Real exchange rate, distribution and macro fluctuations in export-oriented economies*

Massimiliano La Marca†

October 30, 2008

Abstract

The paper investigates the emergence of alternative distributional and real exchange rate patterns as outcome of institutional and socioeconomic interactions between broadly defined actors in an open economy. The focus is on both the long-run configuration and short-run dynamics of real exchange rate, the profit and wage shares, output growth, capacity utilization, and net foreign asset accumulation in a stock-flow consistent framework with fiscal polices affecting the internal and external equilibrium. Fluctuations in output and distribution between income shares and the real exchange rate are obtained via Structuralist-Goodwin dynamics.

Keywords: Equilibrium real exchange rate, income distribution, Structuralist-Goodwin cycles, net foreign assets.

JEL Classification Numbers: B50, E11, E12, E25, E32, F43.

1 Introduction: Identities, causality and fluctuations

How can cyclical fluctuations in capacity utilization, distribution and current account be generated in a growing open economy? What is the role of net foreign assets and interest flows on the current account and aggregate demand dynamics? Are social relations relevant in the determination of the distribution, real exchange rate, capital and net foreign asset accumulation and output? How does the macroeconomic structure, shaped by the existing institutions, affect the social interaction and sectors' behaviour and lead to alternative economic outcomes? The paper aims at providing a framework to answer these and closely related questions emphasizing the role of macroeconomic structure on the decision of economic actors grouped into broadly defined sectors.

Any theory of open economy macroeconomics that aims at explaining the determination of internal and foreign balances has to *(i)* define the characteristics of the labor- and product-market equilibrium, *(ii)* identify the ultimate determinants of national aggregate savings σ, of the current account κ, and of domestic investment g, *(iii)* identify the causality nexus in the determination of the macro equilibrium condition $\sigma - \kappa - g = 0$,

*I would like to thank Duncan Foley and Lance Taylor and two anonymous referees; the usual caveat applies. The views expressed here are those of the author and do not necessarily reflect those of UNCTAD

†United Nations Conference on Trade and Development UNCTAD, Division of Globalization and Development Strategies. Palais des Nations, 8-14 Av. de la Paix, 1211 Geneva 10, Switzerland. Massimiliano.La.Marca@Unctad.org

and, therefore, *(iv)* define the role of the real exchange rate in the adjustment process. Current account, output, and real exchange rate fluctuations have been explained by a variety of adjustment mechanisms underlining alternative views on *(i)* to *(iv)*.

Many supply-driven open economy macro models explain macroeconomic fluctuations as the optimal response of domestic saving and external borrowing to productivity and shocks in the world interest rate and other international prices. The "intertemporal approach to the current account," for instance, extends the general-equilibrium/comparative advantage principle to the open economy macroeconomics. It typically assumes full-employment resource-determined output and marginal productivity-pricing for income distribution, which determines investment and its fluctuations. The current account is obtained passively by the intertemporal optimal determination of national savings σ and investment g. If the income generated with the use of scarce resources is profitably used either as current expenditure or exchanged for "future expenditure" to foreign borrowers, current account imbalances are the intentional device of the individualistic rationally-behaving country for allocating and smoothing consumption over time. This implies income and spending "desired misalignments"can be allowed by trade. External balance cycles are therefore explained as the outcome of intentional expenditure reallocations across countries as a device for buffering exogenous technological and wealth shocks and exploit the comparative advantages of the relative cost of consumption at different time periods. In those intertemporal models, institutional and socioeconomic interactions within the country are notably ruled out, as well as the role of the exchange rate and its role in shaping competitiveness between similar goods and the pattern of trade.[1]

However, real exchange rate changes, "expenditure change" and "expenditure switching" led by price differences in traded goods and internal relative prices have remained over time both a source of concern for policy makers and topical issues in policy debates. Wage determination and and firms' profitability are seen as critical factors for a country competitiveness, incentive to invest and accumulate productive capacity.

These issues can been sensibly addressed by including in the theoretical framework the complex interactions of economic groups such as workers, firms and shareholders, as shaped by the ruling institutional set up.[2]

Profitability and distribution have a fundamental role on macroeconomic performances by affecting investment decisions, the determination of demand composition via differentiated saving behavior of households and firms, by affecting intermediate-input cost and net foreign assets revenues via real exchange rate determination, and by affecting the labor market and labor productivity. Distribution is a fundamental determinant

[1]The empirical applicability of the intertemporal approach proved to be problematic as well: the law of one price unambiguously does not hold in the short to medium run (Rogoff, 1996) and therefore there is no effective arbitrage mechanism ruling out price effect on competitiveness and trade. Moreover, the consumption smoothing hypothesis seems to strongly underestimate current account fluctuations (a survey of some tests of the stochastic current account model in Obstfeld and Rogoff, 1995 and 1996).

[2]Dropping the assumption of the representative agent's MIRA behavior allows us to take into consideration the complexity of economic systems as the outcome of the composition of different - at times contrasting - forces, which do not lead to full exploitation of economic opportunities due to lack of structured information and foresight and persistence of conventional behavior. The failure of market participants to coordinate and clear markets in a Walrasian fashion brings to the fore the role of the aggregate demand and the independence of savings and investment decisions. The centrality of profitability in investment and the imperfection of good markets give prominence to the Keynesian-Kaldor-Kaleckian tradition of independent investment function and markup pricing.

of internal and external balance and has a characteristic trait of confliction. Wages can be a device for labor extraction given the level of economic activity and employment as in the neo-Marxian conflict view of wage setting of (e.g. Bowles and Boyer, 1988), a production cost affecting prices and international competitiveness as in the structuralist tradition (e.g. Taylor, 1991 and 2004), a source of direct and indirect aggregate demand through consumption, investment and net export as in the Kalckian and Kaldorian tradition (e.g. Bhaduri and Marglin, 1990) leading to the profit-led (exhilarations) and wage-led (consumptionist) regimes. Its multiple role and conflictive nature can lead to the emergence of cycles in the closed as well as in the open economy. With mark-up pricing depending on exports price elasticity and with intermediate inputs and commodities as imports, the real exchange rate becomes a distributive variable that crucially feeds back onto both internal and external balances.

The emphasis on the role of institutions in determining the various alternative pricing mechanisms and equilibrium determination in the product, labor and asset market does not imply an unique way to deal with points *(i)-(iv)*. In particular, the distributive, output and current account cycles arising from non-clearing in the labor market, distributional conflict, non-marginal productivity pricing and effects on growth of distribution, may be generated under different causal relations between the macro equilibrium components, g, σ and κ, that can depend on prevailing specific features of the economy under consideration.

In his seminal paper Goodwin (1967) explained endogenous cycles in distribution and economic activity as a wage share/employment rate symbiotic predator-prey dynamics in a closed saving-determined growing economy. Adapting this relation to a Keynesian-structuralist framework, Barbosa-Filho and Taylor (2005) and Taylor(2004) find that an analogous dynamics between wage share and the capacity utilization can emerge in a demand-driven closed economy. At the core of the Goodwin cycles there are a "economic activity curve," and a "distributional curve", which respectively become an "effective demand" and "distributional relation" in the Keynesian adaptation.

The following model focuses on the determination of output, distribution and real exchange rate in an open economy and allows for macro fluctuations extend the Structuralist-Goodwin results to the open economy. We specify a labor extraction process and firms' pricing behaviour that shape the distributional conflict and price-competitiveness effect on trade in the short and long run. The capital and foreign asset accumulation process is integrated with the endogenous distributive dynamics in a stock-flow consistent framework a' la Foley and Taylor (2006). Modeling countries as systems of interacting actors gives rise to a complex macroeconomic scenario, where existing institutions, though allowed to recede on the background, are the source of alternative macroeconomic structures and the consequent alternative dynamics in distribution, trade and output leading to different economic pattern. The model aims at capturing some structural characteristics of emerging market countries. By definition, emerging economies enjoy access to the foreign capital, but typically most of their foreign assets and liabilities are denominated in foreign currency. The external sector is crucial for demand expansion and investment and, excluding energy and other commodity exporting economies, emerging market economies trade some manufactures against a large range of competitive consumer goods as well as commodity, energy and manufactured intermediate and capital goods with a relatively low substitutability with domestic ones. Government borrowing has been important in the past but its relevance has been declining more recently as financial openness and

the relative development of the financial system allows for direct borrowing and lending of the private sector. However, emerging markets financial systems and institutions are such that consumers and investors do not seem to borrow against future income and retained earnings are a still a crucial source of finance for firms. Despite the generality of the model we restrict the analysis to limit the possible scenarios that can emerge in the determination of the equilibrium and stability. We assume that government debt is negligible and, as the model is specified in real terms, we abstract from monetary policies. We further focus on an economy that heavily relies on net "competitive" exports whose price elasticity can be large and relies as well on rigid imported intermediate goods or commodities. We may think of an "export-oriented" emerging market economy such as an East Asian fast industrializing economy whose sustained growth has led to an increasing degree capacity utilization and wage pressure, leading to a substantial tendency toward real appreciation. Such an "export oriented" economy tends to run trade surpluses and, in the longer run, tends to have net foreign assets or small net foreign liabilities.

