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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 despite 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 devaluation a particularly useful tool is that it makes it possible to expand domestic profits while limiting internal distributional conflict and the ensuing negative effects on development.

JEL Classification: O40, F12, F16, O24

Contents

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 as being 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 than industrialized ones. While a lot remains unknown about the relationship between nominal devaluations and output growth, this 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, the link between growth 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 correlation between the growth rate and real exchange rate than in identifying channels of influence. This is particularly true when the horizon of analysis extends beyond the short run. This paper attempts to help fill this gap by developing 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 Ricardian framework) or factor endowments (in the case of Heckscher–Ohlin framework. 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**. Even though, 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 national welfare is maximized by specialization in the range of goods that a country has comparative advantage in at a given level of endowments. This implication holds even as countries abandon old sectors while entering new cones of diversification.

However, beginning with Imbs and Wacziarg (2003), a new strand of literature that carefully analyzes historical patterns of specialization 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 respecialization tend to take place along both the extensive margin (i.e., new sectors) and the intensive margin (i.e., roughly 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:

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

(i)   Developing countries typically have a dual economic structure, with a traditional sector that mostly produces nontradable goods existing alongside a modern industry sector that produces tradable goods. Moreover, the presence of large pools of underemployed workers in the traditional subsistence sector means that wages need not adjust quickly in the face of falling unemployment.

(ii)   Countries tend to industrialize (in terms of both 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.

(iii)   Countries typically follow a nonmonotonic trajectory along their development paths. Low- and middle-income countries tend to diversify during their growth trajectories, only respecializing after they have reached upper or upper-middle income status.

(iv)   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 undermines developing-country growth episodes, as exhibited in boom and bust cycles of gross domestic product (GDP) growth.

(v)   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]

(vi)   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, under certain conditions, a nominal exchange rate devaluation can produce permanent changes in economic structure. In the short run, it results in diversification, investment, and rising employment in the modern tradable sector despite real wage rigidity. Diversification plays a crucial role in this process by ensuring that greater home-country 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 second process dominates, technological progress could create room for higher steady-state real wages without loss of competitiveness in the newly acquired sectors. The long-run effectiveness of the exchange rate policy, therefore, depends on the outcome of the 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 onto 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

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

comparative advantage over time. However, unlike Krugman, 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.

Section 2 of this paper discusses relevant aspects of existing literature. Section 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]

Recent empirical evidence has begun to challenge this view. For example, Levi-Yeyati and Sturzenegger (2007) find that undervalued exchange rates induce higher output and productivity growth in developing countries. Moreover, the effect appears to mainly operate not through substitution effects on the trade side but rather through the deepening of savings and capital accumulation. Levi-Yeyati and Sturzenegger also suggest that interventions to maintain undervalued exchange rates induce redistribution (i) from labor to capital that raises investment incentives, and (ii) 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 explain the undervaluation–growth–accumulation nexus.

Looking at individual episodes of sustained growth, Johnson, Ostry, and Subramanian (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, Pritchett, and Rodrik (2005) 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, Rajan, and Subramanian (2007); and Berg,

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[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 nontradables. 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 (i) a redistribution of income towards profits, (ii) negative valuation effects (especially in the presence of an initial trade deficit and when measured in terms of domestic currency), (iii) adverse movement in income terms of trade if substitution effects are weak, (iv) negative supply-side shocks emanating from higher intermediate input prices or higher (indexed) wages, (v) negative real balance effects, and (vi) 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.

Ostry, and Zettelmeyer (2008). This link 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 suboptimal 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, Rapetti, and Skott (2011) 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 (the Tinbergen 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 undervaluation is 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. As discussed earlier, several 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 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 nonmonotonicity 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 existing activities.

Cadot, Carrére, and Strauss-Kahn (2009) go beyond Imbs and Wacziarg 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 growth along the extensive margin (exports of new product lines). They establish a U-shaped pattern similar to Imbs and Wacziarg. 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 theorists in the Kaleckian–Kaldorian tradition, distributional changes may in turn influence the nature and pace of accumulation. For example, in a profit-led regime where the investment elasticity of demand is sufficiently high, redistribution towards profits may facilitate accumulation and investment. These models, however, typically have a short-run focus. If labor has sufficient bargaining power, the redistribution 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 suggestive.[5] The relevant 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 (2008) 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 will lead to greater investment by reducing the workers' share of income 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 redistribution following a devaluation. Another family of models in the post-Keynesian balance of payments constrained growth tradition has emphasized the long-run constraint that the balance of payments position places on the economy from the demand side. However, although the framework could be interpreted as incorporating technological change through income elasticities, it does not explicitly 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 tightens and wages rise? How do issues related to social and institutional stability come into play as a developing country diversifies? Finally, the balance of payments constrained growth framework typically ignores the role of relative price changes in the external balance adjustment process.

