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Lima, Gilberto Tadeu and Porcile, Gabriel

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Gilberto Tadeu Lima
Department of Economics, University of São Paulo, Brazil
giltadeu@usp.br

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Gabriel Porcile
Economic Commission for Latin America and the Caribbean (ECLAC), Chile
and
Department of Economics, Federal University of Paraná, Brazil
porcile@ufpr.br

Abstract: We present a dynamic model of capacity utilization and growth which takes into due account the joint determination of the international competitiveness (measured by the real exchange rate) and functional income distribution. It follows that how distribution, capacity utilization and growth vary with the real exchange rate depends on the cause of change in the latter (nominal exchange rate or markup). Over the medium run, the nominal exchange rate (markup) changes when the actual real exchange rate differs from the level preferred by the government (capitalists). While there is a medium-run equilibrium in which capitalists and the government come to share a preferred real exchange rate, the economy may not converge to it. In fact, when the government is primarily concerned with preserving workers' share in income when manipulating the nominal exchange rate, a limit cycle obtains: the economy experiences endogenous cyclical fluctuations in the real exchange rate, distribution, capacity utilization and growth that resemble the experience of several developing countries. Thus, growth regressions featuring the real exchange rate should include distribution in the vector of control variables, which has not been the case.

Keywords: growth, distribution, capacity utilization, real exchange rate.

JEL codes: E12, F43, O11, O15.

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1. Introduction

The growth-enhancing properties of a competitive, undervalued real exchange rate have been recently emphasized by a burgeoning theoretical and empirical literature (see, for instance, Rodrik 2008 and Razmi et al. 2009). Nonetheless, functional income distribution and the real exchange rate are functionally related: whether the real exchange rate and the wage share, for instance, move in the same or opposite direction depends on the ultimate source of the change in any of them (Blecker 1989, 1999). In fact, whether or not the domestic pricing equation includes imported intermediates also matters for the relationship between functional distribution and the real exchange rate, as the presence of intermediates represents another direct claimant on domestic income. Therefore, whether exchange devaluations actually make for a rise in capacity utilization and economic growth also depends on the impact on aggregate effective demand of the accompanying change in distribution. Indeed, the possibility that devaluation is contractionary for output due to distributional reasons dates back (at least) to Díaz-Alejandro (1963) and Krugman and Taylor (1978).

Admittedly, the recent theoretical literature has been dealing with the issue of the sustainability of a competitive real exchange rate (given some of its self-undermining 'externalities', such as an upward pressure on non-tradable prices and/or nominal wage) and/or the related issue of avoiding 'negative effective demand externalities' coming through an accompanying change in distribution. For instance, Razmi, Rapetti and Skott (2009) assume unemployment in a two-sector model to show that changes in the real exchange rate affect the quantity and composition of employment in a way that allow the real exchange rate to be used to facilitate sustained capital accumulation. Porcile and Lima (2010) show how the elasticity of labor supply and endogenous (Verdoorn-Kaldor) technological change play a role (individually and connectedly) in preventing the real exchange rate from appreciating as the economy grows. Razmi (2010) shows how production diversification and learning-by-accumulation can avoid negative distributional implications of nominal exchange devaluations. Meanwhile, Rapetti (2011) shows that exchange depreciations will more likely trigger an acceleration of growth if they are simultaneously implemented with domestic demand management policies that prevent non-tradables price inflation and wage management policies that coordinate wage increases with tradable productivity growth.

However, the recent literature on the subject has been ignoring interclass and intraclass conflicts over the preferred real exchange rate, with the latter being invariably (even if implicitly) conceived of as a consensual level, while the (often heated) public debates on exchange rate policy clearly illustrate that those conflicts are pervasive. As a result, it is reasonable to treat capitalists and the government as having preferred real exchange rates which may differ from each other, and an innovation of this paper lies in the incorporation of such a potential conflict of interests. In fact, even though we do not explicitly consider sectoral differences in terms of tradables and non-tradables in this paper, a more inclusive model could assume that capitalists themselves hold heterogeneous preferences as regards the preferred real exchange rate (for instance, with capitalists who are less (or even not) exposed to international competition as either exporters or importers arguably caring less about the real exchange rate). To keep focus on interclass conflicts over the real exchange rate, however, we treat capitalists as holding homogenous preferences in that regard.

Actually, the literature on the subject has been ignoring not only that capitalists, workers and the government (usually reacting to pressures from those classes) have different preferences with respect to the desired real exchange rate, but also that those players have quite different instruments to influence the course of the actual real exchange rate. It is often ignored that none of the players have direct control over all the variables on which the real exchange rate ultimately depends. Capitalists, for instance, taking the nominal wage, the nominal exchange rate and (eventually) the technological parameters as given, have a preferred real exchange rate to which a desired markup (their controllable variable) corresponds. Meanwhile, workers, taking the markup, the nominal exchange rate and (eventually) the technological parameters as given, have a preferred real exchange rate to which a desired nominal wage rate (their controllable variable) corresponds. Finally, the monetary authority, taking the markup, the nominal wage and (eventually) the technological parameters as given, have a preferred real exchange rate to which a desired nominal exchange rate (its controllable variable) corresponds. Admittedly, capitalists' desired markup, workers' desired nominal wage rate and the government's desired nominal exchange (all of them reflecting a preferred real exchange rate by the corresponding player) need not be (all) exogenously given.

In a world in which the degree of openness has tended to increase steadily in the past twenty years and in which foreign competition is fierce, it is reasonable to assume that firms are well aware of the implications of the real exchange rate for market shares.[1] As noted by Blecker (1989, 1999), international competition constraints the degree of monopoly and this has an impact on markups. Moreover, the real exchange rate (international competitiveness) preferred by capitalists is likely to be influenced by their consumption and capital accumulation plans. The higher the desired accumulation, the higher the real exchange rate aimed at by the firms.

Meanwhile, the real exchange rate preferred by the government will have to balance two conflicting objectives: (i) in a context in which it is necessary to stabilize prices, there will be a tendency

[1] There is no need to emphasize that trade interdependence has expanded in an impressive way in the last decades. The new role that China, India and other Asian economies play in global trade contributed decisively to this outcome. Latin America made as well substantial progress in this direction. The region rapidly moved from high tariff and nontariff barriers, with its ensuing low openness coefficient, towards unilateral trade liberalization and a higher share of exports and imports in total GDP. This process of course led domestic firms to adjust. In almost closed economies, they were able to set markups looking principally at the desired share in total income. On the other hand, in increasingly open economies, the key variable for sustaining growth is the real exchange rate, and therefore it could not be ignored in the decision process over prices.

to aim at a lower exchange rate, stimulating imports and curbing inflation; and (ii) conversely, when the economy faces a severe disequilibrium in the external front, related to mounting trade deficits and/or an increasing cost of financing the external debt, the government will prefer a higher real exchange rate, in spite of both its likely inflationary impacts and the worsening of income distribution. Many developing economies went through cycles in which overvaluation during stabilization programs was followed by the quest for competitiveness when external crisis set in.[2] In general, in normal times, it is likely that the government target would be some average of the real exchange rate preferred by workers and capitalists, and a more inclusive model could make the corresponding weights endogenous as well. Two extreme cases would be the monetary authority sharing the same preferred real exchange rate with either capitalists or workers. The set of possible scenarios arising from these different assumptions is extremely rich and we clearly cannot discuss all of them in this paper. To the extent that the real exchange rate affects so many dimensions of the economy (external equilibrium, inflation and growth), and it is frequently a focal point in the distributive conflict, it is necessary to analyze the objectives and instruments that each actor can deploy in the bargaining process.

As a result, given that (i) whether the wage share and the real exchange rate move in the same or opposite direction depends on the ultimate source of the change in any of them and that (ii) capitalists, workers and the government not only have heterogeneous preferences with respect to the real exchange rate, but also different instruments under their control to influence the course of the actual real exchange rate, our relevant state variables in the dynamic analysis will be the markup and the nominal exchange rate rather than the wage share and the real exchange rate itself. This will require, however, the use of some simplifying assumptions.