The paper is organized as follows. Section 2 describes our main modeling components: a labor discipline real wage setting adapted from Bowles and Boyer (1988, 1989); a mark-up pricing and distributional trade-off between wages, profits and the real exchange rate that characterizes the structuralist tradition; a Keynesian investment function, the emergence of wage- and profit-led regimes, and a stock-flow consistent sets of accounts. These Structuralist-Goodwin cycles are sustained by capacity utilization and distributional dynamics and can be generated under alternative closures between g, σ and κ, such as a residually determined current account or a passively determined savings. We explore the first possibility: the current account fluctuates around a long-run trend that depends on more structural net exports and foreign assets revenues. This implies that in the short run the saving-investment gap induced by distribution and output cycles dominates the current account determination, while competitiveness and net exports coefficients determine both its short-run composition and its longer-run determination.

In Section 3, the complex nonlinear dynamics of real exchange rate capacity utilization, distribution and foreign net asset position is explored showing how the distribution and aggregate demand predator-prey dynamics determine macro oscillation.

Section 4 draws some conclusions.

2 The Model

Aggregate production X requires capital K, labor L, and imported intermediate and commodity inputs as a fraction a of total output, aX. Technology is given and coefficients are fixed, therefore the output/capital ratio $u \equiv X/K$ can be used as an index of capacity utilization.[3]

There are four institutional sectors: households, firms, the government and the foreign sector (or ROW); and three assets: productive capital, equities, and net foreign assets (net foreign liabilities, if negative). The balance sheets of the three sectors are reported in table 1, while table 2 is the social accounting matrix, SAM, in real terms. In table 1,

[3]We use the output capital ratio u as proxy for the capacity utilization, X/Q. The latter is the ratio of *effective*, X, to *potential* output, Q, allowed by the existing capital and a given capacity-capital ratio Q/K. Since the effective to potential output ratio, X/Q, is the product of the output capital ratio, u, and the fixed coefficient, Q/K, the determination of the degree of capacity utilization can be simply described by the determination of u.

total assets correspond to the sum of total liabilities and net worth of each sector, which is denoted by Ω. Households, firms, the government and ROW are denoted by the h, b, g and f subscripts, respectively. In table 2, the sum of the elements of a row corresponds to the sum of the elements of the corresponding column. Most of our model relations are consistently derived from this accounting framework and will be explained in the present and following sections.

TABLE 1
BALANCE SHEETS

Households (HH)		Firms		Foreign (ROW)	
$p_E E$	Ω_h	K	$p_E E$	$-\xi B$	Ω_f
		ξB	Ω_b		

TABLE 2
SOCIAL ACCOUNTING MATRIX (SAM)

	Output Cost(1)	HH. (2)	Firms (3)	Gov. (4)	ROW (5)	Cap. (6)	Equit. (7)	Bonds (8)	Tot. (9)
(A) Output		C_h		G	χK	gK			X
Incomes									
(B) HH.	ψX		D_b						Y_h
(C) Firms	πX				$j\xi B$				Y_b
(D) Gov.		T_h	T_b						Y_g
(E) ROW	$\xi a X$								Y_f
Flows of Funds									
(F) HH.		S_h					$-p_E\dot{E}$		0
(G) Firms			S_b			$-gK$	$p_E\dot{E}$	$-\xi\dot{B}$	0
(H) Gov.				(S_g)					0
(I) ROW					(S_f)			$\xi\dot{B}$	0
(J) Tot.	X	Y_h	Y_b	Y_g	Y_f	0	0	0	

Define ψ as the wage share, π as the profit share, ξ as the real exchange rate and j as the real return on net foreign assets or liabilities. Households own firms through equities E whose unit price, p_E, is determined as the present value of firms net profits (table 1, households account). They consume C_h, pay T_h as taxes to the government and save S_h out of total income, Y_h, which comprises wages ψX, and dividends D_b (column 2 and row B, table 2). Savings are used to buy new equities $p_E\dot{E}$ (row F, table 2). A productive sector called "Firms"includes industrial enterprises and the domestic financial sector. They can invest abroad in the form of portfolio investment, loans, FDIs or liquid assets such as deposits or any kind of foreign currency reserve. They can conversely have net foreign liabilities denominated in foreign currency (table 1, firms account). The economy is a net "foreign creditor"or a "foreign debtor"if B is positive or negative, respectively (table 1, ROW account). Firms can finance new real investment and new foreign investments $\xi\dot{B}$ through retained earnings S_b and by issuing new equities $p_E\dot{E}$. Retained earnings, S_b, and dividends, D_b, are assumed to be proportional to business income, Y_b, net of taxes T_b (column 3 and row C, table 2). Firms can pay back loans

and equities (negative $\xi\dot{B}$ and $p_E\dot{E}$). Therefore, net transactions with the "Foreign"or "ROW"sector reflect misalignments between national expenditure and income and lead to an increase in net foreign assets, or reduction in foreign liabilities, if the economy is running a current account surplus and, conversely, an increase in net foreign liabilities, or a reduction net foreign assets, if the economy is running a deficit. A real exchange rate changes ξ lead to changes in net foreign assets valuation and consequently affect the determination of external and internal balances. Finally, the government sector collects taxes and uses the revenues for public expenditure balancing its budget: $T_h+T_b = Y_g = G$ and $S_g = 0$ (column 4, row D and row H, table 2).[4]

2.1 Labor discipline and distribution

The available technology requires a fixed amount of effective labor per unit of product $l \equiv L/X$. The employment rate $h \equiv H/N$ is the ratio of the total amount of worked hours (or hired workers) H and the "potential employment" N. The effectiveness of each work hour varies with the degree of "effort" ε exerted by workers, with $L \equiv \varepsilon H$. Labor productivity, $\varepsilon/l = X/H$, is therefore endogenous and varies with work effort.

We further assume, for simplicity sake, that employable working population grows with capital accumulation, so that $K/N = k$ is constant. This can be due to the strong direct relation between physical and human capital growth: capital accumulation is accompanied by the growth of the education and production-specific knowledge that restricts the employable population to N, which can diverge from actual work-age population. The employment rate is therefore a function of labor productivity and capacity utilization

$$h = \frac{H}{L}\frac{X}{K}\frac{L}{X}\frac{K}{N} = \frac{ulk}{\varepsilon}. \tag{1}$$

Our simplification allow us to define the two standard measures of economic activity, namely the employment rate, h, and the capacity utilization, u, as a function of each other and of the endogenous variation of work effort, ε.

2.1.1 Product market and distribution

Let us define w as the wage rate, e as the nominal exchange rate, $\bar{P}$ as the foreign good price. The wage share out of total output and the real exchange rate are $\psi \equiv wl/P\varepsilon$, and $\xi \equiv e\bar{P}/P$, respectively.[5]

Firms set prices charging a mark-up m over variable costs which include wages as well as imported intermediate inputs

[4]This last assumption allows us to investigate the effect of fiscal policy on aggregate demand without the need to analyse the dynamics of government debt. The model is completely specified in real terms, the economy is financially open and the real interest rate on external assets is exogenously given. Therefore is it possible to analyze fiscal policies explicitly while abstracting from monetary and nominal exchange rate policies.

[5]Given our assumption of a single (composite) consumption/investment domestic good and of a single (composite) foreign good, the natural definition for the real exchange rate is the price of the foreign output per domestic output units: a devaluation consists of a rise of foreign good prices in terms of the domestic ones.

$$P = (1+m)\left(\frac{wl}{\varepsilon} + e\bar{P}a\right), \tag{2}$$

Firms' profits are the residual of sales net of variable costs. We assume that capital is homogeneous and that prices of capital and consumption goods are uniform. The profit rate is

$$r = \frac{PX - \left(\frac{wl}{\varepsilon} + e\bar{P}a\right)X}{PK},$$

or

$$r = \pi u, \tag{3}$$

where $\pi \equiv m/(1+m) = m(\psi + \xi a)$ is the profit share and $rK = \pi X$ is the real value of total profits. From (2), (3), and the definition of π we obtain

$$\pi + \psi + \xi a = 1 : \tag{4}$$

output value is distributed between profits, wages, and intermediate inputs ($\pi X + \psi X + \xi a X = X$, column 1, table 2). We can think of this system as an industrializing economy that produces and exports manufactures which are imperfect substitu

$$\xi = \frac{1-\psi}{a(1+\frac{1}{\eta})} \tag{5}$$

and

$$\pi = \frac{1-\psi}{\eta(1+\frac{1}{\eta})}, \tag{6}$$

with

$$\frac{\partial \xi}{\partial \psi} = -\frac{1}{a(1+\frac{1}{\eta})} < 0,$$

and

$$\frac{\partial \pi}{\partial \xi} = \frac{a}{\eta} > 0.$$

From (5) and (6) we observe that a large exchange rate elasticity of sales compresses profits and imposes a more depreciated real exchange rate for a given level of real wage.[6]

[6]Individual firms' profits per unit of capital are given by $(1 - l\omega_f/\varepsilon - \xi_f a)u_f$, where u_f, ω_f and ξ_f are the firm's sales per unit of capital, the real wage and the relative price, respectively. Profits can be maximized by setting ω_f and ξ_f under the constraints that $u_f = \bar{u_f}\xi^\eta$ and $\varepsilon = \varepsilon[\omega_f]$ with $\eta > 0$, $\partial\varepsilon/\partial\omega_f > 0$ and $\partial^2\varepsilon/\partial\omega_f^2 < 0$. The first constraint is given by the perceived demand function of each firm with η being the relative price elasticity of sales. The second constraint is an effort function that links the wages paid by the firm to the workers' effort and productivity. Firms' setting of ξ_f and price equalization $\xi_f = \xi$ lead to (5). Similarly the setting of ω_f and price equalization $\omega_f = \omega$ lead to the real wage determination discussed in the following section and in the appendix.

