Testing a Marxian-Classical Inflation Theory

Alberto Handfas - Universidade Federal de São Paulo – December 2015

1. Introduction

The aim of this article is threefold: Firstly it intends to outline a pathway for expressing an alternative inflation theory through a Demand-Pull (DP) and Supply-Resistance (SR) framework that follows the Classical Political Economy critical tradition. Secondly, from such inflation DP-SR approach, it is sought to empirically compare conventional, mainstream, theories with an alternate, Marxian-based one (Shaikh, 1999; Handfas; 2012)[1]. Lastly, it aims to check on theoretical and econometric grounds the viability of such alternative as a consistent model to explain inflation.

We will set up a model comparison in which only two general theoretical approaches will be assessed: a "conventional" and an "alternate", each of them based respectively on "Keynesian" (more precisely, Neoclassical-Keynesian Synthesis) and "Marxian-Classical" traditions. Hence, the models to be constructed here will bear different SR gauges, which will be compared. To keep things simple, though, those models will share a common DP variable -- the injections of purchasing power -- that expresses excess demand in a way that does not assume exogenous money.

Two benchmark DP-SR models are constructed: one for the conventional approach; the other for the alternate, Marxian-classical, one. The first one has two variations, one using capacity and the other employment as the SR variable. The second one uses the throughput.

2. Inflation and Accumulation Stiffness: Some Stylized Facts

Inflation and growth (its usual limit measures such as employment and capacity), historical data have puzzled conventional economic wisdom, which assumes supply being -- more or less frequently -- on the brink of rigidity due to full employment of factors. Three remarkable features can be noticed by glimpsing the long run trends of inflation and growth (or its conventional limit: employment being equal to one minus unemployment rate) in the main economies, as those shown in ***Figure 1***.

[FIGURE 1]

First, the bulk of inflationary pressures was at its highest from the late 1960's to the early 1980's. Secondly, as it follows, the supposed trade off between (high) inflation and (high) growth (i.e. low unemployment) is not at all as straightforward as the traditional (Phillips curve – its different versions, including the Nairu -- type of) theories would predict. Far from that, those almost two decade long of resilient inflation was also a period of relative low employment and low capacity utilization – a period of stagflation. Also, more then once, when employment recovered, inflation receded -- all of that at odds with traditional Neoclassical-Keynesian inflation theories. As a matter of fact, there have been criticisms on the accuracy and even on the conceptual validity of the rate of unemployment and of capacity utilization as effective measures of the economic activity (Erceg and Levin, 2013). On the one hand the unemployment data exclude workers "marginally attached" to the labor force as well as the "discouraged" ones – let alone institutional people, etc; on the other hand, capacity (or output gap) data refers to estimated "normal" capacity that much depends on the survey questions, and on the valuation principles used to measure output. Also, the efficiency of production may change over time, due to new technologies etc.

Third, inflation in each and every economy were under the impact of occasional external shocks. For instance, during the mid-to-late fifties the Korean War and the jumps in wages -- following French union-government agreements (Gordon, 1982; p.31) -- were indeed central in explaining idiosyncratic inflationary episodes in the USA and in France respectively. From the mid seventies to the early eighties, the two oil shocks (1973/4 and 1979/80) had a major impact on inflation all over the world. From the 1980's onwards other three main shocks showed up: The international commodity prices deflation in 1985/6 (Morrison and Watleworth, 1987); And two major global financial crises -- 1997/8 with the epicenter in emerging markets, and 2008, having the USA and Europe as its vortex. Many heterodox accounts – such as the Post-Keynesian, "Conflict" and "Cost-Push" inflation theories – are mostly constructed upon such "supply side" inflation.

2.1. Underlying Mechanisms of Accumulation: Alternate Limit Gauge

What is intended to do in this article though is to look beyond those particular shocks by trying to put forward a theory that spells out the "big picture"; i.e. the long-run pattern of inflation. And that would be better understood by inquiring into the inner mechanisms of the accumulation cycles, which in the classical political economy tradition are driven by the rate of profit; the latter being the limit of the former (and of growth) -- and this is precisely the clue that sheds light on such historical (low-growth/high-inflation, or vice-versa) dichotomy.

From the late 1960's throughout the 1970's, while economic activity was weak in most economies, the average rate of profit was quite low – particularly when compared to the post-war "golden years". This is shown in **Figure 2**: rate of profit fell systematically during such period in roughly all major economies.

[FIGURE 2]

That fall in the profit rates must have left capitalists, in certain industries more than in others, unwilling (and/or unable) to re-commit profits into new production, lowering thus their supply ceiling. Keeping up with current aggregate investments in such environment tended to bring about bottlenecks – casted by those certain capitalists' restraining supply (vis-à-vis their not yet reduced demand, as the latter is determined by the economy-wide current investment). Insofar as those bottlenecks spread out to other sectors, aggregate supply became less and less responsive to demand -- even if labor market and/or capacity utilization conditions were loose.

Such stiffness in supply growth is represented here by the throughput coefficient, "τ" (τ = accumulation-rate/profit-rate), whose series are depicted in **Figure 3.** This coefficient measures how close capital accumulation is from its (profit-rate) ceiling, which is roughly shown in the ***Figure 2*** graphs by the distance between the growth rate (dotted line) -- a proxy for accumulation -- and its profit-rate "ceiling" (grey thick line); so that the throughput (in ***Figure 3***) would be the dotted divided by grey thick line. Whenever that distance -- between "floor" (growth) and "ceiling" -- narrows down in the graphs of ***Figure 2***, it means less room is being left for supply expansion. That implies "τ" spiking, SR going up and inflation tending to be eventually triggered. It seems clear from the graphs that, particularly for the USA and UK, inflation pressures went up when the (profit rate) “ceiling” collapsed as it did for instance in the 1970s. Inflation receded only when such “ceiling” rose again in the 1980s and 90s. In Japan, the ceiling did not go up again that much; it was rather the “floor” that collapsed making anyhow enough room enough for inflation to dwarf – and, in this case, be transformed into deflation.

[FIGURE 3]

Recall also that such “ceiling” lines represent the average profit rate among (private non-financial corporate) industries. When such average went down, some industries had their profit rates going even lower than the average, reducing even more their willingness/ability for expanding their supply – casting therefore bottlenecks.

