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## Innovation and Redistribution as Global Markets Drivers: Some Options of Economic Modeling

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### Abstract

Growing literature considers inequality would drag effective demand in the global markets. This would thus be an important causation factor of the current crisis, while the debate remains open. The analysis considers hidden dynamics would tend to hide such causation in the current macroeconomic representation. The purpose is to propose an alternative framework intended to contribute in considering these hidden dynamics. This uses total factor productivity and the level of inequality as macroeconomic factors of production and demand, rather than capital and labor. A graphic geometrical multidimensional representation on a two dimensional plane allows depicting and proposing some options of equations for modeling these dynamics.

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### Introduction

While Atkinson and Morelli (2011) fail to find a relation between inequality and crises, Brown (2004) highlights that “Income distribution does play a role in theories of consumption authored by economists affiliated the Cambridge or Post Keynesian school”. Evidence from Brown’s “article suggests that income inequality can exert a significant drag on effective demand”. Hartwig (2014) tests the post-kaleckian Bhaduri-Marglin model (1990) finding that concentration of productivity gains in profits reduces demand growth on average in OECD countries, slowing productivity growth. Brown (2004) also highlights the widening of the credit availabilities that augments “the spending power of moderate and low-income groups” with an effect “comparable to a decrease in income

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inequality”. Thus “the aggregate propensity to consume can remain stable, or even increase, amidst a sharp increase in income inequality—given a sufficient surge in borrowing”. Dynan, Mian, and Pence (2012) calculate estimates providing evidence that the spending of households who had borrowed large amounts has been especially weak compared with other households. Cynamon and Fazzari (2014) indicate that the bottom 95 percent “lost out to rising inequality” and “raised the leverage” masking “the demand drag caused by rising inequality”. This is the group needing deleveraging, which reduces then consumption. The hypothesis is that: a) the modern mainstream macroeconomic models fall short from adequately representing the inequality dynamics empirical data thus impeding a clearer answer to the debate; b) there would be hidden dynamics that partially cancel out and/or delocalize to be represented in an alternative way; c) such representation would in addition need to analyze how to use empirical data. Point (b) has been analyzed in previous research as in Benazzo (2010, 2013), with a dual economy. This provides theoretical arguments in line with the Post-Keynesian school about a negative effect of increased inequality on effective demand. The point (c) is beyond the scope of these pages. This research addresses point (a) investigating an alternative for integrating inequality within the macroeconomic models.

## 1. From means to ends, rather than from inputs to outputs

### 1.1. Dual economy referred to inequality

A dual economy (Fields, 2007, Gollin, 2014) framework is proposed. The two sectors in a dual economy have been defined in various ways (Fields, 2007). This includes ‘advanced’ compared to ‘backwards’ and ‘capitalist’ compared to ‘subsistence’. The same production that provides subsistence may also satisfy propensity to consume beyond subsistence, such as expensive restaurants, housing larger than needed or in expensive areas, clothing beyond the basic needs. The subdivision is thus referred to the demand side of consumption detaching from a particular production sector in the supply side. The advances of productivity brought by modernization allow additional supplies beyond subsistence. The dual economy sectors are thus here defined as subsistence and advanced sectors. With the simplifying assumption of absence of famine and extreme poverty, all would satisfy subsistence needs equally, thus inequality would need to be measured in the advanced sector alone. Circumscribing inequality to this latter sector alone defines here the two sectors of the economy, rather than different access to capital (Lewis, 1954) or difference of inequality in the level of wages between the two sectors (Kuznets, 1955) .

### 1.2. Total factor productivity (TFP) growth on the supply side

The economy considered starts from subsistence, without an advanced sector, i.e. without surplus. Assumptions are: (i) the ecological footprint is a constant proportion of each unit of output; (ii) initially, the economy is closed, without possibility of changing the terms of trade or delocalizing. Hulten (2001) highlights  $S_t$  in equation (1) as growth of output  $Q$  at constant prices  $p_0$ ,  $w_0$  of labor ( $L$ ) and  $r_0$  of capital ( $K$ ) due to productivity growth. This starts from time=0, here considered subsistence economy, until time= $t$  where a surplus achieves an advanced sector:

$$p_0 Q_t = S_t(p_0 Q_0) = S_t[w_0 L_t + r_0 K_t] \quad \text{where} \quad p_0 Q_0 = 1[w_0 L_0 + r_0 K_0] \quad \text{with} \quad S_{t+1} > S_t > 1 \quad (1)$$