2.1.2 Labor market and productivity

A real-wage Phillips *distributive* curve

$$\psi^* = l \exp\left(\frac{1}{1-h}\right) = l \exp\left(1 + ulk\right), \tag{7}$$

(where c is a measure of the minimum real wage) links the employment or capacity utilization rate to a wage share consistent with the equilibrium in the labor market.

There is no dearth of possible explanation for a upward sloping real-wage Phillips curve such as (7). For instance, larger capacity utilization and employment levels may generate a pressure on real wages by increasing the bargaining power of workers and/or by increasing the search costs for the needed labor force, and/or by changing the opportunity cost of losing a job. We therefore simply assume that labor market institutions are such that profit/wage ratio tends to be squeezed when employment and capacity utilization are rising. In the appendix we provide a possible explanation based on an labor extraction argument *à la* Bowles and Boyer (1988, 1989) in which firms set wages attempting to control work effort and labor productivity taking the employment and other labor market conditions as given. The exponential form of the curve is a convenient analytical device that allows for increasingly larger variation in the proximity of full employment and therefore stronger distributional effects of output variation at high level of economic activity and growth as showed by differentiating (7)

$$\frac{d\psi}{du} = l^2 k \exp\left(1 + ulk\right).$$

Defining τ as an adjustment speed constant, we can assume a linear adjustment

$$\dot{\psi} = \tau\left(\psi^* - \psi\right), \tag{8}$$

that yields to a nonlinear differential equation as the law of motion of the wage share in the labor market

$$\dot{\psi} = \tau\left(l \exp\left(1 + ulk\right) - \psi\right), \tag{9}$$

with

$$\frac{\partial \dot{\psi}}{\partial u} = \tau l^2 k \psi,$$

and

$$\frac{\partial \dot{\psi}}{\partial \psi} = -\tau.$$

Deviations from the equilibrium wage share set off competitive wage changes that can restore equilibrium.

2.2 Effective Demand

2.2.1 Investment under uncertainty

Firms earn gross profits at a rate r and revenues from foreign investments, $j\xi b$, where $b \equiv B/K$ is the real value of foreign assets per unit of capital in the foreign-good index.

The real value of net external position changes with the real exchange rate: a relative price increase of foreign goods (an increase of ξ) raises foreign assets' value or the burden of foreign debt repayment in terms of domestic goods. Firms' asset valuation depends on the flows of both profits and interest discounted by the given real interest rate. The capitalized value of net profits gives the asset value of invested capital. Assuming static expectations we obtain[7]

$$q \equiv \frac{(1-t_b)(\pi u + j\xi b)}{j}, \tag{10}$$

with t_b representing a tax rate on profits. Investment decisions are made by looking at the present and expected profitability. We assume for simplicity that firms build up production capacity considering domestic profitability and that the investment function takes the form

$$g = \alpha\pi u + \gamma \tag{11}$$

where $g \equiv \dot{K}/K$, γ is an exogenous investment component depending on "entrepreneurs' spirits," α^o captures is the sensitivity of investment to profitability and $\alpha \equiv \alpha^o(1-t_b)$. Investment demand responds to net profitability of productive capital and therefore to capacity utilization and distribution.

2.2.2 Product market adjustment and equilibrium

The trade account is made up of three elements: a technologically fixed component of imported inputs, ξaX; a component of "exchange rate-sensitive competitive net exports," $\xi^\eta xK$, that depends on productive and export capacity and the exchange rate; and a component of net imports, Λ, that responds elastically to excess supply. While the former element is reported as a cost component in cell (D1) of the SAM, the latter two elements are the "competitive net exports" reported in cell (A4) with $\chi K = \xi^\eta xK - \Lambda$. The exchange rate sensitive component of the trade balance depends on the real exchange rate with an elasticity equal to η, while the export demand effect of world output growth relative to domestic capital growth is captured by x. The excess demand function generated by the difference between consumption, investment, and competitive net exports demand, $C_h+\xi^\eta xK+gK$, on the one hand, and total supply, $\psi X+\pi X+\xi aX$, on the other, is elastically covered by Λ. The latter can be interpreted as an exchange-rate-insensitive increase in net imports due to insufficient domestic supply or a reduction of net exports due to a redirection of sales from exports to the domestic market induced by a rise in the domestic demand.

Equilibrium between total aggregate demand and total supply (equality between line A and column 1 of the SAM) is obtained when $C_h + G + \chi K + gK = \psi X + \pi X + \xi aX$, or

$$\Lambda = gK - (\psi X + D_b - C_h - T_h) - (\pi X + j\xi B - D_b - T_b) + (\xi^\eta xK + j\xi B - \xi aX). \tag{12}$$

[7]Reducing the capacity of agents to predict the future to a workable hypothesis such as that of static expectation is somehow a strong assumption. However, given that any model of expectation within the range of rational and static expectations can be labeled as "ad hoc" and given the implausibility of the former we opt for the latter.

Households receive both wage income and profit income through distributed net profits (line B, table 2) and save a given fraction of their income. Assuming that their consumption demand depends also on a fraction c of their wealth $p_E E$ and recalling that $p_E E = qK$, we can include a wealth effect in households' consumption equal to cqK.

Define $\upsilon^o \equiv c/j$. Then define s_h^o and s_b^o are the propensity to save of households and of firms out of net income, respectively, and t_h is the tax rate on household income. Then define the net propensities to save as $s_h \equiv s_h^o(1-t_h)$, $s_b \equiv s_b^o(1-t_b)$, and the propensity to consume out of capital gains as $\upsilon \equiv \upsilon^o(1-t_b)$.

Household and firms total savings in units of capital are

$$\sigma^h \equiv (\psi X + D_b - C_h - T_h)/K = s_h\left((1-s_b)(\pi u + j\xi b) + \psi u\right) - \upsilon(\pi u + j\xi b),$$

and

$$\sigma^b \equiv (\pi X + j\xi B - D_b - T_b)/K = s_b(\pi u + j\xi b),$$

respectively, with $0 < s_b \leq 1$, $0 \leq s_h \leq 1$ and $\upsilon^o \neq 0$.

Total national saving, the sum of households' and firms' savings, is therefore

$$\sigma \equiv \sigma^h + \sigma^b = s_h\left((1-s_b)(\pi u + j\xi b) + \psi u\right) - \upsilon(\pi u + j\xi b) + s_b(\pi u + j\xi b),$$

which, defining $s_p \equiv (1-t_b)(s_h^o(1-t_h)(1-s_b^o) - \upsilon^o + s_b^o)$, becomes

$$\sigma = s_p(\pi u + j\xi b) + s_h\psi u. \tag{13}$$

We group in z those components of the current account that respond to the real exchange rate,

$$z \equiv \xi^\eta x + j\xi b - \xi a u. \tag{14}$$

We can further assume that, while in the short run demand pressures are satisfied by elastic imports, in the longer run they induce firms to adjust capacity utilization to a level consistent with the desired level of savings and investment and a more structural level of net exports and interest payments. If production is adjusted by a fraction λ of the excess demand currently filled by imports, with $\lambda\Lambda = \dot{u}K$, using (13) and (14), then the saving-investment equilibrium condition (12) becomes the law of motion of the capacity utilization change in the longer run:

$$\dot{u} = \lambda(g + z - \sigma), \tag{15}$$

or

$$\dot{u} = \lambda\left((\alpha - s_p)\pi - s_h\psi - \xi a)u + \gamma + \xi^\eta x + (1-s_p)j\xi b\right). \tag{16}$$

Differentiation of (15), at the equilibrium yields

$$\frac{\partial \dot{u}}{\partial u}du + \frac{\partial \dot{u}}{\partial \psi}d\psi + \frac{\partial \dot{u}}{\partial b}db = 0$$

with

$$\frac{\partial \dot{u}}{\partial u} = -((s_p - \alpha)\pi + s_h\psi + \xi a),$$

$$\frac{\partial \dot{u}}{\partial \psi} = \frac{\partial \xi}{\partial \psi}((\eta\xi^{\eta-1}x - au) - (s_p - \alpha)\frac{\partial \pi}{\partial \xi}u + (1-s_p)jb) - s_h u,$$

$$\frac{\partial \dot{u}}{\partial b} = (1-s_p)j\xi.$$

For reasonable values of s_p and α, higher capacity utilization increases savings (out of profit, wages and out of intermediate imports) more than investment. The net effect on excess demand is negative and therefore the capacity utilization is self-stabilizing, $\partial \dot{u}/\partial u < 0$.