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[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, Ostry, and Zettelmeyer (2008), cited earlier, find that the duration of sustained growth acceleration episodes is negatively and significantly related to initial income inequality. See also Rodrik (1999) and Alesina and Perotti (1996). It is important to point out here that, while the Kaleckian framework typically models changes in functional distribution, empirical studies generally study household or individual inequality.

[6] That is, as long as workers consume some nontradables and the price of nontradables 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).

To sum up, several recent studies 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.

3. THE MODEL

The model consists of two countries or regions—the home country (Home), and the rest of the world (ROW). Home is a small, open, developing economy that has (i) large amounts of underemployment, and (ii) 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 the Republic of Korea and the zaibatsu [{translation}] in pre-World War II Japan). This enables Home firms to follow a limit-pricing rule.

The Home economy has a traditional sector that produces nontradable goods and uses labor for production; this sector coexists with a modern sector that produces industrial and/or tradable goods. This tradable sector, in turn, consists of a continuum of sectors that require labor and capital for production. Labor is mobile between sectors while capital is not. The workforce consists of workers employed in the two sectors. Workers outside the tradable sector share in production of the nontradable good, which is determined by demand for that good. Thus, the real wage in the nontradable sector (υ_N) equals the average product of labor. Put differently, the total output of the nontradable sector is divided up among its workers who are underemployed in the sense that fewer workers could produce the same amount of output.[8] The real wage in the modern tradable sector (υ_T) 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 underemployed 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. In other words, wage suppression as a policy tool is not an option.

As in Dornbusch, Fischer, and Samuelson (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, 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 and geography, and other factors as traditionally captured by the Ricardian model of trade. However, Home's unit labor requirements are also determined by the

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[8]A real-world example would be that of a whole family employed on a farm that only requires the service of a subset of fully employed members.

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. On the other hand, ROW is on the international technological frontier and has already exhausted this learning externality. Therefore, average productivity in Home is proportional at any given point in time to the domestic capital stock, K. The relationship is nonlinear. As the capital stock grows, learning opportunities shrink and, beyond a certain threshold, say K_{max}, Home resembles ROW in that learning opportunities are 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:

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

where the foreign capital stock has been normalized to unity.

Now arrange the goods in descending order of Home's comparative advantage so that $\frac{a^*(z_0, K^*)}{a(z_0, K)} > \ldots > \frac{a^*(\tilde{z}, K^*)}{a(\hat{z}, K)} > \ldots > \frac{a^*(z_1, K^*)}{a(z_1, K)}$. A fraction λ of domestic income is spent on tradables in each region. Let W_T and W_T^* denote domestic and ROW nominal wages in the tradable sector. Further, suppose $\tilde{z}$ denotes the marginal or borderline commodity so that $W_T a(\tilde{z}, K) = e W_T^* a^*(\tilde{z})$, which implies that Home produces and exports all the commodities in the range $[0, \tilde{z}]$, and ROW produces and exports all the commodities in the range $[\tilde{z}, 1]$. In other words, there is complete international specialization except for in the case of the marginal good which could be produced by either or both countries. Real wage rigidity implies that $\upsilon_T = W_T / P$, and $\upsilon_T^* = W_T^* / P^*$ 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 expenditure shares of tradable and nontradable goods, while $P^* = (P_N^*)^{1-\lambda} (P_T^*)^{\lambda}$ represents the corresponding ROW variable. For simplicity, the price of nontradable goods is assumed to equal unity across countries.[9] Furthermore, since, as discussed below, tradable good prices are given by international production costs, the choice of appropriate units allows us to assume that $P_T^* = 1$ without loss of generality. Thus, the following equation encapsulates the supply side of the model:

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

where e denotes the nominal exchange rate, and ω is the domestic wage relative to ROW. Equation 2 can also be rearranged and expressed a bit differently, as follows:

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

An increase in the domestic relative real wage makes Home less competitive and leads to the loss of sectors to ROW, while an average productivity increase has the opposite effect. As we see later, the state variable $\overline{A}$ plays an important role in the dynamic adjustment of the system over time.

