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Working Paper

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Diskussionsbeiträge - Serie A, No. 155

Provided in Cooperation with:
Department of Economics, University of Konstanz

Suggested Citation: Läufer, Nikolaus K. A. (1980) : Purchasing power parity theory in a model without international trade of goods, Diskussionsbeiträge - Serie A, No. 155, Universität Konstanz, Fakultät für Wirtschaftswissenschaften und Statistik, Konstanz

This Version is available at:
https://hdl.handle.net/10419/75119

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PURCHASING POWER PARITY THEORY IN A MODEL WITHOUT INTERNATIONAL TRADE OF GOODS

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Serie A — Nr. 155

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Dezember 1980

Serie A: Volkswirtschaftliche Beiträge

Serie B: Finanzwissenschaftliche Arbeitspapiere

Serie C: Betriebswirtschaftliche Beiträge

Introduction and Summary

In recent discussions it frequently occurs that the Purchasing Power Parity Theory is identified with Jevons law of one price. By pointing to real world obstacles working against perfect goods arbitrage it is then erroneously concluded that the Purchasing Power Parity Theory cannot be valid while a dinstiction between an absolute version and a relative version of the Purchasing Power Parity Theory is neglected. In the present paper it is shown that the Purchasing Power Parity Theory in the relative sense holds even in a world without international trade in goods and that the propositions of that version of the Purchasing Power Parity Theory are not related to international trade in goods but are implications of the quantity theory of money. Although on occasion oral references to this result are made, formal and rigorous demonstrations of its validity seem not to be available [1]. The validity of the Purchasing Power Parity Theory in a world without international trade of goods is symmetric to the finding that interest rate parity to hold does not presuppose international capital movements [2].

I.

It is well known, that the purchasing power parity theory (PPP-Theory) exists in two versions: there is an absolute and a relative version. The difference is related to the definition of the purchasing power parity (PPP) itself [3].
In the absolute version the purchasing power parity is defined as the ratio of the price levels [4] of the two countries.
In the relative version of PPP-theory the PPP is defined as the ratio of the price indices of the two countries multiplied by the exchange rate in a base period.

absolute version

$$PPP_t^{abs} \equiv \frac{PL_t}{PL^*_t}$$

PL = price level (dimension is $ per unit)

* = foreign

relative version

$$PPP_t^{rel} \equiv \frac{P_t}{P_t^*} \cdot e_o$$

e_o = exchange rate in base period o

P = price index (without demension)

* = foreign

I would like to identify PPP-Theory with the following three propositions:

1. In the long run the equilibrium exchange rate is equal to the PPP.
2. The short run equilibirum exchange rate tends to approach the long run equilibrium rate.
3. The short run PPP tends to approach the long run PPP.

Four definitions are involved here: the definition of the short and long run exchange rates and of the short and long run PPP. The short run equilibrium exchange rate is usually taken to be

the rate that would exist under a freely floating (i. e. unmanaged) exchange rate system. However, this definition is stronger than necessary. I think one can allow a managed floating system provided the management of the float can be described by a permanent or constant behavioural or reaction function forming part of a system, that may be described by a set of structural equations. The long run equilibrium exchange rate is the rate to which the short run rate would tend and to which it would settle down if the economic system had enough time to adjust to a given level of those variables that are treated as exogenous in the structure under consideration. The long run in this sense is a time span in which differences of adjustment speeds of different markets become irrelevant; full employment is reached and all prices have been allowed to vary freely [5)].

The distinction between short and long run PPP has to be related to the difference between short and long run levels of prices. While in the short run prices may be sticky and not attain equilibrium levels in the long run stickyness is overcome and equilibirum levels may be reached.

Let me refer back to the propositions of PPP-Theory. With these formulations the theory seems to refer only to a flexible exchange rate system and not to a system of pegged exchange rates. However, this limitation is not necessary. Since in a system of pegged exchange rates short and long run exchange rates are identical and fixed, it is only the PPP that can vary over time. Therefore, in a system of pegged exchange rates PPP-Theory may be reduced to the following proposition:

> In the long run PPP will tend to approach the pegged exchange rate.

In the case of a system of flexible exchange rates both the PPP and the exchange rate may vary; in a system of pegged exchange rates normally PPP will vary. Thus, PPP-Theory is essentially nothing more than a partial description of long run equilibrium combined with the assumption or hypothesis of stability of that equilibrium.

Very often, PPP-Theory is stated as a hypothesis in which the flexible exchange rate is causally determined by PPP. There is evidence available in favor of causality really running from the flexible exchange rate to PPP [6]. However, it is basically misleading to interpret the long run equilibrium condition in a causal sense. According to the PPP-Theory it is neither PPP that causally determines the exchange rate nor is it the exchange rate that causally determines PPP.

