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The Effects of Foreign Transfers with a Flexible Labor Supply*

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Abstract

We show that the importance of flexible labor supply in determining the impact of foreign transfers depends upon whether the transfers are untied or tied to productivity enhancement. This is because the transfer has both a wealth effect and a relative price effect, the relative importance of which depends upon its allocation. For an untied transfer, the relative price effect is weak, the wealth effect on leisure dominates, and the endogeneity of the labor supply is important. For a tied transfer, the increase in productivity raises the wage rate, thereby inducing an increase in aggregate labor supply and offsetting the increase in leisure due to the wealth effect. The overall response in leisure is small and is dominated by the relative price effect. In this case, given this small response, whether the aggregate labor is supplied elastically or is constrained to be fixed turns out to make little difference.

JEL codes: D31, F34, F41, F43

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1. Introduction

The consequences of the international transfer of resources for relative price movements and internal resource allocation are a longstanding and recurring theme in international economics. The issue first gained attention in the context of the war reparations imposed on Germany at the conclusion of World War I, leading to the debate between Keynes (1929) and Ohlin (1929) concerning the so-called "transfer problem." Then, in the 1970s and 1980s, the role of relative prices was central in analyzing the consequences of the discovery of natural resources in both Australia (raw materials) and Northern Europe (oil and natural gas). It was argued that by increasing the supply of tradable goods and lowering their relative price, productive factors are shifted to the nontraded sector, thereby reducing the size of the country's traditional export sector and thus adversely affecting its growth rate. This problem became known as "Dutch disease," a reference to the decline of the manufacturing sector in the Netherlands after the discovery of a large natural gas field some years earlier, and was first analyzed in some detail by Corden and Neary (1982) and Corden (1984). More recently, the issue of Dutch disease has again been addressed in assessing the benefits of foreign aid. Much of this research has been empirical, yielding a generally mixed relationship between Dutch disease symptoms and aid.[1]

As the literature analyzing foreign transfers has progressed, the formal analytical models employed have increased in sophistication. First, much of the earlier literature analyzing transfers was static. This was certainly true of Samuelson's (1952, 1954) seminal analysis, which assumed that a transfer would have dynamic consequences but would be offset by changes in an economy's trade balance that left the current account unchanged. Similarly, the Corden and Neary (1982) and Corden (1984) analyses of Dutch disease are based on a static version of the dependent-economy model of Salter (1959). More recently, this question has increasingly been addressed within an intertemporal framework. Thus, Brock and Turnovsky (1994) and Brock (1996) employ a dynamic dependent-economy model and show that a small

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[1] For example, Kang, Prati, and Rebucci (2010) find evidence of Dutch disease effects holding in half of their sample of 38 countries. Nkusu (2004) argues that Dutch disease need not occur in low-income countries that can draw upon their idle productive capacity to satisfy the aid-induced increased demand. In contrast, Rajan and Subramanian (2005) do find evidence of Dutch disease leading to adverse effects on growth, even for economies adopting "good policies" in the Burnside-Dollar (2000) sense.

economy's macroeconomic adjustment to a foreign transfer depends upon the relative capital intensities of the traded and nontraded sectors.[2]

Second, virtually all of the literature assumes that the foreign transfer takes the form of a pure income flow, the direct effect of which is to enhance the country's overall resources (i.e., its wealth) and to raise its levels of consumption and savings. Any effects on output or production are indirect and result from the higher demand and the inter-sectoral factor movements induced by the relative price changes. But in practice, the revenue received by a country from abroad may be directly applied to productivity enhancement. Indeed, in the case of the transfers granted by the European Union to potential candidates, this was required as a condition for membership.[3] To the extent that the transfer is invested in enhancing productive capacity, thereby altering the relative sectoral productivities, it will further directly influence relative prices and, therefore, resource allocation.[4]

This paper builds upon a recent contribution by Cerra, Tekin, and Turnovsky (2009), who present a dynamic model of a two-sector-dependent economy that produces both traded and nontraded output. The country they consider receives transfers from abroad, which can be allocated to three potential uses. First, as in the traditional literature, it may be a pure income flow, whose direct effect is to reduce debt and lift consumption and savings. Second, it may be channeled into productivity enhancement in the traded sector; and third, it may similarly end up in the nontraded sector. Their analysis demonstrates how each of these scenarios has substantially different consequences for relative price movements; each case causes the economy to follow a markedly different time path and yields a correspondingly different welfare profile.

But like the previous literature, Cerra et al. (2009) impose one strong assumption, namely, that while labor can move freely between the two sectors, its aggregate supply is fixed inelastically. The present paper relaxes this assumption and instead stipulates that total labor is supplied endogenously, by allowing the representative agent to have a work-leisure choice. As a general

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2 The dependent-economy model, as it originated with Salter (1959), Swan (1960), and Pearce (1961), was purely static. Dynamic extensions have been developed by a number of authors, including Bruno and Sachs (1982), van Wijnbergen (1985), Brock and Turnovsky (1994), Turnovsky and Sen (1995), and Brock (1996). Recently, Kuralbayeva and Vines (2008) employ a dynamic version of this model to analyze Dutch disease effects stemming from a terms-of-trade shock originating from an oil price increase.

3 See e.g., Chatterjee, Sakoulis, and Turnovsky (2003), where this is discussed and documented in more detail.

4 This includes the Balassa-Samuelson effect, which refers to the enhanced productivity of the traded sector, causing an appreciation of the real exchange rate; see Balassa (1964) and Samuelson (1964).

proposition, endogenizing the total labor supply has potentially profound implications. By equating the marginal utility of leisure to the marginal utility of consumption foregone, priced at the real wage (the opportunity cost of leisure), it links the production side of the economy to the demand side. One important effect of this is to strengthen the role of demand shocks as an influence on the dynamic adjustment. This is the case in both the standard one-sector Ramsey representative agent model, as well as in the foreign-aid endogenous-growth model of Chatterjee and Turnovsky (2007).[5]

In the present two-sector production framework, it turns out that endogenizing the labor supply has no effect on those aspects of the long-run equilibrium that are determined solely by supply conditions. Thus, it has no effect on the long-run relative price of nontraded goods, sectoral capital-labor ratios, or the rates of return on capital or labor (the real wage rate). That being the case, the long-run depressive effects on exports produced by a pure transfer should not be viewed as a Dutch disease symptom. Being a pure demand shock, such transfers have no long-term effect on relative prices. Rather, the weakening of exports is a “current-account balance effect,” meaning that untied transfers substitute for the production of export goods in financing the purchase of traded consumption goods.[6]

In other respects, the role of the labor supply in determining the impact of foreign transfers depends upon how these resources are allocated. If they are in the form of a pure transfer, introducing the element of an elastic labor supply has significant outcomes. When the total labor supply is fixed, the decoupling of the consumption and production decisions that occurs permits many variables to respond almost instantaneously, insulating much of the system from the transitional dynamics. However, when labor is supplied elastically, pure transfers modify the marginal rate of substitution between consumption and leisure, thereby exposing more of the economy’s dynamic adjustment to the more sluggish accumulation of the capital stock and debt.

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5 In either case, with an inelastic labor supply, the economy responds fully on impact to demand shocks.

6 The independence of the long-run relative price from untied transfers (a pure demand shock) is an immediate consequence of a basic property of the two-factor two-sector production model, namely that with perfect sectoral factor mobility, the long-run relative price depends solely upon supply conditions. A similar result is obtained by Devarajan, Go, Page, Robinson, and Thierfelder (2008). Arellano et al. (2009) generate long-run Dutch disease effects by introducing the imperfect substitutability of capital *stocks* across sectors. In contrast, untied transfers would continue to have no long-run relative price effects for the form of costly intrasectoral capital *flows* introduced by Morshed and Turnovsky (2004).

The possibility that the wealth effects stemming from the pure transfer may be absorbed by leisure leads to other situations as well. First, whereas with an inelastic labor supply, the response of the long-run capital stock and debt depends solely upon the sectoral capital-labor ratios, the rise in leisure now becomes relevant, and in some cases may dominate this more traditional effect. Second, as leisure goes up, both traded and nontraded production goes down, leading to an overall shrinkage in aggregate output. In this respect, the now smaller size of the export sector now resembles a Dutch disease component, but one due to an increase in wealth, rather than to a change in the relative price.

In contrast to the pure transfer, tied productivity-enhancing transfers have relatively little to do with changes in the labor supply, whether fixed or flexible. While it is true that the labor supply will be slimmed by the wealth effects brought about by the transfer, this is largely offset by the positive supply effect of the higher wages coming from the productivity enhancement. In addition, there are large sustained movements in the relative price, which determines these modest adjustments in the labor supply. Thus, overall, the dynamic adjustments in response to tied transfers entering a country with an assumed inelastic labor supply remain more or less intact.

While the structural consequences of foreign transfers are important, the overriding issue is their welfare implications. In this regard, Cerra et al. (2009) highlight the tradeoffs that exist between (i) the relative price (real exchange rate), (ii) the accumulation of capital (growth), and (iii) the welfare gains associated with the transfer. Overall, the tradeoffs relevant for an inelastic labor supply continue to apply when the labor supply is endogenized.

The two-sector production structure, together with the specification of the financial sector, which we take to involve increasing debt costs, leads to a state of macroeconomic equilibrium that is specified by a fourth-order dynamic system. The key equilibrium dynamic variables consist of: (i) the capital stock, (ii) the stock of debt, (iii) the relative price of nontraded to traded output, and (iv) the shadow value of wealth, expressed in terms of traded output as numeraire. Both the macrodynamic equilibrium, and, in particular, the role of the endogenous labor supply, are characterized as far as possible. But being a high order system, it must inevitably be analyzed numerically, and, thus, much of our analysis is based on a plausible calibration of the model.

As has been shown previously, the dynamics of two-sector models of this type depend upon the relative sectoral capital intensities, which, in turn, have an important bearing on the dynamics of the relative price.[7] However, there is little evidence—and no consensus—as to what the appropriate specification of this aspect should be. For example, Arellano et al. (2009) parameterize their model to make the nontraded sector relatively capital intensive, whereas Kuralbayeva and Vines (2008) adopt precisely the opposite assumption. We therefore contrast two benchmark cases: (i) where the traded sector is relatively capital intensive; and (ii) where the relative sectoral capital intensities are reversed.

