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The exchange rate, diversification, and distribution in a modified Ricardian model with a continuum of goods

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The exchange rate, diversification, and distribution in a modified Ricardian model with a continuum of goods

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Abstract

Several recent empirical and theoretical studies have revived interest in the relationship between the level of the exchange rate and economic development. This paper develops a dynamic model based on the Ricardian framework with a continuum of goods to consider the issue from a somewhat different perspective. In the short run, a devaluation can boost profits in spite of real wage rigidity. Moreover, the resulting diversification can offset the negative consequences for the trade balance of higher employment and profitability at Home. Over the longer run, and in the presence of learning-by-accumulation, the initial boost to profits and investment induced by a devaluation could enable a country to gain a permanent foothold in new sectors at a higher real wage. While directly suppressing the real wage could also lead to diversification, what makes nominal devaluations a particularly useful tool is that these make it possible to expand domestic profits while limiting internal distributional conflict and the ensuing negative effects on development.

1 Introduction and Background

Recent literature has revived interest in the role of the exchange rate as a development policy tool. While real overvaluation is widely acknowledged to be detrimental to economic growth,[1] it is only relatively recently that the merits of undervaluation have become a topic of active study. Several empirical studies have found that real undervaluations tend to promote investment and output growth. Furthermore, these results tend to hold to a much greater extent for developing countries rather than industrialized ones. While a lot remains unknown about the relationship between nominal devaluations and output growth, this

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[1] Depending on the source of the overvaluation, this of course is often termed the "Dutch disease" phenomenon.

literature tends to find support for the view that undervalued exchange rates have preceded and/or coexisted with many sustained episodes of developing country growth such as those in East and Southeast Asia, although the relationship appears to be more general. Indeed, one of the interesting lessons from the last two decades appears to be that while the link between capital inflows and growth is tenuous at best, that between the latter and current account surpluses (and the implied undervalued real exchange rates) seems to be relatively robust, especially for low-income developing countries. As noted by Eichengreen [2007], however, the literature has "invested more in documenting the growth rate-real exchange rate correlation than in identifying channels of influence." This is particularly true when the horizon of analysis extends beyond the short run. This paper is an attempt to help fill this gap with the help of an extended Ricardian model with a continuum of goods.

In the traditional workhorse Ricardian and Heckscher-Ohlin trade frameworks, trade patterns are governed by comparative advantage as dictated by technological differences (in the case of the former) or factor endowments (in the case of the latter). Homogeneity of degree zero in nominal prices means that the exchange rate has no role to play in determining the equilibrium patterns of trade. Moreover, the gains from trade are derived from exchange and *specialization*. Although, in the Heckscher-Ohlin framework countries move across cones of diversification as factor endowments (and hence relative factor prices) evolve, the normative implication remains that specialization in the range of goods that a country has comparative advantage in at a given level of endowments maximizes national welfare. This implication holds even as countries abandon old sectors while entering new cones of diversification.

Beginning with Imbs and Wacziarg [2003], a new strand of literature that carefully analyzes historical patterns of specialization, however, has reached sharply different conclusions. Countries appear to *diversify* along most of their income growth trajectory, specializing only once they have passed a threshold level of per capita income that places them in the group of upper income countries. This pattern seems to hold both for production and employment as well as for exports. Furthermore, diversification and subsequent re-specialization tend to take place along the extensive margin (i.e., new sectors) rather than the intensive margin (i.e., more or less even distribution in pre-existing sectors). Production and exports thus appear to follow a hump-shaped trajectory as countries rise up the income ladder.

On a broader note, factor accumulation and technological progress are seen as unrelated in traditional trade-theoretic frameworks. This can be seen in the working of the Ricardian and Heckscher-Ohlin models as separate explanations for trade patterns. A large body of literature going back to Solow [1960], Kaldor and Mirrlees [1962], and others has challenged this separation, arguing instead that capital accumulation induces technological progress. While a country's endowment of capital may be given at a point in time, accumulation brings with it technological change, which may in turn lead to more accumulation over time. This is the view taken in this paper, which attempts to develop a framework based on the following stylized facts and/or empirical findings:

1. Developing countries typically have a dual economic structure with a traditional sector that mostly produces non-tradable goods existing alongside a modern industrial sector that produces tradable goods. Moreover, the presence of large pools of un- and/or under-employed workers in addition to workers in the traditional subsistence sector means that wages need not adjust quickly in the face of falling unemployment.

2. Countries tend to industrialize (both in terms of output and employment) during the early and middle stages of their ascent up the income ladder. Moreover, the national income shares of industry and investment tend to be positively correlated.

3. Countries typically follow a non-monotonic trajectory along their development paths. Low- and middle income countries tend to diversify during their growth trajectories, only re-specializing after they have reached upper or upper middle income status.

4. Distributional conflict, experienced through wage suppression in the pursuit of export-led growth on the one hand, and rapidly rising wages and prices during upturns on the other, often undermine developing country growth episodes, as exhibited in boom and bust cycles of GDP growth.

5. Empirical studies of trade patterns tend to find more support for the Ricardian model. Even the empirical performance of the Heckscher-Ohlin model improves markedly once we account for technological differences across countries. Productivity differences across countries are a major determinant of trade patterns.[2]

6. While industrialized countries tend to be on the technological frontier and are leaders in research and development, developing countries mostly play technological catch up along their growth trajectory, and possess ample scope for learning through imitating, reverse engineering, and doing. Capital accumulation through investment plays a major role in facilitating this learning process.

I develop a modified Ricardian framework in which a nominal exchange rate devaluation can produce, under certain conditions, permanent changes in economic structure. In the short run, it results in diversification, investment, and rising employment in the modern tradable sector in spite of real wage rigidity. Diversification plays a crucial role in this process by ensuring that greater Home competitiveness leads to trade surpluses and rising tradable sector employment. Over the longer-run, a devaluation sets into motion two dynamic processes: (i) higher tradable employment leads to rising worker aspirations and real wages, and (ii) greater profits translate into accumulation and learning. If the latter process dominates, technological progress could create room for higher steady state real wages without loss of competitiveness in the newly acquired sectors.

[2] See, for example, Davis and Weinstein [2001] and Trefler [1995].

The long-run effectiveness of the exchange rate policy, therefore, depends on the outcome of the "horse race" between learning and distributional dynamics.

The model presented here shows how, even when the real exchange rate (measured as relative unit labor costs in the tradable sector) is endogenous, a temporary devaluation can produce permanent structural changes. More specifically, while trade and production patterns are determined by the technologically induced comparative advantage *at a given point in time,* the level of the exchange rate can be used as an instrument to create and permanently hold on to production in new sectors, thanks to accumulation-induced technological progress. The diversification of the economy that occurs during the transition makes the process sustainable. In this sense, the model is broadly similar to that developed in Krugman [1987]. History matters and like "a river digging its own bed," learning deepens comparative advantage over time. However, unlike that paper, I introduce distributional considerations and investment. Furthermore, given that the Home country is underdeveloped relative to the rest of the world, the flow of knowledge spillovers is unidirectional in my model.

The remainder of the paper proceeds as follows. The next section discusses relevant aspects of existing literature. Sections 3 presents the model, develops its short-run properties, and discusses the dynamic consequences of a nominal devaluation over the longer run. Section 4 concludes.

2 Literature Review

Among the more contentious policy issues in the area of open economy macroeconomics is that of the efficacy of exchange rate devaluation as a tool for growth and development. Macroeconomists generally treat the real exchange rate as an endogenous variable that is determined in general equilibrium by the "deeper" structural parameters of the economy such as preferences, time discount factors, endowments, and productivity. Classical neutrality of money ensures the insulation of real variables from changes in their nominal values beyond the short run. Thus, contrary to mercantilist views, while a nominal exchange rate change may affect output and growth in the short run, the long-run effect has generally been deemed insignificant.[3]

[3] The short-run effect of a devaluation is not uncontroversial either. The traditional view has been that devaluations are inflationary in the short run if the economy is operating at full employment, and expansionary if there are underutilized resources. The expansionary effect from the demand side originates from the shift in global demand towards domestically produced tradables, and the shift in domestic demand towards non-tradables. Starting with Diaz-Alejandro [1963], the potentially contractionary short-run effects of a devaluation have also been widely recognized. Some of the contractionary effects originate from a redistribution of income towards profits, negative valuation effects (especially in the presence of an initial trade deficit and when measured in terms of domestic currency), adverse movement in income terms of trade if substitution effects are weak, negative supply-side shocks emanating from higher intermediate input prices or higher (indexed) wages, negative real balance effects, and negative balance sheet effects in the presence of liability dollarization. See Lizondo and Montiel [1989] for a comprehensive survey. Also, see Frankel [2005] for an interesting discussion of the role of balance sheet effects following currency crashes in developing countries.