Motivated by these considerations, this paper develops a dynamic model of capacity utilization and growth in which the joint determination of income distribution and international competitiveness (measure by the real exchange rate) is taken into account in the determination of aggregate effective demand. In a given short run, how a change in the real exchange rate will affect capacity utilization and growth depends on whether it has come about through a change in either the nominal exchange rate or the markup (or both). The reason is that a change in the real exchange rate (wage share) brought about by a change in either the nominal exchange rate or the markup will not leave the wage share (real exchange rate) unchanged. Meanwhile, a change in the profit share (real exchange rate) brought about by a change in the markup will not leave the real exchange rate (profit share) unchanged. Indeed, a major motivation

[2] For instance, overvaluation during stabilization programmes occurred in Argentina and Chile in the 1970s, and in Brazil and Argentina in the 1990s. Fixed nominal exchange rates, controlled devaluations at a rate below the actual levels of domestic inflation, and high interest rates to achieve inflation targets, have been used in these countries as nominal anchors, leading in all cases to real exchange undervaluation (Ffrench-Davis and Ocampo, 2001). On the other hand, most developing economies and some Eastern European countries in the 1980s were obliged to keep the real exchange rate at a very high level (with disastrous implications, in most cases, for inflation and income distribution) in order to be able to service the external debt.

underlying our formal specification in terms of the markup and the nominal exchange rate (and not the distributive shares and the real exchange rate themselves) as state variables is precisely the need to take into explicit consideration such a joint determination of income distribution and international price competitiveness.

Over the medium run, the nominal exchange rate (markup) will vary in response to discrepancies between the actual real exchange rate and the real exchange rate preferred by the government (capitalists). However, as a change in the actual exchange rate may come about through a change in either the nominal exchange rate or the markup (or both), different specifications of the adjustment dynamics of the nominal exchange rate and the markup will have distinct implications in terms of existence and stability of a medium-run equilibrium solution for the real exchange rate, and thereby for the dynamics of capacity utilization and economic growth over the medium run.

Suppose the economy is in a given short run in which the monetary authority and capitalists have different (though endogenous) preferences with respect to the real exchange rate. The issues worth addressing then become (i) whether there is a medium-run equilibrium in which capitalists and the monetary authority come to have a common preferred real exchange rate, (ii) whether the economy will actually converge to any existing equilibrium solution in which preferences over the real exchange rate have become homogeneous, and (iii) what are the corresponding implications in terms of the dynamics of capacity utilization and growth. As derived in Section 4, while for the existence issue (i) the resulting finding was that there is indeed a medium-run (Nash) equilibrium characterized by capitalists and the monetary authority coming to share a preferred real exchange rate, the resulting findings for issues (ii) and (iii) depend crucially on the specifics of the adjustment dynamics of the nominal exchange rate and the markup. In fact, while in one specification of such adjustment dynamics the economy necessarily converges to the medium-run equilibrium characterized by capitalists and the monetary authority sharing a preferred real exchange rate, in another specification such a convergence obtains only by a fluke. In yet another specification of the adjustment dynamics, in which the government is mainly concerned with distribution in favor of workers when managing the nominal exchange rate, a limit cycle obtains. In this latter specification, therefore, the model produces conservative fluctuations in the markup and the nominal exchange rate, and hence in distributive shares and the real exchange rate; as a result, the economy experiences endogenous cyclical fluctuations of its international competitiveness, capacity utilization and economic growth that closely resemble the experience of several developing countries in different historical periods. As it turns out, a major empirical implication of the model developed in this paper is that all growth regressions featuring the real exchange rate (or an index of real exchange undervaluation) should include functional distribution (or proxies such as real unit labor costs) in the vector of control variables. Or, some procedure should be used to try to decompose a change in the real exchange rate (or in an index of real exchange undervaluation) into changes in the major components of the real exchange rate, namely, nominal exchange rate (or an index of nominal undervaluation), nominal unit labor (and, possibly, intermediate) costs and profit margins.

The remainder of the paper is organized in the following manner. Section 2 describes the building blocks of the model, and Section 3 analyzes its behavior in the short run. While Section 4 discusses the behavior of the model in the medium run, the closing section provides a summary of the main findings derived along the way.

2. The structure of the model

The domestic economy is open to international trade but its government sector is omitted for simplicity (except for the existence of a monetary authority in charge of managing the nominal exchange rate). Domestic production consists of a single good which can be used for both investment and consumption purposes. The resulting output is produced through a (fixed-coefficient) technological combination of two domestic (and homogeneous) factors of production, labor and capital, and an imported (composite) intermediate input. This fixed-coefficient assumption can be justified by reference to an independence of the choice of techniques of factor prices or to technological rigidities in factor substitution, it being amply supported by a reputable literature.[3]

Capitalist firms in oligopolistic markets carry out domestic production. They produce (and hire domestic labor) according to effective demand, it being considered only the case in which excess capital capacity prevails in the short and medium runs.[4] As a result, domestic labor employment is determined by domestic production:

$$L = aX \tag{1}$$

where L is the domestic employment level, X is the domestic real output (hereafter, simply 'output' or 'income') level, and a stands for the corresponding labor-output ratio. The latter, along with the other technical coefficients (domestic capital and imported intermediate input), is given at a point in time, having all resulted from previous technological dynamics. Over time (at least over the medium run),

[3] Verspagen (1990), for instance, shows that localized technological change strongly diminishes the short-run possibilities for factor substitution. Probably the most quoted formalization of localized technological change is still the one by Stiglitz and Atkinson (1969). The underlying idea is that for any industrial grouping the range of efficient techniques is often very small, sometimes reaching the limit of one technological system which rules at any point in time. Localized technical change strongly diminishes the short-run possibilities for substitution, and constant improvements of one single production technique usually lead to a Leontief shape similar to the one assumed here.

[4] Steindl (1952) argues that oligopolistic firms plan excess capital capacity so as to be ready for a sudden expansion of sales. One reason is that it is not possible to expand capacity step by step as the market grows due to the indivisibility and durability of the plant and equipment. There is also the issue of entry deterrence: if prices are sufficiently high, entry becomes feasible even where capital requirements are great; therefore, the holding of excess capacity allows olipolistic firms to confront new entrants by suddenly raising supply and driving prices down.

however, while the other technical coefficients are assumed to remain constant, the domestic labor-output ratio is assumed to fall at a rate h due to purely labor-augmenting (Harrod-neutral) technological change.

The domestic price level (hereafter, simply 'price level') is given at a point in time, it being determined as a markup over average prime costs in the following way:

$$P = z(aW + beP^m) \tag{2}$$

where $z > 1$ is the domestic markup factor (one plus the domestic markup, and hereafter simply 'markup'), W is the domestic nominal wage, b is the imported intermediate input coefficient, e is the nominal exchange rate (home currency price of foreign exchange) and P^m is the exogenously given foreign currency price of the imported (composite) intermediate input, which (for simplicity) is assumed to be equal to the international price level, P^*. Given the focus of this paper, b and P^* are assumed to remain constant over the medium run, so we simplify matters by normalizing both b and P^* to unity. For the same reason, we further assume that the domestic unit nominal labor cost, aW, remains constant over the medium run, as the nominal wage is contractually defined to grow at the same rate as labor productivity. As we normalize the constant value of aW to unity, the price level defined by (1) simplifies to:

$$P = z(1+e) \tag{3}$$

The domestic economy is therefore inhabited by two classes, capitalists and workers. Following the tradition of Kalecki (1971), Kaldor (1956), Robinson (1956, 1962) and Pasinetti (1962), we assume that these classes have different consumption (and hence saving) behavior. Workers provide labor and earn only wage income, which is all spent in consumption. Workers are always in excess supply, with the number of potential workers (labor supply) growing at a rate denoted by n. Capitalists receive profit income, which is the entire surplus over wages and imported inputs, and save all of it. In addition to capitalists and workers, therefore, there is also an external claimant on income represented by the imported intermediates. From (1) and (3), the share of labor in income, σ, is given by:

