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Deregulation and the current account

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Abstract

In this paper we use a dynamic general-equilibrium model to study how removing barriers to competition in the nontraded goods sector affects the current account, the real exchange rate, and factor prices in a small open economy. We show that the expansion of the nontraded sector that results from a "deregulation shock" is associated with an accumulation of foreign assets unless production of nontraded goods is very capital-intensive. Moreover, while the real exchange rate decreases monotonically towards its new steady state, the real wage may temporarily overshoot its long–run level.

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1 Introduction

During the 1990s, both industrialized and developing countries made great progress in liberalizing and deregulating their economies: the Uruguay round of the GATT resulted in the abolition of most barriers to international trade, and in many countries, sectors that were previously dominated by (state-owned) monopolies were opened to competition.[1] Domestic deregulation was particularly important in sectors that are producing nontraded goods since the market structure in these industries is not directly affected by trade liberalization, and competition could only be enhanced by removing entry barriers for new firms.

While the consequences of trade liberalization for the current account and the real exchange rate have been the subject of an ample body of research[2], the international aspects of deregulation in the nontraded goods sector has attracted much less attention. This paper aims at closing this gap and investigates the effects of allowing for free entry into previously monopolized nontraded goods markets. We model an economy in which a perfectly competitive tradables sector coexists with a nontraded goods sector that is initially characterized by monopolistic competiton and restricted market entry. Monopoly power drives a wedge between prices and marginal costs, and we analyze the short–run and long–run effects of removing entry barriers for the current account, the real exchange rate, and the real wage.

We show that, in the long run, employment in the tradables sector decreases since factors of production are reallocated towards the expanding nontraded goods sector. Moreover, the aggregate price level and thus the real exchange rate decreases monotonically as the economy approaches its new steady state. While these results are independent of preference and technology parameters, the reaction of the current account and the real wage crucially depend on relative capital intensities: if the traded goods sector uses capital at least as intensively as the nontradables sector, deregulation is associated with an accumulation of foreign assets, since a portion of the domestic capital stock is sold abroad to

[1]Important examples are the deregulation of the telecommunications sector and of public transport systems in many industrialized countries. In most developing and transition economies, privatization was accompanied by deregulation. A case where the removal of entry restrictions was not associated with the dismantling of state ownership is the deregulation of the Japanese retail sector that started in the mid-nineties (see OECD (2000)).

[2]See, for example, Edwards (1987), Sen and Turnovsky (1989), Gavin (1991), and Keuschnigg (1996).

finance future tradables consumption. On the other hand, if traded goods production is less capital intensive, the economy may run a current account deficit, driven by the investment boom in the nontraded goods sector. Finally, due to the sluggish response of sectoral capital stocks, the real wage may overshoot its long–run level if traded goods production is very capital–intensive and if nontradables consumption represents only a small share of total expenditures.

Our analysis is related to several strands of literature: it shares the notion of Blanchard and Giavazzi (2001) that a key aspect of deregulation is the reduction of market power, reflected by lower markups.[3] Moreover, it inherits elements of dynamic "dependent economy" models that focus on the interaction between perfectly competitive traded and nontraded goods sectors.[4] It also benefits from earlier contributions that analyzed imperfectly competitive nontraded goods sectors in a static setting (see, e.g. Dixon (1994)). More recently, Coto-Martinez (2000) and Coto-Martinez and Dixon (2001) have used dynamic general equilibrium models with imperfect competition to analyze the effects of government expenditure shocks in a small open economy, and by assuming that aggregate demand elasticities are affected by fiscal policy Coto-Martinez (2000) also considers the consequences of changing markups. However, while in Coto-Martinez (2000) these changes result from government expenditure shocks, we focus on the case that they are due to an exogenous change of market structure. Finally, our contribution fits into the research program of the "New Open Economy Macroeconomics" pioneered by Obstfeld and Rogoff (1995) and surveyed by Lane (2001). While we differ from this literature by abstracting from nominal rigidities, we share its focus on dynamic general equilibrium models that are characterized by imperfect competition.

The rest of the paper is organized as follows: the next section introduces the basic elements of our model. Section 3 analyzes how changing the market structure in the nontraded goods sector affects the current account, the real exchange rate, and the real wage. Section 4 summarizes and concludes.

[3]We are aware that this approach is somewhat reductionistic and that it neglects some important aspects of deregulation. In particular, by assuming throughout the paper that firms are maximizing profits, we are abstracting from the fact that deregulation is frequently associated with a fundamental change in firms' objectives. Nevertheless, we think that, by focusing on the competitive effects, our model captures an important component of the phenomenon.

[4]See Brock (1988), Brock (1996), Brock and Turnovsky (1994), and Turnovsky (1997) for an excellent survey.