An essential difference between the short and long run relates to the degree of flexibility of prices. In periods of hyper-inflations the theoretical long run may be extremely short in physical time. PPP-Theory being essentially a hypothesis of convergence between PPP and the exchange rate, intuitively one may expect the convergence to long run equilibrium to be higher when both PPP and the exchange rate are flexible. However, there exists empirical evidence implying that in a system of pegged exchange rates the speed of convergence to long run equilibrium is higher than under a system of flexible exchange rates [7].

So far all statements as to PPP-Theory have not distinguished between the absolute and the relative version of PPP. This was not necessary. Although some of the statements made are more relevant to the relative version, they hold for both versions of PPP.

Let me now turn to the "law of one price" that plays a prominant role in the monetarist literature. For products that are perfectly substitutable, with transport costs assumed away or to be negligable and with no tariffs and quotas that is to say under conditions of free trade due to commodity arbitrage the price of a product expressed in the same currency cannot be different in a pair of countries considered. Thus, under these ideal conditions the ratio of two countries' domestic currency prices of the same product equals the exchange rate.

There is at least a formal similarity between the absolute version of PPP-Theory and the law of one price (of Jevons). This similarity has misled some economists to identify PPP-Theory in general, i. e. including the relative version, with the law of one price and to criticise PPP-Theory by pointing to the observable deviations of the real world from the assumptions of the perfect goods arbitrage model. The following propositions take issue with these misconceptions.

Proposition 1:

The law of one price and PPP-Theory in the relative sense have nothing to do with each other.

Proposition 2:

a) flexible exchange rate system

The long run equilibrium exchange rate moves in proportion

α) to the long run equilibrium ratio of price indices which moves in proportion to the ratio of the quantities of money (relative quantities) of two countries;

β) to the long run equilibirum price index of one country which moves in proportion to the absolute quantity of money of the same country, the quantity of money of the other country being held constant.

b) pegged exchange rate system

The long run equilibrium ratio

α) of the quantities of money (relative quantities),

β) of the price indices

of two countries is proportional to the exchange rate.

Proposition 3:

PPP-Theory in the relative sense (Proposition 2) holds even without international trade in goods.

The law of one price is a law describing the outcome of arbitrage in traded goods. Tautologically, for the law to hold between different countries there must be international trade in goods. If PPP-Theory holds in a model or world without international trade in goods then proposition 1 is valid. Thus, a proof of proposition 3 implies a proof of proposition 1.

For proposition 2 we can distinguish two mutually exclusive cases: a case with and a case without international trade in goods. In proving proposition 3 we only deal with the latter case. As to the first case the proposition is generally undisputed, although the quantity of money theory aspect is generally not emphasized.

II.

In order to substantiate these propositions let us consider a country, that is internationally trading bonds but not goods. I shall assume that the country is small so that the foreign price level and the level of the foreign rate of interest are exogenous to the country under considerations. Wealth of the domestic economic units consists of two assets, money and bonds. Domestic and foreign bonds are perfect substitutes. Bonds are of a Metzlerian type, that is to say they are indexed.

Real wealth of the domestic country is defined as follows:

$$(1) \qquad w = \frac{M}{p} + \frac{B}{i} + \frac{ep^*B^*}{ip}$$

w = real wealth

M = nominal quantity of money

p (p^*) = domestic (foreign) price index

B (B^*) = sum of domestic (foreign) coupons in <u>real</u> value terms of domestic (foreign) console type bonds owned by <u>domestic</u> economic units

e = rate of exchange (price of foreign currency in terms of domestic currency)

i (i^*) = domestic (foreign) rate of interest

In addition to perfect substitutability between domestic and foreign bonds I assume instantaneous portfolio-adjustments. At any moment of time there exists interest-arbitrage-equilibrium. Domestic and foreign interest rates only differ by an amount equal to the forward premium.

(2) $i = i^* + s$ (short term arbitrage equilibrium)

(3) $s = s\ (e, x)$ (short term speculative equilibrium)

s = forward premium
x = vector of exogenous variables

The forward premium is a function of the current exchange rate and of long term exchange rate expectations, which I consider to be a function of the long term exogenous variables of the model. This function for the forward premium is inessential for what will follow. Therefore, I shall not consider it any further.

In macroeconomic equilibrium the markets for goods, money and bonds are in equilibrium. On account of the wealth restriction the bond market will also be in equilibrium if the money market is in equilibrium. For money market equilibrium the real money supply, $\frac{M}{P}$, is equal to the real money demand, which depends on the rate of interest, real GNP and on real wealth.