Recent empirical evidence has begun to challenge this view. For example, Levi-Yeyati and Sturzeneggar [2007] find that undervalued exchange rates induce higher output and productivity growth in developing countries. Moreover, the effect, appears to operate mainly not through substitution effects on the trade side but rather through the deepening of savings and capital accumulation. They also suggest that interventions to maintain undervalued exchange rates induce redistribution from labor to capital that raises investment incentives, and towards individuals with a greater savings propensity. Finally, their results suggest that the redistribution from labor to capital occurs simultaneously with declining unemployment, providing support to the mercantilist view, at least in the medium run. However, the paper does not provide a formal theoretical model to explicate the undervaluation-growth-accumulation nexus.

Looking at individual episodes of sustained growth, Johnson et al. [2007] found that almost all the successful cases avoided overvaluation during the growth period, with some countries exhibiting significant undervaluation. In an earlier study of more than 80 episodes of sustained growth accelerations, Hausmann et al. [2003] had found that such accelerations over the medium-term are associated with increases in trade and investment, and with real exchange rate depreciations. Other studies that have found a positive effect of undervalued exchange rates on growth include Razin and Collins [1997], Polterovich and Popov [2002], Prasad et al. [2007], and Berg et al. [2008]. This linkage is generally found to be more significant for developing countries.

Rodrik [2008] provides a supply-side oriented explanation for why undervalued real exchange rates could spur growth. The explanation centers on two problems that are pervasive in many developing countries: (i) institutional weaknesses in the contracting environment and (ii) market failures. The paper argues that the tradable sector in developing countries is typically more seriously afflicted with these handicaps, leading to these countries devoting a sub-optimal proportion of their resources to this sector. Maintaining an undervalued exchange rate, therefore, acts as a second-best policy by enhancing the profitability of the export sector and facilitating its expansion. Rodrik's study finds robust support for the hypothesis that undervalued exchange rates promote growth but mainly in developing countries. Moreover, the relationship is symmetric in that misalignments in either direction have an impact.

Finally, Razmi et al. [2009] model a dual economy with open and hidden unemployment. The framework is inspired by the dependent economy family of models. Many low income countries import a significant proportion of their capital goods. Growth promoting policies, therefore, have implications for the external balance. If policy makers have two targets, accumulation (or growth) and the trade balance, two instruments are needed in order to achieve both targets (the "Timbergen rule"). By ensuring that the fast-growing economy does not run into external balance problems, the real exchange rate can serve as one of those instruments. The paper presents empirical support for the hypothesis that real undervaluations are a useful instrument for the pursuit of accumulation and growth, although again the evidence is much more robust for low income countries.

Germane to the role of exchange rate changes in influencing growth and development is the relationship between industrialization, investment, and international trade. For, as discussed earlier, several relevant studies have attributed the beneficial effects of undervalued exchange rates to the special nature of the tradable sector, or more specifically, the manufacturing sector, which is mostly tradable. What does trade theory have to say about the relative price of tradables and development? Traditional models based on gains from comparative advantage-driven trade emphasize the benefits of specialization and optimal resource allocation (in a static sense). Following Imbs and Wacziarg [2003], however, a number of studies that have explored the historical pattern of production in successfully developing countries have arrived at conclusions that suggest strong qualifications to the case for international specialization. Using sector level employment shares and value-added, Imbs and Wacziarg [2003] found that national production structures have historically followed a U-shaped pattern, with countries diversifying during the early and middle stages of their industrialization (when the countries are low- or middle-income) and specializing only much later in the development process (once they have passed a certain threshold of per capita GDP roughly approximating that of Ireland in 1992). Moreover, the non-monotonicity does not merely capture the shift from agriculture to industry and services but appears to occur *within* manufactures as well. Furthermore, this is not just a cross-sectional finding but also holds within countries over time. Thus countries diversify over most of their development trajectory. Industrialization and development involves learning to do new things as much as becoming better at carrying out existing activities.

Cadot et al. [2009] go beyond Imbs and Wacziarg [2003] in the sense that they distinguish between growth of *exports* along the "intensive" margin (more exports of product lines that a country already exports) and that along the "extensive" margin (exports of new product lines). They establish a U-shaped pattern similar to Imbs and Wacziarg [2003]. However, they find in addition that while both developing and developed country exports grow mainly along the intensive margin, the U-shape comes mainly from the extensive margin.[4]

An aspect that has traditionally received less attention in the context of the relationship between the exchange rate and growth is that of income distribution. Changes in the level of the nominal (or real) exchange rate may affect the distribution of income in an economy. As pointed out by theoreticians in the Kaleckian/Kaldorian tradition, the latter may, in turn, influence the nature and pace of accumulation. For example, in an profit-led regime where the investment elasticity of demand is sufficiently high, re-distribution towards profits may facilitate accumulation and investment. These models, however, typically have a short-run focus. If labor has sufficient bargaining power, the re-distribution towards profits may also set into motion dynamics that disrupt the functioning of the growth regime beyond the immediate short-run. Systematic evidence on this matter is sparse if sometimes suggestive.[5] The relevant

[4]See Koren and Tenreyro [2007] for similar findings. Also, see Klinger and Lederman [2004] and Brenton and Newfarmer [2007] for related papers.

[5]For example, Berg et al. [2008], cited earlier, find that the duration of sustained growth

point here is that real undervaluations need not boost profits at the expense of the domestic real wage. Domestic tradable sector profits and investment may instead be raised, at least temporarily, through valuation effects in the presence of real wage resistance as long as the nominal devaluation turns into a real devaluation.[6] Alternatively, profits could be boosted through "profit shifting" from abroad as in the model of trade based on Cournot competition developed by Brander and Spencer [1985]. Indeed this may be an advantage of using the real exchange rate in lieu of domestic wage suppression.

Gala [2007] utilizes a simple Keynesian-Kaleckian model with excess capacity and constant mark-up pricing to show the inverse relationship between the real wage and mark-up factor on the one hand, and the real wage and the profit share on the other.[7] Assuming that workers do not save leads to the result that a nominal devaluation, by reducing the workers' share of income, will lead to greater investment and, assuming a sufficiently elastic response of aggregate demand (via investment) to increased profitability, accelerated growth in the short-run. The empirical part of the study finds support for a positive relationship between exchange rate undervaluation and growth.

The effectiveness of real devaluation in the typical versions of the Keynesian/Kaleckian growth framework arises from nominal wage rigidity and the resulting re-distribution following a devaluation. Another family of models in the post-Keynesian balance of payments-constrained growth (BPCG) tradition has emphasized the long-run constraint that the balance of payments position places on the economy from the demand side. However, the framework does not distinguish between export growth along the intensive and extensive margins. Moreover, over longer time horizons, changes in income distribution become a relevant issue for the saving-investment channel. While exports may boost demand and thus output, what ensures that the economy remains competitive as the labor market tighten and wages rise? How do issues related to social and institutional stability come into play as a developing country diversifies? Finally, the BPCG framework typically ignores relative price changes which become important over the longer run.

To sum up, we have cited several recent studies that have found theoretical and empirical support for a positive relationship between exchange rate undervaluation and economic development, especially for developing countries. Several recent studies have also concluded that countries tend to diversify their output and export structures during their growth phase, and tend to limit distributional conflict during episodes of sustained growth accelerations. I develop a model in the next section that attempts to unite some of these themes.

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acceleration episodes is negatively and significantly related to initial income inequality. See also Rodrik [1999] and Alesina and Perotti [1996].

[6] That is, as long as workers consume some non-tradables, and the price of non-tradables increases by less than that of tradables.

[7] This, of course, is a standard result in the neo-Kaleckian framework. See, for example, Blecker [1989].