2 The model

2.1 Households

We consider a small open economy that is populated by a continuum of households of total mass one who maximize their utility over an infinite time horizon. Lifetime utility of a household at time t is given by

$$U_t = \sum_{s=t}^{\infty} \delta^{s-t} ln(C_s). \tag{1}$$

In (1), δ is the household's subjective discount factor, and C_s aggregates the consumption of a bundle of goods at time s. More specifically, we assume that

$$C_s = (C_s^T)^{\gamma}(C_s^N)^{1-\gamma}, \tag{2}$$

where C_s^T represents consumption of a single traded good at time s while C_s^N aggregates the consumption of a large (but fixed) number of nontraded goods:

$$C_s^N = \left[\int_0^1 c_s^N(z)^{1/\mu}\, dz\right]^{\mu}. \tag{3}$$

There are no barriers to international trade and the price of the tradable good is therefore determined by world markets. Using this good as the numeraire, we set its price equal to one at each point in time. With the price of the composite nontraded good in terms of tradables being denoted by P_s^N, we can thus write the consumption–based price index, that is the minimum amount of traded goods required to purchase a unit of the consumption bundle, as

$$P_s = \Gamma(P_s^N)^{1-\gamma}, \tag{4}$$

where $\Gamma \equiv (1/\gamma)^{\gamma}(1/(1-\gamma))^{1-\gamma}$. Since the foreign price level is assumed to remain constant, (4) also gives the real exchange rate, with a real appreciation (depreciation) generated by a rise (fall) in P.

It follows from (3) that

$$P_s^N = \left[\int_0^1 p_s^N(z)^{1/(1-\mu)}\, dz\right]^{1-\mu}, \tag{5}$$

where $p_s^N(z)$ denotes the price of a nontraded good at time s.

In every period, households inelastically supply one unit of labor, collect profits, and rent capital to firms in the tradable and the nontradable goods sectors. The traded good can be transformed into physical capital using a linear technology. Combining this with the assumption that the depreciation rate is zero yields.

$$K_{s+1}^T = K_s^T + I_s^T, \tag{6}$$

$$K_{s+1}^N = K_s^N + I_s^N, \tag{7}$$

where K_s and I_s denote the stock of physical capital and investment at time s, and where the superscripts T and N refer to the traded and the nontraded goods sectors, respectively.[5]

We assume that sector-specific capital has to be put in place one period before it is used in production, and that the capital stock carried into a given period can be transformed back into traded goods only *after* it has been used for production in this period. Hence, capital is earmarked for the use in a particular sector one period in advance. Imposing such a "time-to-build / time-to-dismantle" constraint amounts to assuming infinite adjustment costs which prevent the sectoral capital stocks from jumping to their new steady state levels immediately after a shock has occured. Like a convex adjustment costs function, this assumption

[5]Turnovsky (1997) emphasizes the consequences of assuming that investment goods are traded in dynamic versions of the dependent economy model and also analyzes the implications of allowing for nontraded investment goods.

gives rise to nondegenerate dynamics, but it allows for an analysis that does not rely on a linearized version of the model. This is important since, as we will show below, the new steady state allocation crucially depends on the transition path after a shock, and by linearizing the model one risks to distort both the short-run and the long-run behavior of endogenous variables.

Households have unrestricted access to world capital markets where they can purchase and sell real bonds that pay a constant net interest rate r. The economy's flow budget constraint in terms of traded goods thus looks as follows:

$$B_{s+1} = (1+r)B_s + w_s L_s^T + w_s(1-L_s^T) + R_s^T K_s^T + R_s^N K_s^N + \Pi_s^N - I_s^T - I_s^N - P_s C_s. \quad (8)$$

In (8), B_{s+1} denotes the amount of bonds purchased at the end of period s, w_s is the wage rate, L_s^T is the amount of labor employed in the traded good sector, and $P_s C_s = C_s^T + P_s^N C_s^N$ is the total value of consumption at time s. Since there are no impediments to intersectoral labor mobility, the same wage has to be paid by traded and nontraded goods firms. On the other hand, the capital stocks in the traded and the nontraded goods sectors are determined one period in advance, and the sector–specific rental rates of capital, R_s^T and R_s^N, may therefore differ temporarily if the economy is hit by an unanticipated shock. Finally, Π_s^N are (potentially positive) profits in the nontraded goods sector that accrue to households.

The transversality condition that prevents both suboptimal asset accumulation and infinite debt is

$$\lim_{T\to\infty} \left(\frac{1}{1+r}\right)^T B_{t+T+1} = 0, \quad (9)$$

the households' optimal consumption path is characterized by the intertemporal Euler condition

$$\frac{C_{s+1}}{C_s} = \delta(1+r)\frac{P_s}{P_{s+1}}, \quad (10)$$

and optimal investment at time s has to satisfy

$$R_{s+1}^T = R_{s+1}^N = r. \tag{11}$$

Note, however, that (11) may be violated ex post if the economy is hit by a non-anticipated shock in period $s+1$ since, by assumption, it takes one period to increase or reduce sector-specific capital stocks.

The expression in (10) has a straightforward interpretation: at each point in time, the marginal rate of substitution between consumption in period s and consumption in period $s+1$ has to be equal to the consumption–based real interest rate which depends on the (constant) interest rate paid on bonds and on the evolution of the price level P. If we make the standard assumption that $\delta(1+r) = 1$ and denote the total value of consumption expenditure at time s by $E_s \equiv P_s C_s$, equation (10) requires that $E_{s+1} = E_s$, that is, given his current information, households seek to keep the value of consumption at a constant level.