Hulten (2001) reminds that gains from innovation often arrive from better goods and services, rather than more, and that measuring this correctly is challenging. As Hulten mentions, Krugman (1994) recalls that economic growth “based on expansion of inputs, rather than on growth in output per unit of input, is” “subject to diminishing returns.” Krugman exemplifies that “A man with a bulldozer can dig a ditch faster” than with a shovel without being more efficient. However two bulldozers per worker show diminishing returns. Krugman (1994) defines TFP as the “continual rise of national income for each unit of input” and by large as the main determinant of growth in the long run. The shovel is also capital and previous productivity surpluses must have allowed producing some other tools, i.e. capital, to produce it. Productivity of capital then allows passing from the shovel, to the bulldozer, to other more efficient tools. Hulten (2001) notes the neoclassical growth models provide that in steady-state growth, the exogenous technical change augments the output thus expanding the endogenous stock of capital. Hence, “all capital accumulation and output growth are due to TFP”. New growth models introduce innovation as an endogenous

characteristic of capital. They thus require increasing returns to scale rather than diminishing returns to capital in the production function. Empirical research using different approaches is bound to give different results (Hulten, 2001). The alternative paradigm analyzed here is close to the neoclassical approach. It proposes to consider TFP growth (TFPG) rather than capital as determinant of growth and as macroeconomic production factor. It goes directly from TFPG, considered as means, to production, i.e. the ends, without mentioning explicitly capital and labor as inputs. These latter reflect cumulative stock of constantly regenerating level of productivity. Changes in the ration between capital and labor that expand output by leveraging their relative productivity are considered productivity growth. History has shown that income inequality affects the supply side through the incentives to use the full human capital potential. Inequality is here also considered to affect the demand side, such as with Hartwig (2014) and Cynamon and Fazzari (2013).

### *1.3. Decreasing marginal utility of consumption on the demand side and an inequality trap*

Stockhammer (2013) argues that causes of the current crisis are financial deregulation and rising inequality. Benazzo (2013) presents an inequality trap, somehow differently: (1) When TFPG is distributed in the same percentage to all incomes and wealth levels, it augments the aggregate demand evenly, generating inflation in both sectors. Supply adapts generating deflation, thus rebalancing. (2) When TFP gains accrue instead mostly to top income and wealth agents, inequality increases as in the last decades (Atkinson and Piketty, 2007 and 2011). (3) Stake-holders of the TFP gains have quite an even price elasticity of demand in both sectors. Stockhammer (2013) considers increasing inequality reduces marginal propensity to consume (MPC). This agrees with decreasing marginal utility of consumption. This augments aggregate demand in both sectors less than what TFPG would allow, generating relative deflation in term of higher real purchasing power for the affluent. (4) The other economic agents experience prices increases that are out of reach to their sluggish nominal income, generating relative inflation. They have low price elasticity of demand in the subsistence sector and thus are forced into high price elasticity of demand in the advanced sector, where they reduce demand. Amartya Sen (1981) describes how in 1943 in Bengal barriers determined a very low price elasticity of supply. An increase in income for a small part of the population increased their demand and prices for basic foodstuff more than tripled that year, generating a tragic famine. Normally supply is more elastic thus the increase in prices in the subsistence sector becomes less dramatic however still present. (5) In the continuous rebalancing of supply and demand of (1), due to (2), (3) and (4), the subsistence sector inflates with respect to the advanced sector, while the economy grows less than potential. (6) Housing is a large part of the subsistence sector in developed economies and is less subject to delocalization. Delocalization may contribute to reduce prices, augmenting real purchasing power and in addition more in the advanced sector than in the subsistence sector, thus rebalancing somehow the dynamic (5), however it keeps or pushes down wages and/or generates unemployment. (7) Eventually the nominal value of the advanced sector diminishes to a level requiring unfeasible accelerating TFPG and delocalization to counterbalance. (8) Decreasing MPC augments the marginal propensity to save (MPS) increasing the demand of financial market instruments and thus their valuations. However demand decelerates increasing less than potential, thus these values should rather decrease because their net present value diminishes. A financial bubble generates. (9) Interest rates decrease and financial deregulation augments the credit availability to households, as the advanced sector grows less and needs less credit. Deregulation would thus be largely consequence of increasing inequality (Benazzo, 2010). (10) Savings placed in the enlarging subsistence sector have comparably better, or less grim, net present value perspectives, thus the financial bubble moves to the real estate market. (11) Increased houses prices further inflate the subsistence sector, exacerbating the dynamic into an involution cycle. Moderate inequality is as such considered a major determinant of employment and output. Modern standard macroeconomic policy has both employment (labor) as an output objective and labor (employment) as an input in the equations, thus posing a philosophy of science dilemma. As solution to this, the herewith paradigm proposes to use the level of inequality as macroeconomic production factor, rather than labor.