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[9]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.[10] All 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 nontradable) investment goods. 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.[11]

Total profits in Home are the sum of sector profits:

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

Home has a labor force L, which consists of tradable sector workers, L_T (or, more precisely, workers who produce tradable output at a given point in time), and the nontradable sector workers, L_N, who, as discussed earlier, share the work available in the nontradable sector. Equilibrium in the Home nontradable 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,

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

Thus, employment and profits in the tradable sector generate demand for nontradables, creating nontradable sector income as a result.[12] 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 nontradable income. 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

$$Y = \frac{e^\lambda \upsilon_T L_T + \Pi}{\lambda} \qquad\qquad (5)$$

The nontradable 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, unchanged.

The shares of global expenditures falling on Home tradable goods (Θ) and ROW tradable goods (Θ^*) are given by

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

[11]An example would be that of an engine that could be used either to power 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 nontradable. Making this assumption here, however, would be inconsistent with the assumption of homotheticity since demand for tradable and nontradable goods will no longer be independent of income distribution. Moreover, considering that capital goods tend to fall under both the tradable and nontradable categories, our assumption appears to be more realistic.

[12]The role of underemployment now becomes clearer. An increase in tradable sector employment lowers L_N while at the same time raising output and income in the nontradable sector due to higher demand (equation 4). This is possible only because the extent of underemployment declines, i.e., the amount of output per worker increases. Greater nontradable output divided among fewer workers also means a higher real wage in that sector.

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

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

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,[13] which can be written

$$\Theta e W_T^* L^* = (\lambda - \Theta)Y \qquad\qquad (7)$$

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

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

which further simplifies to

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

where $\Gamma = \int_0^{\tilde{z}} [A(z, \overline{A})a(z)C(z)dz = \Gamma(L_T, \tilde{z}, \overline{A})$ is a weighted measure of domestic employment $(\Gamma_{1,2,3} > 0)$; 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. The second term on the right-hand side makes use of the fact that $\int_0^{\tilde{z}} a(z)C(z)dz = L_T$. Notice that $e\upsilon_T^* \int_0^{\tilde{z}} [A(z)a(z)C(z)dz \geq e^\lambda \upsilon_T L_T$, i.e., revenues exceed costs in the interval $[0, \tilde{z}]$. Also, since $e\upsilon_T^* [A(\tilde{z})a(\tilde{z})C(\tilde{z}) = e^\lambda \upsilon_T a(\tilde{z})C(\tilde{z})$, there are no profits in the marginal sector $\tilde{z}$.

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

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

The consumption of any 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, despite zero profits in the marginal sector,

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[13] Or equivalently, given continuous equilibrium in the nontradable sector, the income = expenditure condition.

the employment of labor in that sector raises national income (because of the presence of underemployed labor).

Despite real wage rigidity, and even with a given pattern of employment and specialization, a change in the exchange rate positively affects profits. This is because of the valuation effect which is only partly offset by the rise in the nominal wage required to maintain the real wage.[14] The gain in profits in this case originates from a valuation effect rather than from domestic redistribution.

Since $e\upsilon_T^*\Gamma \geq e^\lambda \upsilon_T L_T$ 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 equations 5 and 8:

$$L^* - \frac{\lambda - \Theta}{\lambda\Theta}\Gamma(L_T, \tilde{z}, \overline{A}) = 0 \qquad\qquad (10)$$

Equation 10 is written in trade surplus form. An increase in domestic relative income (relative wages or profits) tends to create a trade deficit while increased diversification has the opposite effect at a given level of employment.

Equations 2–10 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 in Home. Once $\tilde{z}$ is determined, Θ and Θ^* are also determined via equations 6a and 6b, and equation 10 yields the level of tradable (and hence, from equation 4, nontradable) employment that is consistent with balanced trade. Figure 1 summarizes the information in $z - L_T$ 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 10. 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. On the other hand, higher Home revenues, some of which are spent on imports, 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 newly acquired sector, 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.[15]

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[14] Put differently, the real profit per unit in sector z is given by $\pi(z)/P = [(eW^*a^*(z) - Wa(z)]/P = e^{1-\lambda}\upsilon^*a^*(z) - \upsilon_T$. Therefore, to the extent that expenditure baskets include nontradables, i.e., $\lambda < 1$, real profits per unit increase following a devaluation.

[15] In formal terms, diversification results in a trade surplus if $\theta(\tilde{z})(\Gamma + \lambda L^*) > (\lambda - \Theta)a^*(\tilde{z})C(\tilde{z})$. The left-hand side represents global expenditure on the newly acquired marginal sector while the right-hand side captures the increase in imports due to increased home revenues. Put differently, the left-hand side reflects the positive impact on the trade balance of turning the previously imported marginal good into an export good. Notice that the lower the initial expenditure share of the tradable sector, the greater the likelihood that this condition is satisfied.