$$\sigma = Va = P^{-1} = \frac{1}{z(1+e)} \tag{4}$$

where $V = (W/P)$ stands for the domestic real wage (hereafter, simply 'real wage'). As $z > 1$ and $e > 0$, it follows the wage share as defined by (4) is automatically constrained to its economically relevant domain given by $0 < \sigma < 1$. However, it also follows that both the real wage and the wage share in income vary negatively with the markup and the nominal exchange rate. Meanwhile, as the profit income is the entire surplus over wages and imported inputs, the profit share in income, π, can be expressed as:

$$\pi = 1 - \frac{WL}{PX} - \frac{beP^*}{P} = 1 - \sigma - q \qquad (5)$$

where $q = eP^{-1}$ is the real exchange rate, as explored below (as b and P^* were normalized to unity, the share of imported intermediates in income is equal to the real exchange rate). As $z > 1$ and $e > 0$, the real exchange rate is automatically constrained to the economically relevant domain of the share of imported intermediates in income given by $0 < q < 1$. Meanwhile, as a rise in the markup lowers both the wage share and the real exchange rate, it unambiguously results in a rise in the profit share. A rise in the nominal exchange rate, however, will both lower the wage share and raise the real exchange rate. As it can be checked that $(\partial\sigma / \partial e) + (\partial q / \partial e) = 0$, though, a change in the nominal exchange rate leaves the profit share unchanged. In fact, we can use (3) and (4) to re-write (5) as follows:

$$\pi = 1 - z^{-1} \qquad (6)$$

which confirms that the profit share varies positively with the markup but is not affected by a change in the nominal exchange rate. Besides, as $z > 1$, the profit share is automatically constrained to its economically relevant domain given by $0 < \pi < 1$. Interestingly, given the purpose of this paper, the preceding analysis reveals that it is not possible for both the wage and the profit shares to rise simultaneously (which would require, per (5), a fall in the share of imported intermediates in income). Indeed, while a change in the markup or the nominal exchange rate will vary the wage share in the opposite direction, the same change will either vary the profit share in the same direction or leave it unaffected, respectively.

As regards the profit rate as an alternative measure of capitalists' profitability, the impact of a change in either the markup or the nominal exchange is ambiguous. To see this, note that the profit rate is given by:

$$r = (1 - \sigma - q)u = (1 - z^{-1})u \qquad (7)$$

where r is the domestic profit rate (hereafter, simply 'profit rate'), which is the flow of money profits divided by the value of the domestic capital stock, K, at output price, while u is domestic (capital) capacity utilization (hereafter, simply 'capacity utilization'). As a result, though a higher markup raises the profit share, the likely accompanying change in capacity utilization may make for a net decrease in the profit rate.

Meanwhile, the real exchange rate also depends ultimately on the markup and the nominal exchange, it being therefore given in the short run. As we define the real exchange rate as the relative price of foreign goods, a higher q means a real depreciation of the domestic currency or improved price competitiveness of domestic goods.[5] Formally, the real exchange rate can be re-written in terms of its ultimate determinants as:

$$q = \frac{e}{z(1+e)} \tag{8}$$

As a result, the real exchange rate varies positively (negatively) with the nominal exchange rate (markup), $\partial q / \partial e > 0$ ($\partial q / \partial z < 0$), which means that the pass-through of a nominal exchange rate change into the price level is incomplete. As seen above, however, both the real wage and the wage share in income vary negatively with the markup and the nominal exchange rate. The wage share and the real exchange rate are therefore functionally related in the following way:

$$\sigma(z,e) = \frac{q(z,e)}{e} \tag{9}$$

Hence whether the wage share and the real exchange rate will move in the same direction depends on what ultimate determinant of them will change. While a rise (fall) in the markup will lower (raise) both the wage share and the real exchange rate, a nominal exchange depreciation (rise in the nominal exchange rate) will lower the wage share and raise the real exchange rate. As it turns out, how a change in the real exchange rate will affect capacity utilization and growth in the short and medium runs will depend on the accompanying change in the wage share. The reason is that the resulting change in aggregate effective demand will depend on how both the wage share and the share of imported intermediates in income (and thereby the profit share, per (5)) will be affected by a change in any of their common ultimate determinants, namely, the markup and the nominal exchange rate.

Let's then move on to the specification of the behavior of the components of the aggregate effective demand, and we simplify matters by mostly using implicit functions all along. Given our assumption that workers' income is all spent in consumption, while capitalists save all of their profit income, the ratio of aggregate consumption to the capital stock, g^c, using (4), can be written as:

$$g^c = \sigma u = \frac{u}{z(1+e)} \tag{10}$$

Therefore, given capacity utilization, a higher markup or nominal exchange rate, by lowering workers' share in income, will lead to a fall in aggregate consumption as a proportion of the capital stock. Meanwhile, firms make capital accumulation plans described by the following implicit investment function:

[5] Clearly, this specification implicitly assumes that domestic and foreign goods are imperfect substitutes, as well as that exported goods are qualitatively the same as domestic goods.

$$g^i = g^i(\alpha, \pi, u, q) \tag{11}$$

where g^i is desired investment as a proportion of the capital stock, α is a parameter describing autonomous investment governed by (say) Keynes' animal spirits and $g^i_\alpha, g^i_\pi, g^i_u > 0$. We follow Marglin and Bhaduri (1990) in making investment to depend positively on the profit share. A broader rationale for this specification is that, given capacity utilization, the current profit share is an index of expected future earnings and both provides internal funding for investment and makes it easier to raise external funding. Meanwhile, we follow Rowthorn (1981) and Dutt (1984, 1990), who in turn follow Steindl (1952), in assuming that capital accumulation plans depend positively on capacity utilization due to accelerator-type effects.[6] As it turns out, so far our investment function follows the specification considered to be the preferred one in the literature following Marglin and Bhaduri (1990).

Meanwhile, there are reasonable theoretical and empirical grounds for including the real exchange rate as a separate argument in the investment function above, even if the sign of the corresponding partial derivative, g^i_q, cannot be unambiguously ascertained. For instance, on theoretical grounds, a change in the exchange rate has an impact on the price competitiveness of firms (both at home, given the competition of imported substitutes, and abroad, due to the change in export prices) and on the cost of imported inputs. Yet most available theoretical models provide no clear indication as to which effect is dominant, and the overall effect of exchange rates on investment remains an empirical question. And, as reported in what follows, the empirical evidence seems to be more favorable to the assumption that investment varies positively with the real exchange rate, so we assume $g^i_q > 0$.

Campa and Goldberg (1999) compare the investment sensitivity to exchange rate in the United States, United Kingdom, Japan, and Canada for the period 1970-93, and find investment in Canada to be the least responsive to exchange rate movements. Nucci and Pozzolo (2001) investigate the relationship between exchange rate fluctuations and the investment decisions of a sample of Italian manufacturing firms. The results support the view that an exchange rate depreciation rate has a positive effect on investment through the price competitiveness channel, but a negative effect through the cost of imported inputs channel. Expectedly, the magnitude of these effects varies over time with changes in the firm's external orientation, as measured by the share of foreign sales over total sales, and the dependence on imported inputs. The impact of exchange rate changes on investment is stronger for firms with lower degree of monopoly power (proxied by lower price-cost margins), facing a high degree of import penetration in the domestic market, and of a small size. Besides, they find evidence that the degree of

[6] As recalled in footnote 5, Steindl (1952) argues that firms aim at the preservation of a certain margin of excess capacity. In the event, therefore, that actual excess capacity falls below the desired one, firms will tend to speed up the pace of capital accumulation.

substitutability between domestically produced and imported inputs influences the impact through the expenditure side.