1.4. An alternative graphic representation of a dual inflation economy and options of equations

In the alternative paradigm, the income/production is as such determined by three variables: (i) the TFP level; (ii) the effect of inequality level on TFP from the supply side; plus (iii) the effect of inequality on demand from the demand side. In addition, inequality would need to be represented in two ways, both on the economy as a whole, and only on the advanced sector where it actually occurs. Population count and income/output would also need to be represented. To represent on a plane these multidimensional interactions, they are subdivided in interlaced sub-groups, each one in a two dimensional Cartesian graph. The axes of the plane, to remind multidimensionality are called u and z, rather than x and y. The origin 0,0 is common. A closed economy is considered in these formulations.

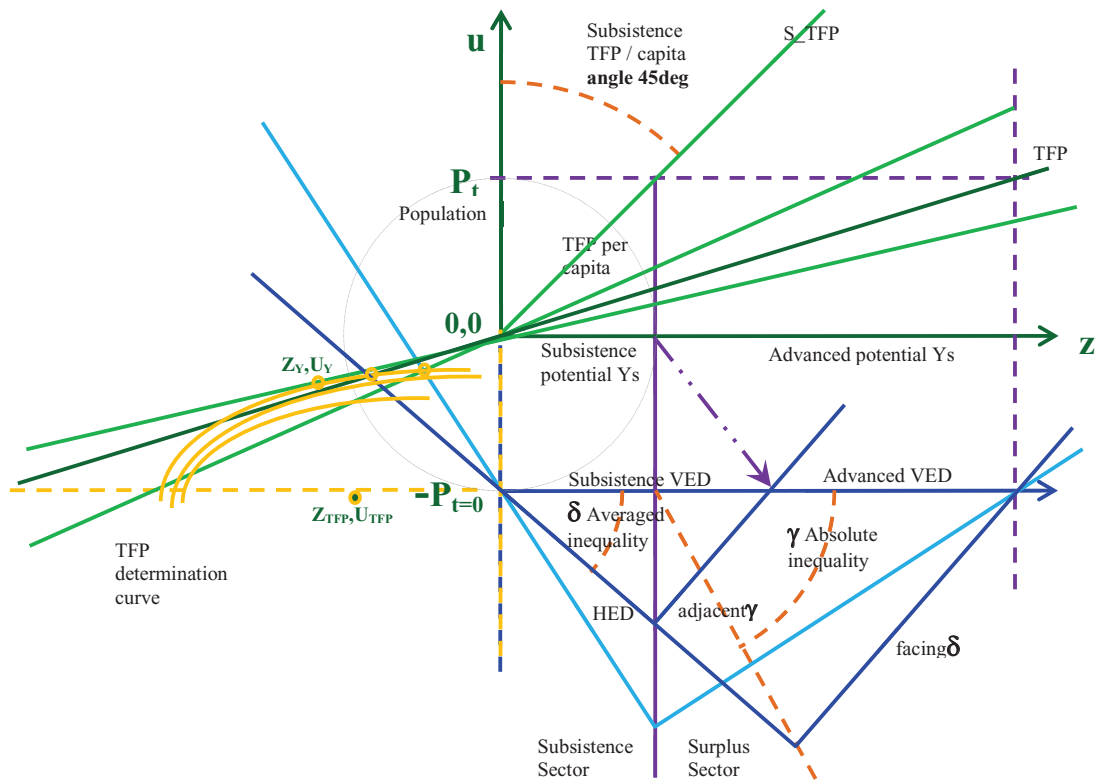


Fig. 1. Representation of TFP and inequality as macroeconomic production factors

The Gini coefficient averages together the subsistence and the advanced sectors, and could be represented in quadrant II, by the angle  $\delta$  and its blue line HED steeping downwards, representing Hidden Effective Demand at  $p_0$ .

$$\text{Angle of averaged inequality in degrees} = \delta = f(\text{Gini}) \tag{2}$$

$$\text{Examples are } \delta = \frac{\text{Gini}}{100} * 90 \quad \text{or} \quad \delta = \frac{\sqrt[2]{\text{Gini}}}{\sqrt[2]{100}} * 90 \quad \text{or} \quad \delta = \frac{\text{Gini}^2}{100^2} * 90 \tag{3}$$

Or other equations and/or parameters that would provide the appropriate transformation of the Gini coefficient or other inequality measure into an angle from 0 to 90 degrees. The proposed equation of HED is:

$$f(z) = u = -P_{t=0} + z * \tan(\text{radians}(\delta)) \quad \text{intersecting the axis u conventionally at } -P_{t=0} \tag{4}$$

This intersects the TFP determination curve in quadrant III, which could relate to capital accumulation, e.g. as its proxy, and possibly to other institutional and cultural factors. Its curvature represents how extremely low (absent incentives) or very high inequality (fostering what Caselli and Gennaioli (2013) call dynastic management) reduces TFP from the supply side due to inefficiencies. This curve could be represented by the upper part of an ellipse:

$$u = \sqrt{\left((c)^2 - (z + Z_{TFP})^2 * \left(\frac{b}{a}\right)^2\right)} - U_{TFP} \quad (5)$$