The effect of net foreign assets on output depends on net asset interest payment and their effect on national savings, $\partial z/\partial b - \partial \sigma/\partial b = (1 - s_p)j\xi$. The injection of larger net interest flows via the current account, $j\xi$, are larger than the leakages generated by increased saving, $s_p j\xi$ and larger net assets raises capacity utilization for any given level of the exchange rate and wage share, $\partial \dot{u}/\partial b > 0$. Since reverse considerations apply if the economy is a net debtor, this economy is said to be *debt-burdened* and $du/db > 0$.

An interesting feature of any open economy is how net foreign asset, capacity utilization and the wage share jointly determine the aggregate demand response to changes in the national income distribution and the real exchange rate. The system is said to be "profit-led" when $du/d\pi > 0$ and "wage-led" when $du/d\psi > 0$, for any given b. Given that $\partial \xi/\partial \psi < 0$ and $\partial \pi/\partial \xi > 0$, the system is profit-led when $du/d\psi < 0$ and $du/d\xi > 0$, and it is wage-led when $du/d\pi < 0$ and $du/d\xi < 0$. Since $\partial \dot{u}/\partial u < 0$, a cut on real wages - that is a redistribution toward profits and a real exchange rate depreciation - drives up aggregate demand if $\partial \dot{u}/\partial \psi < 0$. This partial derivative can be broken down into a number of components: a trade account component $(\partial \xi/\partial \psi)(\eta \xi^{\eta-1} x - au)$, a component that depends on foreign assets $(\partial \xi/\partial \psi)(1 - s_p)jb$, a component that depends on households savings, $-s_h u$, and one that includes the saving leakages and investment injections induced by the change in profits,

$$-\frac{\partial \xi}{\partial \psi}\frac{\partial \pi}{\partial \xi}(s_p - \alpha)u = -\frac{s_p - \alpha}{\eta + 1}u.$$

A wage cut/real depreciation has necessarily a positive effect on the trade account if the latter is positive and if $\eta > \xi$, it has a positive effect on the total injections generated by interest flows from foreign net assets if $b > 0$ (the opposite if $b < 0$) and it has a positive effect on aggregate demand by cutting on savings out of wages. It has a negative effect on aggregate demand by increasing profit-induced savings more than profit-induced investments $(-(s_p - \alpha)u/(\eta + 1) > 0)$. Earlier contributions on the role of distribution on aggregate demand in a Kaldorian-Kaleckian framework such as Blecker (1989) and Bhaduri and Marglin (1990) have emphasized how open economies are more likely to be profit-led. An export oriented economy with a large price elasticity of its competitive net exports, running a trade surplus and/or enjoying net foreign assets, is typically profit-led.

Figures 1 to 4, left panels, plot *effective demand curves*, $\dot{u} = 0$, in the (u, ψ) space for increasing levels of b (left to right). The effective demand curve tends to be more profit-led at larger levels of net foreign assets. The economy can face a relatively low price elasticity of net exports as in figure 1 and 2 or a larger elasticity as in figures 3 and 4. Also η contributes to increase the sensitivity of exports and aggregate demand to distributional changes. In figures 3 and 4 an expansionary (balanced budget) fiscal policy shifts the schedules North-East, while has an ambiguous effect on the their slope. A fiscal policy that reduces savings of households and firms leads to higher levels of output and wage shares.

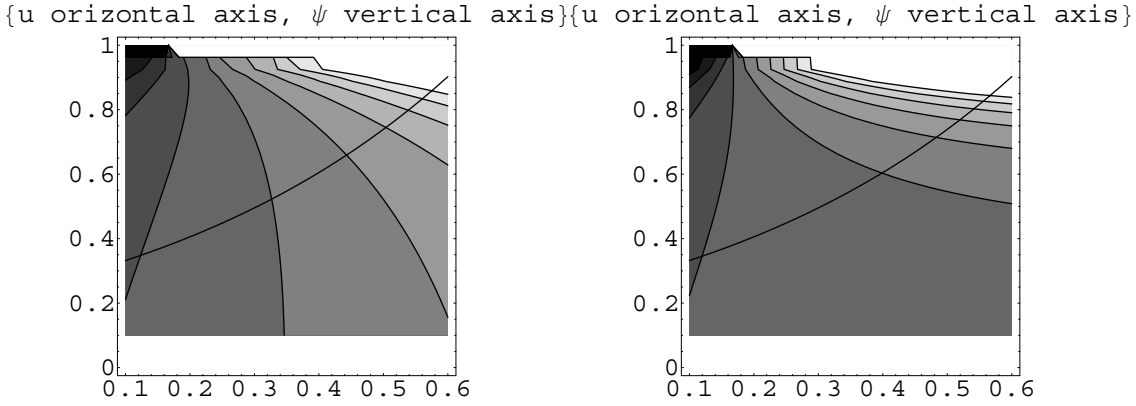

Figure 1: **Effective demand, distributive, and net assets equilibrium: low price elasticity of exports and no fiscal policy**. Left panel: Distributive and aggregate demand curves in the (u, ψ) plane; each curve represents a $\dot{u} = 0$ equilibrium at a given level of b. Right panel: Distributive and net assets equilibrium curves in the (u, ψ) plane; each curve represents a $\dot{b} = 0$ equilibrium at a given level of b. In both panels, curves on the right correspond to higher levels of net assets.(*k= 20; l= .1;* γ*=.05;* α^o*= .5;* η*= .8; a= .1; x= .08; j= .03;* s_b^o*=.5;* s_h^o*=.3;* v^o*= .01;*t_h*=0;* t_b*=0*)

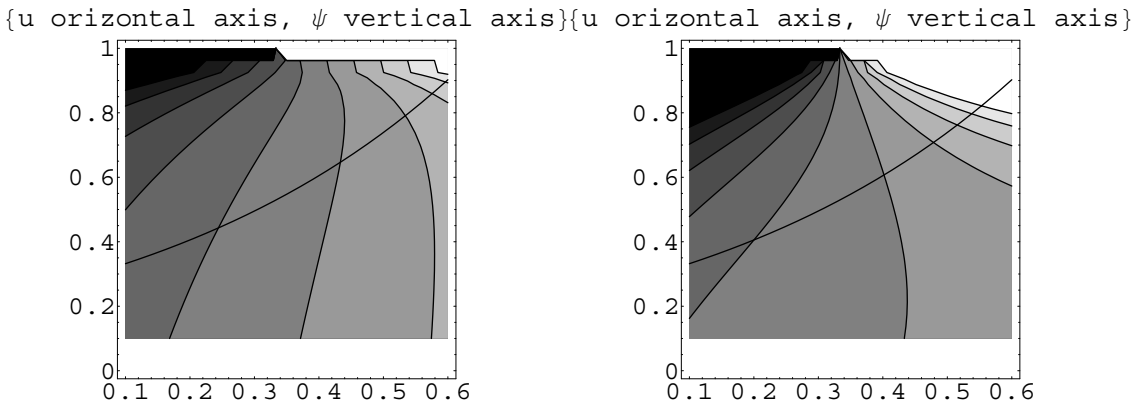

Figure 2: **Effective demand, distributive, and net assets equilibrium: low price elasticity of exports and expansionary fical policy**. See figure 1.(*k= 20; l= .1;* γ*=.05;* α^o*= .5;* η*= 1.2; a= .1; x= .08; j= .03;* s_b^o*=.5;* s_h^o*=.3;* v^o*= .01;*t_h*=0;* t_b*=0*)