Figure 1: The Supply and Demand Sides in the Short Run
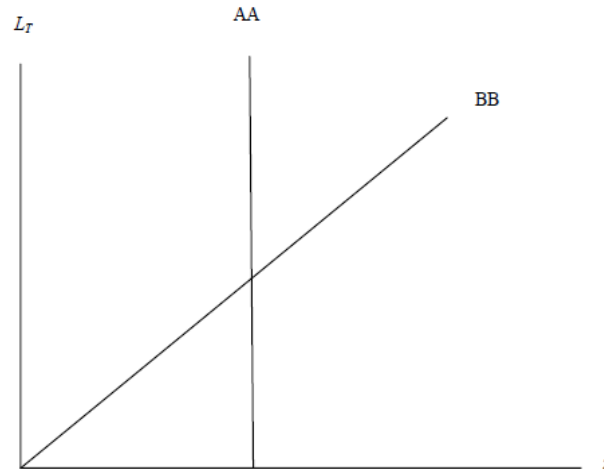
Note: LT = employment in the tradable sector; z = the index used to identify commodities.
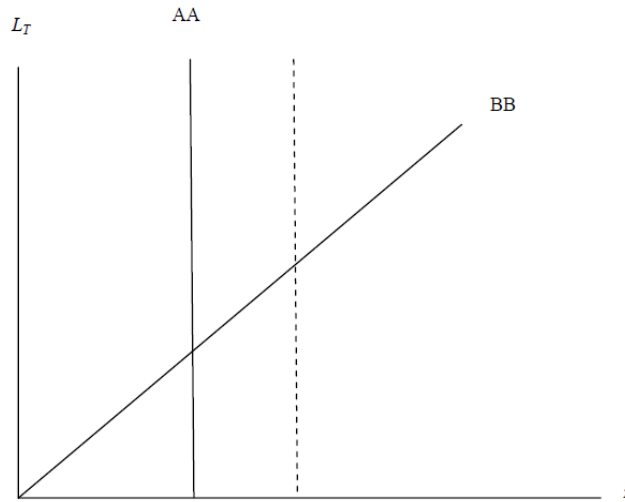
Source: Author

3.1 Comparative Statics

The state variables $\overline{A}$ and υ_T are predetermined 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 10 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. Nontradable 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 summary, 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.

13

Figure 2: Nominal Devaluation

Note: LT = employment in the tradable sector; z = the index used to identify commodities.

Source: Author

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 nontradable sector employment is again zero since tradable sector income is simply redistributed. Therefore, loss of sectors means 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.

Figure 3: The Effects of an Increase in the Real Tradable Sector Wage
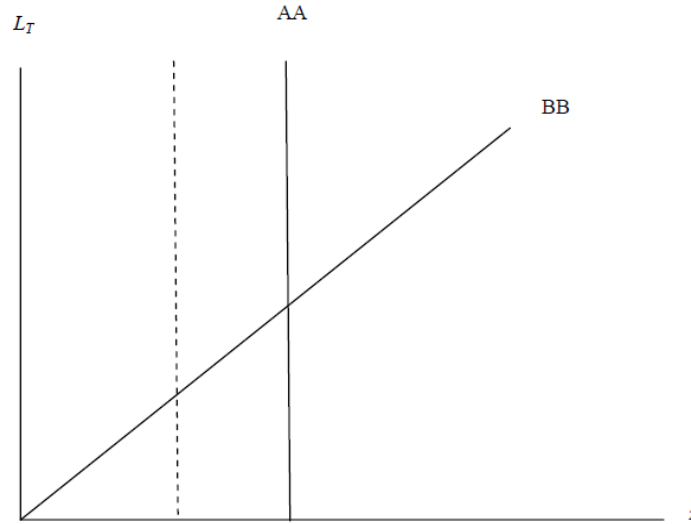
Finally, an increase in the average relative productivity in Home boosts competitiveness and makes it profitable to enter new sectors, and as a result expands the range of products produced in Home. A trade surplus is created in the process. The trade balance is, therefore, restored at a higher level 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 summary:

$$\tilde{z} = \tilde{z}(\overline{A}, \upsilon_T, e); \ \tilde{z}_{\overline{A}} > 0, \tilde{z}_{\upsilon_T} < 0, \tilde{z}_e > 0 \qquad\qquad (11)$$

$$L_T = L_T(\overline{A}, \upsilon_T, e); \ L_{T\overline{A}} > 0, L_{T\upsilon_T} < 0, L_{Te} > 0 \qquad\qquad (12)$$