The economy we consider is one having well-functioning internal markets and with a high degree of access to world financial markets. Thus, our analysis is most applicable to countries such as Greece and Portugal and emerging-market economies, such as Turkey, seeking admission to the European Union. It also may plausibly describe more developed countries like Australia and Norway, following their discovery of natural resources.[8]

Following this introduction, Section 2 outlines the theoretical framework. Sections 3 and 4 discuss some of the long-run and short-run implications of the model, stressing in particular the role played by the endogeneity of the labor supply. In Sections 5 and 6, we perform a numerical simulation of the model and calibrate it for a small open economy. Sections 7 and 8 analyze the dynamics of foreign transfers, given three allocation scenarios: (i) pure transfer, (ii) transfer devoted to increasing the productivity of the traded sector, and (iii) transfer devoted to increasing the productivity of the nontraded sector. Section 9 examines some of the welfare consequences and the tradeoffs involved between different measures of economic performance, while Section 10 concludes the paper.

2. Two-sector Model of Foreign Transfers

The framework we will employ is an extension of Cerra, Tekin, and Turnovsky (2009) to cover an endogenous labor supply. Hence, our explanation of the model is brief.

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7 See e.g., Turnovsky and Sen (1995).

8 But with labor and capital being perfectly mobile across sectors, we are assuming more internal flexibility than would characterize a truly developing economy, although it would be straightforward to adapt the framework to deal with that case. Moreover, as long as the impediments to sectoral factor movements involve only the flows, as in Morshed and Turnovsky (2004), our long-run results, when all sectoral movements cease, should provide some guidance to even developing economies. Arellano et al. (2009) formulate the impediments to sector factor mobility, characterizing a developing economy in terms of a convex transformation function involving the capital stocks. This does have long-run consequences.

2.1 The economic structure

We consider a small open economy model with an infinitely-lived representative agent who is endowed with one unit of time, a fraction L_T of which is devoted to employment in the traded sector, L_N to employment in the nontraded sector, and the remaining l to leisure. Labor is supplied at a competitive wage rate. The agent also accumulates capital, *K*, which he rents out at a competitively determined rental rate.

The economy produces a traded good (the numeraire) using capital, K_T, and labor, L_T, by means of the neoclassical production function, $F(K_T, L_T, G_T)$, where both capital and labor have positive, but diminishing, marginal physical products and are subject to constant returns to scale. In addition, government spending on infrastructure (a nontraded good) allocated to the traded sector, G_T, serves to increase the productivity of that sector, so that $F_G > 0$.

The economy also employs capital, K_N, and labor, L_N, to produce a nontraded good, using the production function, $H(K_N, L_N, G_N)$, having similar neoclassical properties, where G_N represents the government spending on the nontraded good allocated to enhance the productivity of the nontraded output sector, $H_G > 0$.[9] The relative price of nontraded output in terms of the traded output is *p*. It thus serves as a proxy for the real exchange rate, with an increase in *p* representing a real exchange-rate appreciation. All individuals take *p* as parametrically given, although it is determined by the aggregate market-clearing conditions in the economy.

The two private factors, capital and labor, are freely mobile between the two sectors, with the sectoral allocations being constrained by:

$$K_T + K_N = K \tag{1a}$$

$$L_T + L_N + l = 1. \tag{1b}$$

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[9] To preserve tractability, these expenditures are introduced as *flows*, as in Barro (1990), although a natural extension would be to specify them as public capital *stocks*, as in the one-sector analysis of Chatterjee, et al. (2003).

Physical capital is produced in the nontraded sector and depreciates at the rate δ_K , thus implying the following capital accumulation constraint:

$$\dot{K} = I - \delta_K K \tag{2}$$

As discussed by Turnovsky (1997) in detail, the treatment of physical capital as being traded or nontraded has generated substantial debate over the years, although as Brock and Turnovsky (1994) show, restricting capital to be nontraded does not involve a serious loss of generality.[10]

The economy can borrow in the international capital market, although it faces increasing borrowing costs in doing so. We express this by postulating that the rate of interest at which it may borrow is an increasing function of the ratio of its debt to the value of its capital, which serves as a proxy measure of its ability to service its debt. Thus we have:

$$r\left(\frac{N}{pK}\right) = r^* + \omega\left(\frac{N}{pK}\right); \quad \omega' > 0, \quad \omega'' > 0 \tag{3}$$

where *N* is the country's stock of debt, r^* is the exogenous world interest rate, and $\omega\left(N/(pK)\right)$ is the borrowing premium. In making his individual decisions, the representative agent takes the interest rate as given. This is because the interest rate facing the debtor nation is an increasing function of the economy's *aggregate* debt, which the individual assumes he is unable to influence.[11]

Given this access to the world's goods and financial markets, the domestic agent's instantaneous budget constraint is specified by:

$$\dot{N} = C_T + pC_N + p(\dot{K} + \delta_K K) + pT - F(K_T, L_T, G_T) - pH(K_N, L_N, G_N) + r\left(\frac{N}{pK}\right)N \tag{4}$$

where C_T and C_N are the agent's consumption of the traded and nontraded goods, and *T* denotes domestic taxes, which we take to be lump-sum and denominated in terms of nontraded output.

The representative agent chooses his consumption levels, C_T and C_N; sectoral labor allocations, L_T, L_N; leisure, *l*; sectoral capital allocations, K_T

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[10] Brock and Turnovsky (1994) extend this model to include both traded and nontraded capital.

[11] Many variants of (3) can be found in the literature, some of which are discussed by Chatterjee, Sakoulis, and Turnovsky (2003).

and K_N; and the rates of accumulation of capital and debt, $\dot{K}$ and $\dot{N}$; to maximize the intertemporal utility function:

$$\Omega \equiv \int_0^\infty U(C_T, C_N, l)e^{-\rho t}dt \tag{5}$$

subject to the constraints (1)-(4) and given initial stocks of assets $K(0) = K_0$ and $N(0) = N_0$. The instantaneous utility function is assumed to be concave in the two consumption goods, as well as leisure, all of which are assumed to be normal goods. The agent's rate of time preference, ρ, is constant.

Performing the optimization yields the following optimality conditions:

$$U_T(C_T, C_N, l) = \mu \tag{6a}$$

$$U_N(C_T, C_N, l) = \mu p \tag{6b}$$

$$U_l(C_T, C_N, l) = \mu F_L(K_T, L_T, G_T) \tag{6c}$$

$$\frac{1}{p}F_K(K_T, L_T, G_T) = H_K(K_N, L_N, G_N) \tag{6d}$$

$$\frac{1}{p}F_L(K_T, L_T, G_T) = H_L(K_N, L_N, G_N) \equiv w \tag{6e}$$

$$\rho - \frac{\dot{\mu}}{\mu} = r\left(\frac{N}{pK}\right) \tag{6f}$$

$$\frac{F_K(K_T, L_T, G_T)}{p} + \frac{\dot{p}}{p} - \delta_K = r\left(\frac{N}{pK}\right) \tag{6g}$$

together with the transversality conditions that must hold to ensure that the agent's intertemporal budget constraint is met:

$$\lim_{t\to\infty} \mu N e^{-\rho t} = 0; \quad \lim_{t\to\infty} \mu p K e^{-\rho t} = 0. \tag{6h}$$

where μ, the Lagrange multiplier associated with (4), is the shadow value of wealth.

Equations (6a) and (6b) equate the marginal utility of consumption to the shadow value of wealth, appropriately measured in terms of the numeraire. Equation (6c) equates the marginal utility of leisure to the shadow value of wage income foregone. This means that changes in wage income will affect the amount of leisure, as well as traded and nontraded goods consumption. This equation represents the critical departure from Cerra, Tekin, and Turnovsky (2009), where with labor supply taken to be exogenous, it is no longer applicable.[12] Equations (6d) and (6e) determine the sectoral allocation decisions by equating the marginal physical products of the two factors across the two sectors. Equations (6f) and (6g) are arbitrage conditions equating the rate of return on consumption and the rate of return on nontraded capital to the borrowing cost.

The government receives foreign transfers, *TR*, that are denominated in units of traded output, thereby providing it, together with the lump-sum taxes collected from domestic residents, with two sources of revenue. We assume that the government maintains a balanced budget and that these resources may be allocated in three ways: (i) to enhance the productivity of the traded sector, G_T, (ii) to enhance the productivity of the nontraded sector, G_N, and (iii) to reduce the tax burden of the domestic residents.[13]

$$G_T + G_N = T + \frac{TR}{p} \tag{7}$$

The economy starts from equilibrium with zero transfers, so that initially all expenditures are financed using lump-sum taxation:

$$G_{T,0} + G_{N,0} = T_0 \tag{8}$$

At time 0, the government receives a permanent foreign transfer, *TR*, that is allocated toward G_T, G_N, T in accordance with:

$$G_T(t) = G_{T,0} + \lambda(1-\phi)\frac{TR}{p(t)} \tag{9a}$$

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[12] In that case, equation (6c) is replaced with the constraint $l = \bar{l}$, which for convenience they set to be unity.

[13] We assume that the transfer denominated in units of traded output can be costlessly converted to nontraded output (i.e., there are no adjustment costs).

$$G_N(t) = G_{N,0} + \lambda\phi \frac{TR}{p(t)} \tag{9b}$$

$$T(t) = T_0 - (1-\lambda)\frac{TR}{p(t)} \tag{9c}$$

Thus, λ parameterizes the allocation of the transfer between tax reduction and an increase in productive expenditures, while ϕ specifies the allocation of the expenditures between the two sectors. With the transfer specified in terms of the traded good, the resources available to spend on productivity-enhancing infrastructure (nontraded good) vary inversely with the evolving relative price, $p(t)$.