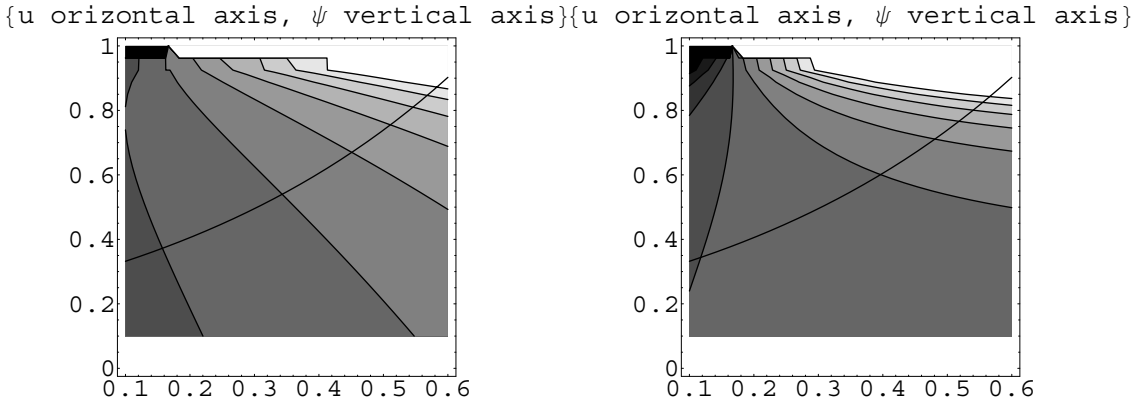

Figure 3: **Effective demand, distributive, and net assets equilibrium: high price elasticity of exports and no fical policy**. See figure 1.(k= *20;* l= *.1;* γ=*.05;* α^o= *.5;* η= *1.2;* a= *.1;* x= *.08;* j= *.03;* s_b^o=*.5;* s_h^o=*.3;* υ^o= *.01;*t_h=*.5;* t_b=*.5*)

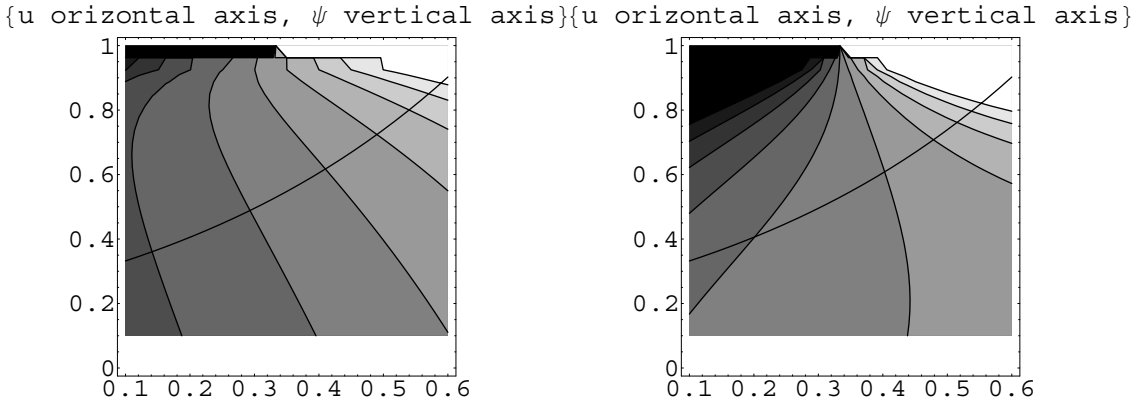

Figure 4: **Effective demand, distributive, and net assets equilibrium: high price elasticity of exports and expansionary fical policy**. See figure 1.(k= *20;* l= *.1;* γ=*.05;* α^o= *.5;* η= *.8;* a= *.1;* x= *.08;* j= *.03;* s_b^o=*.5;* s_h^o=*.3;* υ^o= *.01;*t_h=*.5;* t_b=*.5*)

2.3 External balance

A current account surplus (negative foreign savings, line D and column 4, table 2) represents an increase of claims on the foreign sector, $-S_f = \xi \dot{B}$ (row G, table 2).

$$S_f = \xi \dot{B} = (\xi x + j\xi b - \xi a u)K - \Lambda. \tag{17}$$

From (17) we obtain the dynamic equation of the share of foreign currency denominated debt as a function of capacity utilization and growth rate

$$\dot{b} = x - au - \dot{u}(\xi\lambda)^{-1} + (j - g)b.$$

Using (15) we obtain

$$\dot{b} = \frac{\sigma - g}{\xi} - gb, \tag{18}$$

or

$$\dot{b} = \frac{(s_p - \alpha)\pi u + s_h \psi u - \gamma}{\xi} - (g - s_p j)b.$$

which restate the identity between the current account and the saving-investment gap. Differentiation at the equilibrium gives

$$\frac{\partial \dot{b}}{\partial u} du + \frac{\partial \dot{b}}{\partial \psi} d\psi + \frac{\partial \dot{b}}{\partial u} db = 0$$

with

$$\frac{\partial \dot{b}}{\partial u} = \frac{1}{\xi}\left(\frac{\partial \sigma}{\partial u} - \frac{\partial g}{\partial u}(1 + \xi b)\right)$$

$$\frac{\partial \dot{b}}{\partial \psi} = \frac{1}{\xi}\left(\frac{\partial \sigma}{\partial \psi} - \frac{\partial g}{\partial \psi}\right) - \frac{\partial \xi}{\partial \psi}\frac{\sigma - g}{\xi^2} - \frac{\partial g}{\partial \psi} b$$

and

$$\frac{\partial \dot{b}}{\partial b} = -(g - s_p j).$$

Asset equilibrium is obtained at

$$b = \frac{s[\psi]u - g}{g - s_p j}, \tag{19}$$

where $s[\psi]$ is the average propensity to save of the domestic private sector: $s[\psi] = s_p\pi + s_h\psi$. Figures 1 to 4, right panels, show the net asset equilibrium $\dot{b} = 0$ with b defining different equilibria in the (u, ψ) space. For u and ψ such that $g > s_p j$ and $\xi > 0$, increasing values of b are associated to larger levels of u and ψ. We observe that $g > s_p j$ is also the condition for self-stability and therefore we restrict our analysis to possible equilibria in this region of the (u, ψ) space.

The steady state equilibrium is

$$b^* = \frac{\xi^{*\eta-1}x - au^*}{\xi^*(g^* - j)}. \tag{20}$$

3 Equilibrium and stability

Equations (9), (15) and (18) constitute our dynamic system of distribution, capacity utilization and current account leading to a steady state balanced growth $\dot{u} = 0$, $\dot{\psi} = 0$, and $\dot{b} = 0$, and the equilibrium in the labor and good markets. Equations (5), (6) and (11) allow us to obtain ξ, π and g, respectively.[8]

3.1 Stability and oscillations

We can analyze stability through the Jacobian evaluated at an equilibrium, u^*, ψ^*, and b^*.

$$J = \begin{bmatrix} \partial\dot{u}/\partial u & \partial\dot{u}/\partial\psi & \partial\dot{u}/\partial b \\ \partial\dot{\psi}/\partial u & \partial\dot{\psi}/\partial\psi & 0 \\ \partial\dot{b}/\partial u & \partial\dot{b}/\partial\psi & \partial\dot{b}/\partial b \end{bmatrix}$$

From the analysis in the previous sections, we can expect that an equilibrium at sufficiently high levels of u, ψ, and b is stable and can generate dampened fluctuations of u, ψ, ξ, and π, and current account oscillations. In the appendix, a more formal proof of this proposition is provided.

We can observe that the signs of $\partial\dot{u}/\partial u$ and $\partial\dot{\psi}/\partial\psi$ are negative, while $\partial\dot{u}/\partial b$ and $\partial\dot{\psi}/\partial u$ are positive. A large u is associated with a large ψ via the distributive curve, to a large b via the aggregate demand function, to a large g through the investment and to a small ξ and π due to the distributive trade-off between real exchange rate and profit share with the wage share. As discussed above an export oriented economy is likely to be profit-led - $\partial\dot{u}/\partial\psi$ is negative - and reach an equilibrium with large u, ψ, b, and g and an appreciated ξ and "squeezed" π. If net foreign assets include liquid low-interest-bearing assets, such as reserves, then $g > s_p j$ and $\partial\dot{b}/\partial b < 0$ so that b is self-stabilizing. For positive levels of b and an large ψ, $\partial\dot{b}/\partial u > 0$ and $\partial\dot{b}/\partial\psi > 0$

The signs of the Jacobian associated with the system are as follows:

$$J = \begin{bmatrix} - & - & + \\ + & - & 0 \\ + & + & - \end{bmatrix}.$$

[8]The extended system embracing all the entries of the SAM would include the determination of stock variations, $\dot{E}$ and $\dot{B}$ for instance, valuation p_E and wealth. The latter two are however direct functions of net profitability and we leave them implicit to concentrate on the main flow dynamics in the short run and the long run stock ratio dynamics.