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 constrained growth model has emphasized both the structural importance of income elasticities of demand and the balance of payments constraint on limiting accumulation and output growth.16

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

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[16] I do not assume a systematic relationship between the level of z and the income elasticity of demand for the associated product. Endogenizing θ along these lines, i.e., assuming, for example, that $\theta = \theta(z)$ and $\theta' > 0$ (on the grounds that developing countries produce relatively unsophisticated products for which the income elasticities tend to be low) could create some interesting linkages to the Prebisch–Singer hypothesis as well as the balance of payments constraint growth framework.

over time. Recall that, in the presence of real wage rigidity, profit income is driven by (Home and ROW) demand and valuation effects. Consider first the effect of a devaluation. From equations 8, 11, and 12:

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

(13)

The right-hand side 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 despite 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:

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

(14)

Again, the right-hand side 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 a positive average productivity shock in Home:

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

(15)

An increase in average productivity raises employment in Home. The resulting higher demand along with the increased profit margin boost profits. The rise in profits varies directly with the strength of the diversification effect.

In summary:

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

(16)

Savings equal total profits. This follows from the assumption that there is no saving out of wage income while profit income is not consumed.[17] Furthermore, with balanced trade in the absence of a government sector or international income flows, savings equal investment.[18]

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

[18] One might argue that investment in new sectors is driven by expected profits rather than actual profits. I abstract away the role of expectations for the sake of simplicity. Moreover, actual profits are often used as a proxy for expected future profitability.

3.2 Adjustment Over the Longer Run

As mentioned earlier, υ_T and $\overline{A}$ are state variables that are predetermined 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 profits. Accumulation generates new knowledge about production in the economy as a whole. An incidental by-product of 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. Based on equation 1, the evolution of relative average productivity is given by

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

(17)

The relationship arises from industrywide learning by accumulation. Alternatively, it could be seen as a conveniently modified form of the Kaldorian technical progress function.[19] We know already from equation 16 that $\Pi_{\overline{A}} > 0$, $\Pi_{\upsilon_T} < 0$, and $\Pi_e > 0$. These signs translate into $\widehat{\overline{A}}_{\upsilon_T} < 0$. Furthermore, the assumption that the response of profits to average productivity changes is less than unit elastic is sufficient (but not necessary) to ensure that $\widehat{\overline{A}}_{\overline{A}} < 0$. The effect of an exchange rate change is less clear. As long as the expenditure share of tradables is not too large,[20] $\widehat{\overline{A}}_e > 0$, otherwise $\widehat{\overline{A}}_e < 0$.

The evolution of the domestic real wage is affected by labor market conditions. Workers adjust their real wage demands depending on what they earn relative to their target wage $\overline{\upsilon}_T$. The target wage is positively correlated with L_T for two reasons. First, 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 serves to undermine the bargaining position of workers. Second, increased tradable sector employment reduces underemployment and increases income per worker in the nontradable sector, thus strengthening the fallback position of tradable sector workers. Thus

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

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

(18)

where $L_{T\overline{A}}, L_{Te} > 0, L_{T\upsilon} < 0$ from equation 12. Furthermore,

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[19] 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**.

[20] Specifically, $\lambda < (e/\Pi)\Pi_e$.

$$\upsilon_T = g\left(1 - \frac{\upsilon_T}{\bar{\upsilon}_T}\right); \ g' > 0$$

$$= \upsilon_T(\bar{A}, \upsilon_T; e) \qquad\qquad (19)$$

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

We are now ready to explore the linearized dynamics of the system given by equations 17 and 19 with the help of Figure 4. The $\widehat{\bar{A}} = 0$ isocline represents the combinations of average productivity and real wages such that the international productivity gap is stable.[21] 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 reverse, through reduced profits and investment, the productivity shift in favor of Home. 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 $\widehat{\bar{A}} = 0$ isocline, too high a domestic real wage and negative investment in the Home economy lead to declining relative productivity. Below the $\hat{\upsilon}_T = 0$ isocline, the real wage is lower than that consistent with labor market conditions, and experiences upward pressure as a result.

To guide intuition, consider the adjustment process that occurs over time. For the sake of brevity, we focus only 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 higher than target real wage 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. Consequently the real wage begins to rise 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 phase. Moreover, unlike the first phase, the movement of the real wage and productivity have offsetting effects on diversification during the final phase.