The final two equations are the economy's accumulation equations. Non-traded goods' market equilibrium requires:

$$\dot{K} = H(K_N, L_N, G_N) - C_N - (G_T + G_N) - \delta_K K \tag{10}$$

That is, any nontraded output that is in excess of domestic private consumption, government purchases, and the stock of capital that has depreciated, is accumulated as nontraded capital. This equation, together with the private-sector budget constraint, (4), and the government budget constraint, (8), yields the current-account equation for the economy:

$$\dot{N} = C_T - F(K_T, L_T, G_T) + r\left(\frac{N}{pK}\right)N - TR \tag{11}$$

The rate of debt accumulation equals the excess of domestic private consumption of the traded good over its supply, plus the interest owed on the existing stock of debt, less the transfers received.

2.2 Macroeconomic equilibrium

The linear homogeneity of the production functions in the private factors allows us to express relations in terms of sectoral capital-labor ratios. Thus, defining $k_i \equiv K_i/L_i$ to be the capital-labor ratio in sector *i*, where $i = T, N$, the corresponding production functions can be expressed as

$$f(k_T) \equiv F(K_T, L_T, G_T)/L_T, \quad h(k_N) \equiv H(K_N, L_N, G_N)/L_N.$$

This enables us to summarize the macroeconomic equilibrium with the following set of relationships:

$$U_T(C_T, C_N, l) = \mu \tag{12a}$$

$$U_N(C_T, C_N, l) = \mu p \tag{12b}$$

$$U_l(C_T, C_N, l) = \mu\left[f(k_T, G_T) - k_T f_k(k_T, G_T)\right] \tag{12c}$$

$$f_k(k_T, G_T) = p h_k(k_N, G_N) \tag{12d}$$

$$f(k_T, G_T) - k_T f_k(k_T, G_T) = p[h(k_N, G_N) - k_N h_k(k_N, G_N)] \tag{12e}$$

$$L_T k_T + (1 - L_T - l) k_N = K \tag{12f}$$

$$\dot{K} = (1 - L_T - l) h(k_N, G_N) - C_N - (G_N + G_T) - \delta_K K \tag{13a}$$

$$\dot{N} = C_T - L_T f(k_T, G_T) + r(.)N - TR \tag{13b}$$

$$\dot{p} = p[r(.) + \delta_K - h_k(k_N, G_N)] \tag{13c}$$

$$\frac{\dot{\mu}}{\mu} = \rho - r\left(\frac{N}{pK}\right) \tag{13d}$$

together with the allocation of the transfers being specified by (9).

Equations (12a)-(12f) define the short-run equilibrium. With an endogenous labor supply, the decoupling of production decisions and consumption decisions of the short-run equilibrium, as laid out, for example, in Turnovsky and Sen (1995), partly breaks down. Now the solution is of the following form, and is more recursive in structure. First, as in the inelastic labor case, (12d) and (12e) can be solved for the sectoral capital-labor ratios

$$k_T = k_T(p, G_T, G_N) \tag{14a}$$

$$k_N = k_N(p, G_T, G_N) \tag{14b}$$

Given these sectoral capital-labor ratios, (12a)-(12c) can be solved for the two consumption levels, C_T and C_N, together with leisure, *l*, in the form

$$C_T = C_T(\mu, k_T(p, G_T, G_N), p, G_T) \tag{15a}$$

$$C_N = C_N(\mu, k_T(p, G_T, G_N), p, G_T) \tag{15b}$$

$$l = l(\mu, k_T(p, G_T, G_N), p, G_T) \tag{15c}$$

Then (12f) implies the labor allocation to the traded sector

$$L_T = \frac{K - k_N(p, G_T, G_N)[1 - l(\mu, k_T(p, G_T, G_N), p, G_T)]}{k_T(p, G_T, G_N) - k_N(p, G_T, G_N)} \tag{15d}$$

The solutions (15a)-(15d) indicate two key differences introduced by the endogeneity of the labor supply. First, in addition to their direct dependence on relative price, *p*, and the shadow value, μ, consumptions of both goods now depend upon the sectoral capital-ratio, k_T, and G_T. This occurs through their interactions with leisure and its dependence on the wage rate, providing a second channel for productive government spending and the relative price to influence consumption. Second, because of the time constraint linking leisure and labor, the time allocated to traded labor, L_T (and therefore also nontraded labor, L_N), is now a function of leisure, *l*, and hence depends upon the shadow value of wealth, μ.[14]

Substituting (15a)-(15c) for the production functions, we may express traded and nontraded outputs in the form

$$X = L_T f(k_T, G_T) = X(\mu, K, p, G_T, G_N) \tag{16a}$$

$$Y = (1 - L_T - l)h(k_N, G_T) = Y(\mu, K, p, G_T, G_N) \tag{16b}$$

Again, the endogeneity of the labor supply implies that output depends upon the shadow value of wealth.

3. Steady-state Equilibrium

Substituting (14) and (15) for (13) yields an autonomous dynamic equilibrium determining the evolution of K, N, p, μ, which forms the basis for our numerical simulations. Before discussing this, we shall briefly consider the

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[14] In the case where the utility function is additively separable in leisure, then much (although not all) of the decoupling associated with an inelastic labor supply is restored.

steady state, attained when $\dot{K} = \dot{N} = \dot{p} = \dot{\mu} = 0$. In general, this can be summarized with the following sets of relationships:

A. Sectoral allocation relationships

$$h_k(\tilde{k}_N, G_N) - \delta_K = \rho \tag{17a}$$

$$f_k(\tilde{k}_T, G_T) = \tilde{p}\, h_k(\tilde{k}_N, G_N) \tag{17b}$$

$$f(\tilde{k}_T, G_T) - \tilde{k}_T\; f_k(\tilde{k}_T, G_T) = \tilde{p}\,[\, h(\tilde{k}_N, G_N) - \tilde{k}_N\; h_k(\tilde{k}_N, G_N)\,] \tag{17c}$$

B. Aggregate market-clearing relationships

$$\tilde{p}U_T(\tilde{C}_T, \tilde{C}_N, \tilde{l}) = U_N(\tilde{C}_T, \tilde{C}_N, \tilde{l}) \tag{18a}$$

$$U_l(\tilde{C}_T, \tilde{C}_N, \tilde{l}) = U_T(\tilde{C}_T, \tilde{C}_N, \tilde{l})\left[\, f(\tilde{k}_T, G_T) - \tilde{k}_T\; f_k(\tilde{k}_T, G_T)\right] \tag{18b}$$

$$\tilde{L}_T\tilde{k}_T + (1 - \tilde{L}_T - \tilde{l})\tilde{k}_N = \tilde{K} \tag{18c}$$

$$(1 - \tilde{L}_T - \tilde{l})h(\tilde{k}_N, G_N) - \tilde{C}_N - (G_N + G_T) - \delta_K\tilde{K} = 0 \tag{18d}$$

$$\tilde{C}_T + \rho\tilde{N} = \tilde{L}_T\, f(\tilde{k}_T, G_T) + TR \tag{18e}$$

$$r\left(\frac{\tilde{N}}{\tilde{p}\tilde{K}}\right) = \rho \tag{18f}$$

Equations (17a)-(17c) and (18a)-(18f) determine the steady-state values (denoted by tildes); $\tilde{k}_N, \tilde{k}_T, \tilde{p}, \tilde{C}_T, \tilde{C}_N, \tilde{L}_T, l, \tilde{K}, \tilde{N}$ in terms of given allocations for G_T, G_N, and TR as determined by (9a)-(9c). When they are written this way, we see that the steady-state solution retains the recursive structure of the steady-state equilibrium obtained with a fixed labor supply.

Analogously to Cerra, Tekin, and Turnovsky (2009), we see that the steady-state equilibrium has the following solution. From (17a)-(17c), we obtain

$$\tilde{k}_N = \tilde{k}_N(G_N) \tag{19a}$$

$$\tilde{k}_T = \tilde{k}_T(G_T, G_N) \tag{19b}$$

$$\tilde{p} = \tilde{p}(G_T, G_N) \tag{19c}$$

Given ($\tilde{k}_N, \tilde{k}_T$, and $\tilde{p}$), we can express the solutions for $\tilde{C}_T, \tilde{C}_N, \tilde{L}_T, l, \tilde{K}, \tilde{N}$, as well as output levels, $\tilde{X}, \tilde{Y}$, and GNP, $\tilde{Z} \equiv \tilde{X} + \tilde{p}\tilde{Y}$, in the form:

$$\tilde{\Omega} = \Omega\left(TR, G_T, G_N, \tilde{k}_N(G_N), \tilde{k}_T(G_N, G_T), \tilde{p}(G_N, G_T)\right)$$

$$\tilde{\Omega} \equiv (\tilde{C}_T, \tilde{C}_N, \tilde{L}_T, l, \tilde{K}, \tilde{N}, \tilde{X}, \tilde{Y}, \tilde{Z}) \tag{20}$$

This mode of expression emphasizes the different channels whereby foreign transfers impact the long-run equilibrium. First, the effect of a pure transfer is simply $\partial\tilde{\Omega}/\partial(TR)$. But to the extent that the transfer is allocated to productivity enhancement, it has several other effects, both indirect and direct. The former operate through the impact on the sectoral capital intensities and relative prices, as in (19). The direct effects operate through their impact on excess demand through the market- clearing conditions (18d) and (18e). From (9a)-(9c), the long-run changes in government allocations due to the transfers can be expressed in the form

$$d\tilde{G}_T = \lambda(1-\phi)\frac{dTR}{\tilde{p}} \tag{9a'}$$

$$d\tilde{G}_N = \lambda\phi\frac{dTR}{\tilde{p}} \tag{9b'}$$

$$d\tilde{T} = -(1-\lambda)\frac{dTR}{\tilde{p}} \tag{9c'}$$

3.1 Long-run effects of transfers on the labor-leisure choice

Our main objective is to determine the effects of the endogeneity of the labor supply on the effects of the transfers. To highlight how the labor-leisure choice influences the equilibrium, it is useful to introduce the specific functional forms for the sectoral production functions and utility function that we shall employ in our subsequent numerical analysis. They are the Cobb-Douglas and constant elasticity forms, respectively:

$$X = A K_T^{\alpha} L_T^{1-\alpha} G_T^{\nu_1}; \quad 0 < \alpha < 1 \tag{21a}$$

$$Y = B K_N^{\beta} L_N^{1-\beta} G_N^{\nu_2}; \quad 0 < \beta < 1 \tag{21b}$$

$$U = \left(1/\gamma\right) C_T^{\gamma\theta} C_N^{\gamma(1-\theta)}; \quad 0 < \theta < 1, \quad -\infty < \gamma < 1 \tag{21c}$$

where α, β characterize the degrees of capital intensity in the two sectors, $1/(1-\gamma)$ is the intertemporal elasticity of substitution, and θ reflects the relative importance of traded versus nontraded goods in overall consumption.