Meanwhile, Blecker (2007) analyzes the effects of the real value of the U.S. dollar on aggregate investment in the U.S. domestic manufacturing sector, using annual time-series data for 1973-2004. The main result of the econometric estimation is a negative effect that is much larger than those found in previous studies. Moreover, the exchange rate is found to affect investment mainly, although not exclusively, through the channel of financial or liquidity constraints, rather than by affecting the desired stock of capital. Interestingly, counterfactual simulations show that U.S. manufacturing investment would have been 61% higher in 2004 if the dollar had not appreciated after 1995. In a different approach, Landon and Smith (2006) estimate the impact of exchange rate movements on the industry-level price of investment goods using a panel of OECD countries. They find that an exchange rate depreciation (appreciation) causes a significant rise (fall) in the prices of the investment goods used by most industries. However, the magnitude of this effect differs greatly across sectors, with a currency depreciation causing a stronger increase in the price of investment goods used by industries that produce high-technology products and employ a larger proportion of imported capital. As a result, changes in the exchange rate may affect both the level and distribution of investment across sectors.

Meanwhile, Razmi, Rapetti and Skott (2009) use panel data for 184 countries with 5-year time periods spanning 1960-2004 and find that real exchange rate undervaluations are (statistically) significant drivers of investment growth, but only in developing countries, this result being robust to different specifications, controls, and econometric methods. Meanwhile, Bahmani-Oskooee and Hajilee (2010) investigate the effect of currency depreciation on domestic investment using a time-series model of 50 countries for the 1975–2006 period. Though they find significant positive short-run effects of currency depreciation on domestic investment in 43 out of the 50 countries, it is only in 21 countries that there are also long-run effects. This latter evidence is inconclusive, though, as a depreciation results in an increase in domestic investment in 10 countries, and results in a decrease in the remaining 11 countries.

All in all, the empirical evidence seems therefore to be more favorable to the assumption that investment varies positively with the real exchange rate, which implies assuming $g_q^i > 0$ in (11). Note, however, that the determinants of investment which are taken as given in the short run (namely, π and q) depend on the state variables z and e, with π varying positively with z and q varying positively with e and negatively with z. Therefore, while g^i varies unambiguously positively with e, it varies either positively or negatively with z. Let's then conveniently re-write (11) as:

$$g^i = g^i(z, e, u, \alpha) \qquad (12)$$

with $g_e^i > 0$. As for the sign of g_z^i, it will be positive (negative) if an increase in z, by raising π, makes for a rise in investment which more (less) than offsets the concomitant fall in investment generated by the accompanying fall in q. We will refer to $g_z^i > 0$ ($g_z^i < 0$) as a case of π–effect (q–effect) dominance in investment behavior.

Finally, we specify net exports (in real terms) as a proportion of the capital stock, g^f, using the following implicit function:

$$g^f = g^f(q,u,u^*) \tag{13}$$

where u^* is foreign capacity utilization, which is exogenously given. In a standard way, we assume that net exports vary positively (negatively) with the real exchange rate and foreign (domestic) capacity utilization, so that $g_q^f > 0$ (the Marshall-Lerner condition holds), $g_{u^*}^f > 0$ and $g_u^f < 0$. Now, the domestic determinant of net exports which is taken as given in the short run (namely, q) depends on the state variables z and e, varying negatively with former and positively with the latter. Let's then conveniently re-write (13) as:

$$g^f = g^f(z,e,u,u^*) \tag{14}$$

It then follows that $g_e^f > 0$ and $g_z^f < 0$.

3. The behavior of the model in the short run

For the domestic economy, which is the focus of this paper, the short run is defined as a time frame in which the following variables can be taken as given: the stock of capital, K, the supply of labor, N, the markup, z, the labor-output ratio, a, the money wage rate, W, the imported (composite) intermediate input coefficient, b, the nominal exchange rate, e (and therefore the price level, P, the real exchange rate, q, and the distributive shares, σ and π) and the relevant foreign variables, u^*, P^m and P^*.

Since domestic firms hold excess capacity and produce according to aggregate effective demand, the macroeconomic equality between leakages and injections (or, the goods market equilibrium) is reached through changes in capacity utilization. Hence the existence of excess capacity allows capacity utilization to adjust to remove any excess demand or supply in the domestic economy. The goods market equilibrium condition can therefore be expressed as:

$$u = g^d \equiv g^c + g^i + g^f \tag{15}$$

where g^d is aggregate effective demand as a proportion of the capital stock. As the government sector is omitted for simplicity (except for the existence of a monetary authority that manages the nominal exchange rate), the domestic economy's savings ($g^s = u - g^c$) are spent on financing investment (g^i) and the trade surplus (g^f). As a result, if net exports are negative ($g^f < 0$) and there is therefore a trade deficit, it then follows that the excess of domestic investment over national saving is financed by a corresponding inflow of foreign saving.[7] Meanwhile, when there is trade surplus or deficit ($g^f \neq 0$) and capital is assumed not to depreciate, the growth rate of the capital stock (which is actually the growth rate of this one-good economy) is given by $g = g^i = g^s - g^f$.

Substituting (10), (12) and (14) into (15) yields the following implicit solution for the short-run equilibrium value of domestic capacity utilization:

$$u = g^d = g^c(z,e,u) + g^i(z,e,u,\alpha) + g^f(z,e,u,u^*) \qquad (16)$$

Given the demand-driven nature of the equilibrium value of capacity utilization, the corresponding equilibrium condition is that u varies positively (negatively) when there is positive (negative) excess aggregate effective demand (which is given by $EDG = g^d - u$). Therefore, the short-run equilibrium condition is given by:

$$\frac{\partial EDG}{\partial u} = g_u^c + g_u^i + g_u^f - 1 < 0 \qquad (17)$$

which can be re-expressed alternatively as $g_u^c + g_u^i + g_u^f < 1$ or $g_u^i + g_u^f < g_u^c$. Intuitively, using the latter inequality, in the neighborhood of the equilibrium value of capacity utilization, effective demand injections (investment and exports) should respond less than effective demand leakages (national savings plus imports) to a change in capacity utilization. In other words, any deviation of the excess aggregate effective demand from its zero value is self-correcting.

Even though we cannot obtain an explicit solution for capacity utilization (denoted by u'), we can nonetheless perform useful comparative statics exercises with respect to distribution and the real exchange rate. Note, however, that we cannot hold the shares of wages and profits constant when the real exchange rate changes and vice versa. The reason is that a change in the real exchange rate (wage share) brought about by a change in either the nominal exchange rate or the markup will not leave the wage

[7] Note that $g^s = u - g^c = (\pi(z) + q(z,e))$, so that national saving per unit of capital, g^s, is also comprised by saving supplemented by imports. Indeed, recall that $q = [e / z(1+e)]$, so that the share of imported inputs in income (which is equal to the real exchange rate) is increasing in the share of imports in variable cost (given by $be/(aW+be) = e/(1+e)$). As a higher import cost acts a vehicle for foreign saving, national saving per unit of capital therefore rises with the share of imports in variable cost.

share (real exchange rate) unchanged, as shown by (4) and (8). Meanwhile, a change in the profit share (real exchange rate) brought about by a change in the markup will not leave the real exchange rate (profit share) unchanged, as shown by (6) and (8). Indeed, a major motivation underlying our model specification in terms of the markup and the nominal exchange rate (and not the distributive shares and the real exchange rate) is precisely the need to take into explicit consideration such a joint dynamic endogeneity of distribution and the real exchange rate.

Let's then firstly totally differentiate (16) with respect to capacity utilization and the nominal exchange rate (and hence hold the markup constant) to obtain:

$$\frac{\partial u'}{\partial e} = \frac{g_e^c + g_e^i + g_e^f}{\Delta} \tag{18}$$

where $\Delta \equiv 1 - g_u^c - g_u^i - g_u^f > 0$ is the short-run equilibrium condition given by (17). Therefore, for a nominal exchange devaluation (and, given its incomplete pass-through into the price level, a real exchange devaluation) to raise equilibrium capacity utilization the numerator of the above expression has to be positive. Now, while a nominal devaluation leading to a real devaluation makes for a rise in both investment and net exports, it also makes, by reducing the wage share, for a fall in consumption (recall that a nominal devaluation, despite leaving the profit share unchanged, makes for a rise in the share of intermediate imports in income, which is equal to the real exchange rate, at the expense of the wage share). As it turns out, nominal exchange devaluations raise (lower) equilibrium capacity utilization if what we term its price competitiveness effect (raising of the real exchange rate) is stronger than what we term its distributive effect (lowering of the wage share).

