (2021). Beyond the stereotype: Restating the relevance of the dependency research programme. *Development and Change*, *52*(1), 76–112.

Kvangraven, I. H., Styve, M. D., & Kufakurinani, U. (2021). *Samir Amin and beyond: The enduring relevance of Amin's approach to political economy*.

Lavoie, M. (2014). *Post-Keynesian economics: New foundations*. Edward Elgar. http://books.google.com/books?hl=de&lr=&id=bv72AwAAQBAJ&oi=fnd&pg=PR1&dq=Post-Keynesian+Economics:+New+Foundations&ots=7Rb1TrgE-i&sig=o4t4-R2e6QlPLZJXQYPe23We9vI https://books.google.com/books?hl=de&lr=&id=bv72AwAAQBAJ&oi=fnd&pg=PR1&dq=introduction+post+k

MacDonald, R., & Ricci, L. (2001). *PPP and the Balassa Samuelson effect: The role of the distribution sector*. International Monetary Fund.

McCauley, R. N. (2015). Does the US dollar confer an exorbitant privilege? *Journal of International Money and Finance*, *57*, 1–14. https://doi.org/10.1016/j.jimonfin.2015.06.005

Nagayasu, J. (2021). Causal and frequency analyses of purchasing power parity. *Journal of International Financial Markets, Institutions and Money*, *71*, 101287. https://doi.org/10.1016/j.intfin.2021.101287

McCallum, B. T., & Nelson, E. (2005). Monetary and fiscal theories of the price level: The irreconcilable differences. *Oxford Review of Economic Policy*, *21*(4), 565–583.

Mehrling, P. (2013). Essential hybridity: A money view of FX. *Journal of Comparative Economics*, *41*(2), 355–363.

Mehrling, P. (2017). Financialization and its discontents. *Finance and Society*, *3*(1), 1–10.

Mehrling, P. (2018). *Economics of Money and Banking*. https://www.youtube.com/watch?v=KNEouYM5wRE&list=PLmtuEaMvhDZbmfO7rtVLBGJ4Eu_iFBtSU

Mehrling, P., & Neilson, D. H. (2014). A new measure of liquidity premium. In G. Epstein, T. Schlesinger, & M. Vernengo, *Banking, Monetary Policy and the Political Economy of Financial Regulation* (pp. 290–318). Edward Elgar Publishing. https://doi.org/10.4337/9781783472642.00024

Minardi, A. M. A. F., Sanvicente, A. Z., & Monteiro, R. (2006). Bid-ask spread and liquidity premium in Brazil. *No. Wpe_53). Insper Working Paper, Insper Instituto de Ensino e Pesquisa*.

Minsky, H. P. (1976). *John maynard keynes*. Springer.

Murau, S., Pape, F., & Pforr, T. (2021). *The Hierarchy of the Offshore US-Dollar System. On Swap Lines, the FIMA Repo Facility and Special Drawing Rights* (Global Economic Governance Initiative Study, p. 38). Boston University Global Development Center.

Njindan Iyke, B., & Odhiambo, N. M. (2017). An empirical test of the Balassa-Samuelson hypothesis: Evidence from eight middle-income countries in Africa. *Economic Systems*, *41*(2), 297–304. https://doi.org/10.1016/j.ecosys.2016.10.001

Olk, C. (forthcoming). Complementary currencies in the global hierarchy of money: Implications for sustainability. *Sustainability Science.*

Olk, C. (2021, June 16). A note on unequal exchange rates: Does the Balassa-Samuelson effect distort the Exchange Rate Deviation Index? *Medium.com*. https://christopher-olk.medium.com/a-note-on-unequal-exchange-rates-does-the-balassa-samuelson-effect-distort-the-exchange-rate-549f72b53653

Pigou, A. C. (1917). The value of money. *The Quarterly Journal of Economics*, *32*(1), 38–65.

Prebisch, R. (1962). The economic development of Latin America and its principal problems. *Economic Bulletin for Latin America*.

Reich, U.-P. (2014). *Inequality in global production and trade: A proposal for measurement*. IARIW 33rd General Conference, Rotterdam, The Netherlands.

Riese, H. (2001). *Grundlegungen eines monetären Keynesianismus*. Metropolis. https://scholar.google.com/scholar?q=+%09Grundlegungen+eines+monet%C3%A4ren+Keynesianismus#0

Rogoff, K. (1996). The purchasing power parity puzzle. *Journal of Economic Literature*, *34*(2), 647–668.

Strange, S. (2015). *States and markets*. Bloomsbury Publishing.

Svartzman, R., & Althouse, J. (2020). Greening the international monetary system? Not without addressing the political ecology of global imbalances. *Review of International Political Economy*, 1–26. https://doi.org/10.1080/09692290.2020.1854326

Svartzman, R., & Althouse, J. (2021). *Bringing Subordinated Financialisation Down to Earth: The Political Ecology of Finance-Dominated Capitalism*. Working paper.

Taylor, M. P. (1987). Covered interest parity: A high-frequency, high-quality data study. *Economica*, 429–438.

Tubadji, A., & Nijkamp, P. (2018). Revisiting the Balassa–Samuelson effect: International tourism and cultural proximity. *Tourism Economics*, *24*(8), 915–944. https://doi.org/10.1177/1354816618781468

Wang, W., Xue, J., & Du, C. (2016). The Balassa–Samuelson hypothesis in the developed and developing countries revisited. *Economics Letters*, *146*, 33–38.