Calculating the appropriate marginal products for the two production functions, substituting for the sectoral allocation (17), and taking proportionate derivatives, we can immediately show:

$$d\hat{\tilde{k}}_T = d\hat{\tilde{k}}_N = \frac{\nu_2}{1-\beta} d\hat{\tilde{G}}_N = \frac{\nu_2}{1-\beta} \frac{\lambda\varphi}{\tilde{G}_N} \frac{dTR}{\tilde{p}} \tag{22a}$$

$$d\hat{\tilde{p}} = \nu_1 d\hat{\tilde{G}}_T - \nu_2 \frac{(1-\alpha)}{(1-\beta)} d\hat{\tilde{G}}_N = \lambda \left[\nu_1 \frac{(1-\varphi)}{\tilde{G}_T} - \nu_2 \frac{(1-\alpha)\varphi}{(1-\beta)\tilde{G}_N} \right] \frac{dTR}{\tilde{p}} \tag{22b}$$

where ^ denotes percentage change. These expressions are identical to those obtained for an inelastic labor supply, and so the comments made in Cerra et al. (2009) continue to apply. Equation (22b) indicates the factors that determine whether or not a foreign transfer is associated with a long-run appreciation of the real exchange rate. This depends upon the allocation parameters, λ, ϕ, as well as the impact of the transfer on the productivities of the two sectors, ν_1, ν_2.

Taking the partial derivatives of the utility function, (21c), and substituting them for the consumer optimality conditions, (18a) and (18b), yields the equilibrium consumption allocation conditions

$$\theta \tilde{p} \tilde{C}_N = (1-\theta)\tilde{C}_T \tag{23a}$$

$$\eta \tilde{C}_T = \theta \tilde{l} A (1-\alpha)(\tilde{k}_T)^{\alpha} (\tilde{G}_T)^{\nu_1} \tag{23b}$$

from which we derive the following proportionate changes:

$$d\hat{\tilde{C}}_N = d\hat{\tilde{C}}_T - \nu_1 d\hat{\tilde{G}}_T + \nu_2 \frac{(1-\alpha)}{1-\beta} d\hat{\tilde{G}}_N = d\hat{\tilde{C}}_T - \lambda \left[\nu_1 \frac{(1-\varphi)}{\tilde{G}_T} - \nu_2 \frac{(1-\alpha)\varphi}{(1-\beta)\tilde{G}_N} \right] \frac{dTR}{\tilde{p}} \tag{24a}$$

$$d\hat{\tilde{l}} = d\hat{\tilde{C}}_T - \nu_1 d\hat{\tilde{G}}_T - \nu_2 \frac{\alpha}{1-\beta} d\hat{\tilde{G}}_N = d\hat{\tilde{C}}_T - \lambda \left[\nu_1 \frac{(1-\varphi)}{\tilde{G}_T} + \nu_2 \frac{\alpha\varphi}{(1-\beta)\tilde{G}_N} \right] \frac{dTR}{\tilde{p}} \tag{24b}$$

These two equations make clear how the responses of the two consumption goods to the transfers depend upon the introduction of the labor-leisure choice. To see how this operates, we focus initially on the case of the pure transfer, $\lambda = 0$. With an inelastic labor supply, (23b) and therefore (24b) do not apply, and (24a) reduces to

$$d\hat{\tilde{C}}_N = d\hat{\tilde{C}}_T \tag{25}$$

so that, given the constant elasticity utility function, the two consumption goods will increase proportionately. With the introduction of an elastic labor supply, (24b) now becomes relevant, and (25) is modified to

$$d\hat{\tilde{l}} = d\hat{\tilde{C}}_T = d\hat{\tilde{C}}_N \tag{25'}$$

The pure transfer is associated with a pure wealth effect. As long as agents derive utility from leisure, and with all three commodities—traded consumption, nontraded consumption, and leisure—being normal goods, the escalation in wealth from the transfer will generate equally proportionate increases in all three goods. As a result, consumption of the two goods will grow less when the labor supply is elastic than when it is inelastic and the option to take additional leisure does not exist.

In contrast, if the transfer is tied to some productive use, this raises the wage and reduces the incentive for the agent to raise his leisure by the same proportionate amount. In the case where the transfer is allocated to the traded sector, the wage rate (expressed in terms of the traded output) increases by the amount $d\hat{w} = \nu_1 d\hat{\tilde{G}}_T$. Alternatively, if it is allocated to the nontraded sector, $d\hat{w} = \alpha d\hat{\tilde{k}}_T = [\alpha/(1-\beta)]\nu_2 d\hat{\tilde{G}}_N$. In both cases, (24b) indicates that the higher wage rate cancels out the incentive to increase leisure stemming from the wealth effect, and the net impact on the overall labor supply is much reduced.

Indeed, one of the interesting insights of the simulations that we report in Table 3 is that the endogeneity of the labor supply has a large impact on the effects of pure transfers with its pure wealth effect. But it has very little effect in the case of tied transfers, when the wage effect largely offsets the wealth effect, making the overall change in the labor supply almost negligible. In that case, whether the labor supply is elastic or is fixed inelastically turns out to be of little consequence.

Irrespective of how it is allocated, a rise in foreign transfers eventually causes productive resources, and specifically labor, to migrate from the traded sector. This is a reflection of both an increase in wealth (which pushes up the demand for the nontraded good, necessitating an expansion in its domestically produced output) and shifts in demand due to relative price movements. When labor is supplied inelastically, the only option is for it to move to the non-traded sector. But with an elastic labor supply, agents may choose to devote more time to leisure. This is, in fact, what happens when the transfer is untied, in which case there is little movement to the nontraded sector. With tied transfers, on the other hand, the fact that the overall labor supply (leisure) remains essentially unchanged implies that the labor moves to the nontraded sector, in much the same way as it does when the labor supply is fixed.

3.2 Transfers, economic activity, and Dutch disease

The response of the overall labor supply (and leisure) to a pure transfer has implications for other aspects of the aggregate economy. With the long-run relative price remaining unchanged after such a transfer, capital and debt must eventually change in the same proportions for the long-run borrowing rate to remain equal to the given rate of time preference [see (18f)]. When the labor supply is fixed, these quantities must both increase if the migration of labor from the traded sector implies a move to the more capital-intensive sector ($k_N > k_T$), while they will decrease if these sectoral capital intensities are reversed. But with an elastic labor supply, the fact that the agent chooses to allocate a larger fraction of his time to leisure exerts a negative effect on the capital stock and debt that may be overwhelming to the point of forcing an overall decline in these quantities, even if the nontraded sector is the more capital intensive. Our simulations discussed in Section 7.2 provide an example of this.

An extensively discussed issue concerns whether or not a pure transfer is associated with so-called Dutch disease; see e.g., Arellano et al. (2009). That is, does the transfer lead to an appreciation of the real exchange rate, resulting in a decline in the traded output $X = L_T f(k_T, G_T)$? Cerra et al. (2009) address this for the inelastic labor supply and show that, while a pure transfer is associated with a long-run decline in traded output, this is not due to any movement in the real exchange rate, which remains unchanged in the long run. They therefore do not identify this as Dutch disease. Basically, the decline in the traded sector is a result of the long-run current-account balance, (18d). On the left-hand side of this equation, we have the country's international obligations, namely, its purchase of traded consumption plus debt-servicing costs, while on the right- hand side we have its sources of finance. Given demand, the larger the transfers, the less the need to produce traded output, and the more resources can be allocated to the nontraded sector.

In contrast, the elastic labor supply does generate elements of Dutch disease, but one associated with the wealth effect via leisure, rather than the conventional relative price effect. In this case, a rise in wealth resulting from the transfer lowers its marginal utility, increasing leisure and reducing the time allocated to labor and production of the traded good. Thus, the overall production of the traded good declines.

4. Role of the Labor Supply in Short-run Adjustments

One of the consequences of the endogeneity of the labor supply is that it provides a second channel, in addition to the relative price, through which the economy can carry out any required short-run equilibrating adjustments to the transfers. This is especially true in the case of pure transfers, where the labor-supply responses are more robust. To see the issues involved, we shall focus on the short-run factor allocations (1b), together with (12d)-(12f), using the specific production functions (21a) and (21b). In this case, we shall focus on a pure transfer, the immediate effects of which are to (i) change the relative price, dp, and to reduce the marginal utility of wealth, $d\mu$, both of which will have immediate consequences for leisure and factor allocations across the sectors. More specifically, from these equations we may determine the following short-run responses:

$$d\hat{k}_T = d\hat{k}_N = \frac{d\hat{p}}{\alpha - \beta} \tag{26a}$$

$$dL_T = \frac{1}{(k_N - k_T)}\left[K\frac{d\hat{p}}{\alpha - \beta} - k_N dl\right] \tag{26b}$$

$$dL_N = \frac{1}{(k_N - k_T)}\left[K\frac{d\hat{p}}{\beta - \alpha} + k_T dl\right] \tag{26c}$$

implying the following output effects

$$\frac{dX}{X}=\frac{1}{L_T(k_N-k_T)}\left[K\frac{d\hat{p}}{\alpha-\beta}-k_N dl\right]+\frac{\alpha}{\alpha-\beta}d\hat{p} \tag{27a}$$

$$\frac{dY}{Y}=\frac{1}{L_N(k_N-k_T)}\left[K\frac{d\hat{p}}{\beta-\alpha}+k_T dl\right]+\frac{\beta}{\alpha-\beta}d\hat{p} \tag{27b}$$

When labor is supplied inelastically, only the relative price effect is operative. In that case, Cerra et al. (2009) found that a pure transfer causes an immediate migration of labor from the traded to the nontraded sector, leading to an immediate increase in nontraded output and decline in traded output.