3 The Model

The model consists of two countries or regions. The Home country in our model has high levels of hidden and open unemployment. The economy has a traditional non-tradable goods-producing sector, which uses labor for production, and coexists with a modern industrial/tradable goods-producing sector. The latter, in turn, consists of a continuous spectrum of sectors that require labor and capital for production. Labor is mobile between sectors while capital is not. Following the endogenous growth literature, capital here is defined broadly, as physical capital as well as infrastructure and human capital such as education, training, management skills, etc. The workforce consists of workers employed in the non-tradable and tradable sectors, in addition to a segment of the population that constitutes the pool of unemployed workers. The real wage in the non-tradable sector υ_N equals the average product of labor. Given constant returns to scale, this also translates into the marginal product of labor. Put differently, the total output of the non-tradable sector is divided up among its workers. The real wage υ_T in the modern tradable sector reflects worker bargaining power at any given point in time. Over the longer-run, real wages in this sector evolve in line with conditions in the labor market, i.e., the size of the labor pool available to the tradable sector, with the proviso that productivity places a ceiling on the real wage. Workers have sufficient bargaining power so that real wages display short-run rigidity in both countries. Wage suppression as a tool of policy, in other words, is not an option.

The model is perhaps best interpreted as reflecting a world consisting of the Home country and the rest of the world (ROW). Home is a small open developing economy that has large amounts of unemployment and faces tradable good prices that are determined by production costs in the rest of the world. Each region specializes in a range of goods. Firms in each country initially specialize in their niche sectors and sell at the international price associated with each good (as determined by ROW unit labor costs). Internal competition between firms in ROW has driven out profits. Each sector in Home, on the other hand, has one producing firm, reflecting either the presence of prohibitively high fixed entry costs in the presence of underdeveloped financial markets or a government policy of favoring specific firms (e.g., the *chaebols* in South Korea and the *zaibatsu* in pre-World War II Japan). This enables Home firms to follow a limit pricing rule.

As in Dornbusch et al. [1977], global production is described by a Ricardian model with a continuum of goods, such that a good indexed z is associated with each point along the continuum, and $z \in [0, 1]$. One firm in each Home tradable sector produces with *sector specific* capital in combination with labor. Denoting the unit labor coefficient associated with commodity z by $a(z)$ when produced in Home and $a^*(z)$ when produced in ROW, the relative productivity in sector z at Home is given by $A(z) = a^*(z)/a(z)$. Unit labor coefficients have a component determined by "natural" comparative advantage such as climate, geography, and other factors as traditionally captured by the Ricardian model of trade. However, Home's unit labor requirements are also determined by the *average* level of productivity relative to ROW, $\overline{A}$, which in turn is proportional to the given relative capital stock at a point in time. Home is the developing region that has large unexploited opportunities for learning-by-accumulation. The rest of the world, which, on the other hand happens to be on the international technological frontier, has already exhausted the externality arising from learning-by-accumulation. Average productivity in Home is proportional, at any given point in time, therefore to the domestic capital stock K. The relationship is non-linear. As the capital stock grows, learning opportunities shrink, and beyond a certain threshold, say $K_{\max}$, Home resembles ROW in that learning opportunities stand exhausted, and average productivity equals a constant α. As long as the capital stock at Home is below this threshold, variable $\overline{A}$ is determined by relative capital stocks, or, since learning opportunities have been exhausted in ROW, simply by the domestic capital stock. Mathematically,

$$\overline{A} = f(K/K^*) = f(K);\ f' > 0,\ f'' < 0,\ f(K_{\max}) = \alpha \tag{1}$$

where the foreign capital stock has been normalized to unity.

Now arrange the goods in descending order of Home's comparative advantage so that $\frac{a^*(z_0,K^*)}{a(z_0,K)} > \ldots > \frac{a^*(\tilde{z},K^*)}{a(\tilde{z},K)} > \ldots > \frac{a^*(z_1,K^*)}{a(z_1,K)}$. A fraction λ of domestic income is spent on tradables in each region. Let W and W^* denote domestic and ROW nominal wages, respectively. Further suppose $\tilde{z}$ denotes the "borderline" commodity so that $Wa(\tilde{z},K) = eW^*a^*(\tilde{z})$, which implies that Home produces and exports all the commodities in the range $[0,\tilde{z})$, while ROW produces and exports all commodities in the range $(\tilde{z},1]$. Real wage rigidity implies that $\upsilon_T = W/P$ and $\upsilon^* = W^*/P^*$ are both given at a point in time. Here $P = P_N^{1-\lambda}P_T^{\lambda}$ is the Home price index weighted by the shares of tradable and non-tradable goods in the expenditure basket while $P^* = (P_N^*)^{1-\lambda}(P_T^*)^{\lambda}$. The price of non-tradable goods is assumed to be equal to unity across countries for simplicity.[8] Furthermore, the choice of appropriate units ensures that $P_N = 1$ for notational simplicity. Furthermore, since ROW unit labor costs are given, the limit pricing assumption allows us to assume that $P_T^* = 1$ without loss of generality. Thus, the following equation encapsulates the supply side of the model:

$$\omega = \frac{W}{eW^*} = \frac{\upsilon_T}{e^{1-\lambda}\upsilon^*} = \frac{a^*(\tilde{z},K^*)}{a(\tilde{z},K)} = A(\tilde{z},\overline{A}) \tag{2}$$

where W and W^* denote domestic and foreign wages, e denotes the nominal exchange rate, and ω is the domestic wage relative to ROW. Equation (2) can also be re-arranged and expressed a bit differently as follows:

$$\tilde{z} = A^{-1}\left(\omega,\overline{A}\right) = A^{-1}\left(\frac{\upsilon_T}{\upsilon^*},\overline{A}\right);\ A_1^{-1} < 0, A_2^{-1} > 0 \tag{1'}$$

As we see later, the state variable $\overline{A}$ plays an important role in the dynamic adjustment of the system over time.

[8] Alternatively, taking into account the Balassa-Samuelson effect, one could assume that their proportion is a given constant.

Preferences are Cobb-Douglas, homothetic, and identical across countries, implying that each good receives a constant share of expenditure regardless of relative prices.[9] All the goods are essential, i.e., the consumption of each good is positive at any finite set of prices. Workers spend on consumer goods while capitalists save to purchase (tradable and non-tradable) investment goods. In order to maintain the homotheticity assumption in the simplest possible manner, assume that each good can be used either for consumption or for investment. Wage income is used to consume the good while profit income utilizes it as a capital good.[10]

Total profits in Home are the sum of sectoral profits:

$$\Pi = \int_0^{\tilde{z}} \pi(z)dz \tag{3}$$

Home has a labor force L, which consists of non-tradable sector workers L_N, tradable sector workers L_T, and the unemployed. Equilibrium in the Home non-tradable sector is defined by the following condition:

$$W_N L_N = (1-\lambda)(W_N L_N + W_T L_T + \Pi)$$

or, simplifying and utilizing the definition of the real wage,

$$L_N = \frac{1-\lambda}{\lambda}\left(\frac{e^{\lambda}\upsilon_T L_T + \Pi}{e^{\lambda}\upsilon_N}\right) \tag{4}$$

Thus, employment and profits in the tradable sector generate demand for non-tradables, creating non-tradable sector employment as a result. Notice that, with given preferences, homotheticity of demand ensures that a mere redistribution of income within the tradable sector at a given level of national income does not affect non-tradable employment. This can be seen more clearly if we define Home nominal income Y so that $Y = W_N L_N + W_T L_T + \Pi$. Then substituting from equation (4) yields:

$$Y = \frac{e^{\lambda}\upsilon_T L_T + \Pi}{\lambda} \tag{5}$$

The non-tradable sector magnifies national income over that from the tradable sector by a multiple $1/\lambda$. With a given λ, any redistribution in the tradable sector keeps the numerator and hence national income (and aggregate demand) unchanged. The shares of global expenditures falling on Home and Foreign tradable goods, Θ and Θ^*, respectively, are given by,

[9] Homotheticity also implies that the composition of global demand is independent of income distribution within and between countries.