Where 'a' and 'b' are the semi-major and semi-minor axes and 'c' the scale. An alternative could be:

$$u = az + (b - cz)\log_d(z + Z_{TFP}) - U_{TFP} \quad (6)$$

Its shape could be approached by the following parameters interrelation to be scaled together appropriately:

$$u = 0.12z + (0.3 - 0.1z) * \log_3(z + Z_{TFP}) - U_{TFP} \quad (7)$$

Equation n.6 is preferred, as it looks the simplest to configure. Another representation of such curve could be:

$$u = az - b(1/(z + Z_{TFP})) - U_{TFP} \quad (8)$$

Eq.n.4 intersects twice this eq.n.8 curve, requiring an additional criterion and thus making it less handy.

Where a, b, c, d determine the shape, while  $+Z_{TFP}$  and  $-U_{TFP}$  the positioning from the common origin 0,0:

$$\text{TFP level and TFP sensitivity to inequality in eq. n.5, n.6 and n.8} = f(a, b, c, d, U_{TFP}, Z_{TFP}) \quad (9)$$

The TFP line for subsistence slopes at 45 degrees. Assuming eq. n.6 as the best choice, its intersection with eq. n.4 provides z and u coordinates,  $Z_Y$  and  $U_Y$ , for eq. n.10 of the TFP curve. This swivels with respect to inequality. The lowest slope determines the full potential output  $Y_s$  on the supply side. The u matches the total P (population).

$$z = u \left(\frac{Z_Y}{U_Y}\right) \quad \text{thus} \quad Y_s = P \left(\frac{Z_Y}{U_Y}\right) \quad (10)$$

Angle  $\delta$  influences potential production  $Y_s$  from the supply side, from quadrant II, through III and to I. The same angle determines in quadrant II how different levels of inequality would inflate the subsistence sector with respect to the advanced sector. It transforms the potential  $Y_s$  from the supply side of quadrant I in effective demand Y that determines the global markets on the demand side, on the line of Hidden Effective Demand (HED) in quadrant II. The geometry then projects HED in quadrant II into the Visible Effective Demand (VED) of global markets at  $p_i$ .

$$\text{Advanced VED} = Y_s - \text{Subsistence VED} = Y_s - \left(\frac{\text{Subsistence potential } Y_s}{\cos \delta * \cos \delta}\right) \quad (11)$$

The Gini coefficient averages the inequality-free subsistence sector with the advanced sector. Inequality confined to this latter is called here absolute inequality and is represented with the angle  $\gamma$ . This includes the effect of calculating inequality only in the advanced sector and the effect of demand drag from inequality. Trigonometry calculations are used. Relation with empirical data could need additional factors of transformation to derive  $\gamma$ .

$$\gamma = \arccos \frac{\text{AdvPot}Y_s^2 + \text{adjacent}_\gamma^2 - \text{facing}\delta^2}{2 * \text{AdvPot}Y_s * \text{adjacent}_\gamma} \quad \text{with} \quad \text{facing}\delta = Y_s * \sin(\delta) \quad (12)$$

$$\text{and with} \quad \text{adjacent}_\gamma = \sqrt{\text{AdvPot}Y_s^2 + \text{facing}\delta^2 - 2 * \text{AdvPot}Y_s * \text{facing}\delta * \cos(\pi - 0.5\pi - \delta)} \quad (13)$$

Further research should clarify which of these or other equations and parameters represent best the data. Additional research could introduce the ecological footprint and extend to an open economy.

### 1.5. Representation related to policy considerations

Cynamon and Fazzari (2014) identify policies they consider inadequate or at least doubtful. To solve these, they suggest reversing the inequality trend through (i) “robust after-tax wage growth across the income distribution” and (ii) a redistributive tax policy. As more attractive, they recall (iii) “the equality of real wage growth and labour productivity growth ... as a ‘golden rule’ for sustainable growth consistent with full (or even simply a constant rate of) employment.” Setterfield (2013) and Silos Labini (1981) analyzed such rule. The effect depends on how a decline in inequality augments domestic demand more than it reduces net exports (Benazzo, 2013). This would have a win-win effect even for the affluent, whose recovery of wealth long-term real valuations netted of financial bubbles virtual effects could outgrow the additional taxes, wage levels and other gains to the middle class and poor.

### Concluding remarks

A multidimensional geometry of three frames of reference on a flat plane represents TFP and the inequality level as macroeconomic production factors, in place of capital and labor. Options of equations describe the interactions in the geometry. These are in agreement with an analysis of economic policy recommendations to exit the crisis. They compel decreasing inequality for reinstating the domestic income real purchasing power in the advanced sector.

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