The ability to adjust the labor supply changes the short-run responses significantly. Countering the impetus of the price effect on labor's migration to the nontraded sector is the wealth effect, which boosts leisure more than enough to overtake the price effect. Whether this comes out of labor allocated to the traded sector or to the nontraded sector depends upon the sectoral capital intensities. If the traded sector is more capital intensive $(\alpha>\beta)$, $k_T>k_N$ and the only viable way to reallocate productive resources and maintain full employment is for labor to move from the nontraded sector to the traded sector and leisure, then traded output immediately rises, while nontraded output falls. This is precisely the opposite short-run response to that obtained with fixed labor.

5. Numerical analysis

To study the local dynamics of the economy, we linearize the dynamic equilibrium system in K, N, p, μ about its steady state as defined in (17) and (18). For there to be a unique stable adjustment path, it must have two positive and two negative eigen values. With the capital stock, K, and the national debt, N, evolving gradually, convergence is achieved by instantaneous jumps in the shadow value of wealth, μ, and the real exchange rate, p.

As previously noted, because of the complexity of the model, we will solve it numerically rather than analytically. The functional forms we employ for the sectoral production functions and utility function are (21a)-(21c), and, in addition, we assume that the borrowing function is of the form

$$r=r^*+\xi\left[e^{a(N/pK)}-1\right] \tag{21d}$$

which is a positive convex function of the ratio of debt to the value of capital.

The parameters used to calibrate the benchmark economy are summarized in Table 1, which represents a typical small emerging open economy. We consider two different scenarios: Case I, where the traded sector is *more* capital intensive than the nontraded sector ($\alpha > \beta$); and Case II, where it is *less* capital intensive ($\alpha < \beta$). This is important, since the dynamics of a two-sector-dependent economy model are known to be dependent on the relative sectoral capital intensities.[15] The preference parameters γ, θ, ρ are standard, while the other preference parameter, η, is chosen to ensure a plausible equilibrium allocation of time to leisure of around 0.72, consistent with the empirical evidence. The production parameters α, β and the productivity parameters A, B, on the other hand, are chosen to attain a plausible equilibrium labor share in the traded sector.[16] The borrowing premium $a = 0.15$ and the weight of the borrowing premium ξ are chosen in order to attain a plausible debt-to-output ratio.[17]

Since one of the issues of concern pertains to the allocation of the transfer to sectoral infrastructure, the base values of G_T and G_N are key. As is typical of most emerging economies, we assume that the economy begins with a shortage of infrastructure, so that G_T and G_N are initially below their respective optimal levels. But how far below is important. The choice of these base spending values is crucial and was discussed in some detail in Cerra et al. (2009). Here we choose them so as to preserve comparability with the earlier paper, in which there is no labor-leisure choice.

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[15] In both cases, we find that the equilibrium is a saddlepoint, implying that there is a unique stable adjustment path.

[16] The choice of parameters, particularly those relating to the sectoral aspects, are discussed in greater detail by Morshed and Turnovsky (2004). Our choice of elasticities on government expenditures in production, v_1=0,15, v_2=0.15, imply that government expenditure is equally productive in producing both nontraded and traded output, which seems like a natural benchmark and implies that both production functions are subject to 15% increasing returns to scale.

[17] Our benchmark debt-GDP ratios of around 0.40 represent a plausible average for small emerging economies. It is also close to that of Cerra et. al. (2009), thus facilitating the comparison between a model with exogenous labor and the present model, where labor is supplied endogenously. In order to examine the importance of access to world financial markets, Cerra et al. perform a sensitivity analysis with respect to different values of *a*, allowing it to vary between a=0.015 (easy access), a=0.15 (medium access), and a=15 (highly restricted access). We have conducted a similar sensitivity analysis and find that the introduction of endogenous labor has little influence on the importance of access to world commodity markets.

For Base Case I and Base Case II, the optimal levels of traded and non-traded government spending are $\hat{G}_T = 0.025$, $\hat{G}_N = 0.043$ and $\hat{G}_T = 0.034$, $\hat{G}_N = 0.062$, respectively. We assume that the initial total government spending is $G = 0.05$, which is financed fully with lump-sum taxation, $T = 0.05$. In Base Case I, total government spending is therefore 29% below its optimum. Assuming that this shortfall applies proportionately to both components, we set $G_T = 0.018, G_N = 0.032$. In Base Case II, total government spending is 52% below its optimum, and the corresponding base components are $G_T = 0.018, G_N = 0.032$.[18]

Inserting the benchmark parameters into the steady-state equations (17a)-(17f) and (18a)-(18d) and into the functional forms in (21) yields the benchmark equilibrium values summarized in Table 2. Panel A reports the key steady-state equilibrium ratios for Case I, when the traded sector is more capital intensive. The sectoral capital-output ratios in the traded and nontraded sectors are 3.5 and 2.5, respectively, yielding an overall capital-output ratio of 2.88. The traded sector produces 38% of total output, similar to a model with exogenous labor. However, only 10% of a unit time is allocated towards the traded sector, while 72% of the time is allocated to leisure activities. The long-run relative price of the nontraded good is 1.26, and the debt-GDP ratio is around 0.38. Table 2(B) reports the key steady-state equilibrium ratios in Case II, where the nontraded sector is more capital intensive. The sectoral capital-output ratios in the traded and nontraded sectors are 2.5 and 3.5, respectively, yielding an overall capital-output ratio of 3.1. The traded sector produces slightly more of total output and employs slightly more labor than in the case where the traded sector is capital intensive. The fraction of time devoted to leisure is also slightly higher. The long-run relative price of the nontraded good is 0.91, and the debt-GDP ratio is about 0.41.[19]

6. Foreign transfers: General characteristics of real exchange rates

Starting from these initial equilibria, we analyze the economic impact and welfare consequences of the three allocations of the transfers, namely debt

[18] In Cerra et. al. (2009), the initial lump-sum tax chosen was 30% (Case I) and 54% (Case II) below its optimal level, very close to what we have here.

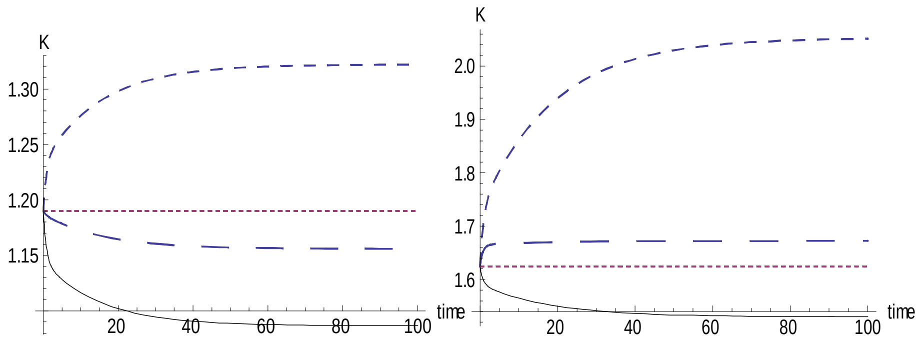
[19] These calibrations are similar to those reported in Cerra et al. (2009), which in turn were shown to be consistent with the economic structures of a range of developing countries summarized by Morshed and Turnovsky (2004).

reduction vs. greater productive government spending in either sector. We set the size of the permanent transfer to 0.04 units of traded output, which equals about 8% of baseline GDP in Case I and 8.5% in Case II.[20] We analyze the long-run effects and transitional dynamics generated by these shocks, as summarized in Table 3 and Figs. 1-4.

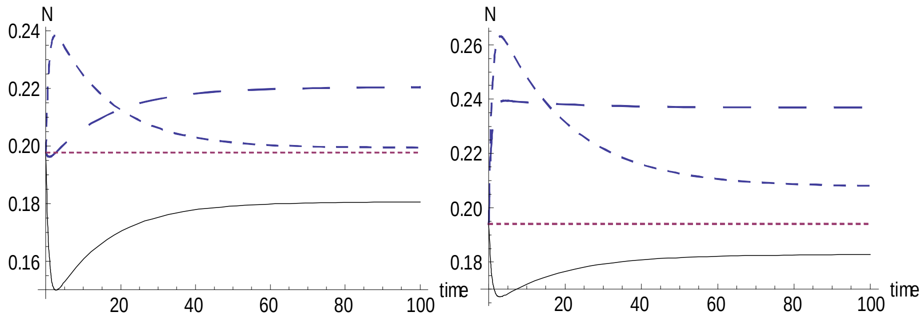
(A) Traded sector more capital intensive:	**(B) Nontraded sector more capital intensive:**
$(\alpha = 0.35, \beta = 0.25)$	$(\alpha = 0.25, \beta = 0.35)$

Figure 1. Capital and Debt

1.1 Time Path for Capital (K)



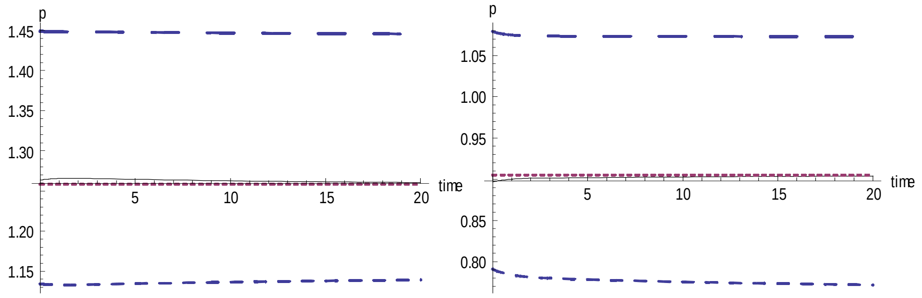
1.2 Time Path for Debt (N)



[20] The size of the transfer is chosen such that its magnitude relative to initial GNP is comparable to that in Cerra et al. (2009), thereby allowing for more accurate comparison between the two cases of fixed versus flexible labor supply.