In a first, very rough, approximation one can compare the graphs of figures 1 and 3 and realize that inflation seems to be for most countries and periods better related to throughput than to employment (and that would also be trough usually for capacity utilization). One should notice though that – at least visually saying -- even the throughput correlation with inflation is not always strong. The main reason for that -- beyond issues related to inflation lag (with regard to SR), hysteresis and external shocks – must be the complex transmission from SR into inflation which must be mediated by the dynamics of purchasing-power injections into goods and services circulation and of sectors’ growth unbalances. In order to the model we suggest here to capture that, the pervasively accelerating supply resilience might be represented by a nonlinear τ-driven SR function. And that SR, when increased, tends to turn any occasional, short-run, injection of purchasing power (“e”) into a long run, persistent, episode of excess demand, which subsequently boosts inflation. Conversely, if SR is high but "e" is very low, inflation is not supposed to be that pressured.

3. Model Specifications

Inflation, π, is triggered whenever injections of excess demand persistently meet a sluggish supply. Therefore most inflation theories could be expressed as a DP-SR model as follows.

$$\pi = f\,[\text{DP, SR}] \tag{1}$$

Conventional inflation theories have incorporated a Keynesian (transient) underemployment output provided the economy is prone to return to its long-run full employment through either policy or real-balance effects. Their SR component would be a gauge of how close the economy is from its full-employment supply limit. Hence, conventional theories' SR are usually represented by a function of employment rate (one minus the unemployment rate), λ, or of capacity utilization rate, κ. Also, in such Neoclassical-Keynesian Synthesis framework, at least in its relevant versions, money is not completely exogenous since credit bank also plays a role through the money multiplier (Tobin, 1958; Snowden, 2005). Since most conventional inflation theories were developed under such Synthesis umbrella, we will disregard for empirical comparison purposes more extreme cases such as the Quantitative Theory of Money (QTM), or its renewed versions (purely Rational Expectations, or Real Busines Cycles theories).

A Marxian version of equation (1), notwithstanding, would have to adopt a SR variable that is not related to employment of either labor or capital at all. For Marx capitalism bears built-in devices for both refilling the reserve army of labor and self-expanding capacity – the "general law of accumulation" (Marx, 1976, p. 795). For him (as well as for other Classical political economists), supply growth would be limited by the rate of profit, r, which is the "maximum expanded reproduction" in Marx´s schemes – which is the capital growth reached if all profit is reinvested,

$$g_{max} = \frac{I_{max}}{K} = \frac{P}{K} = r$$

where g_{max}, I_{max}, P and K are respectively maximum capital growth (accumulation) rate, maximum investment, profits and fixed-capital stock. Therefore the Marxian-Classical SR variable would be a gauge of how close capital accumulation, g, is from its maximum, r. And this variable is precisely "τ", the "throughput" coefficient:

$$\tau = \frac{g}{g_{max}} = \frac{g}{r} = \frac{\Delta K/K}{P/K} = \frac{I}{P} \tag{2}$$

It is interesting now to re-write equation (1) according to the two abovementioned different theoretical paradigms, conventional (Neoclassical-Keynesian) and alternate (Marxian-Classical).

$$\pi = f[e, F(\lambda)] \tag{3.1}$$

$$\pi = f[e, F(\kappa)] \tag{3.2}$$

$$\pi = f[e, F(\tau)] \tag{4}$$

Where: "e", the DP component, is a measure of injections of excess demand that for, simplification´s sake, could be roughly considered the same for both conventional and alternate theories; and F(.) represents the SR component, which is different for each version. Both equations (3.1) and (3.2) represent two similar ways of representing conventional theories in a DP-SR framework, the former uses unemployment, the latter capacity utilization as supply-strain gauges – notice that without "e", they simply boil down to a Phillips-curve type of model. Equation (4) is the Marxian-Classical model properly. Since inflation requires both SR and DP to be in place concomitantly, a multiplicative variable is a good way to represent it:

$$\pi = f[e.F(\cdot)]$$

3.1. The Nonlinearity of the SR Function

The SR function, F(.), should bear a nonlinear form in both Marxian-Classical and Neoclassical-Keynesian models, although for quite different theoretical reasons.

In the Marxian-Classical framework, the strain gauge, τ, is the average proportion of profit recommitted to production among all industrial sectors, 1, 2, … i. Whenever the economic growth, g, makes τ to be at a relatively high level, there will be an industry "i", with the lowest individual rate of profit, r_i, either reaching, or already at, its individual ceiling ($\tau_i \cong 100\%$; i.e. $g = g_i \cong g_{imax} = r_i$) and thus casting a bottleneck. That may increase tremendously the supply resistance, much more than what the average τ would indicate, since that bottleneck turns industry "i" ceiling into the whole economy growth limit. If the average throughput is not too high, there is still room for rearrangements among industries relieving the SR – i.e. there is still the possibility of "changing the output proportions", as in a Pasinetti-Sraffa system of commodity production (Pasinetti, 1977, pp. 208-212). But inasmuch as the average throughput gets even higher, the rearrangements possibilities become narrower and bottlenecks can no longer be dissipated, which leads to a much more drastic effect on supply resistance. And, on the contrary, if such average, τ, is very low, gluts rather than bottlenecks may even show up yielding in some extreme cases a negative supply resistance.

All of that boils down to a nonlinear relation between SR and τ, so that $f(\tau)$ could be mathematically represented by a convex function that may yield either negative or increasingly positive outcomes – the former only for too low levels of τ ; the latter for most of the range of economically relevant values of τ. The Marxian-Classical SR function can be represented as follows (Handfas, 2012):

$$f(\tau) = -\beta\, \tau_t + \gamma\, \tau_t^2 \qquad (5)$$

In Neoclassical-Keynesian inflation types of theories, a Phillips curve is also supposed to be nonlinear, but usually for different reasons. Originally it was drawn with a double-log functional form in order to capture the effects of the hypothesis that large changes in wage rates are associated with small changes in unemployment when unemployment is low; and large changes in unemployment with small changes in wages when unemployment is high (Phillips, 1958; Routh, 1959). Since then, most of its new adaptations use either capacity utilization or unemployment as the main independent variable and the dependent variable has been switched from change in wages to inflation or change in inflation. Most of models though have held the nonlinearity of the original curve (Semmler & Zhang 2003, Nobay&Peel 2000, Fair, 2007). Among the microfundations for such nonlinearity, "increasing marginal costs and a fixed capacity in the short run" would be "making (…) inflation (…) more sensitive to output in times of excess demand and [therefore] the short-run Phillips curve has a convex shape". This shape is also claimed to be a consequence of expectations: "the Phillips curve's slope will vary positively with the volatility of inflation" (Elianson, 2001). Interesting enough, there are also a couple of models -- that became popular within IMF researches in the mid 1990's -- that have a quadratic form, similar to the one we suggest here for the Marxian-Classical model[4].