(4) $\frac{M}{P} = L\ (i, Y, w)$ (money market equilibrium)

Y = real GNP

In goods market equilibrium GNP supplied is equal to GNP demanded.

The country considered does neither import nor export goods. Therefore the demand for GNP of the small country only consists of domestic absorption without any import component. Domestic real absorption is a function of real GNP, the rate of interest and real wealth. Since there is no international trade in goods, the terms of trade do not play any role in the absorption function.

(5) $Y = A\ (i, Y, w)$ (goods market equilibrium)

A = real domestic absorption

With flexible exchange rates the balance of payments is always zero. I assume that net-factor income from abroad is continuously balanced by a corresponding amount of net transfers to the foreign country. Under these conditions or assumptions any surplus or deficit in the balance of trade is equal to a corresponding deficit or surplus in the balance of capital movements. Obviously, with no international trade in goods the balance of trade is identically equal to zero. Then, on the assumption of a permanent balance between factor incomes and transfer payments, the balance of capital movements is also identically equal to zero.

The assumptions made so far imply that B^* cannot change over time or that

(6) $\dot{B} \equiv \dot{B}^* \equiv 0.$

B and B^* are exogenous variables [8]. Thus, so far, the list of exogenous variables consists of B, B^*, i^*, p^* and M. With respect to the domestic price level it is assumed that it may only change over time. At any given moment of time, i. e. in the short run, it is exogenous.

In long run equilibrium we have

(7) $Y = Y^f$

Y^f = full employment real GNP, exogenous.

In the long run domestic prices are fully flexible and therefore endogenous and the forward premium becomes zero.

(8) $s = 0$ (long term speculative equilibirum)

From (2) and (8) we have

(9) $i = i^*$ (long term arbitrage equilibrium)

Using (7) and (9) one obtains as a condition of long run equilibrium for the goods market:

(10) $Y^f = A\ (Y^f, i^*, w)$

and similarly for the money market:

(11) $\frac{M}{P} = L\ (i^*, Y^f, w)$,

while the definition of real wealth becomes:

(12) $w = \frac{M}{p} + \frac{B}{i^*} + \frac{B^* p^* e}{i^* p}$.

Now, in equation (10) only real wealth, w, is endogenous. With the equilibrium condition for the goods market the long run equilibrium value of real wealth may be determined. Taking this long run equilibrium value for real wealth, w, together with the exogenous values for the rate of interest, i^*, the full employment level of GNP, Y^f, and for the money supply, M, it is possible to derive from equation (11) the long run equilibrium value of the domestic price level and of the real balances. With these long run equilibrium values of w, $\frac{M}{p}$ and p and the given values of the exogenous variables B, B^*, p^* and i^* the long run equilibrium exchange rate can be determined from the definition of real wealth in equation (12). Given the long run equilibrium values of e and p and with p^* exogenous the long run equilibrium value of c may be determined, where by definition

$$(13) \qquad c \equiv \frac{e\, p^*}{p}$$

By an appropriate choice of units for the quantities of domestic and foreign goods we can make both the exogenous p^* and the long run equilibrium level of the endogenous p equal to one. An equilibrium normalized such that $p = p^* = 1$ may be called an initial or base period equilibrium and may be marked by an index zero. For such a base period equilibrium (13) implies (14)

$$(14) \qquad c \equiv e_o$$

Now, if c does not vary from one long run equilibrium to another then c is a constant (for long run equilibria) and, using (14), (13) may be restated as

$$(15) \qquad e \equiv e_o \frac{p}{p^*}$$

where e_o is the base period long run equilibrium exchange rate and a constant factor of proportionality.

In (15) the long run equilibrium exchange rate and the long run relative PPP are equated. Thus, (15) is a statement of the relative version of PPP-Theory and we have found a possibility of proving Proposition 3. If we can show that the long run equilibrium value of c does not vary with M while it may change with B or B^* or some other real exogenous variables such as i^* and Y^f, then we have proved Proposition 3 for our system with flexible exchange rates.

From the definition of real wealth (12) it may be seen that the long run equilibrium value of c is independent of the quantity of money if w, $\frac{M}{p}$, B, B^* and i^* have this invariance or independence property. That real wealth, w, and real balances, $\frac{M}{p}$, have this property is obvious from (10) and (11). B, B^* and i^* have this independence property by definition: they are exogenous variables and are not related to M. Thus, we have shown, that the long run equilibrium value of c is invariant with respect to variations of the nominal quantity of money, M. On the other hand, from (10) - (13) it may be seen that if either B or B^* are varied then the long run equilibrium value of c changes although that of w and $\frac{M}{p}$ remains unchanged. Furthermore, if either Y^f or i^* are varied, then the long run equilibrium values of both w and $\frac{M}{p}$ will change and in general the long run equilibrium value of c cannot remain constant.