Figure 2. Financial Variables

2.1 Real Exchange Rate (p)



2.2 Interest Rate (r)

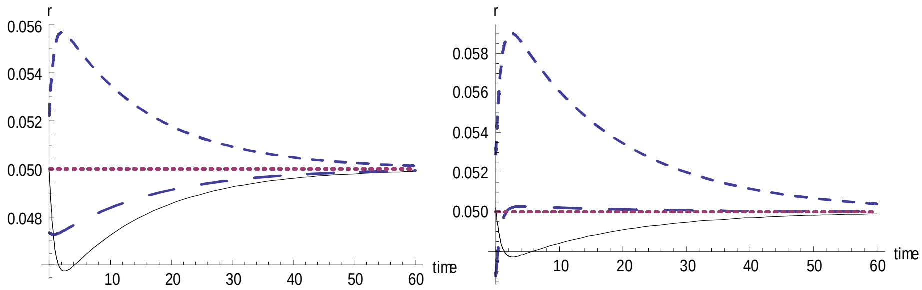
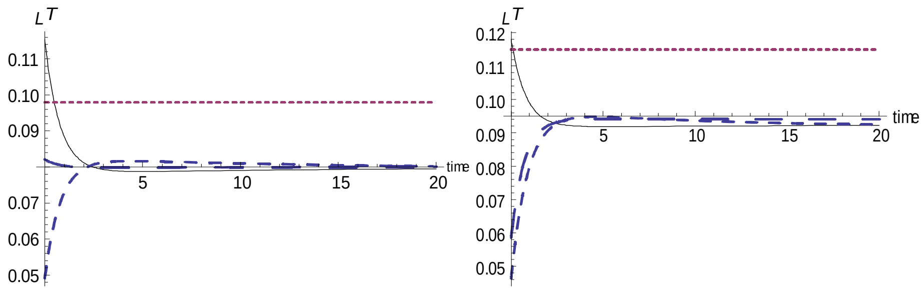
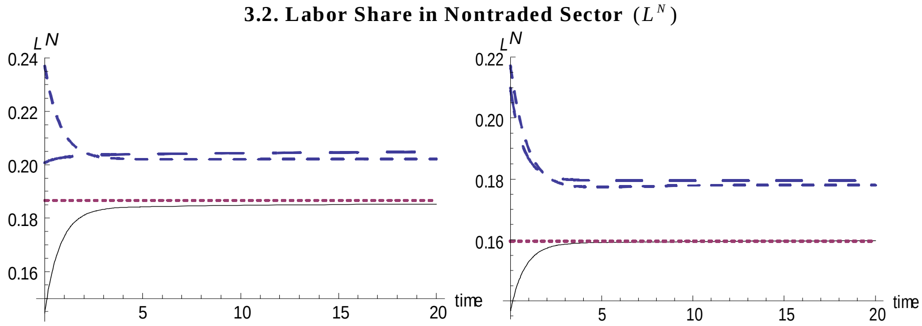


Figure 3. Sectoral Activity and Output

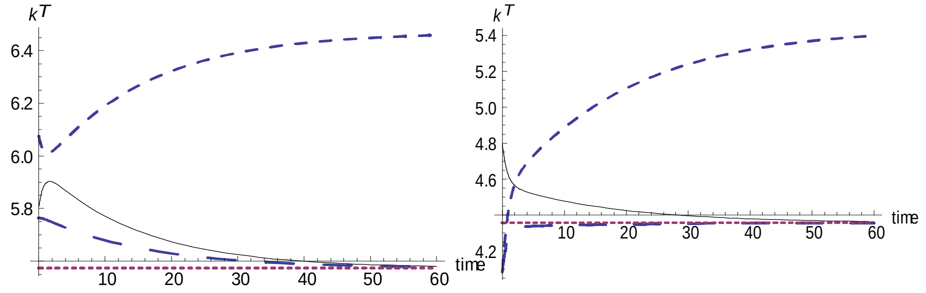
3.1. Labor Share in Traded Sector (L^T)



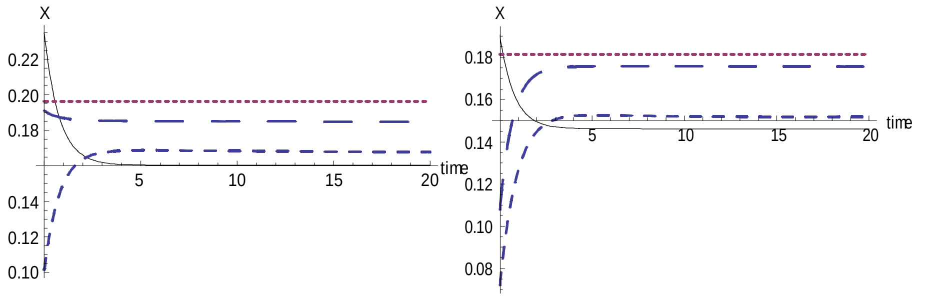
3.2. Labor Share in Nontraded Sector (L^N)



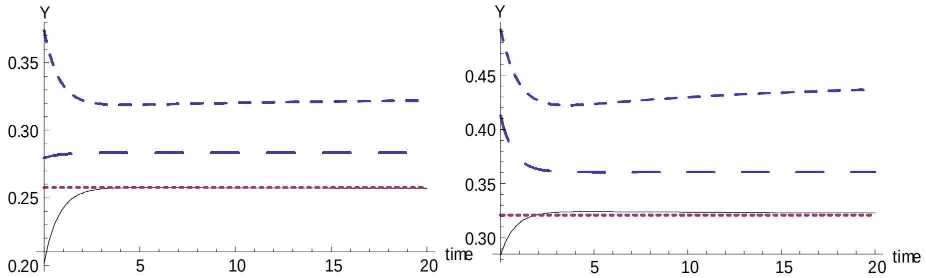
3.3 Capital Intensity in Traded Sector (k^T)



3.4 Traded Output (X)



3.5 Nontraded Output (Y)



3.6 Total Output (Z)

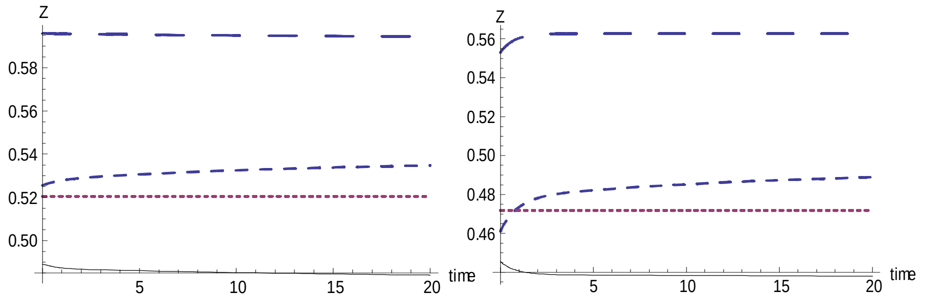
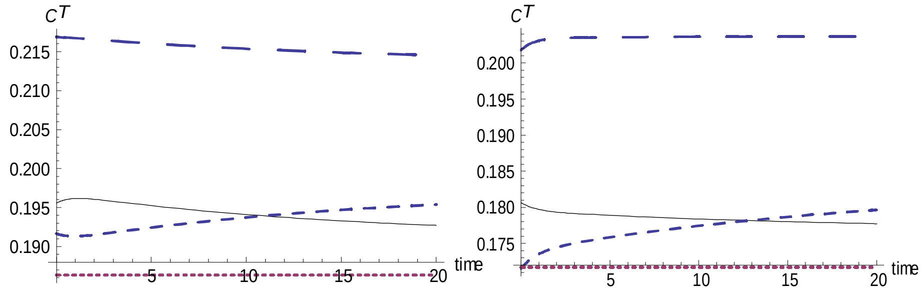
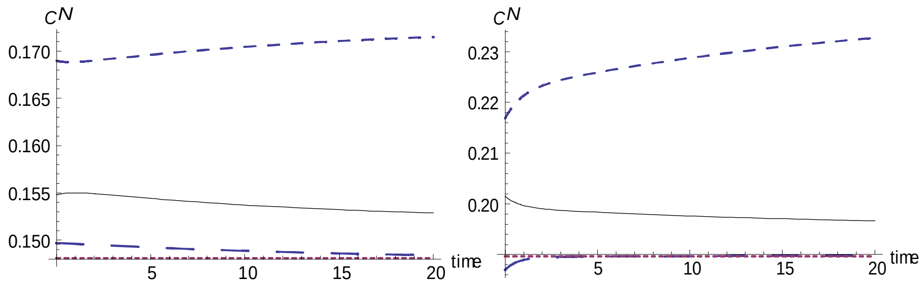


Figure 4. Consumption, Leisure and Welfare

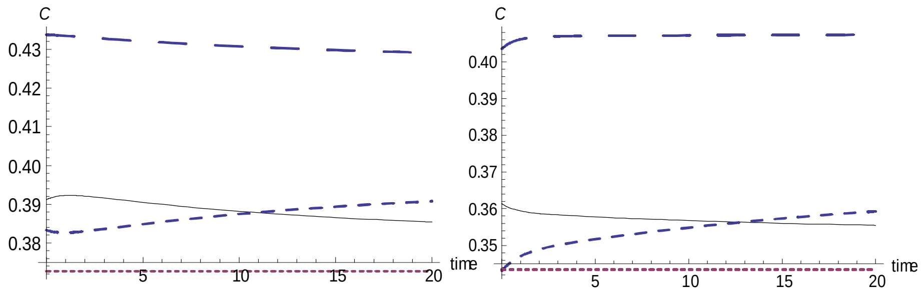
4.1 Traded Consumption (C^T)