[10] An example would be that of an engine that could be used either to motor a consumer durable or to produce other engines. This assumption, of course, is an extremely stylized one. Most literature assumes for simplicity that the capital good is either tradable or non-tradable. Making this assumption, in our case, however, would be inconsistent with the assumption that demand is homothetic since demand for tradable and non-tradable goods will no longer be independent of income. Moreover, considering that capital goods tend to fall under both the tradable and non-tradable categories, our assumption appears to be more realistic.

$$\Theta(\tilde{z}) = \int_0^{\tilde{z}} \theta(z)dz;\ \Theta' = \theta(\tilde{z}) > 0 \tag{6a}$$

$$\Theta^*(\tilde{z}) = \int_{\tilde{z}}^1 \theta(z)dz;\ \Theta^{*\prime} = -\theta^*(\tilde{z}) < 0 \tag{6b}$$

where $\theta(z)$ and $\theta^*(z)$ are the fractions of global income that are spent on each domestically and foreign produced good so that λ can now be defined more precisely as $\int_0^1 \theta(z)dz$. Equilibrium in the tradable sector is defined by the trade balance condition,[11] which can be written

$$\Theta e W^* L^* = (\lambda - \Theta)Y \tag{7}$$

Next, it would be useful to define profits more explicitly. As mentioned earlier, Home firms have market power and follow a limit pricing rule. More specifically, these set the price at a level infinitesimally lower than the international price and supply according to demand. Using $C(z)$ to denote the global consumption of good z, equation (3) can be rewritten

$$\Pi = \int_0^{\tilde{z}} [P(z) - Wa(z)]C(z)dz = \int_0^{\tilde{z}} [eW^*a^*(z) - W_T a(z, \overline{A})]C(z)dz$$

which further simplifies to:

$$\Pi = e\upsilon^* \int_0^{\tilde{z}} [A(z, \overline{A})a(z)C(z)dz - e^{\lambda}\upsilon_T L_T \tag{8}$$

The second term on the RHS makes use of the fact that $\int_0^{\tilde{z}} a(z)C(z)dz = L_T$. The first term is a weighted measure of total domestic tradable sector employment, where the weights are a function of relative Home productivity. To understand the intuition underlying these weights, recall that, since the price of any commodity is determined by ROW unit labor costs, Home profitability in each sector is determined, at a given relative wage, by the productivity (and hence cost) differential. Notice that $e\upsilon^* \int_0^{\tilde{z}} [A(z)a(z)C(z)dz \geqslant e^{\lambda}\upsilon_T L_T$ in the interval $[0, \tilde{z})$. Notice also that $e\upsilon^*[A(\tilde{z})a(\tilde{z})C(\tilde{z}) = e^{\lambda}\upsilon_T a(\tilde{z})C(\tilde{z})$ so that there are no profits in the marginal sector $\tilde{z}$.

Since each good attracts a constant proportion of world expenditure, therefore, $P(z)C(z) = \theta(z)[Y + eW^*L^*]$. Substitution from eqs. (5) and (8) yields

[11] Or equivalently, given continuous equilibrium in the non-tradable sector, the income=expenditure condition.

$$C(z) = \frac{\theta(z)}{\lambda a^*(z)} \left[\int_0^{\tilde{z}} [A(z,\overline{A})a(z)C(z)dz + \lambda L^* \right]$$
$$= \frac{\theta(z)}{\lambda a^*(z)} (\Gamma + \lambda L^*) \tag{9}$$

where $\Gamma = \int_0^{\tilde{z}} [A(z,\overline{A})a(z)C(z)dz = \Gamma(z, L_T, \tilde{z}, \overline{A})$ is the weighted measure of domestic employment described earlier, $\Gamma_1 < 0$, and $\Gamma_{2,3,4} > 0$. The consumption of any Home good z in real terms, is thus partially a function of domestic and foreign employment, relative productivity, and the proportion of world income spent on that good. With reference to equation (5), notice that, in spite of zero profits in the marginal sector, the employment of labor in that sector would raise national income. Substituting equation (9) into (8) yields

$$\Pi = ev^*\Gamma - e^{\lambda} v_T L_T \tag{10}$$

In spite of real wage rigidity, and even with a given pattern of employment and specialization, a change in the exchange rate positively affects profits, thanks to the valuation effect which is only partly offset by the rise in the nominal wage required to maintain the real wage.[12] The gain in profits in this case originates from a valuation effect rather than from domestic redistribution. Since $ev^*\Gamma \geqslant e^{\lambda} v_T L_T$ in the interval $[0, \tilde{z})$, any increase in domestic employment *at given relative prices* boosts domestic profits. Any consequent enlargement of employment or of the range of goods produced domestically further magnifies this impact on profits via greater demand.

We are now ready to specify our trade balance condition (equation (7)) in a more concise form after substitution from eqs. (5) and (10),

$$L^* - \frac{\lambda - \Theta}{\lambda\Theta} \Gamma(z, L_T, \tilde{z}, \overline{A}) = 0 \tag{11}$$

Equation (11) is written in trade surplus form. Notice that, if $\lambda = 1$, i.e., there is no non-tradable sector, the the trade balance condition reduces to equation (10') of Dornbusch et al. [1977]. Finally, notice that an increase in domestic relative income (relative wages or profits) tends to create a trade deficit while increased diversification has the opposite effect.

Equations (2)-(11) describe our system in the short run. The simplicity of the system renders the logic transparent. At a given level of the real wage, equation (2) determines the range of goods that can be produced at Home. Once $\tilde{z}$ has been pinned down, Θ and Θ^* are also determined via eqs. (6a) and (6b), and equation (11) yields the level of tradable (and hence, from equation (4), non-tradable) employment that is consistent with balanced trade. Figure 1

[12] Put differently, the real profit per unit in sector z is given by: $\pi(z)/P = [(eW^*a^*(z) - Wa(z)]/P = e^{1-\lambda}v^*a^*(z) - v_T$. To the extent that expenditure baskets include non-tradables, therefore, real profits per unit increase following a devaluation.

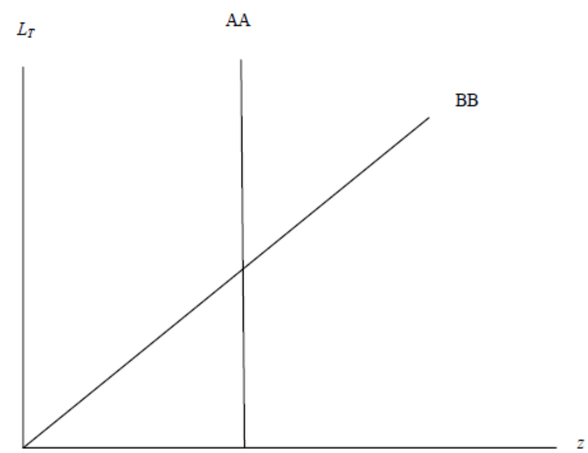

Figure 1: The supply and demand sides in the short run

below, summarizes the information in $\tilde{z} - L_T$ space. The AA curve represents equation (2). Given $\overline{A}$, each level of relative wages between the two regions is consistent with a unique pattern of specialization. The BB curve captures equation (11). An increase in the range of goods produced domestically increases Home goods' share of global expenditures – call this the "diversification effect" – creating a trade surplus. Higher Home revenues, some of which are spent on imports, on the other hand, tend to create a deficit. Assuming a relatively strong diversification effect enables us to conclude that the overall result is a trade surplus. Employment must rise to restore the trade balance through higher consumption, investment, and, hence, imports. The greater the share of world expenditures on the marginal sector newly acquired, i.e., the greater the diversification effect, the greater the trade surplus created, and hence the greater the room created for an increase in tradable sector employment.

3.1 Comparative statics

The state variables $\overline{A}$ and υ_T are pre-determined in the short run. The appendix provides the detailed mathematical solutions. Here I focus on the intuition.

Begin with the equilibrium levels of $\tilde{z}$ and L_T as defined by the system of equations (2) and (11) and consider the effects of relevant shocks.

One route to boosting Home competitiveness is a nominal devaluation. This has the effect of increasing the range of goods produced in Home, thus tending to create a trade surplus. The magnitude of the surplus is a positive function of the share of global expenditure devoted to the marginal good that Home now produces (i.e., Θ'). A devaluation has no *direct* effect on the trade balance since it simply redistributes income within the tradable sector, with the lower Home relative wage reducing imports of consumption goods but the increased value of profits boosting imports of capital goods. Non-tradable sector employment is also unaffected. Given the trade surplus created by diversification, an increase in employment is required to restore the trade balance through higher (wage and profit) income. In sum, the diversification of the production structure means that the trade balance is restored at a higher level of tradable sector employment. Figure 2 illustrates the comparative statics graphically.