Finally, it follows from (2) that in each period, households allocate a constant fraction of total consumption expenditure to traded goods and nontraded goods, respectively, that is $C_s^T = \gamma E_s$ and $P_s^N C_s^N = (1-\gamma)E_s$.

2.2 Traded goods firms

The traded good is produced by identical firms whose technology is given by

$$Y_s^T = (K_s^T)^\alpha (L_s^T)^{1-\alpha}. \tag{12}$$

Obviously, the firms' optimal choice of capital and labor has to satisfy the following first order conditions:

$$R_s^T = \alpha \left(\frac{L_s^T}{K_s^T} \right)^{1-\alpha}, \tag{13}$$

$$w_s = (1-\alpha) \left(\frac{K_s^T}{L_s^T} \right)^{\alpha}. \tag{14}$$

2.3 Nontraded goods firms

All firms in the nontraded goods sector use the same technology, which is given by

$$Y_s^N(z) = (K_s^N(z))^{\beta}(L_s^N(z))^{1-\beta}. \tag{15}$$

In (15), $Y_s^N(z)$ denotes the output of firm z at time s, and $K_s^N(z)$ and $L_s^N(z)$ are the amounts of labor and capital employed by that firm.

If every nontraded good is supplied by one (monopolistic) firm, that firm charges the price

$$p_s^{N,re}(z) = \mu\psi_s^N, \tag{16}$$

where μ is the firm's markup over marginal costs which follows from profit maximization given the aggregator in (3), and where the superscript re indicates that the nontraded goods sector is characterized by *restricted entry*. Marginal costs in the nontraded sector are given by

$$\psi_s^N = \left(\frac{R_s^N}{\beta}\right)^{\beta}\left(\frac{w_s}{1-\beta}\right)^{1-\beta}. \tag{17}$$

Note that, since firms can continuously adjust their factor demands, there are no fixed costs, and – for given factor prices – both marginal and average costs are constant.

If there is free entry of firms, competition results in every firm charging a price equal to marginal costs, i.e.

$$p_s^{N,fe}(z) = \psi_s^N, \tag{18}$$

where fe stands for *free entry*.[6] It follows from (5) that, in a symmetric equilibrium, $P_s^N = p_s^N(z)$, both in case of restricted and of free entry.

Equilibrium in the market for nontraded goods requires

$$\frac{(1-\gamma)E_s}{P_s^N} = (K_s^N)^{\beta}(L_s^N)^{1-\beta}. \tag{19}$$

Substituting this expression into (8) and taking into account that the output of nontradables equals the sum of factor rewards and profit income in this sector yields

$$B_{s+1} = (1+r)B_s + (K_s^T)^{\alpha}(L_s^T)^{1-\alpha} - I_s^T - I_s^N - \gamma E_s. \tag{20}$$

Hence, the evolution of foreign assets is determined by the difference between the economy's production and absorption of traded goods.

3 The effects of deregulation

We will now consider the following scenario: through period 0, the nontraded sector is *regulated*, and every good is produced by a single firm. Further market entry is prevented by the government, and all profits accrue to households. In period 1, the government permanently *deregulates* the nontraded sector by permitting free entry of competing firms. This step comes as a surprise, that is, agents have no possibility to adjust their behavior in preceding periods.

3.1 The steady state before and after deregulation

In period 0, the economy is still characterized by monopolistic competition in the nontraded goods sector, that is, $P_0^N = \mu\psi_0^N$. Using (11), (13), (14), (16), (17), and the fact that the sectoral capital stocks and the stock of foreign assets are

[6] Note that, while in the standard monopolistic competition framework profits are eliminated by the introduction of new goods, the number of nontraded goods is constant in our model. However, if entry barriers are removed, the market for each nontraded good becomes contestable, which prevents firms from charging a price above average costs.

constant in the steady state, (19) and (20) for period 0 can therefore be written as

$$(1-\gamma)E_0 = \mu\phi\nu(1-L_0^T), \tag{21}$$

and

$$\gamma E_0 = rB_0 + \nu L_0^T, \tag{22}$$

with $\phi \equiv \frac{1-\alpha}{1-\beta}$ and $\nu \equiv \left(\frac{\alpha}{r}\right)^{\alpha/(1-\alpha)}$.
These equations can be used to derive

$$L_0^T = \frac{\gamma\mu\phi - \frac{(1-\gamma)rB_0}{\nu}}{(1-\gamma)+\gamma\mu\phi}. \tag{23}$$

Note that steady state employment in the traded goods sector decreases in the level of foreign assets B_0. This is due to the fact that, while the capital–labor ratio in this sector is pinned down by the world interest rate, L_0^T is determined by the volume of traded goods output that is necessary to keep B_0 at a constant (steady state) level. Moreover, L_0^T is increasing in μ, that is, a high markup reduces demand for nontraded goods and thus employment in this sector.[7] To simplify the subsequent computations we set $B_0 = 0$.