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

Figure 4: Long-Run Adjustment
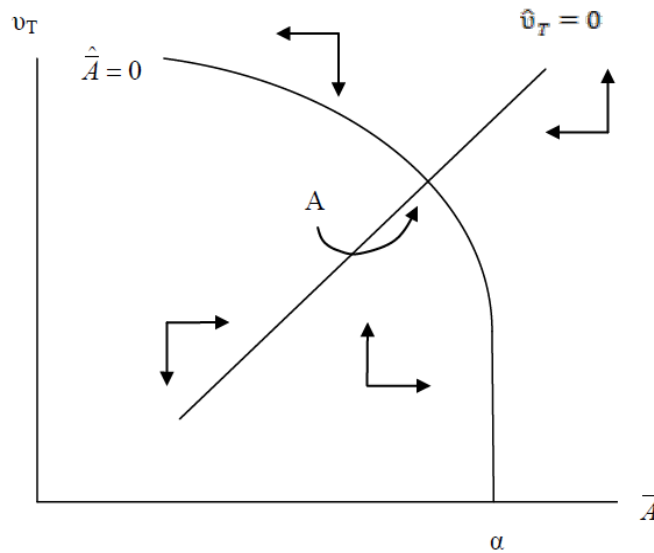
Source: Author

3.3 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 $\widehat{\overline{A}}_e \lessgtr 0$. 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 are also possible but I focus on (i) and (ii) to highlight the 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, despite the profit squeeze caused by rising real wages. Figure 5 graphically presents this scenario. In

addition to the condition $\widehat{\overline{A}}_e > 0$, this scenario requires that the direct effect of the

devaluation on profits (captured by $\widehat{\overline{A}}_e$) is large while that on the labor market (captured by

$\hat{\upsilon}_{Te}$) is small. In graphical terms, the $\widehat{\overline{A}} = 0$ isocline must shift more than the $\hat{\upsilon}_T = 0$ isocline.

Figure 5: The Best-Case Scenario Following a Devaluation
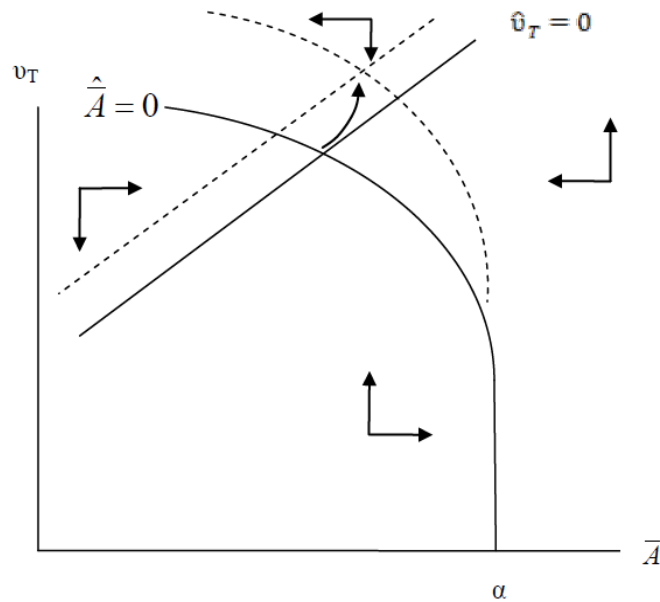
Consider next the worst-case scenario. In this case the initial expenditure share of the tradable sector is large enough so that $\widehat{\overline{A}}_e < 0$, i.e., the positive effect of a devaluation on profits is more than offset by the valuation effect on the capital stock so that profits per unit 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 it 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. In addition to the condition $\widehat{\overline{A}}_e < 0$, this scenario requires that the effect of the devaluation on profits and investment is large while that on the labor market is small. Again, the $\widehat{\overline{A}} = 0$ isocline must shift more than the $\hat{v}_T = 0$ isocline for this scenario to eventuate.