Consider next the effect of a higher tradable sector real wage in Home. Such an increase has the effect of reducing the range of products produced domestically, creating a trade deficit. The direct effect on the trade balance and non-tradable sector employment is again zero since tradable sector income is simply redistributed. Loss of sectors means, therefore, that employment and income must fall to remove the overall trade deficit. The magnitude of this decline is directly related to the share of world expenditures falling on the marginal good that is now produced abroad. Figure 3 illustrates these results.

Finally, an increase in the average relative productivity in Home boosts competitiveness, makes it profitable to enter new sectors, and as a result expands the range of products produced at Home. A trade surplus is created in the process. The trade balance is, therefore, restored at a higher level of employment. The results are qualitatively similar to those presented in Figure 2. Recall that the diversification effect depends positively on world demand for the marginal good newly acquired by Home producers.

In sum,

$$\tilde{z} = \tilde{z}(\overline{A}, \upsilon_T, e);\ \tilde{z}_{\overline{A}} > 0, \tilde{z}_{\upsilon} < 0, \tilde{z}_e > 0 \tag{12}$$

$$L_T = L_T(\overline{A}, \upsilon_T, e);\ L_{T\overline{A}} > 0, L_{T\upsilon} < 0, L_{Te} > 0 \tag{13}$$

Notice that, in all three cases, assuming a strong impact of diversification on the trade balance, i.e., a high value of Θ', magnifies the effect on employment. Diversification helps set the longer-run process of accumulation and technical progress in motion by ensuring that trade deficits do not impede imports of much-needed capital goods. Moreover, the higher the income elasticity of international demand for the output of the newly acquired Home sectors, the greater the likelihood that diversification has the desired effect. The crucial role in the development process of the income elasticity of demand for a country's output was, of course, highlighted famously by Singer [1950] and Prebisch [1950]. More recently, much of the work originating from Thirlwall [1979], and identified with the Balance of Payments-Growth Model has emphasized both the structural importance of income elasticities of demand and the balance of payments constraint in limiting accumulation and output growth.

3.1.1 Profit income

The general equilibrium comparative static effects on profit income merit a more detailed exploration given that these play a major role in the evolution of the economy over time. Recall that, in the presence of real wage rigidity, profit

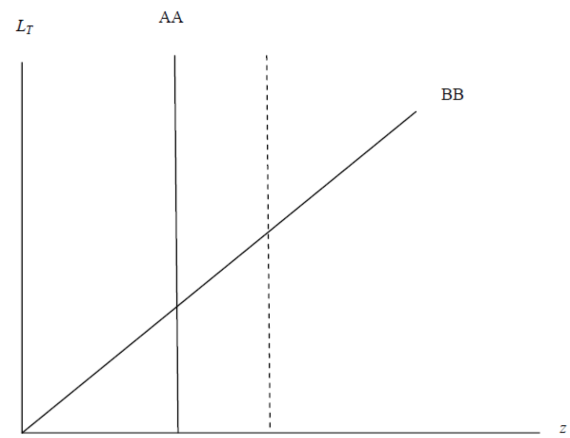

Figure 2: Nominal devaluation

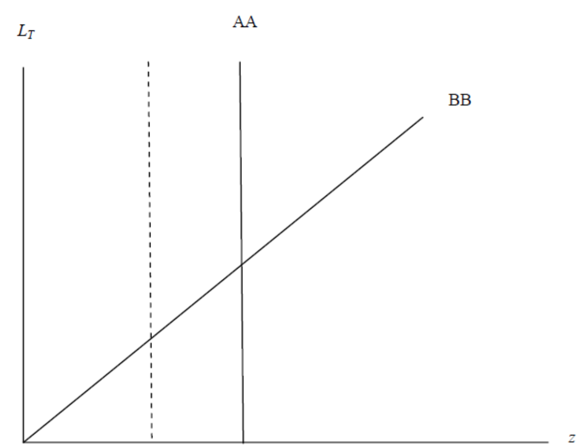

Figure 3: The effects of an increase in the real tradable sector wage

income is driven by (Home and ROW) demand and valuation effects. Consider first the effect of a devaluation. From equations (10), (12), and (13):

$$\frac{d\Pi}{de} = \left(\upsilon^{*}\Gamma - \frac{\lambda \upsilon_T L_T}{e^{1-\lambda}}\right) + \left(\upsilon^{*}\frac{d\Gamma}{dL_T} - \frac{\upsilon_T}{e^{1-\lambda}}\right) e \frac{dL_T}{de} \tag{14}$$

The right hand side (RHS) can be broken down into two terms: (i) the term in the first set of parentheses captures the valuation effect; as already discussed, this effect is positive in spite of real wage rigidity since nominal wages rise only by a fraction λ, and (ii) the term involving the second set of parentheses captures the employment effect. Employment increases following a nominal devaluation as does demand, and since the price per unit exceeds unit labor costs in the relevant interval, the rise in output translates into the conclusion that this term is positive. The stronger the diversification effect, the greater the rise in employment and demand, and hence the greater the increase in profits. A nominal devaluation serves as a device to boost profits in Home's sectors of specialization. As is well-known from trade literature, it also serves as both an export subsidy and an import tariff.

Consider next the impact on Home profits of a rise in the real wage.

$$\frac{d\Pi}{d\upsilon_T} = -e^{\lambda} L_T + \left(\upsilon^{*}\frac{d\Gamma}{dL_T} - \frac{\upsilon_T}{e^{1-\lambda}}\right) e\upsilon_T \frac{dL_T}{d\upsilon} \tag{15}$$

Again, the RHS can be broken down into two terms: (i) the first term captures the effects of higher labor costs which squeeze the profit margin, and (ii) the term involving the parentheses reflects the employment effect. Lower tradable sector employment and thus demand, along with the fact that the price per unit exceeds unit labor costs in the relevant interval, ensures that this term is negative. The stronger the diversification effect, the greater the decline in employment, and hence the greater the fall in profits.

Finally, consider the effect of a shift in average productivity in favor of Home.

$$\frac{d\Pi}{d\overline{A}} = \left(\upsilon^{*}\frac{d\Gamma}{dL_T} - \frac{\upsilon_T}{e^{1-\lambda}}\right) e \frac{dL_T}{d\overline{A}} \tag{16}$$

Since an increase in average productivity raises employment in Home, the resulting higher demand boosts profits. The rise in profits varies directly with the strength of the diversification effect.

In sum,

$$\Pi = \Pi(\overline{A}, \upsilon_T, e);\ \Pi_{\overline{A}} > 0, \Pi_{\upsilon_T} < 0, \Pi_e > 0 \tag{17}$$

Savings equals total profits. This follows from the assumption that there is no saving out of wage income while profit income is not consumed.[13] Furthermore, with balanced trade in the absence of a government sector or international income flows, savings equal investment.

[13] One could relax this assumption without qualititively affecting the main results. The notation and exposition, however, will have to be much more involved.

3.2 Adjustment over the longer run

As mentioned earlier, υ_T and $\overline{A}$ are state variables that are pre-determined in the short run. Consider now the behavior of the system over time. From equation (1), the evolution of Home's average productivity is a function of capital accumulation, which, in turn, depends on savings, and hence total profits. Accumulation generates new knowledge about production in the economy as a whole. An incidental by-product of capital accumulation is, therefore, the improvement of the technology used by firms. This accumulation of knowledge slows down as Home accumulates capital and moves toward the technological frontier. The equation of motion of relative average productivity is given by:

$$\widehat{\overline{A}} = \frac{f'\Pi}{P\overline{A}} = \widehat{\overline{A}}(\overline{A}, \upsilon_T; e) \tag{18}$$

We know already from equation (17) that $\Pi_{\overline{A}} > 0$, $\Pi_{\upsilon_T} < 0$, and $\Pi_e > 0$. These signs translate into $\widehat{\overline{A}}_{\upsilon_T} < 0$, and on the assumption that the response of profits to average productivity changes is less than unit elastic, $\widehat{\overline{A}}_{\overline{A}} < 0$. The effect of an exchange rate change is less clear. As long as the expenditure share of tradables is not too large, $\widehat{\overline{A}}_e > 0$,[14] otherwise $\widehat{\overline{A}}_e < 0$.