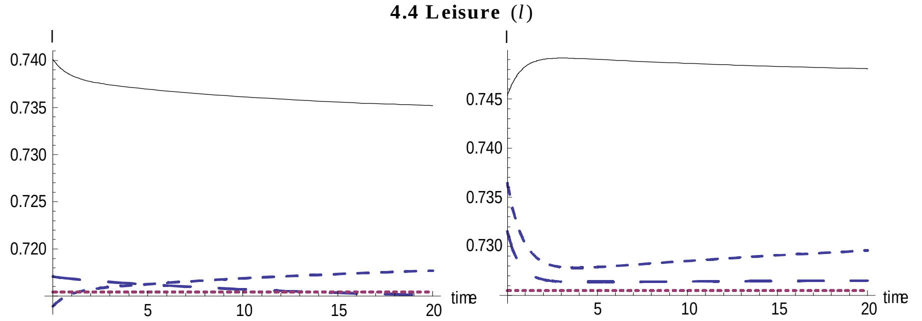
4.2 Nontraded Consumption (C^N)



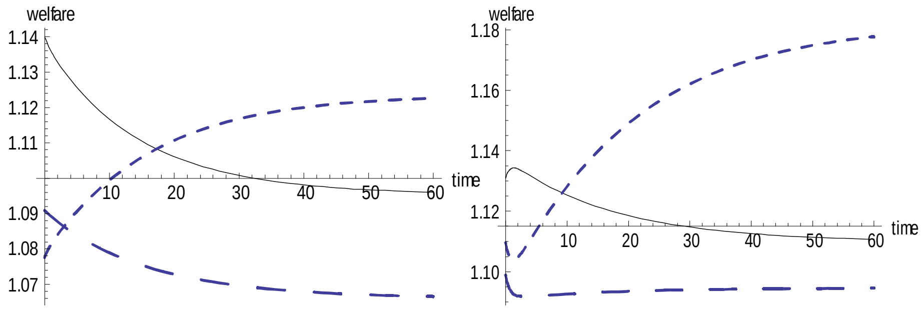
4.3 Total Consumption (C)



4.4 Leisure (l)



4.5 Welfare (W)



_________pure transfer   __ __ __ __ G^T _ _ _ _ _ _ _ _G^N -------------Initial SS

From Fig. 2, we see that in all cases the real exchange rate responds virtually instantaneously to the transfer. This is characteristic of these models, and the underlying intuition is explained by Cerra et al. (2009). It is unsatisfactory in terms of capturing the empirical phenomenon of "real exchange-rate persistence." This requires more sluggishness, and as Morshed and Turnovsky (2004) discuss, one natural way to obtain more plausible exchange-rate dynamics is to introduce adjustment costs on inter-sectoral capital movements. The fact that there is slightly more transition in the exchange rate with endogenous labor, as compared to inelastic labor (discussed by Cerra et al.), is consistent with more recent work by Morshed and Turnovsky (2011), who show how the endogeneity of the labor supply can also be a central determinant of short-run real exchange-rate dynamics.

7. Pure Transfer

The pure transfer is equivalent to a reduction in taxes, which decreases the economy's rate of debt accumulation and enables it to increase its consumption of both the traded good and the nontraded good, as well as to enjoy more leisure. It is a pure demand shock that does not influence the relative productivities of either sector and therefore represents a pure wealth effect. Some of the long-run constraints in the responses have been discussed in Section 3.1. The second rows in Table 3 (A) and (B) present the more detailed numerical responses, corresponding to two cases where the traded sector is relatively more capital intensive and vice versa.

These numerical results confirm the qualitative responses discussed previously, and the following aspects merit highlighting.

(i) The sectoral capital-labor ratios and relative price remain unchanged.

(ii) The consumption of the traded good, the nontraded good, and leisure all increase proportionately as a result of the enhanced wealth, with the increase being 2.6% if $\alpha > \beta$ and 3.1% if $\beta > \alpha$.

(iii) If $\alpha > \beta$, the migration of labor from the traded sector leads to an 8.7% slide in both capital and debt. This is far greater than that obtained by Cerra et al. (2009) (around 1.9%) with an inelastic labor supply. This arises from the jump in leisure that occurs. Indeed, this effect is sufficiently dominant that capital and debt decline even when $\beta > \alpha$. However, the fact that the drop in capital is now 5.8% rather than 8.7% accounts for the larger increase in consumption when $\beta > \alpha$.

(iv) A further consequence of the sectoral capital-labor ratios remaining constant is that the changes in output of the two goods are proportional to the changes in sectoral employment. Therefore, output of the traded sector and employment in that sector both decline by 18.3% or 19.5%, depending upon sectoral capital intensities. These are much larger than the corresponding reductions with an inelastic labor supply (around 10%) in reaction to the negative impact of the wealth effect on the labor supply [see (15c), (15d)]. Thus, the opportunity to enjoy more leisure, following the transfer, contributes significantly to the decline in the traded sector and can be viewed as a kind of Dutch disease.

(v) In both cases, labor moves from the traded sector to leisure. Employment in the nontraded sector remains virtually unchanged, with nontraded output remaining essentially unchanged as well. This contrasts with corresponding increases of around 5.7%-7.7% with an inelastic labor supply, obtained by Cerra et al. (2009).

We now turn to a brief discussion of the dynamics.

7.1 Traded sector is capital intensive: ($\alpha > \beta$)

The increase in wealth due to the transfer immediately raises the demand for both traded and nontraded consumption, as well as leisure [see Figs. 4.1, 4.2, 4.4]. As discussed in Section 4, the introduction of leisure changes the short-run responses from those that appear if labor is supplied inelastically. The fact that the wealth increase is now partially taken in leisure implies that the short-run rises in consumption are reduced from the order of 11% to 4.5%-5.0%. As noted previously, if $\alpha > \beta$, then for factor markets to clear, labor must move to the traded sector, and, as seen from Fig. 3.1, L_T immediately climbs from 0.098 to 0.115. Given the simultaneous increase in leisure, this requires employment in the nontraded sector, L_N, to decrease substantially, from 0.187 to 0.144. This is precisely the opposite short-run response to that occurring when labor is supplied inelastically.

For reasons discussed in more detail in Cerra et al. (2009), the real exchange rate remains close to its (unchanged) steady-state value, although there is some slight initial appreciation. But overall, real exchange-rate movements play little role in the equilibrating process. Rather, in the short run, the net increase in demand for the nontraded good is met by a reduction in the accumulation of nontraded capital, which falls at an almost precipitous rate [Fig. 1.1]. In contrast, the increase in the demand for the traded good is more than met by a combination of the transfer and the additional output, which allows the rate of debt-to-accumulation to move downward, again initially at a rapid rate [Fig. 1.2].

Over time, capital and debt both decline by 8.7%; with the country being initially solvent $(K > pN)$, this implies a long-run erosion in wealth of 8.7%. Thus, following the initial plunge in the shadow value of wealth in response to the transfer, the shadow value will gradually increase during the transition as wealth declines. This, together with the fact that the price remains virtually unchanged, is reflected in the very slight dips in consumption and leisure that occur during the transition and partially offset the initial increases. In particular, with the fall in leisure during the transition being on the order of only half a percentage point [from 0.740 to 0.735], any further adjustments in labor allocation must take place almost entirely directly between the two productive sectors. Now, given the declining capital stock and the relative sectoral capital intensities, both capital and labor must move from the traded to the nontraded sector, in order to provide the necessary additional nontraded output. Thus, following its initial shift to the traded sector, labor will reverse that move and migrate back to the nontraded sector, compensating for the gradual reduction in the capital stock. Because of the sluggishness of capital, during the transition the capital-labor ratios in both sectors exceed their steady-state values.[21] As a result, following its initial discrete drop, domestic production of nontraded output begins to turn around, while traded output begins to subside gradually over time.

The direct effect of the transfer is to lower the rate of debt accumulation, which slows considerably at first. However, the reduction in traded output, coupled with the generally sustained upward trend in traded consumption,

[21] We illustrate the capital intensity only in the traded sector, since both k_N and k_T move together.

negates this initial decline, and, after approximately four periods, debt starts to expand, eventually settling at 8.7% below its original pre-transfer level. The abrupt reversal in the accumulation of debt is reflected in the interest rate. The initial appreciation of the exchange rate immediately pushes down the ratio $N/(pK)$, lowering the borrowing costs, and with debt decreasing, this descends from 5.0% to 4.58% after three years. At that point, the accumulation of debt reverses that decline, and the interest rate gradually returns to its long-run equilibrium of 5% [Fig. 2.2].

Finally, we can trace out the implications for welfare, which we measure in terms of the equivalent variations of consumption flows. The short-run increments in consumption and leisure immediately following the transfer imply a short-run improvement in welfare of around 14%. Over time, the retreat of consumption and leisure after the lessening of wealth causes a gradual decrease in welfare, which makes up for the initial increase and leads to a net present value jump in welfare of 11.3%.

7.2 Nontraded sector is capital intensive: ($\beta > \alpha$)

Reversing the sectoral capital intensities so that $\beta > \alpha$ sharpens the contrast between the two cases of fixed and flexible labor supply. With an inelastic labor supply, Cerra et al. (2009) showed that with labor migrating from the traded to the nontraded sector, and with the latter being more capital intensive, a long-run accumulation of capital and debt would ensue. In contrast, we now find that because the wealth resulting from the transfer induces labor to up its leisure time, it will tend to switch from providing labor to leisure, with only a slight move upward in employment in the nontraded sector of 0.32%, causing a long-run loss in both capital and debt of 5.8%.

In the short run, due to the sectoral capital intensities, the growth in leisure stemming from the wealth effect approximately balances with the relative price effect in the traded good sector, and L_T ascends by a negligible amount; see Fig. 3.1. Therefore, in the short run, the gain in leisure is obtained by reducing employment in the nontraded goods sector. Following the initial impact, the pattern of the subsequent dynamics is generally similar to those obtained for the case $\alpha > \beta$. Hence, over time, with leisure remaining generally stable, the increase in employment in the nontraded sector, which restores nontraded employment approximately to its pre-transfer level, is met by migration from the traded good sector, which in the long run plummets by 19.5%.