Such literature on Phillips curves allows us therefore to foster a common quadratic form for both the Marxian-Classical and the Neoclassical-Keynesian SR functions. This will make it easier and clearer the comparison between those two paradigms.

As it follows, the inflation models would look like:

$$\pi_t = a + \Sigma[e_{t-j}(-\beta_j \lambda_{t-j} + \gamma_j \lambda_{t-j}^2)] + \varepsilon_t \qquad (6.1)$$

$$\pi_t = a + \Sigma[e_t(-\beta_j \kappa_{t-j} + \gamma_j \kappa_{t-j}^2)] + \varepsilon_t \qquad (6.2)$$

$$\pi_t = a + \Sigma[e_t(-\beta_j \tau_{t-j} + \gamma_j \tau_{t-j}^2)] + \varepsilon_t \qquad (7)$$

Equations (6.1) and (6.2) are the two "conventional" models that use employment and capacity strain gauges respectively. Equation (7) is the Marxian-Classical model. Notice that they all show the long-run dynamics of the variables' relationship (including the multiplicative interaction between "e" and F[.]) and include the impact on inflation of the lagged independent variables, both DP ("e_{t-j}") and SR (either, "τ_{t-j}", or "λ_{t-j}",or "κ_{t-j}"), in previous "j" periods. More short-run exogenous shocks that might transiently disrupt such long-run path as well as other less important variables that also impact inflation are all to be captured either by dummy variables or by the intercept "a" and by the error term of the equation, ε_t.

4. ADL Model and Long Run Relationship

A more short-run form of such relationship should also take into account the economy inflationary memory, or momentum, which is expressed by the autoregressive term , π_{t-i}.

In this model, as in any stationary system, an external shock would have a higher impact on the current or next period inflation and then start to lose momentum over the following periods until it fades completely away. The speed of such adjustment equals thus to $(1 - \alpha_i)$; where $0 < \alpha_i < 1$. Having that in mind, one can now rewrite equations (6.1), (6.2) and (7) as a generical autoregressive distributed-lag (ADL) model of the type:

$$\pi_t = a + \alpha_1 \pi_{t-1} - \sum_{i=0}^{n} \beta_i x_{t-i} + \sum_{i=0}^{p} \gamma_i z_{t-i} + \varepsilon_t \qquad (8)$$

where x and z are the multiplicative variables that represent either (i) $x=e^*\lambda$ and $z = e^*\lambda^2$ in the Employment-Neoclassical-Keynesian model, or (ii) $x=e^*\kappa$ and $z = e^*\kappa^2$ in the Capacity-Neoclassical-Keynesian model; or (iii) $x=e^*\tau$ and $z = e^*\tau^2$ in the Marxian-Classical model. Notice that the momentum term in equation (3) accounts only for the previous year inflation – again, this is only for simplifying our presentation; one can easily generalize the model for higher autoregressive orders.

4.1. Stationarity, the ECM and the long run relationship

In order to set up a model that can test and compare theories expressed by equations (8), one needs to take into account a few econometric problems. As π, x and z are economic variables that change in time, it would not be surprising if non-stationarity is found out in their behavior, which would compromise the estimators and the whole regression. One then needs to make sure that the roots of each of the three variables' auto-regressive vectors lie outside the unit circle. This could be tested with an Augmented Dickey-Fuller procedure for unit root test. However the power of an ADF test is weak (Hamilton, 1994, p.321).

That just makes it more appealing for us to set up an Error Correction Model (ECM) parametrization of the ADL model – i.e. equation (8). The ECM method allows us to make sure that the model is co-integrated in case of unit root -- in the case that all variables have unit root, say I(1) but share a common trend. By co-integrating them the model itself becomes stationary I(0). Accordingly we can then rewrite equation (8) through a Bewley transformation (Patterson, p 351-4) such as:

$$\pi_t - \pi_{t-1} = a + (\alpha_1 - 1)\pi_{t-1} + \sum_{i=0}^{n} \beta_i x_{t-i} + \sum_{i=0}^{n} \gamma_i z_{t-i} + \sum_{i=0}^{n} \beta_i x_{t-i-1} - \sum_{i=0}^{n} \beta_i x_{t-i-1} + \sum_{i=0}^{n} \gamma_i z_{t-i-1} - \sum_{i=0}^{n} \gamma_i z_{t-i-1} + \varepsilon_t$$

Rearranging that further will give us

$$\Delta\pi_t = a + (\alpha_1 - 1)\pi_{t-1} + \sum_{i=0}^{n} \beta_i x_{t-i-1} + \sum_{i=0}^{p} \gamma_i z_{t-i-1} + \sum_{i=0}^{n} \Delta\beta_i x_{t-i-1} + \sum_{i=0}^{p} \Delta\gamma_i z_{t-i-1} + \varepsilon_t$$

and then,

$$\Delta\pi_t = \sum_{i=0}^{n} \Delta\beta_i x_{t-i-1} + \sum_{i=0}^{p} \Delta\gamma_i z_{t-i-1} + \varepsilon_t + (1 - \alpha_1)\left[-\pi_{t-1} + \frac{a}{1-\alpha_1} + \sum_{i=0}^{n} \frac{\beta_i}{1-\alpha_1} x_{t-i-1} + \sum_{i=0}^{p} \frac{\gamma_i}{1-\alpha_1} z_{t-i-1}\right] \quad (9)$$

If either the three variables, π, x and z, are stationary, I(0), or if they share a common trend, being each I(1), the ADL (equation [9]) is stationary; then, in the long run

$$\Delta\pi_t = \sum_{i=0}^{n} \Delta\beta_i x_{t-i-1} + \sum_{i=0}^{p} \Delta\gamma_i z_{t-i-1} + \varepsilon_t \quad (10)$$