Note that the use of *per output* shares π and ψ in our analysis may seem to hide the real and more interesting dynamics of the profit $\pi/(1-\xi a)$ and wage share $\psi/(1-\xi a)$ in *GDP units*, respectively. GDP is distributed between wages and profits

$$\frac{\pi}{(1-\xi a)} + \frac{\psi}{(1-\xi a)} = 1.$$

We observe that reduction of the output wage share is associated with a real exchange rate depreciation and net output $(1-\xi a)$ contraction and therefore a larger profit rate in GDP units; signs are preserved shifting from one to the other normalization while the profit share in GDP units shows the usual trade-off with the wage share. Moreover, the wage share and net output correlation - wage recipients get less of a smaller pie - reduce the relative fall of the wage share to GDP.

We can easily observe the main aspects of the adjustment process and the possible emergence of distributive business cycles by assuming a "classical" saving pattern such as $s_b = 1$, $t_b = s_h = \upsilon = 0$. Firms save all their income while households do not save and profits are not taxed. The aggregate demand injections generated by net foreign assets revenues are perfectly offset by a correspondent amount of saving leakages. With $s_p = s_b = 1$, $\partial\dot{u}/\partial b = 0$ and foreign assets changes affect neither the aggregate demand nor the distributive equilibrium. The output-distribution adjustment can be treated separately from the asset adjustment. If equilibrium is obtained in a (u, ψ) subset satisfying $g > j$, the net asset/capital ratio converges as before.

With a suffcient trade surplus in equilibrium, the Jacobian of the reduced system has the following signs

$$J_{\bar{b}} = \begin{bmatrix} - & - \\ + & - \end{bmatrix} :$$

The system is profit led: the consumption effect of a larger wage share does not offset the reduction of investment and net exports induced by a redistribution/appreciation.

While the signs of $J_{\bar{b}}$ satisfy the conditions for stability with a negative trace and positive determinant, the relative magnitude of the own and cross effects of the variables can lead to damped cycles. For relatively similar values of $\partial\dot{u}/\partial u$ and $\partial\dot{\psi}/\partial\psi$ and large absolute values of $\partial\dot{u}/\partial\psi$ and $\partial\dot{\psi}/\partial u$, such as in the case of a flat demand and steep distributive curve in the (u, ψ) space, $(\partial\dot{u}/\partial u - \partial\dot{\psi}/\partial\psi)^2 < -4(\partial\dot{u}/\partial\psi)(\partial\dot{\psi}/\partial u)$ and the roots of $J_{\bar{b}}$ become complex. That implies a cyclical counterclockwise adjustment of u and ψ to the "medium run" equilibrium (see figure 5 below). These considerations hold a fortiori for $s_p < 1$ which implies a smaller $|d\psi/du|$ than in the case of $s_p = 1$, that is a flatter aggregate demand equilibrium in the (u, ψ) space.[9]

These counterclockwise cycles reproduce the *Lotka-Volterra* predator-prey symbiosis between wage share and employment/capacity utilization described first by Goodwin (1967) in his seminal paper adapted in a structural framework in Barbosa-Filho and Taylor (2005) and Taylor (2004).

If supply falls short of aggregate demand and the employment rate is below the equilibrium level, then the wage share falls. Excess demand is temporary satisfied by imports, but production and employment pick up, while capacity utilization rise. The ensuing depreciation increases net foreign assets revenues and the exchange-rate-sensitive net exports, while output expansion generates larger savings and slows down net export growth. When the employment rate is sufficiently large to push up wages, the exchange rate begins to appreciate, the exchange-rate-sensitive net exports and the net asset revenues contract, but still generate enough demand to make production and employment still growing. Output expansion pushes up the wage share vigorously and increases savings, while the redistribution/appreciation reduces net exports. Eventually, output expansion and growth slows down. The fall in net exports and interest revenues induced by larger wages and the growth in savings generate an excess supply. Despite the appreciation unsold product is redirected abroad through *forced* exports. Employment and growth are contracting, until the wage increase-real appreciation will come to an end and then reversed with employment falling below its equilibrium level. The depreciation and the increased competitiveness will eventually restore capacity, employment and growth expansion leading toward another cycle. Assets variation play a side role in the simplified

[9]The wage-led regime however does not allow for distributional cycles (u, ψ) for $\partial\dot{u}/\partial\psi > 0$ exclude the possibility of complex roots.

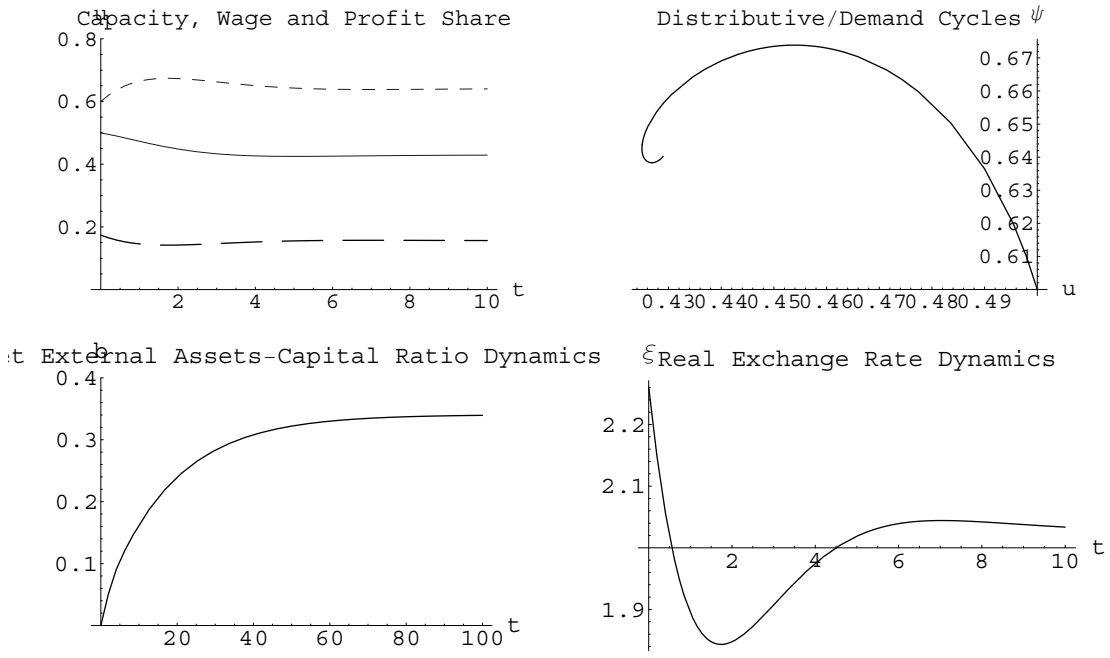

Figure 5: **Equilibrium and stability**. Left upper panel: Wage share (small dashes), Capacity utilization (solid), and profit share (large dashes). Right upper panel: wage share and capacity utilization dampened fluctuations in (u, ψ) space. Left lower panel: net foreign assets in per capital units. Right lower panel: real exchange rate.(*k= 20; l= .1; γ=.05; α^o= .5; η= 1.3; a= .1; x= .05; j= .03; s_b^o=.5; s_h^o=.3; υ^o= .01;t_h=.5; t_b=.5*)

system, adjusting to the output-distribution variations.

For the complete system with $s_p < 1$, the considerations are similar. The oscillations of the net assets-capital ratio due to changes output and distribution feed back into the aggregate demand equilibrium. With b preserving its sign, cycles persist until $\dot{u} = \dot{\psi} = 0$ while further output and distributional changes can arise from a slow stock adjustment toward steady state. The macro oscillations are therefore the outcome of the dynamic interaction of a large number of variables and arises as a complex composition of market and social forces. The fairly straightforward cyclical predator-prey dynamics of output and distribution feeds into the dynamics of exchange exchange rate, international competitiveness and factor payments that combine to generate oscillations in the current account-output ratio.

3.2 Current account and real exchange rate determination via distribution

The real exchange rate moves in the opposite direction of the wage share and generates clockwise dampened cylces in the (u, ξ) space. Its sensitivity to the wage share dynamics depends on the price elasticity of net exports. Hence, expasionary fiscal policies that cut savings and allow for higher wages lead to an appreciated equilibrium real echange rate.