Notice that the specification in equation (18) has the crucial implication that, as in a familiar version of the AK family of growth models, productivity catch-up in Home is a by-product of accumulation. The relationship arises from Arrow-type industry-wide learning-by-accumulation. Alternatively, it could be seen as a conveniently modified form of the Kaldorian "technical progress" function.[15]

The evolution of the domestic real wage is affected by labor market conditions. The tradable sector is the modern industrialized segment of the economy that requires a relatively well-trained labor force. Scarcity of skills in the economy, the cost of training employees, and industrial working conditions give workers in this sector some bargaining power. It seems reasonable to assume, therefore, that over the longer run, the real wage is influenced by the availability of "outside" labor for employment in this sector. Easy availability of a large pool of outside workers works to undermine the bargaining position of the currently employed tradable sector workers, as reflected in their "target" real wage $\bar{\upsilon}_T$. Workers adjust their real wage demands depending on what they earn relative to their target. These ideas can be formulated in the form of the following simple specifications:

$$\bar{\upsilon}_T = h\left(\frac{L - L_T}{L}\right);\ h' < 0 \tag{19a}$$

$$= h\left(1 - \frac{L_T}{L}(\overline{A}, \upsilon; e)\right) \tag{19b}$$

[14] Specificallly, $\lambda < (e/\Pi)\Pi_e$.

[15] Recall that Kaldor and Mirrlees [1962] specified the technical progress function as a relationship between the rate of growth of productivity (or output per worker) and that of investment *per capita*.

where $L_{T\overline{A}}, L_{Te} > 0, L_{T\upsilon} < 0$ from equation (13). Furthermore,

$$\begin{aligned} \upsilon_T &= g\left(1 - \frac{\upsilon_T}{\overline{\upsilon}_T}\right);\ g' > 0 \qquad (20a) \\ &= \upsilon_T(\overline{A}, \upsilon_T; e) \qquad (20b) \end{aligned}$$

where $\hat{\upsilon}_{T\overline{A}} > 0$, $\hat{\upsilon}_{T\upsilon_T} < 0$, and $\hat{\upsilon}_{Te} > 0$.

We are now ready to explore the linearized dynamics of the system given by equations (18) and (20a) with the help of Figure 4. The $\widehat{\overline{A}} = 0$ isocline represents the combinations of average productivity and real wages such that the international productivity gap is stable.[16] An increase in average productivity in Home generates additional domestic profits, investment, and hence, productivity growth. A higher steady state real wage is required to eliminate the productivity gap created in favor of Home through reduced profits. Along the $\hat{\upsilon}_T = 0$ isocline the real wage is at a level consistent with workers' target. An increase in average productivity in Home raises tradable sector employment, reduces the pool of workers available for working in the tradable sector, and hence, raises the target real wage. The actual real wage must gradually rise in response to higher worker aspirations as a result. The standard Routh-Hurwitz conditions for local stability are unambiguously satisfied in this case. Above the $\widehat{\overline{A}} = 0$ isocline, negative investment in the Home economy leads to declining relative productivity. Below the $\hat{\upsilon}_T = 0$ isocline the real wage is lower than that consistent with labor market conditions, and rises as a result.

In order to guide intuition, consider the adjustment process that occurs over time. For the sake of brevity, we only focus on the non-oscillatory, most direct paths. Suppose we are at point A in Figure 4 where we have a combination of a real wage that is too high given labor market conditions and high profits per unit of capital stock. The latter on its own leads to investment, rising relative productivity, and, as a result, greater tradable sector employment, specialization in a wider range of sectors, and learning. The former results in declining real wages, which further boost profitability, diversification, and employment generation in the tradable sector, dampening the downward pressure on the real wage as a result. The change in tradable sector employment and the range of goods produced in Home is, therefore, positive during this phase.

Over time the economy reaches a stage where the real wage has declined to the point where it equals tradable sector workers' target level. Continued profitability, however, ensures continuing investment and tradable sector employment generation. The real wage begins to rise consequently even as rising investment makes the economy more productive, leading unambiguously to diversification and tradable sector employment generation. Rising real wages dampen profits until further accumulation ceases as the economy reaches its steady state. Average productivity and the real wage, which moved in opposite directions during the earlier phase, move in the same direction in this final

[16] Or, equivalently, the rate of accumulation is zero.

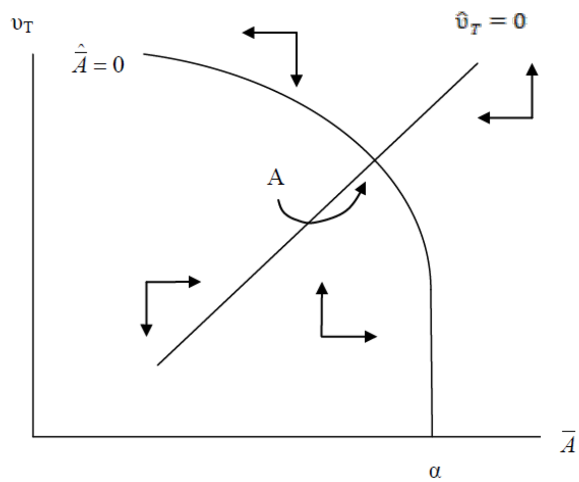

Figure 4: Long-run adjustment

phase. Moreover, unlike the first phase, the movement of the real wage and productivity have offsetting effects on diversification during the final phase.

3.2.1 The Exchange Rate, Real Wage, and Relative Productivity

Suppose policy makers raise the level of the nominal exchange rate (i.e., a nominal devaluation). Such a step could be forced by immediate competitiveness considerations but will have consequences beyond that, as illustrated by Figures 5 and 6. In the short run, the devaluation leads to a rise in the range of tradable goods produced and in tradable sector employment. Home profits rise too, thanks to demand-side and valuation effects. Over the longer run, the initial effect is a rise in the real wage as the labor market tightens, although the effect on investment is ambiguous. We know from our earlier discussion that $\widehat{\overline{A}}_e \lesseqgtr 0$. Based on these signs, I consider two polar cases: (i) the best case scenario where both the steady state real wage and average domestic productivity rise, and (ii) the worst case scenario where both these variables decline. Intermediate cases too are possible but I focus on (i) and (ii) to highlight the "horse race" between wages and learning following a devaluation.

Consider first the best case scenario. Here the expenditure share of the tradable sector initially is sufficiently small so that $\widehat{\overline{A}}_e > 0$. Put differently, the positive effect of a devaluation on profits dominates the valuation effect on the capital stock so that profits per unit of capital stock rise. The rise in real wages over time is accompanied in this case by investment and learning, putting further upward pressure on wages. Learning accumulates and the average productivity gap narrows as Home experiences the catching up process. With the passage of time, the rise in the real wage creates a profit squeeze, leading eventually to a stable international productivity gap, assuming that the steady state arrives before Home exhausts learning possibilities. If the initial direct effect of the devaluation on profits is large enough, both average productivity and the real wage are higher in the new steady state in spite of the the profit squeeze caused by rising real wages. Figure 5 graphically presents this win-win scenario. It requires, in addition to the condition $\widehat{\overline{A}}_e > 0$, that the effect of the devaluation on profits (captured by $\widehat{\overline{A}}_e$) be large while that on the labor market (captured by $\hat{\upsilon}_{Te}$) be small. In graphical terms, the $\widehat{\overline{A}} = 0$ isocline must shift more than the $\widehat{\upsilon} = 0$ isocline.

Consider next the worst case scenario. In this case the initial expenditure share of the tradable sector is small enough so that $\widehat{\overline{A}}_e < 0$, i.e., the positive effect of a devaluation on profits is more than offset by the valuation effect on the capital stock so that profits per unit of capital stock fall. Now rising real wages are accompanied by falling investment and declining productivity, which dampens the rise in the real wage until the latter is consistent with labor market conditions but still too high to maintain a stable international average productivity gap. Beyond this point, both productivity and the real wage in Home decline as the economy loses sectors to ROW and specializes until the new steady state is attained.