And for that, ε_t needs only be a stochastic error, with $E(\varepsilon_t)=0$. It needs not even be i.i.d.. Equation (10) implies that the expression inside the squared brackets in equation (9) to also be equal zero. If so, then

$$\pi_t = \frac{a}{1-\alpha_1} + \sum_{i=0}^{n} \frac{\beta_i}{1-\alpha_1} x_{t-i} + \sum_{i=0}^{p} \frac{\gamma_i}{1-\alpha_1} z_{t-i}$$

If $a^* = \frac{a}{1-\alpha_1}$; $\beta^* = \frac{\beta_i}{1-\alpha_1}$; $\gamma^* = \frac{\gamma_i}{1-\alpha_1}$, then by substituting those parameters we get

$$\pi_t = a^* + \sum_{i=0}^{n} \beta_i^* x_{t-i} + \sum_{i=0}^{n} \gamma_i^* z_{t-i} \qquad (11)$$

Equation (11) represents the long-run behavior suggested by either the "conventional" or the "Marxian-Classical" models: setting aside external (short-run) shocks, inflation is explained by the interaction between DP (excess demand) and SR, which grows nonlinearly either with capacity or with employment or with throughput. If equation (11) parameters are proven to be statistically significant, it means the ADL model is stationary and consistent. What is more, this equation reveals the long run relationship between inflation and the other two variables, their current value as well as – if this is the case -- lagged ones.

5. Variables and Their Underlying Components

The two independent variables and the dependent one -- DP, SR and π respectively -- of the theoretical frameworks we are about to test are defined as follows[5].

5.1. Injections of Excess Demand:

Since, for simplification's sake, we accept here that endogenous money is workable for both theoretical paradigms – the Marxian-Classical and (at least to certain extent) the Neoclassical-Keynesian – the demand pull component are to be expressed commonly by new injections of purchasing power, $e_t = E_t/GDP_t$. It represents, in an open economy, the Excess Demand as a proportion of income, where E_t, is a composite of two different items: New Domestic Credit to Commodity Market and Net Foreign Demand[6].

For defining what to count in Net Credit to Commodity Market, a few important remarks (Shaikh, 1999) should be raised. Banks actively create new money by extending loans. Those who borrow from them do so for spending, not holding -- since they have to pay interest for such loan. Only part of such bank funded expenditures goes to the market of commodity goods -- its complement goes to financial assets markets. Government bills and bonds bought by private banks are generally monetization of bank reserves and go to financial asset markets, injecting no purchasing power in good markets. In terms of International Financial Statistics survey, “thrift institutions” (S&L, Mutual Saving Banks and Credit Unions) and money market funds are financial intermediaries and do not create new purchasing power.

In other words the new purchasing power can arise out of (i) new high powered money which enters as expenditures; of (ii) credit advanced by banking institutions (commercial banks, thrifts, consumer unions, etc.); or of (iii) trade credit (among businesses, and between businesses and consumers). However, only those new purchasing power that come from (i) high powered money or (ii) banking institutions can result in increases in the quantity of money -- currency holdings plus bank deposits. In this respect, there are three main domestic sources of such injections that can be found in the national accounts: banks, which create new money when they extend loans; direct consumer credit; and the portion of government deficits financed by direct printing money or Central Bank credit (indirect printing money). International trade surpluses are also a source of inflows. Then:

e_t = [net injections of excess demand]/GDP = [yearly changes in the stock of (Central Bank Claims on Central Govt +Net Debt of Central Govt to Depository Corporations +

Depository Corporations Claims on State & Local Govts + Depository Corporations Claims on Private Sector) + Current Account]/GDP.

5.2. The Supply-Resistance Variable

As discussed in Section 3, the three possible gauges for growth limit to be comparatively tested would be:

(i) The capacity utilization ratio: $\kappa = Y_{ind}/Y_{ind,max}$ (for one Neoclassical-Keynesian model)

(ii) The employment ratio: $\lambda = (L\text{-}U)/L = (1\text{-}u)$ (for the other Neoclassical-Keynesian model)

(iii) The throughput coefficient: τ = Private enterprise Gross Capital Formation/ Private enterprise Gross Operating Surplus.

Where Y_{ind}, $Y_{ind,max}$, u are respectively the current and maximum industrial output (usually the latter is an estimate based upon surveys with corporate managers), the unemployment rate and the rate of profit.

5.3. Inflation

$\boldsymbol{\pi}$ = % change in the GDP Deflator

6. Preliminary Tests: Comparing Theories (SR Gauges) in the Long Run

In order to assess the viability of the DP-SR model preliminary comparison tests for seven OECD countries will be run so that it will be possible to investigate how fitted to the data are the supply stiffness gauges, τ, κ and λ, and also check whether those gauges interact (nonlinearly) with excess demand when impacting inflation -- as predicted by each of their models [equations (6.1), (6.2) and (7)].

Table 1 presents the only the most significant ECM (long run) regression test result for each gauge and each country. For simplification's sake we choose to show only the long-run relationship, excluding therefore the momentum and shock variables (π_{t-i} , and dummies). Also, since this first step means to be only a prefatory test, only the most simplest models were presented: only models with one set of independent variables (x and z) – lagged or not.

Results for the models using the SR-only as dependent variables are shown in the second compounded column of ***Table 1***. For keeping the table as summarized as possible the constant term was omitted. The models with the DP-SR interactive (multiplicative) variables -- as in equations (6.1), (6.2), (7) or, generally saying, (11) – are presented in the third compounded column.

[TABLE 1]

Two initial assessments can be drawn from such preliminary tests. Firstly, for barely all countries -- with the exception of the models using capacity for Canada and Japan and employment for Korea -- the DP-SR models outperformed the SR-only ones: regardless the supply limit gauge, when the dependent variable is the multiplication of SR and "e" its the estimates are usually more significant when it relies only on the SR. Without such interaction, they are usually not (or at least they are very weakly) significant.

Secondly, among the DP-SR models, for all those OECD economies and panel datasets, the throughput regressions yield significant estimates. What is more, with the exception of Japan and France, for all datasets, the regressions using throughput have coefficients with higher significance than those using employment or capacity as SR. These conventional gauges' regressions, in many cases, bear either one or more insignificant estimated parameters – which gravely compromises the significance of the model. And in certain cases, their estimates are not only insignificant but also have the opposite sign expected by the theory (a U-shaped quadratic function as in equations (6.1), (6.2) and (7)) – which lead the whole regression to lose meaningfulness.