**Figure 6: The Worst-Case Scenario Following a Devaluation**
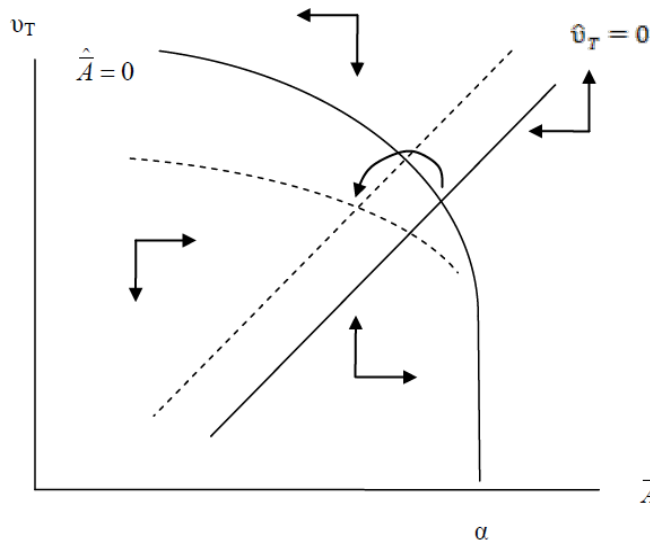
Thus, both the best- and worst-case scenarios require that the direct effect of a devaluation on investment is greater than that on wage growth. The initial effect of the nominal exchange rate change on accumulation constitutes the dividing line. A positive effect, which is helped by a small initial size of the tradable sector so that profits per unit of capital rise and $\widehat{\overline{A}}_\varepsilon > 0$ results in the best-case scenario. A negative effect so that $\widehat{\overline{A}}_\varepsilon < 0$ leads to the worst-case scenario.

The efficacy of exchange rate policy in influencing productivity growth and structural change is likely to be greater for developing countries. To see this, 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, 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 initially to greater tradable sector employment, diversification, labor market tightening, and hence a rising real wage, there is no accompanying scope for catch-up through learning. Rising real wages simply squeeze out profits. Notice that the exchange rate is no longer effective as an instrument for real wage management either once the economy has transformed to the point where the nontradable sector has a bargaining structure similar to the tradable sector and underemployment has vanished.22

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22 Note also that nontradable employment would never shrink to zero as long as $\lambda < 1$.

Figure 7: Devaluation in an Economy Where Learning Has Been Exhausted
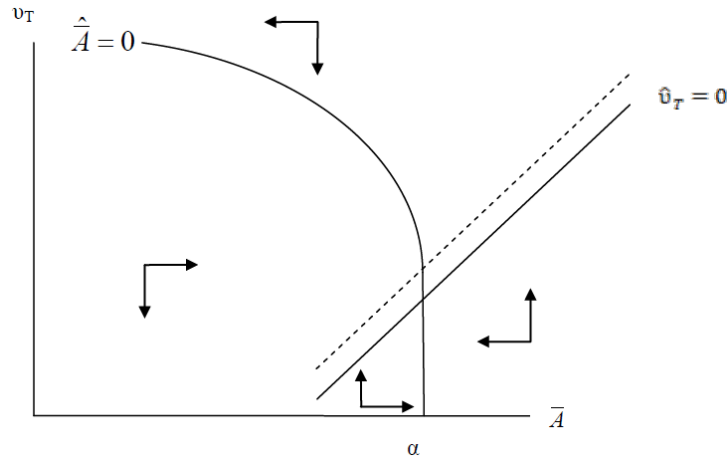
Thus, the overall long-run effects on the economy hinge on the behavior of the labor markets as well as the response of profits to exchange rate changes and of productivity to investment. Since the modern tradable goods sector is the driver of real wages, the higher the amount of available labor outside 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 11, 12, and 16–19:

$$\Delta = \frac{f'g'}{e^\lambda \overline{A}\overline{v}_T}\left[\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\overline{A}}\right)\left(1+\frac{v_T h'}{\overline{v}_T L}L_{Tv_T}\right)+\frac{\Pi_{v_T}\overline{v}_T h'}{\overline{v}_T L}L_{T\overline{A}}\right]>0 \tag{20}$$

$$\frac{d\overline{A}}{de}=\frac{\left[-\frac{\Pi}{e}\left(\lambda-\frac{e}{\Pi}\Pi_e\right)\left[1+\frac{v_T h'}{\overline{v}_T L}L_{Tv_T}\right]-\frac{\Pi_{v_T}h'v_T}{\overline{v}L}L_{Te}\right]}{\left[\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\overline{A}}\right)\left(1+\frac{v_T h'}{\overline{v}_T L}L_{Tv_T}\right)+\frac{\Pi_{v_T}h'}{\overline{v}_T L}L_{T\overline{A}}\right]}<>0 \tag{21}$$

$$\frac{dv_T}{de}=\frac{\left[-\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\overline{A}}\right)\left(\frac{v_T h'}{\overline{v}_T L}L_{Te}\right)+\frac{\Pi}{e}\left(\lambda-\frac{e}{\Pi}\Pi_e\right)\frac{v_T h'}{\overline{v}_T L}L_{T\overline{A}}\right]}{\left[\frac{\Pi}{\overline{A}}\left(1-\frac{\overline{A}}{\Pi}\Pi_{\overline{A}}\right)\left(1+\frac{v_T h'}{\overline{v}_T L}L_{Tv_T}\right)+\frac{\Pi_{v_T}h'}{\overline{v}_T L}L_{T\overline{A}}\right]}<>0 \tag{22}$$

By way of comparison with Dornbusch, Fischer, and Samuelson (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 (see Figure 8 below). 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 10). A devaluation causes both curves to shift to the right on impact. 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 to the 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, in the absence of 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.