It follows from (11) and (13) that the initial capital stocks in the traded goods and the nontraded goods sector are given by

$$K_0^T = \nu^{1/\alpha}L_0^T, \tag{24}$$

[7]To show that this also holds if $B_0 < 0$, one has to take into account that $Y_0^T > -rB_0$, which implies $\nu > -rB_0$. Otherwise, interest payments on outstanding debt would exceed total traded goods production, and the steady state level of foreign debt would clearly be unsustainable.

$$K_0^N = \frac{\beta(1-\alpha)}{\alpha(1-\beta)}\nu^{1/\alpha}(1 - L_0^T). \tag{25}$$

Moreover, with $B_0 = 0$, the value of consumption expenditure in the initial steady state is

$$E_0 = \frac{\nu\mu\phi}{(1-\gamma) + \gamma\mu\phi}. \tag{26}$$

To determine the new steady state allocation (denoted by the omission of time subscripts), we use the equilibrium conditions

$$(1-\gamma)E = \phi\nu(1 - L^T), \tag{27}$$

$$\gamma E = rB + \nu L^T, \tag{28}$$

from which we can derive

$$L^T = \frac{\gamma\phi - (1-\gamma)\frac{rB}{\nu}}{1 - \gamma + \gamma\phi}. \tag{29}$$

Of course, the new capital stocks in the traded good and the nontradables sectors are given by

$$K^T = \nu^{1/\alpha} L^T, \tag{30}$$

$$K^N = \frac{\beta(1-\alpha)}{\alpha(1-\beta)}\nu^{1/\alpha}(1 - L^T), \tag{31}$$

and the new steady-state level of consumption expenditure is

$$E = \phi \left(\frac{rB + \nu}{1 - \gamma + \gamma\phi} \right). \tag{32}$$

It follows from (10) and $\delta(1 + r) = 1$ that the value of expenditure moves to that level as soon as the government has started to deregulate the nontraded sector in period 1. Hence $E_s = E$ for all $s \geq 1$.

In (29), B represents the stock of assets (or debt) accumulated during the transition to the new steady state, which depends on the households' consumption and investment decisions after the shock. This indicates that the allocation in the new steady state cannot be determined without analyzing the transition path. Hence, to identify the long–run consequences of a deregulation shock, we have to consider the adjustment that is taking place in period 1.[8]

3.2 The transition in period 1

In period 1, the capital stocks in both sectors are predetermined by their old steady state values (i.e. $K_1^T = K_0^T$ and $K_1^N = K_0^N$), while employment in the traded goods sector (L_1^T) possibly differs from its previous level. Hence, it follows from (11), (13), (19), and $E_1 = E$ that

$$(1 - \gamma)E = \phi\nu \left(\frac{L_0^T}{L_1^T} \right)^{\alpha} (1 - L_1^T). \tag{33}$$

In both sectors, the adjustment of the capital stock takes place in period 1, and the economy reaches its new steady state in period 2. The period-1 market–clearing condition for traded goods is thus given by

$$B_2 = (K_0^T)^{\alpha}(L_1^T)^{1-\alpha} - (K^T - K_0^T) - (K^N - K_0^N) - \gamma E. \tag{34}$$

[8]Setting $\gamma = 1$ in (29) reveals that the path-dependence of the long-run allocation is due to the existence of nontraded goods. Turnovsky (1997) demonstrates that in models where all goods are traded but where the labor supply is endogenous, the long–run steady state after a shock also depends on the transition path.

In (34), B_2 represents the foreign assets that are accumulated during the transition to the new steady state, i.e. the current account balance in period 1. Since no further adjustment takes place after period 2, we can write $B_2 = B$, and substituting (24) and (30) into (34) we thus get

$$B = \nu(L_0^T)^\alpha(L_1^T)^{1-\alpha} - \nu^{1/\alpha}\zeta(L^T - L_0^T) - \gamma E, \tag{35}$$

where $\zeta \equiv \frac{\alpha-\beta}{\alpha(1-\beta)}$. Note that ζ is positive (negative) if the traded goods sector uses capital more (less) intensively than the nontradables sector.

3.3 Results

Together with (21), (22), (27), and (28), the expressions in (33) and (35) form a system of nonlinear equations that determine the endogenous variables E_0, L_0^T, L_1^T, L^T, E, and B. We will now analyze this system to derive the qualitative responses of sector–specific employment and of the current account to a deregulation shock. In a second step we will then consider the evolution of the real exchange rate and the real wage.

Our first result refers to the current account reaction to the unanticipated deregulation. This reaction is driven by the reallocation of the labor force and by the households' investment and consumption responses, and we show that the sign of the current account balance in period 1 crucially depends on the relative capital intensities of the tradables and the nontradables sector:

Lemma 1 *If $\alpha \geq \beta$, the economy runs a current account surplus during the transition to the new steady state. Hence, $\alpha \geq \beta$ implies $B > 0$.*

Proof: See the Appendix.

Note that Lemma 1 presents a sufficient but not a necessary condition for a current account surplus. Hence, as long as the difference between α and β is not too large, it is possible that B is strictly positive although the nontraded goods sector is relatively capital intensive.