Such inferences indicate one should not reject either the interaction between DP and SR or the quadratic functional form of the SR as feasible ways for explaining inflation. One can also add that, at least within such DP-SR framework, those preliminary tests show evidences that the Marxian-Classical τ could explain inflation at least as well as, if not better than the other two, conventional, gauges.

7. Testing the Marxian-Classical Model

We will turn our attention now to the Marxian-classical model suggested by this article. Since the foregoing preliminary tests have shown it feasible, we intend now to double-check its fitness by fine-tuning the regressions considering short-run shocks. Again, the tests will be run for quarterly data for all countries -- except for Korea, due to lack of data availability. In order to re-run the Marxian-Classical models we first regress the long-run relationship (ECM) and, if it shows significance and good fitness, we add then dummy variables in order to cope with short-run external shocks.

Table 2 summarizes such test results, presenting only the best (fitness and significance) models for each economy: the regressions' adjusted R^2 ("Adj R^2"), their degrees of freedom ("DF"), their estimated coefficients values and significance ("t-statistics") for both the long run, simplified ECM, models and their complete, short-run shocks calibrated versions. For keeping the table as summarized as possible the constant term was omitted and the dummies are only mentioned.

[TABLE 2]

Notice that the critical values (t*) at 1% significance level range between 2,60 and 2,63 for all the quarterly data regressions (and are around to 2,73 for the Korean annual data), much lower than the t-statistics of all coefficient estimates – meaning one should reject the null hypothesis of coefficients insignificance (H_0: $\beta>0$ and $\gamma<0$) for all those seven economies.

8. Final Remarks and a Few Possible Policy Implications

This article has empirically investigated and found evidences for the validity of a non-orthodox approach for understanding inflation based upon the Classical political economy critical tradition. Such approach takes into account the interaction of excess demand and capital expansion hindrances for explaining upswing (or downswing) pressures over general prices needing not assume either neutrality of money, or full-employment-reaching supply limit, or steady-state equilibrium. It can be expressed by a second-degree function that relates inflation with the interaction of injections of excess-demand and supply-resistance (the capital expansion hindrances). Such function – its long run ECM version as well as its expanded versions -- was tested for seven different main economies.

In all tested countries the statistical regression of the abovementioned Classical DP-SR model yielded significant coefficient estimates. Just by itself – even without the dummies or any other resort -- such model can explain a good deal of the actual historical (long-run) inflation. When adjusted to short-run shocks (and eventually to inflation memory effects – which was not done here), it gains precision and the regressions improve their fit to the data.

As a caveat, it is never too much recalling that although the regressions tested for the different SR gauges have helped us to make comparative inferences about each country population coefficients based upon the samples we have gathered, the estimates' significance (or lack thereof) by itself neither proves the ultimate validity of the Classical inflation theory nor disproves its conventional counterparts. On the same token, also notice that, as always in macroeconomics, there are many "good" statistical correlations between variables that should be cautiously considered: some of them may simply be coincidental and actually meaningless, others spurious and just a few should really be taken as reliable support to theories – particularly when such empirical evidences are corroborated by good analytical and historical assessments [8].

Bibliography

Eliasson, A.C. 2001. Is the Phillips Curve Non-Linear: Empirical Evidences for Australia, Sweden and United States. *Sveriges Riksbank Working Paper Series*, September 2001.

Erceg, C.J. and Levin, A.T. 2014. Labor Force Participation and Monetary Policy in the Wake of the Great Recession, *Journal of Money, Credit and Banking*, Blackwell Publishing, vol. 46(S2), 3-49.

Handfas, A. 2012. '*Demand Pull Supply Resistance in a Classical Inflation Model*', PhD Thesis, New School for Social Research Dissertations: http://gradworks.umi.com/35/11/3511238.html

Laxton, D., Rose, D., and Tambakis, D. 1989. The U.S. Phillips Curve: The Case for Asymmetry. *Mimeo IMF*.

Lipsey, R.G. (1960). The Relationship Between Unemployment and the Rate of Change of Money Wage Rates in the UK, 1862-1957: A Further Analysis. *Economica*, 27 (105), 1-32.

Marx, K. 1976. *Capital – Volume I*. London: Penguin Classics, 1990.

Marx, K. (1981). *Capital – Volume III*. London: Penguin Classics, 1991.

METI (Japan) http://www.meti.go.jp/english/statistics/index.html

Morrison, T. and Wattleworth, M. 1987. *The 1984-86 Commodity Recession: An Analysis of the Underlying Causes. IMF-Working Papers*, no. 87/71.

Pasinetti, L. 1977. *Lectures on the Theory of Production*, Columbia University Press, NY.

Patterson, K. 2000. *An Introduction to Applied Eonometrics*, Palgrave Press.

Phillips, A.W. 1958. The Relationship between Unemployment and the Rate of Change of Money Wages in the United Kingdom 1861-1957. *Economica* 25 (100), 283–299.

Pyyhtia, I. 1999. *The Nonlinearity of the Phillips Curve and European Monetary Policy*, *Bank of Finland Discussion Papers*.

Routh, G. 1959. The Relation between Unemployment and the Rate of Change of Money Wage Rates: A Comment, *Economica* (299), 299-315.

Shaikh, A. 1999. Explaining Inflation and Unemployment: An Alternative to Neoliberal Economic Theory, in *Contemporary Economic Theory*, Vachlou, A. (ed.), Macmillan, London. 1999.

Semmler, W. and Zhang, W. 2003. Monetary Policy with Nonlinear Phillips Curve and Endogenous NAIRU, *Center For Empirical Macroeconomics*.