Figure 6 illustrates this scenario, the end result of which is a lower real wage, lower average productivity, and a greater technological gap between Home and ROW. This requires, in addition to the condition $\widehat{\overline{A}}_e < 0$, that the effect of the devaluation on profits and investment be large while that on the labor market be small. Again, the $\widehat{\overline{A}} = 0$ isocline must shift more than the $\widehat{\upsilon} = 0$ isocline for this scenario to eventuate.

Thus, both the best and worst case scenarios require that the effect of a devaluation on investment be greater than that on wage growth. The initial effect of the nominal exchange rate change on accumulation constitutes the dividing line. A positive effect, which is helped by a smaller initial size of the tradable sector so that profits per unit of capital rise and $\widehat{\overline{A}}_e > 0$, results in the best case scenario. A negative effect so that $\widehat{\overline{A}}_e < 0$, leads to the worst case scenario.

Finally, consider the case where Home has already exhausted learning possibilities so that average productivity is constant at a level lower than or equal to ROW. As shown in Figure 7, now a nominal devaluation simply translates into an increase in the real wage without any change in average productivity. More than a tool of technological development through diversification and accumulation, the exchange rate now becomes a tool of real wage management. This is because while a nominal devaluation still leads to greater tradable sector employment, diversification, labor market tightening, and hence a rising real wage, there is no accompanying technological progress. Rising real wages simply squeeze out profits. Notice that once the economy has transformed to the point where the nontradable sector has a bargaining structure similar to the tradable sector and unemployment has vanished, the exchange rate no longer is

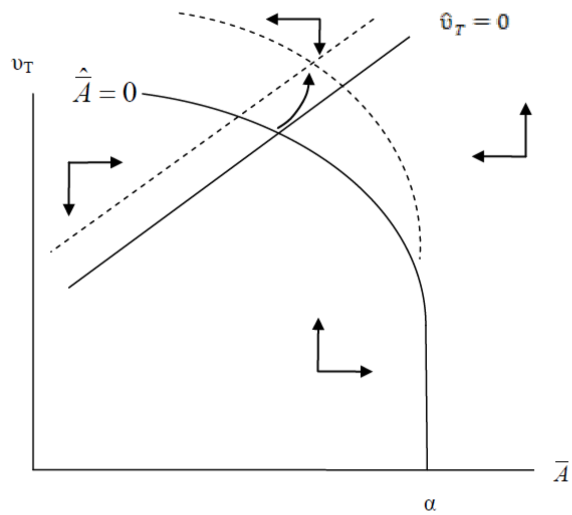

Figure 5: The best case scenario following a devaluation

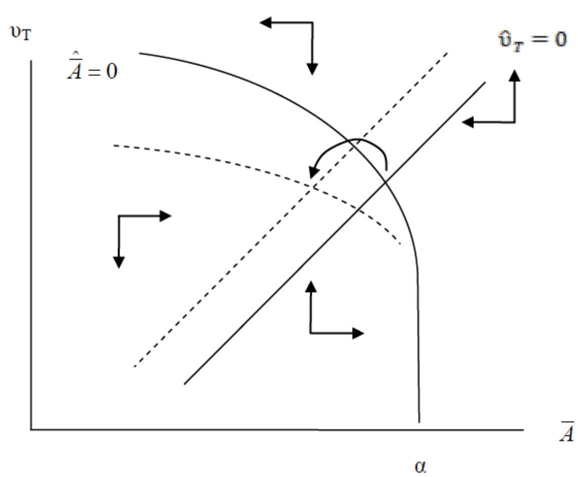

Figure 6: The worst case scenario following a devaluation

effective as an instrument for real wage management either.[17]

Thus, the overall long-run effects on the economy hinge on the behavior of the labor markets as well as the response of profits to exchange rate changes and of productivity to investment. Since the modern tradable goods sector is the driver of real wages, the higher the amount of available labor outside the tradable sector to begin with, the greater the likelihood that wages adjust slowly following a devaluation, and thus the more useful a policy of exchange rate undervaluation will be in promoting diversification, employment, and technical progress. The relevant expressions for the determinant of the Jacobian (Δ) and the steady state values can be expressed explicitly with the help of equations (12), (13), (17), (18), (19a) and (20a):

$$\Delta = \frac{f'g'}{e^{\lambda}\overline{A}\bar{\upsilon}_T}\left[\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\bar{A}}\right)\left(1+\frac{\upsilon h'}{\bar{\upsilon}L}L_{T\upsilon_T}\right)+\frac{\Pi_{\upsilon_T}h'\bar{\upsilon}_T}{\bar{\upsilon}L}L_{T\overline{A}}\right]>0 \qquad (21)$$

$$\frac{d\overline{A}}{de} = \frac{\left[-\frac{\Pi}{e}\left(\lambda-\frac{e}{\Pi}\Pi_e\right)\left[1+\frac{\upsilon h'}{\bar{\upsilon}L}L_{T\upsilon_T}\right]-\frac{\Pi_{\upsilon_T}h'\upsilon_T}{\bar{\upsilon}L}L_{Te}\right]}{\left[\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\bar{A}}\right)\left(1+\frac{\upsilon h'}{\bar{\upsilon}L}L_{T\upsilon_T}\right)+\frac{\Pi_{\upsilon_T}h'}{\bar{\upsilon}L}L_{T\overline{A}}\right]} \lesseqgtr 0 \qquad (22)$$

$$\frac{d\upsilon_T}{de} = \frac{\left[-\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\bar{A}}\right)\left(\frac{h'\upsilon_T}{\bar{\upsilon}L}L_{Te}\right)+\frac{\Pi}{e}\left(\lambda-\frac{e}{\Pi}\Pi_e\right)\frac{\upsilon_T h'}{\bar{\upsilon}_T L}L_{T\overline{A}}\right]}{\left[\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\bar{A}}\right)\left(1+\frac{\upsilon_T h'}{\bar{\upsilon}_T L}L_{T\upsilon_T}\right)+\frac{\Pi_{\upsilon_T}h'}{\bar{\upsilon}_T L}L_{T\overline{A}}\right]} \lesseqgtr 0 \qquad (23)$$

By way of comparison with Dornbusch et al. [1977], and in order to shed some more light on the long-run adjustment process, it might be useful to explore developments in the $z-\omega$ space. The A'A' curve is the equivalent of the AA curve in Figure 1, and represents the relative wage associated with the marginal good $\tilde{Z}$. The B'B' curve represents the trade balance, and is the $z-\omega$ space equivalent of the BB curve. In this case it is vertical since limit pricing and real wage rigidity mean that the trade balance equation is independent of relative wages (recall equation (11)). A devaluation causes both curves to shift to the right on impact, the B'B' curve shifting due to higher employment. The (lower) Home relative wage ω_1 resulting directly from a devaluation is consistent with a more diversified structure and higher tradable sector employment. The economy moves from point E to E'. Greater employment, a lower relative wage, and higher profits result in accumulation, investment, and rising wages over time. In the best case scenario corresponding to Figure 5, both curves shift further right since the learning dominates rising wages. A more diversified structure results even if the relative wage rises to its original level ω_0, as shown at point E" in the figure, or to an even higher level. It is obvious from equation (2) that, absent the technical progress caused by greater profits and investment during the transition, ω_0 would still be associated with the original pattern of specialization and employment.

[17] Note also that non-tradable employment would never shrink to zero as long as $\lambda < 1$.