Before interpreting the contents of Lemma 1, we present a further result which clarifies how removing the markup affects the short– and long–run allocation of the labor force:

Lemma 2 $L^T < L_1^T < L_0^T$: *After deregulation, employment in the traded goods sector monotonically decreases to its new steady state level.*

Proof: See the Appendix.

The result in Lemma 2 does *not* depend on the two sectors' relative capital intensities: regardless of the sign of $(\alpha - \beta)$, deregulation triggers a reallocation of the labor force from the traded to the nontraded goods sector, and since for a constant world interest rate the steady state capital–labor ratios of the two sectors are not affected by deregulation, this also implies that the capital stock in the non–traded sector expands while it contracts in the tradables sector. The intuition behind this result is straightforward: deregulation lowers the price of nontraded goods, and to meet the resulting higher demand, production of nontradables has to expand, which requires a reallocation of factors towards this sector.

While this reallocation of factors is independent of preference and technology parameters, Lemma 1 shows that its effect on the current account crucially depends on the relative capital intensities in the two sectors, i.e. on the sign of $(\alpha - \beta)$. If $\alpha > \beta$, i.e. if the traded goods sector is relatively capital–intensive, the additional capital required in the expanding nontradables sector is provided by the contracting traded goods sector. Moreover, a portion of the capital that is no longer needed in traded goods production is sold abroad. In the long run, the contraction of employment in the traded goods sector is associated with a reduction of the capital stock and with lower traded goods output. However, interest payments received from abroad enable domestic households to consume more traded goods than the economy produces.

On the other hand, if α is much smaller than β, the expansion of the nontraded sector requires large investments, which are partly financed via the current account and are reflected by the accumulation of foreign debt. Finally, if $\alpha = \beta$, the additional investment in the nontraded goods sector equals the disinvestment in the tradables sector. Nevertheless, the current account balance in period 1 is positive. This can be explained as follows: in the long run, the expansion of the nontraded goods sector requires a reduction in traded goods production. However, in period 1 the capital stock in the tradables sector exceeds the new steady state level, and domestic households take advantage of this by accumulating foreign assets in order to smooth their consumption of tradable goods.

The following results consider the evolution of the real exchange rate P_s and the real wage after the deregulation shock:

Lemma 3 $P < P_1 < P_0$: *After a deregulation shock, the real exchange rate monotonically decreases to its new steady state level.*

Proof: See the Appendix.

Lemma 4 *Let* $\omega_s = w_s/P_s$ *be the real wage in period* s *and* ω *the real wage in the new steady state. Then*

i) $\omega > \omega_0$,

ii) $\omega_1 > \omega_0$,

iii) $\omega_1 > \omega$ *iff* $\left(\frac{L_0^N}{L_1^N}\right)^{\beta(1-\gamma)} \left(\frac{L_0^T}{L_1^T}\right)^{\alpha\gamma} > 1$.

Proof: See the Appendix.

Since steady state factor prices are pinned down by the world interest rate, the long–run price level apparently decreases and the real wage increases as a result of removing barriers to entry (and thus monopoly pricing) in the nontraded goods sector. However, in the short run the capital stocks in both sectors are fixed, and this slows down the adjustment of goods and factor prices and may even result in an *overshooting* of the real wage rate. The third part of Lemma 4 indicates that both preference and technology parameters decide whether such an overshooting actually takes place: while it follows from Lemma 2 that $L_0^N < L_1^N$ and $L_0^T > L_1^T$, the second component of the expression in part *iii*) of Lemma 4 gets a larger weight if $\alpha\gamma$ is greater than $\beta(1-\gamma)$. Hence, overshooting becomes more likely if traded goods production is very capital–intensive and if these goods attract a greater share of the household's total expenditure. This can be explained as follows: since sectoral capital stocks are fixed in period 1, the reallocation of labor towards the nontradables sector drives up the marginal productivity of labor and thus the nominal wage rate. The higher wage partly feeds into higher nontraded goods prices, slowing down the real depreciation, but if γ – the weight of traded goods in the consumption aggregator – is large, this does not have a strong effect on the aggregate price level. As a result, the short–run real wage may exceed its long run level.

4 Summary and conclusions

This paper has shown that removing barriers to entry in the nontraded goods sector of a small open economy leads to an accumulation of foreign assets if the traded goods sector is relatively capital–intensive, but may result in a current account deficit if the nontradables sector is very capital–intensive. Moreover, while the gradual depreciation of the real exchange rate does not depend on preference or technology parameters, the real wage may overshoot its long–run level if the traded goods sector is relatively capital–intensive and if nontraded goods consumption represents a small share of total expenditure. The driving mechanism behind these results is the reallocation of the labor force from the tradables sector to the nontraded goods sector which expands due to enhanced competition. Combined with the sluggish adjustment of sectoral capital stocks, this results in a volume of traded goods production that temporarily exceeds its long–run level, possibly leading to an accumulation of foreign assets and partly financing long–run traded goods consumption. Moreover, the marginal productivity of labor may temporarily rise above its long–run level and thus result in an overshooting of the real wage.