Footnotes:

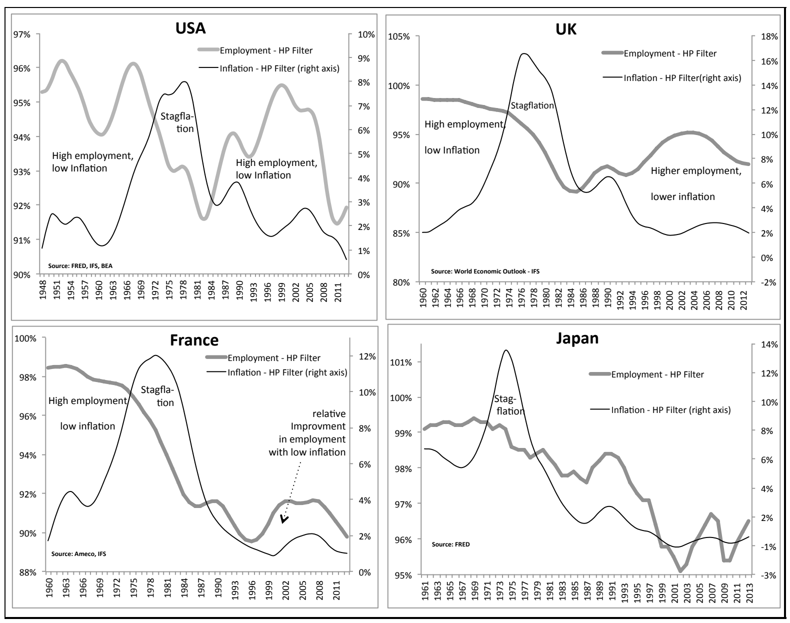
(1) The "Marxian-classical" inflation theory unfolded and presented here as a benchmark was first outlined by Shaikh (Shaikh, 1999). This theory is but one, among others, that have elaborated on Marx's thinking for explaining inflation (as a XX and XXI centuries' phenomenon). Among relevant examples of those are Rowthorn discussion on conflict/class-struggle or wage-push inflation, Dumenil & Levy multi-sector model and Foley's debate on the circuits of capital and inflation (Rowthorn, B. 1980; Dumenil, G. and Levy, 1993; Foley, D., 1982). Although those theories are not necessarily contradictory with the one here investigated, former and latter have followed distinct interpretations of Marx and reached different conclusions.

(2) It is needed to recognize though that not all inflation narratives fit straightly (or completely) to the DP-SR framework suggested here. For instance, within Post-Keynesian (or Kaleckian) tradition, the "cost-push" theories would claim that increasing production costs -- the cause of inflation -- rises independently from mismatches between aggregate supply and demand (Stirati, 2001).

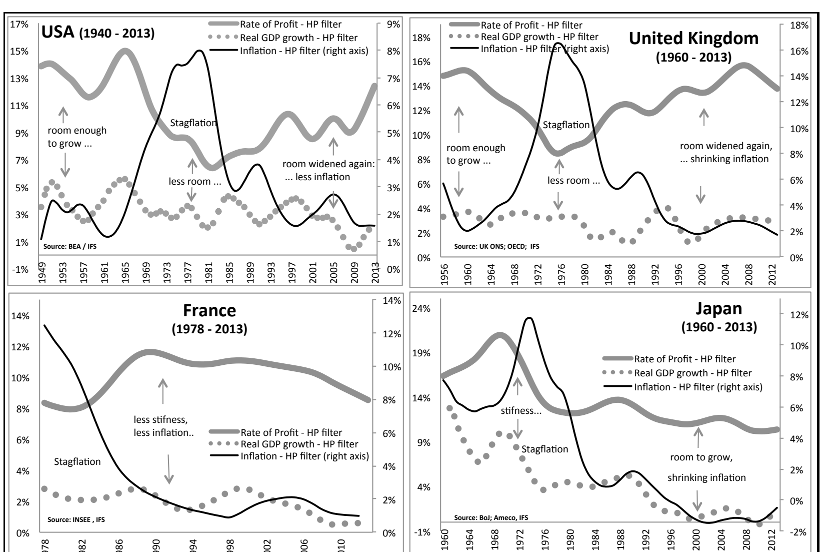
(5) Regressions' Data Sources. **Ameco:** Complementary data on throughput for Japan and Germany. **Bank of Korea:** South Korea external accounts, GDP and GDP deflator and throughput data (corporate operation ratio and investment). **BEA**: USA throughput (corporate profits and fixed capital formation), GDP and GDP deflator and current account datasets. **BLS**: USA unemployment rate. **FRED**: USA Capacity Utilization. **IFS**: bank credit data for all seven countries. **INSEE**: France external accounts, GDP and GDP deflator and throughput data (Corporate gross operating surplus and Capital formation); Business leaders' opinion survey: Productive Capacity Utilization and Unemployment rates. **METI**: Japan Operating Ratio (Capacity Utilization). OECD-DATA: complementary throughput data for all countries. **ONS**: UK external accounts, GDP and GDP deflator and throughput data (Corporate gross operating surplus and Capital formation). **StatCan**: Canada external accounts, GDP and GDP deflator and throughput data (Corporate gross operating surplus and investments). **Statistics Bureau of Japan**: Japan external accounts, GDP and GDP deflator and throughput data (Corporate gross operating surplus and Capital formation). **Statistisches Bundesamt**: Germany external accounts, GDP and GDP deflator and throughput data (Corporate gross operating surplus and investments). **World Economic Outlook**: Canada, Japan, Korea and UK Unemployment and Output Gap.

(6) Notice that an increase in domestic credit may lead (via imports and/or capital outflows) to exchange-rate devaluation, which boosts (domestic currency) tradable-goods prices and thus is eventually translated into inflation. In a closed economy though, inventories and capacity utilization may respond to excess demand.

<u>Figure 1</u>: Inflation vs. Employment for a Few OECD Economies



<u>Figure 2</u>: A Few OECD Countries Inflation, Growth and its (Rate of Profit) Ceiling



The rate of profit is computed as: non-financial corporate (profit/current-cost net stock of fixed assets) for the USA; private (gross operating surplus/gross capital stock) for UK, non-financial corporate (gross operating surplus/gross fixed capital stock) for France; total economy (gross operating surplus/gross capital stock) for Japan.