Along the cycle, the trade account is determined by the savings investment gap, $\kappa = \sigma - g$, but settles to z in equilibrium. The current account surplus in unit of

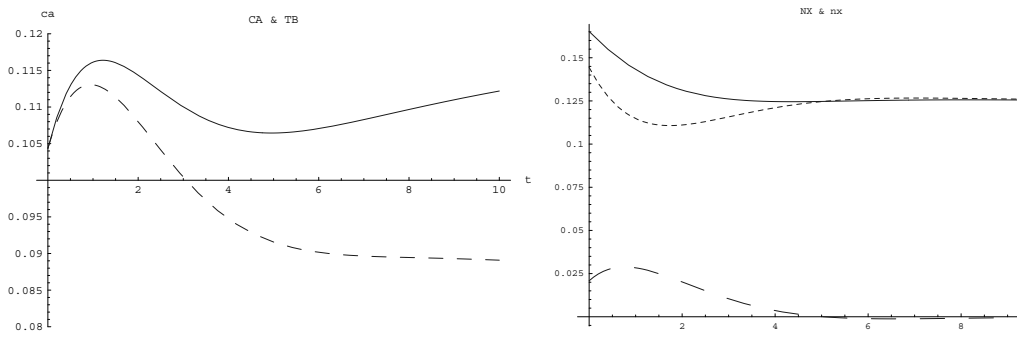

Figure 6: **External balance**. Left panel: Current account (solid line) and trade balance (dashed line) in units of output. Right panel: Competitive net exports over the cycle (solid line), exchange rate sensitive net exports over the cycle (small dashes) and their difference (large dashes).((*k= 20; l= .1; γ=.05; α^o= .5; η= 1.3; a= .1; x= .05; j= .03; s_b^o=.5; s_h^o=.3; υ^o= .01;t_h=.5; t_b=.5*)

domestic output is

$$-\frac{\xi \dot{B}}{X} = \frac{\kappa}{u} = \frac{\sigma - g}{u}. \tag{21}$$

Figure 6, left panel, shows the current account dynamics corresponding to our predator-prey distributional cycles and net assets dynamics of figure 5. Current account fluctuations tend to be smoothed by the co movement of saving and investment via the profit rate. On the other hand, real wage/exchange rate changes have opposite effects on savings out of wages and out of net foreign revenues: their interaction becomes the relevant source of the current account variability. On the right panel of figure 6 we observe the convergence of net competitive exports to their exchange rate sensitive component $\xi^\eta x$. When wages are rising and the excess supply gap closing, net exports are larger than their exchange-rate-sensitive net exports. When wages and output are falling and the exchange rate is depreciating, exchange-rate-sensitive net exports increase. With the excess supply gap closing net exports converge to $\xi^\eta x$. In other words, the trade balance can be more sensitive to the distributional effect of real exchange rate via the effect on excess demand during the cycle, while responding directly via standard trade elasticities in the longer run.

4 Conclusions

The model describes the generation of distributional-demand cycles leading to oscillations in the current account and the real exchange rate. Some useful descriptive insights on the internal and external balance patterns are obtained by modeling the Goodwin predator-prey idea of distributional conflict cycles in its structuralist extension (which includes the Keynes-Kaldor-Kalecki role of distribution in the demand and relative price determination) and the specification of the distributive conflict as a labor extraction process a' la Bowles and Boyer, all rigorously contained in a stock-flow consistent set of accounts.

The focus of the paper is on that cyclical dynamics predominantly induced by a distributional-output fluctuations in profit-led export-oriented economies arising from

strong reaction of wages on employment and of aggregate demand on distribution/real exchange rate changes. This implies a steep distributive upward sloping and relatively flat downward sloping aggregate demand curve in the capacity utilization - distribution plan. A sufficiently steep distributive curve can be the result of organized labor and increasing bargaining power at high level of employment, while a sufficiently flat effective demand curve may be the outcome of a high sensitivity of the real exchange rate and output to wage changes. This is likely to be the case for an export oriented economy that is experiencing high levels of growth and capacity utilization. Consistently with some recent features of emerging market economies the government does not represent a source of net saving or dissaving for the economy. Yet, fiscal policy has an important role to play by affecting the savings rates of households and firms. Taxes on profits and household income affect aggregate demand and therefore the steady state although may have an ambiguous effect on the stability conditions. Alternative modern macroeconomic frameworks such as the intertemporal approach to the current account derive their prescription from general implications obtained under the assumption full employment, marginal cost pricing and perfect foresight (or rational expectations) and need to explain trade imbalances as equilibrium outcomes of the intertemporal allocation of expenditure and to exclude a role for the exchange rate in the trade balance. In the proposed framework, the exchange rate responds to changes in the aggregate demand via distribution and may affect the current account via traditional trade elasticities as well as via income distribution and savings generation. The relation between exchange rate and current account can be complex, but role of the exchange rate as a relative price relevant for macro adjustment can be preserved. Alternative modern macroeconomic frameworks such as the intertemporal approach to the current account explain external imbalances as equilibrium outcomes of the intertemporal allocation of expenditure and exclude a role for the exchange rate in the current account balance. In the proposed framework, the exchange rate responds to changes in the aggregate demand via distribution and may affect the current account via traditional trade elasticities as well as via income distribution and savings generation. The relation between exchange rate and current account can be complex, but role of the exchange rate as a relative price relevant for macro adjustment can be preserved.

The descriptive power of the framework, in fact, relies on the relevance of economic institutions, social and labor relations. A distributional/aggregate demand cyclical behavior may be generated under some other specification of the effective and distributional schedules that can be able to explain fluctuations in the exchange and current account balance in low growth and/or indebted economies. Business cycles can be generated within the Kaleckian, Keynesian, Marxian and Structuralist tradition by the interaction between asset prices, sectoral debt-equity and debt-capital ratios, productivity changes and interaction between profit and interest rates (Taylor et al., 2006). The model's main framework allows for extensions in that direction.

5 Appendix A: Labor market and endogenous productivity

In section 2.1.2 we simply described a distributive curve as a labor market equilibrium representation in the (u, ψ) plane, and we stated a possible adjusting mechanism.

As emphasized in Bowles and Boyer (1988, 1989), labor effort is a crucial endogenous

variable in a model that takes into account social relations. The effectiveness of the work done in a hour depends both on the work and social environment: the overall labor market's and the individual firm's work conditions determine the job loss cost for workers and therefore the power of the employer to induce work effort per hour worked. Define ω_f as the single firm's wage rate per hour worked, ω_a the wage offered by any other firm and consider the employment rate h as a proxy of the probability of reemployment. Threatened by a job loss cost equal to the difference between their current wage and the expected wage in case of lay off, $(\omega_f - h\omega_a)$, a sort of employment rent, workers will exert effort according to a reaction function $\varepsilon = \varepsilon\left[\omega_f, \omega_a, h\right]$ with the general properties of being increasing in the wage paid by the employing firm, $\partial\varepsilon/\partial\omega_f > 0$, but in a decreasing way, $\partial\varepsilon^2/\partial\omega_f^2 < 0$, and being decreasing in the alternative wage, $\partial\varepsilon/\partial\omega_a < 0$, and the employment rate, $\partial\varepsilon/\partial h < 0$ the components of the expected reemployment wage $h\omega_a$. Such work effort function can be easily dealt with in a logarithmic form

$$\varepsilon = \ln(\omega_f - h\omega_a).$$

Firms' profit maximization or minimization of labor cost per effective work unit, ω/ε, is obtained at the equilibrium wage

$$\omega^o = \varepsilon\left(\frac{\partial\varepsilon}{\partial\omega_f}\right)^{-1}.$$

The labor cost minimizing wage rate offered by any single competitive firm ω^o, in our specification

$$\omega^o = (\omega^o - h\omega_a)\ln(\omega^o - h\omega_a), \tag{22}$$

is therefore a function of ω_a and h which are taken as given by any single competitive firms but vary in the aggregate.

Differentiation of (22) shows the effect of rising employment on the single firm's optimal wage rate. The rise in workers' probability of reemployment raises their expected alternative wage, lowers their employment rent and work effort: firms can restore an optimal wage/effort ratio by raising the offered wage rate and consequently labor productivity,

$$\frac{d\omega^o}{dh} = \left(2 - h\frac{\omega_a}{\omega^o}\right)\omega_a. \tag{23}$$

However, as pointed out by Bowles and Boyer, the effect of employment on the single firms' equilibrium wage rate is just the basis of a larger multiplicative effect leading to higher aggregate wage responses to any given employment change: an initial rise in the employment rate induces single firms to increase their offered wage, but when they observe a rise in workers' alternative wage ω_a are consequently forced to further raise their own wages until the optimal wage-effort ratio is obtained. The aggregate effect becomes

$$\frac{d\omega}{dh} = \frac{d\omega^o}{dh}\left(1 - \frac{h}{\omega_a}\frac{d\omega^o}{dh}\right)^{-1} = \frac{\left(2 - h\frac{\omega_a}{\omega^o}\right)\omega_a}{1 - h\left(2 - h\frac{\omega_a}{\omega^o}\right)},$$

where the latter equation is obtained using (23).

Optimality for any single firm and the equilibrium for the firms sector as a whole is obtained at the uniform wage rate $\omega = \omega_f = \omega_a$, which implies

$$\frac{d\omega}{dh} = \frac{(2-h)\,\omega}{(1-h)^2}. \tag{24}$$

Integrating (24) we obtain the market real wage as a function of the employment rate $\omega^* = \omega^*[h]$

$$\omega^* = c\frac{\exp\left(\frac{1}{1-h}\right)}{1-h}; \tag{25}$$

where c is an integration constant which pins down the minimum real salary for $h = 0$ as $\omega_{\min} = c\exp(1)$ that we normalize for semplicity to one.