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? 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 (2003), for example, identify market failures as the cause. Uncertainty about production costs in new export lines and the inability to fully internalize benefits leads imperfectly informed entrepreneurs to deliver diversification that is less than socially optimal.

Figure 8: The Structural Evolution of the Economy
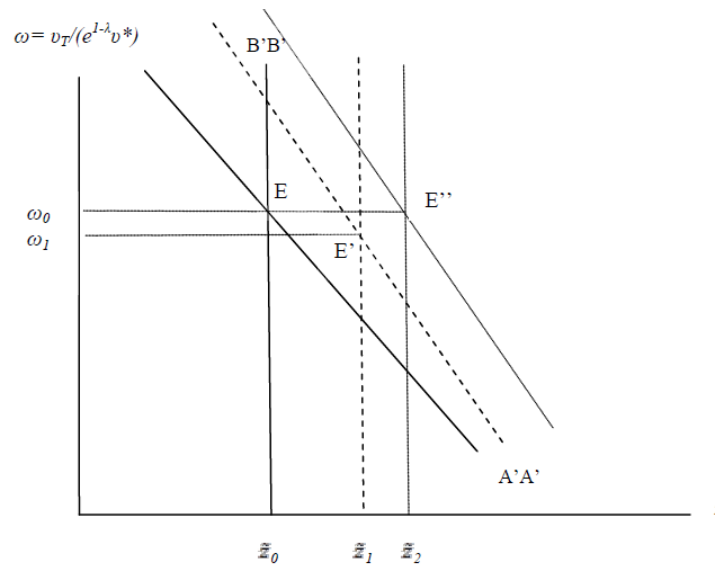
Source: Author

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 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, learning, 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 boost profits while leaving the manufacturing real wage untouched in the short run. The long-run effect on workers is ambiguous but, given the right conditions, the effect of a 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 the Republic of 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 even as it loses sectors. Limit pricing is a special assumption, which is perhaps more plausible for the sophisticated, cutting-edge sectors in developing countries rather than the more traditional and/or less sophisticated traded sectors where domestic firms are likely to face intense competition. Assuming homothetic demand functions ignores interesting distributional issues. 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 hidden unemployment. 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 policy makers in developed countries. An economy which is closer to the global technological frontier is likely to have less scope for learning by accumulation. Moreover, advanced economies tend not to have the dual labor market structure and underemployment that plays an important role in this model. Labor market 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, a large economy 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.

Based on a comprehensive empirical study, Freund and Pierola (2008) find that maintaining a competitive currency leads firms to expand the product and market space for exports, resulting in a major reconfiguration of the tradable sector. It is important to recognize, however, that diversification is a complex process, albeit one that most countries traverse during periods of successful development. A large body of neo-Schumpetarian literature has analyzed the technological and institutional complications that hinder the process of diversification in developing countries. More recently, Hidalgo et al. (2007) have shown that the potential product space that countries traverse contains discontinuities that make it much harder for some countries to diversify. My framework does not explicitly incorporate these complications. By highlighting the role of the exchange rate, however, it does implicitly highlight the potential role of real exchange rate policy in offsetting some of these hurdles.

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 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) accelerated 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.[23] I leave these issues to future research. Also left to future research are other issues that attain

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[23] See, for example, Pedro and Yang (2009) for a comprehensive survey.

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.[24]

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[24]See Schott (2004); Xiang (2007); and Cadot, Carrére, and Strauss-Kahn (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.

5. MATHEMATICAL APPENDIX

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

$$\frac{dL_T}{d\tilde{z}}\bigg|_{AA} = \infty$$

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

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

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

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

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

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

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

The expressions for the various isocline shifts discussed in section 3.1 are as follows:

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

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

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

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

$$\frac{\partial\hat{\upsilon}_T}{\partial\upsilon_T} = -\frac{g'}{\upsilon_T}\left(1 + \frac{\upsilon_Th'}{\overline{\upsilon}_TL}\frac{dL_T}{d\upsilon}\right)$$

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

26

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