Let's now totally differentiate (16) with respect to capacity utilization and the markup (and hence hold the nominal exchange rate constant) to obtain:

$$\frac{\partial u'}{\partial z} = \frac{g_z^c + g_z^i + g_z^f}{\Delta} \tag{19}$$

where $\Delta \equiv 1 - g_u^c - g_u^i - g_u^f > 0$ is again the short-run equilibrium condition given by (17). Therefore, for a rise in the markup, which lowers both the real exchange rate (and hence the share of imported intermediates in income) and the wage share (and hence raises the profit share by more than it lowers the wage share) to raise equilibrium capacity utilization the numerator of the above expression has to be positive. Now, a rise in the markup, by leading to a real exchange appreciation, makes for a fall in both investment and net exports. Meanwhile, though a rise in the markup, by lowering both the wage share and the share of imported intermediates in income, makes for a fall in consumption, it also makes, by increasing the profit share, for a rise in investment. As inferred above in the discussion following (12), the sign of g_z^i is positive (negative) if an increase in the markup, by raising the profit share, makes for a rise in investment which more (less) than offsets the concomitant fall in investment generated by the accompanying fall in the real exchange rate. Therefore, if there is q–effect dominance in investment ($g_z^i < 0$), as we termed it in the discussion following (12), a rise in the markup unambiguously makes for a fall in equilibrium capacity utilization. Meanwhile, a π–effect dominance in investment ($g_z^i > 0$) which is strong enough to more than offset the accompanying fall in consumption and net exports following a rise in the markup makes for a resulting rise in equilibrium capacity utilization. We will refer to $u'_z > 0$ ($u'_z < 0$) as a case of π–effect (σq–effect) dominance in capacity utilization. Therefore, while a necessary condition for a π–effect dominance in capacity utilization ($u'_z > 0$) is a π–effect dominance in investment ($g_z^i > 0$), a q–effect dominance in investment ($g_z^i < 0$) makes for an unambiguously σq–effect dominance in capacity utilization ($u'_z < 0$).

Interestingly, our model shows that what is usually dubbed 'wage-led capacity utilization' ($u'_\sigma > 0$) in the post-Keynesian literature more broadly can be brought about, in an open economy, by a fall in either the markup or the nominal exchange rate. As seen above, however, while a nominal exchange appreciation leading to a real appreciation makes for a fall in both investment and net exports, it also makes, by raising the wage share, for a rise in consumption (recall that a nominal appreciation, despite leaving the profit share unchanged, makes for a fall in the share of intermediate imports in income which translates into a rise in the wage share). Therefore, wage-led capacity utilization through a nominal appreciation obtains when what we termed as its distributive effect (raising of the wage share) is stronger than what we termed as its price competitiveness effect (real appreciation); in this case, a nominal appreciation makes for a rise in consumption that more than compensates the accompanying fall in investment and net exports. Meanwhile, as also seen above, a fall in the markup, by leading to a real exchange depreciation, makes for a rise in both investment and net exports. However, though a fall in the markup, by raising the wage share, makes for a rise in consumption, it also makes, by reducing the profit share, for a fall in investment. Therefore, wage-led capacity utilization through a fall in the markup obtains when there is what we termed above as σq–effect dominance in capacity utilization; in this case, a fall in the markup makes for a rise in consumption and net exports that more than compensates any eventual accompanying fall in investment.

Meanwhile, our model shows that what is usually dubbed 'profit-led capacity utilization' ($u'_\pi > 0$) in the post-Keynesian literature can be brought about, even in an open economy, solely by a rise in the markup, as the profit share does not depend on the nominal exchange rate. Indeed, it is only the distribution between workers and an external claimant represented by the share of imported intermediates in income which is affected by changes in the nominal exchange rate. Now, as seen above, a rise in the markup, by leading to a real exchange appreciation, makes for a fall in both investment and net exports. Meanwhile, though a rise in the markup, by lowering both the wage share and the share of imported intermediates in income, makes for a fall in consumption, it also makes, by increasing the profit share, for a rise in investment. As inferred in the discussion following (12), the sign of g_z^i is positive (negative) if an increase in the markup, by raising the profit share, makes for a rise in investment which more (less) than offsets the concomitant fall in investment generated by the accompanying fall in the real exchange rate. Therefore, profit-led capacity utilization through a rise in the markup obtains when there is what we termed above as π–effect dominance in capacity utilization; in this case, a rise in the markup makes for a rise in investment that more than compensates the accompanying fall in consumption and net exports.

We cannot obtain an explicit solution for the growth rate either, but can likewise perform useful comparative statics exercises with respect to distribution and the (nominal and real) exchange rate. As noted above, when there is trade surplus or deficit ($g^f \neq 0$) and capital is assumed not to depreciate, the growth rate of the capital stock (which is actually the growth rate of this one-good economy, denoted by g') is given by $g' = g^i = g^s - g^f$.

Therefore, let's firstly differentiate (12) with respect to the nominal exchange rate (and hence hold the markup constant) and use (18) to obtain:

$$\frac{\partial g'}{\partial e} = \frac{g_e^i(1 - g_u^c - g_u^f) + g_u^i(g_e^c + g_e^f)}{\Delta} \tag{20}$$

where $\Delta \equiv 1 - g_u^c - g_u^i - g_u^f > 0$ is again the short-run equilibrium condition given by (17), so that the first term in parentheses in the numerator is positive. Meanwhile, g_u^i, which measures the accelerator effect in the investment function, g_e^i, which measures the impact of a nominal devaluation (which leads to a real devaluation) on investment, and g_e^f, which measures the impact of a nominal devaluation (which leads to a real devaluation) on net exports, are all positive. It is intuitive, therefore, that it takes a very strong (negative) impact of a nominal devaluation on consumption, given by g_e^c, to avoid that such devaluation results in a higher equilibrium growth rate.

Interestingly, our model shows that what is usually dubbed 'wage-led growth' ($g'_\sigma > 0$) in the post-Keynesian literature more broadly can be brought about, in an open economy, by a nominal exchange appreciation. However, it requires that the positive impact of a nominal appreciation (which leads to a real appreciation) on consumption is strong enough to more than compensate the accompanying fall in investment and net exports[8].

Let's now differentiate eq. (12) with respect to the markup (and hence hold the nominal exchange rate constant) and use eq. (19) to obtain:

$$\frac{\partial g'}{\partial z} = \frac{g_z^i(1-g_u^c-g_u^f)+g_u^i(g_z^c+g_z^f)}{\Delta} \tag{21}$$

where $\Delta \equiv 1-g_u^c-g_u^i-g_u^f>0$ is again the short-run equilibrium condition given by (17), so that the first term in parentheses in the numerator is positive. As seen above, the sign of g_z^i is ambiguous, it being positive (negative) if an increase in z, by raising π, makes for a rise in investment which more (less) than offsets the concomitant fall in investment generated by the accompanying fall in q. We referred to $g_z^i>0$ ($g_z^i<0$) above as a case of π–effect (q–effect) dominance in investment behavior. Meanwhile, g_z^c, which measures the impact of a change in the markup on consumption, and g_z^f, which measures the impact of a change in the markup on net exports, are both negative. Therefore, given that g_u^i, which measures the accelerator effect in the investment function, is positive, it follows that a situation of q–effect dominance in investment behavior ($g_z^i<0$) ensures that the equilibrium growth rate unambiguously varies negatively with the markup; in this case, after all, a rise in the markup makes for a fall in all components of aggregate effective demand. It is then the case that a necessary condition for the growth rate to vary positively with the markup is that there is π–effect dominance ($g_z^i>0$) in investment behavior. However, (21) shows that it may take a strong positive impact of a rise in the markup on investment for the corresponding rise the profit share to reduce in a higher growth rate. Hence our model shows that what is usually dubbed 'profit-led growth' ($g'_\pi>0$) in the post-Keynesian literature can be brought about, even in an open economy, solely by a rise in the markup; however, profit-led growth may require quite a strong positive response of investment to a rise in the markup.