In order to keep the analysis tractable and transparent we have used simple specifications for agents' preferences and firms' technologies. However, we believe that the main results of our paper would carry over into a more general framework. In particular, they are likely to hold if one introduces a more sophisticated notion of adjustment costs: convex costs of changing the sectoral capital stocks would just further slow down the adjustment process without altering our key observations – namely, that the current account effect of deregulation depends on relative capital intensities and that the sluggish adjustment of capital may result in an overshooting of the real wage.

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5 Appendix

5.1 Proof of Lemma 1

Substitution of (32) into (33) yields

$$B = \frac{\nu}{r}\left[\left(\frac{1-\gamma+\gamma\phi}{1-\gamma}\right)(L_0^T)^{\alpha}(L_1^T)^{(-\alpha)}(1-L_1^T)-1\right]. \tag{36}$$

On the other hand, by substituting (29) and (32) into (35) we get

$$B = \frac{\nu}{\psi}\left[(L_0^T)^{\alpha}(L_1^T)^{(1-\alpha)}+\frac{\alpha}{r}\zeta L_0^T-\frac{\gamma\phi}{1-\gamma+\gamma\phi}\left(1+\frac{\zeta\alpha}{r}\right)\right], \tag{37}$$

where

$$\psi = \frac{\phi(1+r\gamma)}{1-\gamma+\gamma\phi} > 0. \tag{38}$$

It is easy to see that in (36) B is monotonically decreasing in L_1^T while in (37) B is monotonically increasing in L_1^T. We can thus draw the two equations as curves I and II in Figure 1, and the point of intersection determines the equilibrium levels of B and L_1^T. We know that $B = 0$ if $\mu = 1$: if the firms didn't charge a markup in the initial steady state, removing barriers to entry would not have any effect, and there would be no accumulation of foreign assets or debt. Hence, for $\mu = 1$, the two curves intersect at $B = 0$. It follows from (23) that the initial level of labor in the traded goods sector (L_0^T) increases in μ. Hence, if $\alpha \geq \beta$ and thus $\zeta \geq 0$ both curves shift upward if the markup becomes greater than one, and the equilibrium level of B that is defined by the point of intersection has to be positive. This implies that the economy runs a current account surplus during its transition to the new steady state. On the other hand, if $\alpha < \beta$, ζ is negative, and curve II may therefore shift downward as a result of raising μ. If this shift dominates the upward shift of curve I, B is negative.

5.2 Proof of Lemma 2

We start by showing that $L^T < L_0^T$: comparing (23) (with $B_0 = 0$) and (29), we can show that $L^T > L_0^T$ iff

$$B < \frac{(1-\mu)\phi}{\frac{r}{\nu}\left(\frac{1-\gamma}{\gamma} + \mu\phi\right)} \equiv \hat{B}. \tag{39}$$

Note that $\hat{B} < 0$ for $\mu > 1$. In Lemma 1 we have shown that $B > 0$ for $\alpha \geq \beta$, which implies that the condition in (39) cannot be satisfied if the traded goods sector is at least as capital intensive as the nontradables sector. Hence $L_0^T > L^T$ if $\alpha \geq \beta$.

On the other hand, the preceding Lemma has shown that B may be negative if $\alpha < \beta$. To show that nevertheless $L_0^T > L^T$, we show that, regardless of the sign of $(\alpha - \beta)$, B cannot be smaller than $\hat{B}$. It follows from (36), (37), and (39) that for $B < \hat{B}$ we need

$$(L_1^T)^{1-\alpha} < \frac{1-\gamma}{(1-\gamma+\mu\gamma\phi)}\left(\frac{1}{L_0^T}\right)^{\alpha}\left(\frac{L_1^T}{1-L_1^T}\right) = f_1(L_1^T, L_0^T) \tag{40}$$

and

$$(L_1^T)^{1-\alpha} < \frac{\gamma\phi\left[(1-\mu)\left(\frac{1-\alpha\gamma-\beta(1-\gamma)}{1-\beta}\right)+r(1-\gamma+\gamma\phi)\right]}{r(1-\gamma+\mu\gamma\phi)(1-\gamma+\gamma\phi)(L_0^T)^{\alpha}} = f_2(L_1^T, L_0^T). \tag{41}$$

The functions $(L_1^T)^{1-\alpha}$, $f_1(L_1^T, L_0^T)$, and $f_2(L_1^T, L_0^T)$ are depicted in Figure 2.[9] If $\mu = 1$, the three curves intersect, since in this case $B = \hat{B} = 0$. If μ becomes bigger than one, $f_1(L_1^T, L_0^T)$ and $f_2(L_1^T, L_0^T)$ shift downward. Figure 2 illustrates that, in this case, (40) and (41) cannot be simultaneously satisfied. Hence, for $\mu > 1$, $L_0^T > L^T$ even if $\alpha < \beta$.

We can use this result to show that $L_0^T > L_1^T > L^T$: it is easy to see that for (27) and (33) to be jointly satisfied we need either $L_0^T < L_1^T < L^T$ or $L_0^T > L_1^T > L^T$. Since we have already shown that $L_0^T > L^T$ it follows that $L_0^T > L_1^T > L^T$.