Recalling that in equilibrium $\varepsilon[h] = \ln\left((1-h)\,\omega^*[h]\right)$, the market optimal wage and the work effort functions are,

$$\omega^* = \frac{\exp\left(\frac{1}{1-h}\right)}{1-h} = (1+ulk)\exp(1+ulk), \tag{26}$$

and

$$\varepsilon^* = \frac{1}{1-h} = 1+ulk \tag{27}$$

respectively, with the second equalities of both functions obtained recalling that $h = ulk/\varepsilon$. Indeed, at the equilibrium, the employment rate can be expressed as a function of capacity utilization alone: $h = ulk/(1+ulk)$.

The equilibrium wage share $\psi^* = \omega^* l/\varepsilon^*$ is our *distributive curve*

$$\psi^* = l\exp\left(\frac{1}{1-h}\right) = l\exp(1+ulk),$$

As mentioned in above, we define τ as an adjustment speed constant and assume a linear adjustment of the kind

$$\dot{\psi} = \tau\left(\psi^* - \psi\right).^{10}$$

[10]We note that under the hypothesis of perfect information of any firm's real wage and the condition of uniformity $\omega = \omega_f = \omega_a$, any market wage rate ω could represent a Nash equilibrium from which no single firm has any incentive to deviate (firms are only concerned about differential between their ω_f and other firms' ω_a). Such equilibrium among decentralized and competing wage setters can falter in condition of scarce observability, wrong perception and lack of trust on other firms' intentions.

Once the wage changes have been set off, firms will converge to the wage rate consistent with the current level of employment h and minimum salary $\omega_{\min}$.

6 Appendix B: Stability analysis

The general form of our Jacobian is

$$J = \begin{bmatrix} \partial\dot{u}/\partial u & \partial\dot{u}/\partial\psi & \partial\dot{u}/\partial b \\ \partial\dot{\psi}/\partial u & \partial\dot{\psi}/\partial\psi & \partial\dot{\psi}/\partial b \\ \partial\dot{b}/\partial u & \partial\dot{b}/\partial\psi & \partial\dot{b}/\partial b \end{bmatrix}.$$

The Routh-Hurwitz conditions:
(i) $Tr[J] < 0$,
(ii) $Det[J] < 0$, and
(iii) $Det[J_1] + Det[J_2] + Det[J_3] > 0$, and
(iv) $-Tr[J](Det[J_1] + Det[J_2] + Det[J_3]) + Det[J] > 0$,
where J_i are the principal minors of order 2 of the Jacobian, are necessary and sufficient conditions for the system's stability.

As we are focusing on an export oriented economy with we can assume that $\partial\dot{u}/\partial\psi$, $\partial\dot{\psi}/\partial u$, $\partial\dot{\psi}/\partial\psi$, and $\partial\dot{b}/\partial\psi$ tend to be large and $\partial\dot{u}/\partial b$ and $\partial\dot{b}/\partial b$ and $\partial\dot{b}/\partial\psi$ tend to be small, in absolute terms.

The stability conditions

(i) $Tr[J] = \partial\dot{u}/\partial u + \partial\dot{\psi}/\partial\psi + \partial\dot{b}/\partial b < 0$

(ii) $Det[J] = \partial\dot{u}/\partial u \begin{vmatrix} \partial\dot{\psi}/\partial\psi & \partial\dot{\psi}/\partial b \\ \partial\dot{b}/\partial\psi & \partial\dot{b}/\partial b \end{vmatrix} - \partial\dot{u}/\partial\psi \begin{vmatrix} \partial\dot{\psi}/\partial u & \partial\dot{\psi}/\partial b \\ \partial\dot{b}/\partial u & \partial\dot{b}/\partial b \end{vmatrix} + \partial\dot{u}/\partial b \begin{vmatrix} \partial\dot{\psi}/\partial u & \partial\dot{\psi}/\partial\psi \\ \partial\dot{b}/\partial u & \partial\dot{b}/\partial\psi \end{vmatrix} < 0$

$Det[J] = (-)\begin{vmatrix} - & 0 \\ + & - \end{vmatrix} - (-)\begin{vmatrix} + & 0 \\ + & - \end{vmatrix} + (+)\begin{vmatrix} + & - \\ + & + \end{vmatrix} < 0$ are easily verified. Moreover,

the sum of the principal minors' determinants, $Det[J_1] + Det[J_2] + Det[J_3]$, is

$$\begin{vmatrix} \partial\dot{\psi}/\partial\psi & \partial\dot{\psi}/\partial b \\ \partial\dot{b}/\partial\psi & \partial\dot{b}/\partial b \end{vmatrix} + \begin{vmatrix} \partial\dot{u}/\partial u & \partial\dot{u}/\partial b \\ \partial\dot{b}/\partial u & \partial\dot{b}/\partial b \end{vmatrix} + \begin{vmatrix} \partial\dot{u}/\partial u & \partial\dot{u}/\partial\psi \\ \partial\dot{\psi}/\partial u & \partial\dot{\psi}/\partial\psi \end{vmatrix} =$$

$\begin{vmatrix} - & 0 \\ + & - \end{vmatrix} + \begin{vmatrix} - & + \\ + & - \end{vmatrix} + \begin{vmatrix} - & - \\ + & - \end{vmatrix} > 0$ and condition *(iii)* is satisfied. For a sufficiently

large trace and sum of principal minors and for a small absolute value of the determinant, condition *(iv)* is also satisfied.

References

[1] Barbosa-Filho, Nelson and Lance Taylor (2006), "Distributive and Demand Cycles in the US Economy - A Structuralist Goodwin Model," *Metroeconomica*, 57 (3): 389-411.

[2] Bhaduri, Amit and Stephen Marglin (1990), "Unemployment and the Real Wage: the Economic Basis for Contesting Political Ideologies," *Cambridge Journal of Economics*, 14: 375-393.

[3] Blacker, Robert A. (1989), "International competition, income distribution and economic growth," *Cambridge Journal of Economics*, 13: 395-412.

[4] Bowles, Samuel and Robert Boyer (1988), "Labor Discipline and Aggregate Demand: A Macroeconomic Model," *American Economic Review*, : 395-400.

[5] Bowles, Samuel and Robert Boyer (1989), "A Wage-Led Employment Regime: Income Distribution, Labor Discipline, and Aggregate Demand in Welfare Capitalism," in S.A. Marglin ed. *The Golden Age of Capitalism*, Oxford, Oxford University Press, 1989.

[6] Foley, Duncan K. and Lance Taylor (2006), "A Heterodox Growth and Distribution Model," in Salvadori N. (ed.) *Economic Growth and Distribution: On the Nature and Causes of the Wealth of Nations*, Edward Elgar, Cheltenham UK Northampton USA.

[7] Goodwin, Richard (1967), "A Growth Cycle" in C. H. Feldstein (ed.), *Socialism, Capitalism and Growth*, Cambridge Cambridge University Press.

[8] Kaldor, Nicholas (1956) "Alternative Theories of Distribution," *Review of Economic Studies*, 23: 83-100.

[9] Krugman, Paul and Lance Taylor (1978), "Contractionary Effects of Devaluation," *Journal of International Economics*, 8: 445-56.

[10] La Marca, Massimiliano (2004), "Real Exchange Rate, Competitiveness and Policy Implications: a Formal Analysis of Alternative Macro Models," *SCEPA Working Papers* (2004), *Schwartz Center for Economic Policy Analysis,* New York.

[11] La Marca, Massimiliano (2005), "Foreign Debt, Growth and Distribution in an Investment-led System," in Salvadori N. and Balducci R. (eds), *Innovation, Unemployment and Policy in the Theories of Growth and Distribution*, Edward Elgar, Cheltenham UK Northampton USA.

[12] Obstfeld, Maurice and Kenneth Rogoff, (1995), "The Intertemporal Approach to the Current Account," in Grossman G. M. and Rogoff K. (eds), *Handbook of International Economics*, volume 3. North Holland, Amsterdam, ch 34, pp. 1731-1799.

[13] Obstfeld, Maurice and Kenneth Rogoff, (1996), *Foundations of International Macroeconomics*, MIT Press, Cambridge Massachusetts.

[14] Rogoff, K. (1996), "The Purchasing Power Parity Puzzle," Journal of Economic Literature, XXXIV, June, 647-668.

[15] Taylor, Lance (1991), *Income Distribution, Inflation and Growth*, Cambridge MA, MIT Press.

[16] Taylor, Lance (2004), *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream*, Cambridge MA: Harvard University Press.

[17] Foley, Taylor, Lance, Nelson H. Barbosa-Filho, and Codrina Rada (2006), "Heterodox Business Cycles," in Salvadori N. (ed.) *Economic Growth and Distribution: On the Nature and Causes of the Wealth of Nations*, Edward Elgar, Cheltenham UK Northampton USA.