Finally, (21) also reveals under what conditions what is usually dubbed 'wage-led growth' ($g_\sigma>0$) is generated by a fall in the markup. Indeed, a fall in the markup, by leading to a real exchange depreciation, makes for a rise in both investment and net exports. However, though a fall in the markup, by raising the wage share, makes for a rise in consumption, it also makes, by reducing the profit share, for a fall in investment. Therefore, wage-led growth through a fall in the markup unambiguously obtains when there is what we termed above as q–effect dominance in investment behavior ($g_z^i<0$); in this

[8] Clearly, wage-led growth driven by the appreciation of the domestic currency may give rise to mounting problems in the external front over the longer run. Though we confine attention to the medium run in the dynamic analysis carried out in the next section, such a strategy would be unsustainable in the long run.

case, a fall in the markup makes for a rise in all components of aggregate effective demand. Yet wage-led growth ($g_\sigma > 0$) through a fall in the markup may still obtain even if there is what we termed above as π–effect dominance in investment behavior ($g_z^i > 0$); what is necessary, in this case, is that the corresponding fall in investment is not strong enough to more than compensate the accompanying rise in consumption and net exports.

4. The behavior of the model in the medium run

In the medium run we assume that the short-run equilibrium values of the variables are always attained, with the economy moving over time with changes in the following variables: K, whose dynamics is given by g above; z; e; N, whose growth rate is equal to n; a, which falls at an exogenous rate h; and W, whose growth rate is equal to h. Given the focus of this paper, the labor market (but not the labor supply) is assumed to play a passive role, which justifies the assumption that the nominal wage is contractually defined to grow at the same rate as labor productivity. In this spirit, we assume that the natural growth rate (given by $g_n = n + h$) adjusts to g through changes in n, which implies (further assuming that such an adjustment is fast enough) a constant employment rate over the medium run. Therefore, we will follow the behavior of the system over the medium run by formally examining the joint dynamic behavior of the markup and the nominal exchange rate. As shown by (3)-(4) and (6)-(8), steady-state values for z and e imply steady-state values for the price level, the distributive shares (including the share of intermediate imports, which is equal to the real exchange rate) and the profit rate, and hence for the rates of capacity utilization and growth.

The nominal exchange rate is managed by the monetary authority in the following 'crawling peg' way:

$$\hat{e} = \phi(q_g - q) \tag{22}$$

where $\hat{e} = (de/dt)(1/e)$ denotes the proportionate rate of change of the nominal exchange rate, q_g is the preferred real exchange rate by the government and $\phi > 0$ is the corresponding speed of adjustment. The reaction function above is intended to convey the idea that the monetary authority, taking the markup as given (as it is not under its direct control), manages the nominal exchange rate so as to achieve its preferred real exchange rate. Given the markup, therefore, corresponding to a given preferred real exchange rate by the government there is an exogenous preferred nominal exchange rate, e_g. To make this intuition explicit, we use (8) to re-write the above reaction function as:

$$\hat{e} = \phi\left[\frac{e_g}{z(1+e_g)} - \frac{e}{z(1+e)}\right] \tag{23}$$

Meanwhile, capitalists manage the markup so as to achieve a preferred level of international competitiveness as measured by the real exchange rate:

$$\hat{z} = \lambda(q - q_c) \tag{24}$$

where $\hat{z} = (dz/dt)(1/z)$ denotes the proportionate rate of change of the markup, q_c is the preferred real exchange rate by capitalists and $\lambda > 0$ is the corresponding speed of adjustment. Analogously to the reaction function governing the dynamics of the nominal exchange rate, the reaction function above is intended to convey the idea that capitalists, taking the nominal exchange rate as given (as it is not under their direct control), manage the markup so as to achieve their preferred international competitiveness as measured by the real exchange rate. Given the nominal exchange rate, therefore, corresponding to a given preferred real exchange rate by capitalists there is an exogenous preferred markup, z_c. To make this intuition explicit, we use (8) to re-write the above reaction function as:

$$\hat{z} = \lambda\left[\frac{e}{z(1+e)} - \frac{e}{z_c(1+e)}\right] \tag{25}$$

We can now solve for the medium-run equilibrium by imposing the equilibrium conditions $\hat{z} = \hat{e} = 0$ on (25) and (23). As z and e are both strictly positive, this yields the isoclines:

$$z = z_c \tag{26}$$

and:

$$e = e_g \tag{27}$$

It follows directly from (26) and (27) that $z' = z_c$ and $e' = e_g$, respectively (where an apostrophe again denotes the equilibrium value of a variable), so that there is a unique (non-trivial) medium-run equilibrium solution.[9] Moreover, the corresponding equilibrium solution for the real exchange rate is given by $q' = q_c = q_g$. Note that the equilibrium configuration so identified is stable, as the determinant and the trace of the Jacobian matrix corresponding to the system given by (23) and (25) (both evaluated at the non-trivial solution) are positive and negative, respectively. Graphically, the $\hat{z} = 0$ isocline is parallel to the e axis, while the $\hat{e} = 0$ isocline is parallel to the z axis, with the equilibrium configuration

[9] In game-theoretic parlance, the reaction functions given by (23) and (25) can be interpreted as best reply functions and the resulting medium-run equilibrium solution can therefore be defined as a Nash equilibrium.

given by $E_1 = (z', e') = (z_c, e_g)$ being a stable node (which implies that any convergence of the nominal exchange rate to its medium-run equilibrium value does not involve either over- or undershooting).

Note that our specification of the preferred real exchange rates q_g and q_c (which makes explicit the distinction between controllable and non-controllable variables by those who hold them) makes them endogenous variables. Indeed, it is only in the medium-run equilibrium that the monetary authority and capitalists come to share a common preference with respect the level of the real exchange rate.

As a result, not only is the monetary authority able to both set and achieve a desired nominal exchange rate, it is able to do so without thwarting the achievement of any desired markup by capitalists set independently of e_g. Note that, by the same token, it is also possible in the model above for capitalists to set and pursue a desired markup without thwarting the achievement of any desired nominal exchange by the monetary authority set independently of z_c. To see these results, consider again a figure plotting the isoclines in (26) and (27) assuming two different desired nominal exchange rates and two different desired markups. Suppose firstly that the monetary authority, willing to improve external competitiveness from its medium-run equilibrium, raises q_g to $q_g^{''}$ by raising e_g to $e_g^{''}$. As a result, the $\hat{e} = 0$ isocline moves upward (assuming that e is in the vertical axis) and the new medium-run equilibrium, E_2, is characterized by higher levels of nominal and real exchange rate. In fact, the economy converges to its new medium-run equilibrium along the original $\hat{z} = 0$ isocline, with the gap between the higher q_g and the current q being closed over time as e rises. And as e and q rises, so does q_c, given that $z = z_c$ along the convergence path.

Indeed, this same rise (depreciation) in the medium-run equilibrium real exchange rate could be obtained through a rise in the same amount in the preferred real exchange rate by capitalists. Indeed, a rise in q_c (to which, given the nominal exchange rate, a fall in z_c to $z_c^{''}$ corresponds) moves the $\hat{z} = 0$ isocline leftward (assuming that z is in the horizontal axis), with the new medium-run equilibrium configuration, E_3, being characterized by a lower markup and a higher real exchange rate. In this case, the economy converges to its new medium-run equilibrium along the original $\hat{e} = 0$ isocline, with the gap between the higher q_c and the current q being closed over time as z rises. And as z falls and q rises, q_g likewise rises, given that $e = e_g$ along the convergence path.