Figure 3: A Few OECD Countries Inflation and Throughput

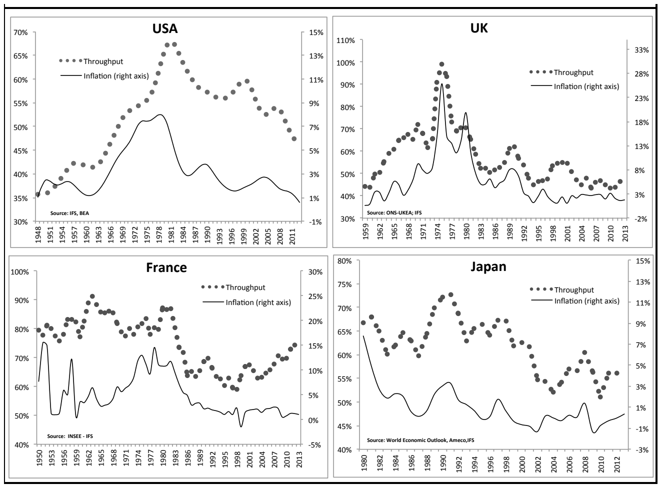


Table 1: Supply Resistance Gauges Comparison for a Few OECD Countries

Country / SR gauges		SR only models (no DP interaction variables) "Phillips curve" style: $\pi = \beta_0 - \beta_1(SR) + \beta_2 (SR)^2$					DP-SR models (with interaction variables) $\pi = \beta_0 - \beta_1 (DP)(SR) + \beta_2 (DP)(SR)^2$						
		variable	coefficient	t-stat.	Adj R^2	comments	variable	coefficient	t-stat.	Adj R^2	comments	DF	$\lvert t^*_{2\%} \rvert$
USA	throughput	τ_t	-0.25	-1.59	32%	insignificant	$e_t\tau_t$	-2.86	**-11.21**	67%	BEST	244	2.34
	(1953, 1Q - 2014,3Q) 247 obs	τ^2_t	0.38	2.59			$e_t\tau^2_t$	6.69	**14.98**		MODEL		
	capacity	κ_{t-6}	-1.27	-2.85	24%		$e_{t-7}\kappa_{t-7}$	-2.40	-4.12	69%		182	2.35
	(1966, 4Q - 2014,3Q) 192 obs	κ^2_{t-6}	0.96	3.42			$e_{t-7}\kappa^2_{t-7}$	3.79	5.43				
	employment	λ_{t-7}	3.56	0.44	4%	meaningless	$e_{t-8}\lambda_{t-8}$	2.00	1.04	35%	meaningless	236	2.34
	(1953, 1Q - 2014,3Q) 247 obs	λ^2_{t-7}	-2.07	-0.48		(coeff signal)	$e_{t-8}\lambda^2_{t-8}$	-1.61	-0.79		(coeff signal)		
France	**throughput**	τ_t	-24.60	-8.10	43%		$e_t\tau_{t-4}$	-14.70	**-10.6**	**41%**	BEST	**220**	**2.34**
	(1958, 1Q - 2014,3Q) 227 obs	τ^2_t	36.80	8.37			$e_t\tau^2_{t-4}$	41.60	**11.0**		MODEL		
	capacity	κ_{t-4}	-0.11	-0.04	7%	insignificant	$e_{t-4}\kappa_{t-4}$	-3.71	-1.94	14%	insignificant	148	2.35
	(1976, 1Q - 2014,3Q) 155 obs	κ^2_{t-4}	0.29	0.16		coefficients	$e_{t-4}\kappa^2_{t-4}$	4.57	2.06		coefficients		
	employment	λ_{t-7}	41	6.90	50%	meaningless	$e_{t-7}\lambda_{t-7}$	-12.04	-9.70	49%	2nd best	149	2.35
	(1975, 1Q - 2014,3Q) 159 obs	λ^2_{t-7}	-21	-6.80		(coeff signal)	$e_{t-7}\lambda^2_{t-7}$	12.93	9.90		model		
UK	**throughput**	τ_t	0.41	**4.00**	**53%**	meaningless	$e_{t-3}\tau_{t-3}$	-1.74	-12.34	**50%**	BEST	**213**	**2.34**
	(1960, 1Q - 2014,3Q) 219 obs	τ^2_t	-0.14	**-1.90**		(coeff signal)	$e_{t-3}\tau^2_{t-3}$	2.85	14.02		MODEL		
	capacity	κ_{t-9}	-3.00	-3.08	8%		$e_{t-2}\kappa_{t-2}$	-1.43	-4.95	14%		115	2.36
	(1984, 4Q - 2014,3Q) 120 obs	κ^2_{t-9}	1.91	3.12			$e_{t-2}\kappa^2_{t-2}$	1.75	4.96				
	employment	λ_t	-10.43	-1.38	1%	insignificant	$e_{t-6}\lambda_{t-6}$	-1.35	-1.64	1%	insignificant	210	2.34
	(1960, 1Q - 2014,3Q) 219 obs	λ^2_t	5.47	1.36		coefficients	$e_{t-6}\lambda^2_{t-6}$	1.44	1.67		coefficients		
Canada	**throughput**	τ_t	73.45	2.35	7%	meaningless	$e_t\tau_t$	-688.84	-9.03	**30%**	BEST	**240**	**2.34**
	(1954, 1Q - 2014,3Q) 243 obs	τ^2_t	-37.98	-2.12		(coeff signal)	$e_t\tau^2_t$	908.28	9.46		MODEL		
	capacity	κ_{t-3}	-421.87	-1.90	2%	insignificant	$e_{t-3}\kappa_{t-3}$	-838.68	-1.88	1%	insignificant	205	2.34
	(1962, 1Q - 2014,3Q) 211 obs	κ^2_{t-3}	267.22	1.95		coefficients	$e_{t-3}\kappa^2_{t-3}$	992.47	1.87		coefficients		
	employment	λ_{t-1}	62.32	0.10	1%	meaningless	$e_{t-1}\lambda_{t-1}$	-2473.03	-2.88	3%		236	2.34
	(1954, 4Q - 2014,3Q) 240 obs	λ^2_{t-1}	-24.45	-0.07		(coeff signal)	$e_{t-1}\lambda^2_{t-1}$	2679.73	2.89				
Japan	throughput	τ_{t-6}	-0.15	-0.1	5%	insignificant	$e_{t-5}\tau_{t-5}$	-2.27	-8.61	59%		128	2.36
	(1980, 4Q - 2014,3Q) 136 obs	τ^2_{t-6}	0.18	0.91		coefficients	$e_{t-5}\tau^2_{t-5}$	5.51	10.03				
	capacity (output gap)	κ_t	-0.85	-2.30	2%		$e_t\kappa_{t-3}$	-0.64	-1.84	17%		157	2.35
	(1974, 1Q - 2014,3Q) 163 obs	κ^2_t	0.49	2.36			$e_t\kappa^2_{t-3}$	1.20	2.84				
	employment	λ_{t-2}	-123.80	-4.99	78%		$e_{t-2}\lambda_{t-2}$	-4.85	**-10.65**	**45%**	BEST	221	2.34
	(1958, 1Q - 2014,3Q) 227 obs	λ^2_{t-2}	65.10	5.09			$e_{t-2}\lambda^2_{t-2}$	5.11	**10.80**		MODEL		
Germany	throughput	τ_t	-3.67	-5.90	51%		$e_t\tau_t$	-4.08	-7.56	**57%**	BEST	**31**	**2.45**
	(1991, 4Q - 2014,3Q) 92 obs	τ^2_t	4.35	6.26			$e_t\tau^2_t$	10.00	9.11		MODEL		
	Capacity	κ_{t-6}	-0.10	-0.15	0%	insignificant	$e_{t-6}\kappa_{t-6}$	-0.26	-0.80	0%	insignificant	31	2.45
	(1991, 4Q - 2014,3Q) 92 obs	κ^2_{t-6}	0.08	0.19		coefficients	$e_{t-6}\kappa^2_{t-6}$	0.34	0.90		coefficients		
	employment	λ_{t-7}	-12.80	-2.35	16%	insignificant	$e_{t-7}\lambda_{t-7}$	-0.26	-3.08	10%		28	2.47
	(1991, 4Q - 2014,3Q) 92 obs	λ^2_{t-7}	7.10	2.40		coefficients	$e_{t-7}\lambda^2_{t-7}$	2.80	3.12				
South Korea (annual data)	**throughput**	τ_t	-0.09	1.04	23%	insignificant	$e_{t-1}\tau_{t-1}$	-2.74	-6.33	**62%**	BEST	**30**	**2.46**
	(1976 - 2013) 39 obs	τ^2_t	0.16	-0.69		coefficients	$e_{t-1}\tau^2_{t-1}$	3.30	7.90		MODEL		
	capacity (output-gap)	κ_{t-1}	19.78	0.99	-3%	meaningless	$e_{t-1}\kappa_{t-1}$	-1.71	-0.59	4%	insignificant	30	2.46
	(1976 - 2013) 35 obs	κ^2_{t-1}	-10.05	-1.00		(coeff signal)	$e_{t-1}\kappa^2_{t-1}$	1.49	0.51		coefficients		
	employment	λ_t	-128.88	-2.43	15%	insignificant	$e_{t-3}\lambda_{t-3}$	-5.91	-1.44	-5%	insignificant	28	2.47
	(1976 - 2013) 35 obs	λ^2_t	67.62	2.44		coefficients	$e_{t-3}\lambda^2_{t-3}$	6.17	1.43		coefficients		