Since the long run equilibrium values of c and $\frac{M}{p}$ are both independent of the nominal quantity of money, M, we have the following results:

1. the long run equilibrium value of the price index, p, is proportional to M;
2. the long run equilibrium value of the exchange rate, e, is proportional to p if the change of p is caused by a variation in M;
3. the long run equilibrium value of the exchange rate is proportional to the exogenous quantity of money, M.

These proportionality properties make it clear that the relative PPP-Theory with flexible exchange rates is nothing else than an implication of the quantity theory of money and thus has nothing to do with the law of one price.

III.

We may now turn to the case of pegged exchange rates. In this case M is dropped from the list of exogenous variables and replaced there by e. As the proof for the case of flexible exchange rates has shown B and B^* are "real" variables. In order to prove our propositions for the case of a pegged exchange rate we have to exclude changes in B and B^* when varying the exchange rate. Therefore B and B^* will be held constant and are again treated as exogenous variables. It will also be assumed that there is no change in the domestic component of the monetary base in the country considered, changes in the money supply, M, being identical to nonzero balances of payments.

The long run equilibrium value of real wealth and real money stock will again be determined by (10) and (11). With B and B^* exogenous and given the long run eqilibrium value for the real money stock the definition of wealth, (12), again implies a long run equilibrium value of c as defined in (13), e now being exogenous [9]. It is left to the reader to convince himself that the long run equilibrium values of c, w and $\frac{M}{p}$ will not vary with a change in e while the other exogenous variables are held constant.

Since both the long run equilibrium value of c and $\frac{M}{p}$ are independent of the exchange rate e, we have the following results:

1. the long run equilibrium value of the price index, p, is proportional to e;
2. the long run equilibrium value of the quantity of money, M, is proportional to p if the change of p is caused by a variation in e;
3. the long run equilibrium value of the quantity of money is proportional to the exogenous exchange rate, e.

A comparison of result 3 in the different exchange rate cases makes it clear that the roles of the money stock and of the exchange rate are simply reserved in the two exchange rate regimes. In the case of pegged exchange rates one can speak of an exchange rate theory of the money stock entirely symmetric to a quantity of money theory of the exchange rate for the case of flexible exchange rates.

Footnotes

1) There is no mention of this result f. e. in Lawrence H. Officer, The Purchasing-Power-Parity Theory of Exchange Rates: A Review Article, Staff Papers, International Monetary Fund, Vol. 23, No. 1, March 1976, pp. 1 - 60.

2) See Michele Fratianni and Lee Mac-Donald Wakeman, Capital Asset Pricing and the Foreign Exchange Market, Paper presented to the Konstanzer Seminar on Monetary Theory and Monetary Policy, June 1980.

3) To make life easier I shall limit myself in the following to consider a two-country world.

4) The term price level may be taken to refer to the price of a commodity basket.

5) I refuse to join L.H. Officer in defining the long equilibrium exchange rate as "that fixed rate that would yield balance of payments equilibrium over a time period incorporating any cyclical fluctuations in the balance of payments (including those related to business cycles at home and abroad)". Such a definition appears to relate the equilibrium exchange rate to a balance of international flows of goods and capital, neglecting the more recent asset-market equilibrium or stock approach to the determination of the short and long run equilibrium exchange rate.

6) See Jacob A. Frenkel, Purchasing, Power Parity: Doctrinal perspective and evidence from the 1920's, Journal of International Economics, Vol. 8, No. 2, May 1978, pp. 181-183.

7) See Hans Genberg, Purchasing power parity under fixed and flexible exchange rates, Journal of International Economics, Vol. 8, No. 2, May 1978, P. 268.

8) To assume $\dot{B} = \dot{B}^* = 0$ i. e. assuming B and B^* to be exogenous is not equivalent to excluding capital movements. A zero net

capital movement is entirely consistent with gross flows in both directions. On the other hand assuming a zero (net) trade balance does not imply nonzero (gross) trade flows. So, the presence or absence of international trade in goods or of capital movements should not be decided on the basis of the corresponding balances. In the present model international capital movements have the effect of driving the covered interest rate differential to zero. If capital movements were excluded the model would determine equilibrium domestic interest rates independent of foreign rates instead of determining the exchange rate.

9) With the absorption function, the demand for money function and the full employment level of GNP unchanged, these long run equilibrium values will even be the same in both systems of exchange rates.