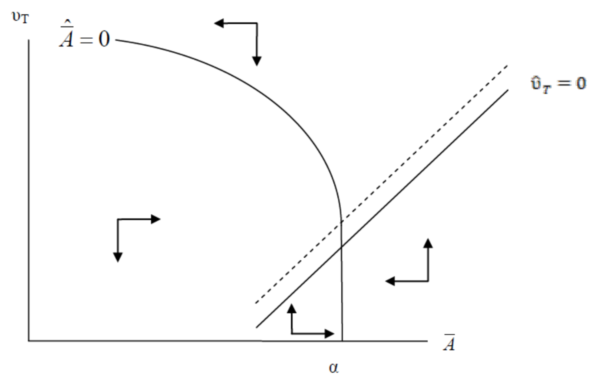

Figure 7: Devaluation in an economy where learning has been exhausted

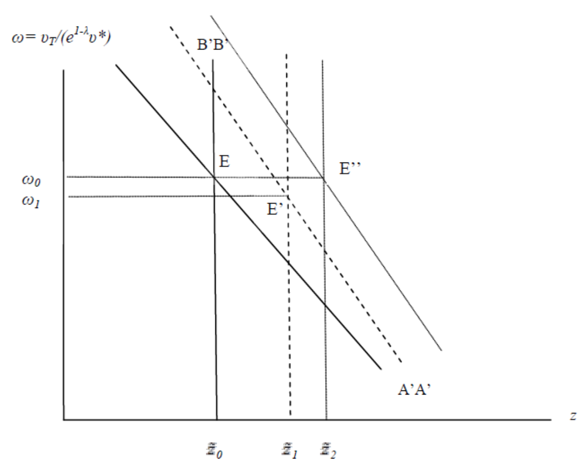

Figure 8: The structural evolution of the economy

4 Conclusions and Future Extensions

There is substantial empirical evidence that countries tend to diversify along both the output and export dimensions during most of their growth trajectory and that undervalued exchange rates can promote investment and growth. Countries develop by learning to successfully carry out new activities. Why do some countries successfully diversify and catch up while others fail to follow suit? One reason almost certainly lies in the risk underlying ventures in new industries, especially when potential customers reside outside of investors' familiar terrain, as in the case of export markets. Hausmann and Rodrik [2005], for example, pin the blame on market failures. Uncertainty about production costs in new export lines and the inability to fully internalize benefits leads imperfectly informed entrepreneurs to deliver less than socially optimal diversification.

This paper presented a model consistent with the idea that, by boosting profits, policy action through devaluation can help offset the risky nature of investment in new sectors in the presence of shallow financial markets. Thus devaluation is potentially a highly useful tool to subsidize risk-taking. Perhaps more importantly, by facilitating diversification, an undervalued exchange rate could help counter the negative external account effects of higher investment. Finally, by boosting investment and productivity, an undervalued exchange rate helps ensure that firms have staying power in the newly acquired sectors. Such a policy, however, could be thwarted if distributional conflict undermines competitiveness. This is one dimension in which exchange rate policy may be superior to more direct routes to boosting profitability and investment such as wage suppression. An undervalued exchange rate could potentially boost profits while leaving the real wage untouched in the short run. The long-run effect on workers is ambiguous but, given the right conditions, the effect of a nominal devaluation is to cause a permanent rise in the real wage, tradable sector employment, and productivity. Moreover, the economy diversifies along the growth path. For the profit-investment-learning nexus to come into play, however, Home firms must have some market power, which in our case is exhibited through the assumption that lack of domestic competition makes limit pricing possible. Related considerations at least partly motivated policy makers in South Korea and several other successful cases of development to limit domestic competition in the tradable sector and to selectively "champion" firms.

My aim here was to develop a relatively simple framework in which investment, distribution, and diversification could be simultaneously analyzed as endogenous to the system. I ignored a number of complications along the way. For example, the rest of the world does not retaliate to a nominal devaluation carried out by the Home country. Limit pricing is a special assumption. This assumption is perhaps more plausible for the sophisticated, cutting edge sectors in developing countries rather than the more traditional/less sophisticated traded sectors where domestic firms are likely to face intense competition. Assuming homothetic demand functions sweeps interesting distributional issues under the rug. Also, in the very long-run, growth would eventually cause the subsistence wage to rise and hidden unemployment to disappear, even in an economy that starts with a large amount of the latter. A more involved long-run framework would relax these assumptions.

In line with empirical evidence, the simple framework developed here suggests several reasons why the real exchange rate may be a less effective tool for developed country policy makers. An economy which is closer to the global technological frontier may have lesser scope for learning by investing. Moreover, advanced economies tend not to have the dual labor market structure that plays an important role in this model. Labor tightening is, therefore, likely to offset any initial boost to competitiveness. Moreover, internal competition is much more likely to neutralize the effects of a devaluation on profits in the absence of deliberate championing of chosen firms by policy makers. Finally, an economy that is economically large would be unable to increase supply without adversely affecting its terms of trade; a problem that the Home economy does not face in the present model.

While in my model the benefits of diversification arise in the form of offsetting the trade deficit-creating effects of higher profits and employment generation in the modern sector, the advantages of diversification almost certainly extend beyond that. Indeed one could easily identify at least two additional benefits: (i) portfolio diversification on the production side, which, as pointed out more than half a century ago by Prebisch [1950] and Singer [1950], among others, is likely to contain volatility in the face of external shocks, and (ii) learning-by-doing as the labor force is exposed to more challenging tasks in the newly acquired sectors. In addition, a series of studies following Melitz [2003] have analyzed the learning-by-exporting channel which seems to be more significant in the case of developing countries.[18] I leave these issues to future research. Also, left to future research are other issues that attain theoretical salience in the very long run, such as movement along cones of diversification as old industries gradually die out once a country attains a certain level of income.[19]

5 Mathematical Appendix

The detailed expressions for the slopes of the various curves and the comparative statics in Section 3.1 are as follows:

$$\left.\frac{dL_T}{d\tilde{z}}\right|_{AA} = \infty$$

$$\left.\frac{dL_T}{d\tilde{z}}\right|_{BB} = \frac{\frac{\lambda}{\Theta(\lambda-\Theta)}\Theta' - \Gamma(\tilde{z})}{\Gamma_2}$$

$$\frac{d\tilde{z}}{de} = -\frac{-(1-\lambda)}{e^{\lambda-2}A_1}\frac{\upsilon_T}{\upsilon^*}$$

[18] See, for example, Pedro and Yang [2009] for a comprehensive survey.

[19] See Schott [2004], Xiang [2007], and Cadot et al. [2009] for very interesting discussions of country evolutions across cones of diversification as new industries develop while old ones that a diversifying country loses comparative advantage in die out only gradually.

$$\frac{dL_T}{de} = -\frac{(1-\lambda)\frac{\upsilon_T}{e^{2-\lambda}\upsilon^*}\left[\frac{\lambda}{\Theta(\lambda-\Theta)}\Theta' - \Gamma(\tilde{z})\right]}{A_1\Gamma_2}$$

$$\frac{d\tilde{z}}{d\upsilon_T} = \frac{1}{e^{1-\lambda}\upsilon^* A_1}$$

$$\frac{dL_T}{d\upsilon_T} = \frac{\frac{1}{e^{1-\lambda}\upsilon^*}\left[\frac{\lambda}{\Theta(\lambda-\Theta)}\Theta' - \Gamma(\tilde{z})\right]}{A_1\Gamma_2}$$

$$\frac{d\tilde{z}}{d\bar{A}} = -\frac{A_2}{A_1}$$

$$\frac{dL_T}{d\bar{A}} = \frac{-A_2\left[\frac{\lambda}{\Theta(\lambda-\Theta)}\Theta' - \Gamma(\tilde{z})\right]}{A_1\Gamma_2}$$

The expressions for the various isocline shifts discussed in Section 3.2 are as follows:

$$\frac{\partial\widehat{\overline{A}}}{\partial\overline{A}} = -\frac{f'\Pi}{f^2P}\left(1 - \Pi_{\overline{A}}\frac{\overline{A}}{\Pi}\right)$$

$$\frac{\partial\widehat{\overline{A}}}{\partial\upsilon_T} = \frac{f'}{fP}\Pi_{\upsilon_T}$$

$$\frac{\partial\widehat{\overline{A}}}{\partial e} = \frac{f'\Pi}{efP}\left(\Pi_e\frac{e}{\Pi} - \lambda\right)$$

$$\frac{\partial\hat{\upsilon}_T}{\partial\overline{A}} = -g'h'\frac{\upsilon_T}{(\bar{\upsilon}_T)^2L}\frac{dL_T}{d\overline{A}}$$

$$\frac{\partial\hat{\upsilon}_T}{\partial\upsilon_T} = -\frac{g'}{\upsilon_T}\left(1 + \frac{\upsilon h'}{\bar{\upsilon}L}\frac{dL_T}{d\upsilon}\right)$$

$$\frac{\partial\hat{\upsilon}_T}{\partial e} = -g'h'\frac{\upsilon_T}{(\bar{\upsilon}_T)^2L}\frac{dL_T}{de}$$

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