__Table 2__ : **"Marxian-Classical" DP-SR Inflation Model Test Results**

QUARTERLY DATASET:

			$e_t\tau_t$	$e_t\tau^2_t$	$e_{t-4}\tau_{t-4}$	$e_{t-4}\tau^2_{t-4}$	$e_{t-5}\tau_{t-5}$	$e_{t-5}\tau^2_{t-5}$	Dummies	DF	Adj R^2
USA	ECM (Long Run)	coefficient	-2.863	6.685							67%
sample size: 247 obs		t-statistics	-11.21	14.98						244	
from 1953,1Q	Complete Model	coefficient	-2.902	6.565					Int'l Commodity Deflation; 1st & 2nd Oil Shocks; Exchange Rate (dollar appreciation).		88%
to 2014, 3Q		t-statistics	-18.45	23.94						242	
Canada	ECM (Long Run)	coefficient	-374.6	505.9	-502.7	685.9					47%
sample size: 239 obs		t-statistics	-5.3	5.65	-7.16	7.7				234	
from 1954,1Q	Complete Model	coefficient	-329.1	455.2	-573.3	788.7			Banking broken series (1957); Commodity Int'l deflation, 1st & 2nd Oil Shocks; sub prime crisis		81%
to 2014, 3Q		t-statistics	-7.3	7.88	-13.21	14.23				210	
France	ECM (Long Run)	coefficient	-14.7	41.6							41%
sample size: 227 obs		t-statistics	-10.6	11.0						224	
from 1958,1Q	Complete Model	coefficient	-3	9.9	-11.2	32			1958/9 Exchange Rate Devaluation, 1st & 2nd Oil Shocks; Banking broken series (1978); Capital Flight w/ Mitterand Election(1981)		78%
to 2014, 3Q		t-statistics	-2.4	2.83	-9.05	9.4				210	
UK	ECM (Long Run)	coefficient	-0.696	1.214	-1.263	2.041					56%
sample size: 215 obs		t-statistics	-3.84	4.53	-7.06	7.65				206	
from 1960,1Q	Complete Model	coefficient	-0.47	0.836	-0.957	1.57			1st & 2nd Oil Shocks; Int'l Commodity Deflation; "Black Wednesday"; DotCom bubble		88%
to 2014, 3Q		t-statistics	-4.83	5.8	-9.67	10.42				202	
Japan	ECM (Long Run)	coefficient					-2.265	5.508			59%
sample size: 131 obs		t-statistics					-8.6	10.03		123	
from 1980,4Q	Complete Model	coefficient					-2.293	5.531	2nd Oil Shock; broken data; Asian crisis (1997/8); Subprime; wages		75%
to 2014, 3Q		t-statistics					-10.93	12.64		117	
Germany	ECM (Long Run)	coefficient	-4.08	9.998							57%
sample size: 92 obs		t-statistics	-7.56	9.11						89	
from 1991,1Q	Complete Model	coefficient	-3.766	9.366					German Unification; Exchange rate appreciation		77%
to 2014, 3Q		t-statistics	-8.1	9.57						83	

ANNUAL DATASET:

			$e_{t-1}\tau_{t-1}$	$e_{t-1}\tau^2_{t-1}$	Dummies	DF	Adj R^2
South Korea	ECM (Long Run)	coefficient	-2.738	3.296			62%
sample size: 39 obs		t-statistics	-6.33	7.9		34	
1976 - 2009	Complete Model	coefficient	-2.429	3.067	1st & 2nd Oil Shocks; Asian crisis (1997/8);Dot com bubble		88%
		t-statistics	-8.7	12.03		32	