However, note that these two ways of increasing the medium-run equilibrium level of international competitiveness have quite different distributive (and hence capacity utilization and growth) implications. In fact, nominal exchange devaluations, by translating into real depreciations, reduce the wage share despite keeping the profit share unchanged. As seen in the previous section, while a real exchange devaluation makes for a rise in both investment and net exports, it also makes, by reducing the wage share, for a fall in consumption which may be strong enough to result in a fall in capacity utilization and (eventually) growth in the new medium-run equilibrium (per (18) and (20)). Meanwhile, a fall in the markup, by leading to real exchange depreciation, also makes for a rise in both investment and net exports. Now, though a fall in the markup, by raising both the wage share and the share of imported intermediates in income, makes for a rise in consumption, it also makes, by reducing the profit share, for a fall in investment. As inferred above in the discussion following (12), the sign of g_z^i is negative (positive) if a fall in the markup, by lowering the profit share, makes for a fall in investment which less (more) than offsets the concomitant rise in investment generated by the accompanying rise in the real exchange rate. Therefore, if there is q–effect dominance in investment ($g_z^i < 0$), as we termed it in the discussion following (12), a fall in the markup unambiguously makes for a rise in equilibrium capacity utilization. Meanwhile, a π–effect dominance in investment ($g_z^i > 0$) which is strong enough to more than offset the accompanying rise in consumption and net exports following a fall in the markup makes for a resulting fall in equilibrium capacity utilization and (eventually) growth (per (19) and (21)).

Therefore, an interesting feature of the model is that it provides an explanation for a stable medium-run real exchange rate based on the tradition of analyzing the evolution of prices (among which the nominal exchange rate) from the standpoint of the distributive conflict. While macrodynamic models generally assume that there is an exogenous level of the real exchange rate acting as a medium (or long) run attractor, our model endogenously produces an equilibrium real exchange rate stemming from evolving heterogeneous preferences over the exchange rate by the government and capitalists. In fact, the level at which the real exchange rate will become stable in the medium run can be traced back to reasonable assumptions about the preferred levels by capitalists and the monetary authority and their corresponding reaction functions.. Moreover, the dynamic framework set forth above is flexible enough to allow for changes in behavioral assumptions related to domestic and external conditions (more or less intense foreign competition) and evolving objectives by the government (giving more weight either to income distribution, stabilization or international competitiveness and growth).

Indeed, the dynamic analysis conducted so far assumes that the monetary authority has a preferred real exchange rate, q_g (to which, given the markup, a desired nominal exchange rate, e_g, corresponds) and manages the actual nominal exchange rate as described by (22). Analogously, capitalists are assumed to have a preferred real exchange rate, q_c (to which, given the nominal exchange rate, a desired markup, z_c, corresponds) and to manage the actual markup according to (24). Meanwhile, (23) conveys the idea that the monetary authority, by taking its non-controllable variable (z) as given, manages its controllable variable (e) over time so as to achieve its preferred real exchange rate. Analogously again, (25) conveys the idea that capitalists, by taking their non-controllable variable (e) as given, manage their controllable variable (z) over time so as to achieve their preferred real exchange rate.

Let's now specify the dynamic adjustment of the nominal exchange rate and the markup in the following alternative way (allowed by our decomposition of the real exchange rate into its ultimate determinants, the nominal exchange rate and the markup). Instead of (23) and (25) we now have:

$$\hat{e} = \phi\left[\frac{e}{z_g(1+e)} - \frac{e}{z(1+e)}\right] \tag{28}$$

and

$$\hat{z} = \lambda\left[\frac{e}{z(1+e)} - \frac{e_c}{z(1+e_c)}\right] \tag{29}$$

We are therefore assuming, let's say, interactive reaction functions. We are basically assuming that $e = e_g$ and $z = z_c$ continuously, as if resulting from an instantaneous adjustment. Meanwhile, z_g denotes the desired markup by the monetary authority (that is, given e, the markup implied by its preferred real exchange rate) and e_c denotes the desired nominal exchange rate by capitalists (that is, given z, the nominal exchange rate implied by their preferred real exchange rate). Basically, we are again using the fact that there are at least two reasons for why, for instance, q is lower than q_g: first, given z, we have $e < e_g$; and second, given e, we have $z > z_g$. Recall, however, that the monetary authority controls e rather than z. In the previous specification, we assumed that the monetary authority, taking z as given, measures any discrepancy between q and q_g, and changes e accordingly, by the corresponding discrepancy between e and e_g. In this alternative specification, meanwhile, we assume that the monetary authority, taking e as given (as $e = e_g$ instantaneously), measures any discrepancy between q and q_g, and changes e accordingly, by the corresponding discrepancy between z and z_g. And we are applying the same intuition to capitalists' preferred real exchange rate. In fact, there are at least two reasons for why, for instance, q is lower than q_c: first, given e, we have $z > z_c$; and second, given z, we have $e < e_g$. Recall, however, that capitalists control z rather than e. In the previous specification, we assumed that capitalists, taking e as given, measure any discrepancy between q and q_c, and changes z accordingly, by the corresponding discrepancy between z and z_c. In this alternative specification, meanwhile, we assume that capitalists, taking z as given (as $z = z_c$ instantaneously), measure any discrepancy between q and q_c, and change z accordingly, by the corresponding discrepancy between e

and e_c. In the first specification, therefore, the lag is in the adjustment of e to e_g, and of z to z_c; in this second specification, the lag is in the adjustment of e to e_c, and of z to z_g.

A possible substantive rationale for the reaction function given by (28) is to assume that the government aims to curb firms' market power. Whenever the markup is considered by policy-makers as too high, the government reduces e and puts more competitive pressure on domestic firms. In fact, such a policy may be part of an effort to reduce the price level of the economy. Conversely, if z is already low and the government considers that this may compromise, for instance, internal funds for investment, then the government raises e (which amounts to increase the "protection" of domestic firms from foreign competition). Firms then react by reasserting their own perception of the market power they actually have. They will be less concerned with income distribution and more concerned with not moving too far apart of what they see as a sustainable level of international competitiveness.

We can solve for the medium-run equilibrium corresponding to this alternative specification by imposing the equilibrium conditions $\hat{z} = \hat{e} = 0$ on (28) and (29). As z and e are both strictly positive, this yields the isoclines:

$$e = e_c \qquad (30)$$

and:

$$z = z_g \qquad (31)$$

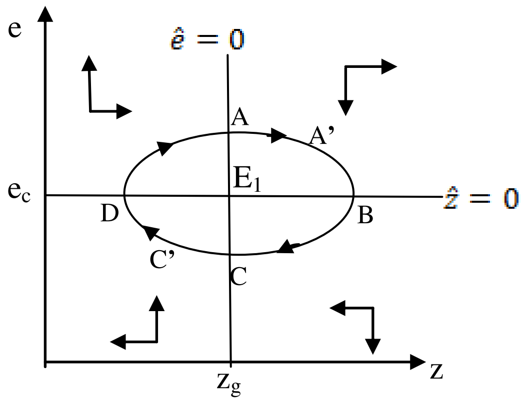
It follows directly from (30) and (31) that $e' = e_c$ and $z' = z_g$, respectively (where an apostrophe again denotes the equilibrium value of a variable), so that there is a unique (non-trivial) medium-run equilibrium solution. Moreover, the corresponding equilibrium solution for the real exchange rate is given by $q' = q_c = q_g$. Note that the equilibrium configuration so identified is saddle-point unstable, though, as the determinant of the Jacobian matrix corresponding to the system given by (28) and (29) (evaluated at the non-trivial solution) is negative, which is a necessary and sufficient condition for saddle-point instability to obtain. Graphically, the $\hat{z} = 0$ isocline is parallel to the z axis, while the $\hat{e} = 0$ isocline is parallel to the e axis, with the equilibrium configuration given by $E_1 = (z', e') = (z_g, e_c)$ being saddle-point unstable. As a result, any convergence of the nominal exchange rate to its medium-run equilibrium value (which nonetheless takes place solely along the negatively sloped stable arm of the saddle path, assuming that e is in the vertical axis) does not involve either over- or undershooting.