5.3 Proof of Lemma 3

It follows from (4) that $P_0 > P_1 > P$ iff $P_0^N > P_1^N > P^N$. Equations (16) to (18) and the fact that $R^N = R_0^N$ and $w = w_0$ imply that $P_0^N > P^N$. To show that $P_0^N > P_1^N$ we use (19), which implies that $P_0^N > P_1^N$ iff $E_0/(1-L_0^T)^{(1-\beta)} > E/(1-L_1^T)^{(1-\beta)}$. In Lemma 3 we have shown that $L_0^T > L_1^T$. Hence $E_0 > E$ is sufficient for $P_0^N > P_1^N$. To show that this condition actually holds we substitute (29) and (32) into (35). Combined with $E_0 = \nu L_0^T/\gamma$ this yields

$$\frac{E}{E_0} = \left(\frac{r\gamma}{1+r\gamma}\right)\left[\left(\frac{L_1^T}{L_0^T}\right)^{1-\alpha} + \frac{\alpha\zeta}{r} + \frac{\phi}{rL_0^T}\right]. \tag{42}$$

It is easy to show that, if $\mu = 1$, (42) implies that $E = E_0$. On the other hand, $(L_1^T/L_0^T)^{1-\alpha}$ decreases as μ becomes greater than one (see Lemma 2) while L_0^T increases. Hence, the term on the RHS of (42) becomes smaller than one, which implies $E < E_0$ and thus $P_0^N > P_1^N$.

To show that $P_1^N > P^N$ we use the nontraded goods sector's marginal cost function (17). Combined with the fact that $(L_s^N/K_s^N) = (1-\beta)R_s^N/(\beta w_s)$, the

[9] We have drawn Figure 2 assuming that the RHS of (41) is positive. If this were not the case, the condition in (41) could obviously not be satisfied.

wage equation in (14), and the fact that $(L_0^N/K_0^N) = (L^N/K^N)$ this implies that $P_1^N > P^N$ iff

$$\left(\frac{L_1^N}{L_0^N}\right)^{\beta}\left(\frac{L_0^T}{L_1^T}\right)^{\alpha} > 1. \tag{43}$$

It follows from Lemma 2 that this condition is satisfied. Hence $P_0^N > P_1^N > P^N$.

5.4 Proof of Lemma 4

The real wage ω_s is computed by dividing w_s as given in (14) by the price level P_s as given in (4). Taking into account (16) – (18) and the nontraded goods firms' first order conditions for cost minimization, we can thus derive

$$\omega_0 = \frac{(1-\alpha)\nu}{\Gamma\left[\mu\left(\frac{\alpha}{\beta}\right)^{\beta}\left(\frac{1-\alpha}{1-\beta}\right)^{1-\beta}\nu^{(1-\beta/\alpha)}\right]^{1-\gamma}}, \tag{44}$$

$$\omega_1 = \frac{(1-\alpha)\nu\left(\frac{L_0^T}{L_1^T}\right)^{\alpha}}{\Gamma\left[\left(\frac{\alpha}{\beta}\right)^{\beta}\left(\frac{1-\alpha}{1-\beta}\right)^{1-\beta}\nu^{(1-\beta/\alpha)}\left(\frac{L_1^N}{L_0^N}\right)^{\beta}\left(\frac{L_0^T}{L_1^T}\right)^{\alpha}\right]^{1-\gamma}}, \tag{45}$$

$$\omega = \frac{(1-\alpha)\nu}{\Gamma\left[\left(\frac{\alpha}{\beta}\right)^{\beta}\left(\frac{1-\alpha}{1-\beta}\right)^{1-\beta}\nu^{(1-\beta/\alpha)}\right]^{1-\gamma}}, \tag{46}$$

which immediately reveals that $\omega_0 < \omega$ if $\mu > 1$ (Part *i*)). Moreover, it follows from $L_0^T > L_1^T$ (Lemma 2) and $E_0 > E$ (see proof of Lemma 3) that $\omega_1 > \omega_0$ if $\mu > 1$ (Part *ii*)).

To investigate the relationship between ω and ω_1 we use (45), (46), and the definition of the price level, from which it follows that $\omega_1 > \omega$ iff

$$\left(\frac{L_0^N}{L_1^N}\right)^{\beta(1-\gamma)}\left(\frac{L_0^T}{L_1^T}\right)^{\alpha\gamma} > 1. \tag{47}$$

Our previous results have shown that $L_0^T > L_1^T$, which implies $L_0^N < L_1^N$. Hence, we cannot infer from (47) whether $\omega_1 > \omega$ or not. However, if $\alpha\gamma$ is much larger than $\beta(1-\gamma)$, i.e. if the production of traded goods production is much more capital intensive than nontraded goods production, and if traded goods have a greater weight in agents' utility function, it is more likely that the real wage overshoots.