Now, what if the monetary authority cares more about distribution (to wit, share of workers in income) than international competitiveness? Recall that the real exchange rate and the share of workers in income are inversely related. In the previous specification, (28) shows that when z rises, the monetary authority reacts by raising e. However, both changes affect the wage share negatively, so that workers my have enough influence over the monetary authority to persuade it to compensate for a rise in z with a reduction in e. Note that now it is the real exchange rate that is affected negatively by both changes, though the workers' share may end up rising. Formally, this pro-labor crawling peg, let's say, means that the parameter ϕ in (28) becomes negative. As with previous specification, it follows directly from (30) and (31) that $e' = e_c$ and $z' = z_g$, respectively, so that there is a unique (non-trivial) medium-run equilibrium solution. Moreover, the corresponding equilibrium solution for the real exchange rate is given by $q' = q_c = q_g$. Note that a limit cycle obtains, though, as the determinant and the trace of the Jacobian matrix corresponding to the system given by (28) and (29) (evaluated at the non-trivial solution) are now positive and zero, respectively. Graphically, the $\hat{z} = 0$ isocline is parallel to the z axis, while the $\hat{e} = 0$ isocline is parallel to the e axis, yielding the equilibrium configuration represented by $E_1 = (z', e') = (z_g, e_c)$. As a result, the nominal exchange rate oscillates over time, alternating between over- or undershooting along the way.

In this third specification, therefore, we suppose that the monetary authority (possibly under the pressure of workers) actually manages the nominal exchange rate to ensure that workers' share in income (and the implied real exchange rate) is realized: $\sigma_g = \sigma_w \Rightarrow q_g = q_w$. As a result, there is a (unique) stationary point again, but a *limit cycle* obtains. For any initial values of the nominal exchange rate and the markup, the solution of the system yields a closed trajectory: if left undisturbed, the model will produce conservative cyclical fluctuations in the nominal exchange rate and the markup (and hence in the real exchange rate, income distribution, capacity utilization and growth). In fact, there is now a dynamic conflict between distribution (with the monetary authority managing the nominal exchange rate so as to ensure that workers' desired wage share, and the implied workers' preferred real exchange rate, is reached) and external competitiveness.

Consider point A in Figure 1. As $z = z_g$ but $e > e_c$, it follows that $q > q'$, so that the reaction functions make the economy move over time with rising markup and falling nominal exchange rate. In B, $e = e_c$ but $z > z_g$, so that $q < q'$. In fact, in its way from A to B the economy crosses point A', in which $q = q'$. Now, what happens to distribution (measured by the wage share), capacity utilization and growth as the economy travels from A to B depends on the signs of the corresponding comparative statics, as discussed in the previous section. Consider point C now. As $z = z_g$ but $e < e_c$, it follows that $q < q'$, so that the reaction function make the economy moves over time with rising nominal exchange rate and falling markup. In D, $e = e_c$ but $z < z_g$, so that $q > q'$. Indeed, in its way from C to D the economy crosses again the isocline through the origin (point C') in which $q = q'$. As $q > q'$ in D, the reaction functions make the economy move over time with rising markup and nominal exchange rate, which keeps $q > q'$ up to point A'.

Figure 1: Limit cycle and endogenous cyclical fluctuations



Therefore, one way of comparing the results derived in this section is the following. Suppose the economy is in a short run in which the monetary authority and capitalists have different preferences with respect to the real exchange. The question is: will these differences vanish over time? If so, how, with kind of adjustment dynamics? Or, more formally, is there a medium-run equilibrium in which they come to have a common preferred real exchange rate? Will the economy converge to that situation? That is, does an equilibrium with $q_c = q_g$ exist? If so, is it stable? The answer to all these questions is that it depends on the adjustment dynamics. In the first case, in which a stable node obtains, the answer is a double yes: there is an equilibrium with $q_c = q_g$ and it is stable, so that the economy will converge monotonically to it from any initial point which is not the equilibrium itself. In the second specification, in which saddle-point instability obtains, the answer is that there is an equilibrium with $q_c = q_g$, but the economy will converge to it only by a fluke (that is, only if it happens to be in the stable arm of the saddle path). In the limit cycle case, the answer is that there is an equilibrium with $q_c = q_g$, but the economy will never converge to it from any initial point which is not the equilibrium itself.

As a result, interesting policy implications can be drawn from the dynamic analysis conducted above. As regards stability, the first specification is clearly the more benign for the economy: if the government cares about e while firms care about z, both reach their targets. The only problem is that this may not be viable in the longer run, depending on the equilibrium real exchange rate and ensuing effects on current account. In the second specification the government "monitors" the markup, which makes sense if the government aims at reducing inflation, or as part of a policy in which the government wants to encourage competition in the industry by reducing the price of imports. The last specification, in which the government is mainly concerned with distribution in favor of workers, is interesting because it makes sense form a political point of view (in many countries unions have significant influence on government) and at the same time produces a cyclical movement of the exchange rate (and other macro variables) that resembles the experience of several developing countries.

5. Summary

Although a burgeoning theoretical and empirical literature has been emphasizing the growth-enhancing properties of an undervalued real exchange rate, interclass and intraclass conflicts over the preferred real exchange rate, which are actually very common, have been ignored. In fact, the literature has been ignoring not only that capitalists, workers and the government (usually reacting to pressures from those classes) have different preferences with respect to the desired real exchange rate, but also that those players have quite different instruments to influence the course of the actual real exchange rate, with none of them having direct control over all the variables on which the real exchange rate ultimately depends. Meanwhile, the real exchange rate and functional income distribution are functionally related: whether the real exchange rate and the wage share, for instance, move in the same or opposite direction depends on the ultimate source of the change in any of them.

This paper contributes to this literature by developing a dynamic model of capacity utilization and growth in which the joint determination of income distribution and international competitiveness (measure by the real exchange rate) is taken into account in the determination of aggregate effective demand. In a given short run, how a change in the real exchange rate will affect capacity utilization and growth depends on whether it has come about through a change in either the nominal exchange rate or the markup (or both). Indeed, a major motivation underlying our formal specification in terms of the markup and the nominal exchange rate (and not the distributive shares and the real exchange rate themselves) as state variables is precisely the need to take into explicit consideration such a joint determination of income distribution and international competitiveness.

Over the medium run, the nominal exchange rate (markup) will vary in response to discrepancies between the actual real exchange rate and the real exchange rate preferred by the government (capitalists). However, as a change in the actual exchange rate may come about through a change in either the nominal exchange rate or the markup (or both), different specifications of the adjustment dynamics of the nominal exchange rate and the markup will have distinct implications in terms of existence and stability of a medium-run equilibrium solution for the real exchange rate, and thereby for the dynamics of capacity utilization and growth over the medium run.

While there is a medium-run (Nash) equilibrium characterized by capitalists and government coming to share a preferred real exchange rate, whether and how the economy will converge to it depends crucially on the specifics of the adjustment dynamics of the nominal exchange rate and the markup. In fact, while in one specification of such adjustment dynamics the economy necessarily converges to the medium-run equilibrium characterized by capitalists and the monetary authority sharing a preferred real exchange rate, in another specification such a convergence obtains only by a fluke. Meanwhile, when the government is primarily concerned with distribution in favor of workers when managing the nominal exchange rate, a limit cycle obtains. In this latter specification, the model produces conservative fluctuations in the markup and the nominal exchange rate, and hence in distributive shares and the real exchange rate; as a result, the economy experiences endogenous cyclical fluctuations of its international competitiveness, capacity utilization and economic growth that closely resemble the experience of several developing countries. As it turns out, a major empirical implication of the model developed in this paper is that growth regressions featuring the real exchange rate (or an index of real exchange undervaluation) should include functional distribution (or proxies such as real unit labor costs) in the vector of control variables. Or, some procedure should be used to decompose a change in the real exchange rate into changes in the major components of the real exchange rate, namely, nominal exchange rate, nominal unit labor (and, possibly, intermediate) costs and profit margins.

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