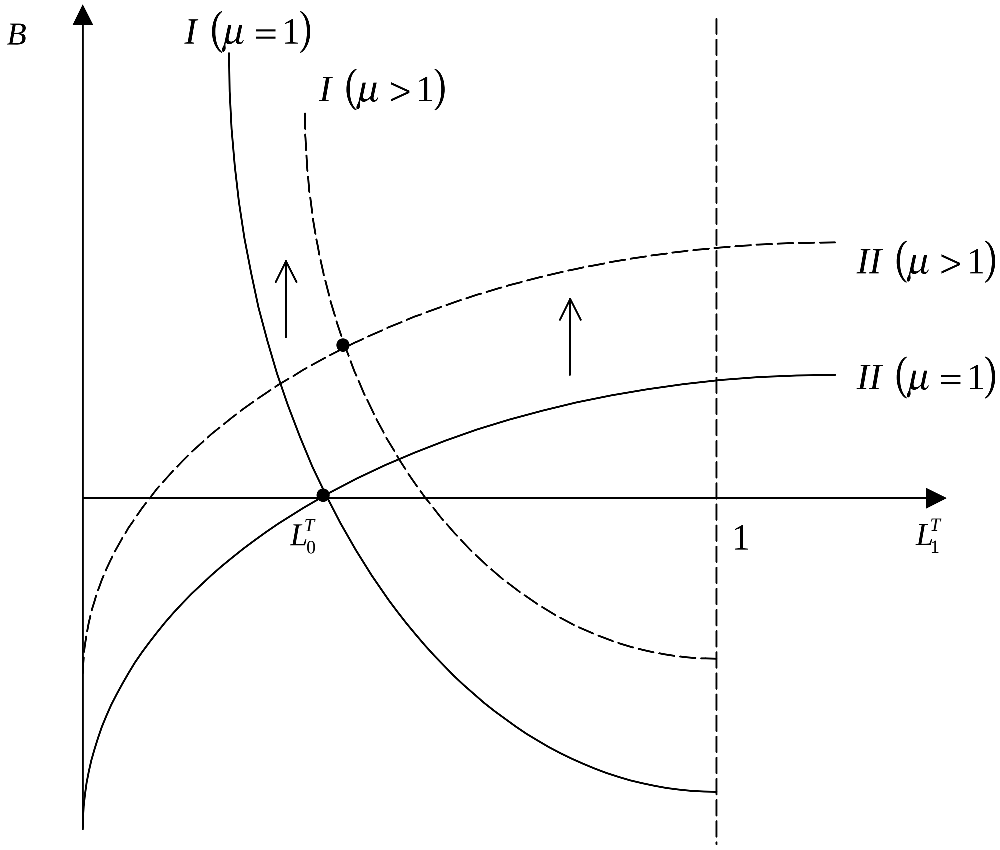

Figure 1

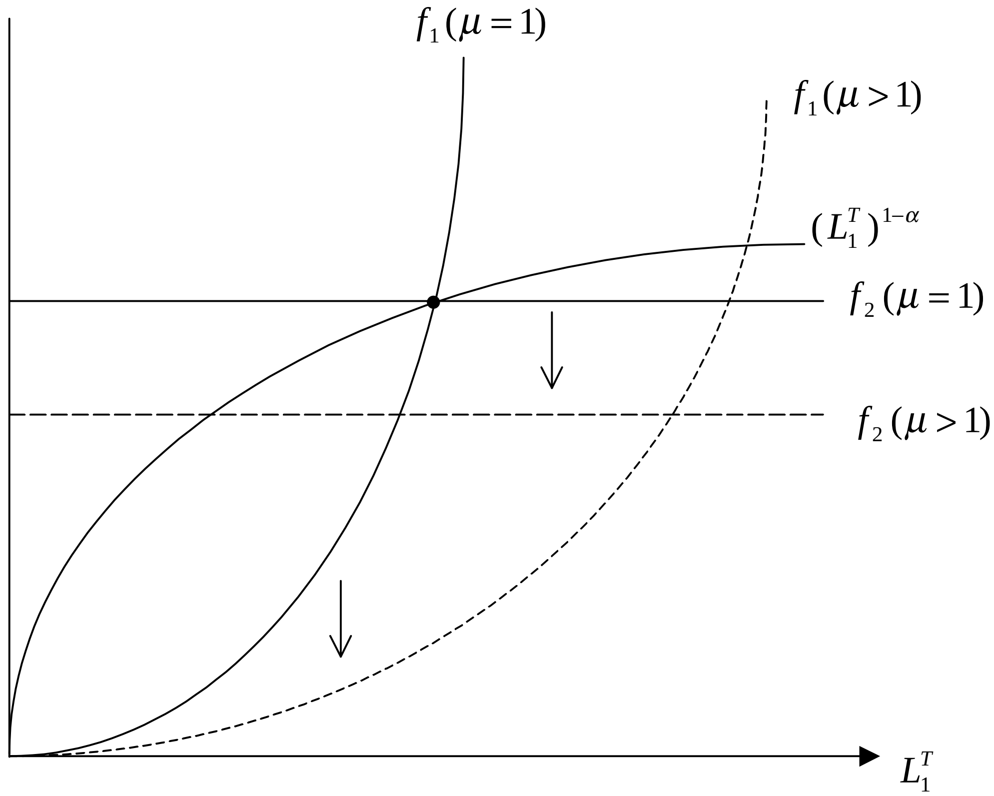

Figure 2