The fact that the capital stock and debt both decline over time generates two further contrasting responses between an elastic and an inelastic labor supply when $\beta > \alpha$. The first involves the long-run GNP, which is seen to drop substantially, by 7.3% over the long run. This compares to Cerra et al. (2009), who find that a pure transfer actually led to a slight increase in total output. The second difference is in the response of the borrowing rate, which follows a path very similar to that obtained when $\alpha > \beta$, but is the mirror image of that reported by Cerra et al.

8. Productive Government Spending in the Traded and Nontraded Sector

The long-run effects arising from transfers allocated to productive government spending are summarized in the third and fourth rows of Table 3(A) and 3(B). In both cases, the long-run changes in leisure are modest, being much less than for the pure transfer. This is because of the positive wealth effect on leisure being largely offset by the higher wage rate resulting from the enhanced productivity, with its inducement to supply more labor. At the same time, the direct increases in productivity resulting from the transfers being tied to production have substantial relative price effects. For example, if $\alpha > \beta$, a transfer tied to the productivity enhancement of the traded sector causes the relative price of nontraded output to climb by 14.8%; however, when applied to the nontraded sector, the decrease is 9.2%.

In the long run, the response in the relative price clearly outdoes that due to leisure. Moreover, comparing Figs. 2.1 and 4.4, the same is true along the transitional path, although if $\beta > \alpha$, leisure is more responsive in the short run. Overall, however, the adjustment in leisure plays a relatively minor role, in which case we find that the responses to tied transfers as detailed by Cerra et al. (2009) require relatively minor adjustments to account for the endogeneity of labor supply and, accordingly, require no further discussion here.

9. Welfare

As can be seen from Table 3, there are many conflicting responses to the transfer, obviously implying the existence of tradeoffs among them. Table 4 summarizes the long-run percentage changes in several key macroeconomic variables, including the real exchange rate, long-run capital accumulation (growth), export production, aggregate production, and long-run gain in welfare, according to each type of allocation. Several interesting observations can be made from this table.

(i) The relative welfare gains resulting from the three allocations of the transfers obtained by Cerra et al. (2009) for fixed labor do not change significantly when labor is supplied elastically. In both cases, though, they are sensitive to the size of government spending relative to its socially optimal level.

(ii) The change in long-run GNP is a poor indicator of the change in welfare. This is particularly true for the pure transfer, where in both cases it is associated with a loss of around 7.2%, while long-run welfare advances by 11-12%. This is because it is ignoring the benefits associated with additional leisure. It also reverses the welfare ranking between allocation to the traded sector and allocation to the nontraded sector.

(iii) Major declines in the size of the traded sector happen irrespective of the allocation of the transfers and are a poor indication of welfare changes. In fact, the smallest declines in the size of the nontraded sector correlate with the smallest welfare gains.

None of the three polar allocations is optimal. If $\alpha > \beta$, the welfare gain of 11.3% obtained for the pure transfer can be improved further to 11.5%, by setting $\lambda = 0.3, \phi = 0.8$. That is, 70% of the transfer should be allocated to tax reduction and 30% allocated to productivity enhancement, with 80% of that being allocated to the nontraded sector. This will bring the economy to the socially optimal allocation and will be associated with a 1.3% real depreciation of the exchange rate, accompanied by a 3.1% decrease in the capital stock, a 15.8% reduction in traded output, and a 2.6% shrinkage in total output. If $\beta > \alpha$, we see that the welfare gain of 13.8% obtained from enhancing the productivity in the nontraded sector can be improved further to 14.4% by setting $\lambda = 1, \phi = 0.8$. In other words, none of the transfer should be allocated to tax reduction; instead, all should be allocated to productivity enhancement, with 80% of that going to the nontraded sector. This will bring the economy to the socially optimal allocation and will yield a 6.8% real depreciation of the exchange rate, along with a 21.3% expansion in the capital stock, a 9.7% fall in traded output, and a 10.6% boost to total output.

10. Conclusions

The consequences of the international transfer of resources are one of the longstanding issues in international economics. The existing literature on this topic makes the strong assumption that labor is supplied inelastically. In this paper, we have relaxed this constraint, assuming instead that aggregate labor is supplied elastically, by allowing agents to have a labor-leisure choice. This is important, since along with the relative price (real exchange rate), the level of employment is a key channel through which an economy can make necessary short-run adjustments.

The results we obtain are quite strong. We show that the elasticity of the labor supply is pivotal to determining the impact of transfers on the recipient economy, but to what degree depends upon the following: whether the transfers are untied and can be fully devoted to debt reduction and consumption, or whether they are tied to productivity enhancement in either of the productive sectors. The underlying reason for this dichotomy is the existence of two potential effects of the transfer—a wealth effect and a relative price effect—the relative importance of which depends upon its allocation.

A pure transfer devoted to debt reduction has a wealth effect, which leads to proportionate increases in both consumption goods and in leisure. Being balanced in this way, it has only a weak transitory relative price effect, so the impact of the enhanced wealth on leisure is therefore the dominant effect. In this case, the introduction of an endogenous labor supply becomes crucial in producing notable qualitative and quantitative differences from those obtained when the labor supply is fixed.

In contrast, if the transfer is devoted to productivity enhancement, two additional effects come into operation. The first is that being directly applied to the production of one good or the other, it has a substantial direct impact on the relative price. Second, in either case, the rise in productivity raises the wage rate, thereby inducing an increase in the aggregate labor supply and offsetting the lift in leisure due to the wealth effect. In fact, the overall response in leisure is small, both in the long run and during the transition, and is overwhelmingly dominated by the relative price effect. Thus, given this small response, whether aggregate labor is supplied elastically or is constrained to be fixed turns out to be unimportant insofar as the effects of tied transfers are concerned.

We conclude by noting two directions in which this analysis could be usefully extended. The first is in regard to further sensitivity analysis, particularly with respect to the production side. Recent work by Morshed and Turnovsky (2006) has shown that the elasticity of substitution is important in determining the speed of convergence of the exchange rate. While this will influence the transitional dynamics, we nevertheless expect that the internal structure of the system will ensure that the contrast we have emphasized will largely remain intact. The second area worth exploring concerns the implications of the transfers for the distribution of wealth and income. Tekin-Bouza and Turnovsky (2011) explored this question assuming a fixed labor supply, and it will be of interest to examine the degree to which the dichotomous role of the labor supply we have obtained in this paper extends to the distributional dynamics.

Table 1. The Benchmark Economy

Preference parameters:	$\gamma = -1.5, \theta = 0.5, \rho = 0.05, \eta = 2.5.$
Production parameters:	$I.\ \alpha = 0.35, \beta = 0.25;\ II.\ \alpha = 0.25, \beta = 0.35$
Productivity parameters:	$A = 2, B = 1.7$
Depreciation rate:	$\delta_K = 0.05$
World interest rate:	$r^* = 0.03$
Premium on borrowing:	$a = 0.15$
Weight on the premium:	$\xi = 1$
Government Expenditure:	$I.\ G_T = 0.018, G_N = 0.032;\ II.\ G_T = 0.018, G_N = 0.032$
Elasticities of government expenditures:	$\nu_1 = 0.15, \nu_2 = 0.15$
Transfers:	$TR = 0.0$

Table 2. Key Steady-State Equilibrium Ratios

A. Traded Sector More Capital Intensive: α=0.35, β=0.25

$\frac{K_T}{L_T}$	$\frac{K_N}{L_N}$	$\frac{pK_T}{X}$	$\frac{K_N}{Y}$	$\frac{pK}{X+pY}$	$\frac{N}{X+pY}$	L_T	l	p	$\frac{X}{X+pY}$	$\frac{G_T}{G}$	$\frac{pG_T}{X}$	$\frac{G_N}{Y}$	$\frac{pG}{X+pY}$
5.573	3.450	3.500	2.500	2.877	0.380	0.098	0.715	1.258	0.377	0.368	0.118	0.123	0.121

B. Nontraded Sector More Capital Intensive: α=0.25, Β=0.35

$\frac{K_T}{L_T}$	$\frac{K_N}{L_N}$	$\frac{pK_T}{X}$	$\frac{K_N}{Y}$	$\frac{pK}{X+pY}$	$\frac{N}{X+pY}$	L_T	l	p	$\frac{X}{X+pY}$	$\frac{G_T}{G}$	$\frac{pG_T}{X}$	$\frac{G_N}{Y}$	$\frac{pG}{X+pY}$
4.357	7.039	2.500	3.500	3.116	0.411	0.115	0.725	0.905	0.384	0.354	0.088	0.101	0.096

Table 3.

A. Steady-State Responses to Permanent Changes $\alpha = 0.35$, $\beta = 0.25$ (traded sector is more capital intensive)

	K	N	k_T	k_N	P	L_T	I	X	Y	Z	C_T	C_N	C
Benchmark $G_T = 0.018$, $G_N = 0.032$ $T = 0.05, TR = 0.0$	**1.190**	**0.198**	**5.573**	**3.450**	**1.258**	**0.098**	**0.715**	**0.196**	**0.258**	**0.520**	**0.186**	**0.148**	**0.373**
Pure Transfer $(\lambda = 0)$ $G_T = 0.018$, $G_N = 0.032$ $T = 0.018, TR = 0.04$	1.087 (-8.7)	0.181 (-8.7)	5.573 (0.0)	3.450 (0.0)	1.258 (0.0)	0.080 (-18.3)	0.734 (+2.6)	0.160 (-18.3)	0.256 (-0.5)	0.483 (-7.2)	0.191 (+2.6)	0.152 (+2.6)	0.383 (+2.6)
Tied Transf $(\lambda = 1, \varphi = 0)$ $G_T = 0.046$, $G_N = 0.032$ $T = 0.05, TR = 0.04$	1.156 (-2.9)	0.220 (+11.5)	5.573 (0.0)	3.450 (0.0)	1.444 (+14.8)	0.080 (-18.0)	0.714 (-0.1)	0.185 (-5.9)	0.283 (+10.0)	0.594 (+14.1)	0.214 (+15.1)	0.148 (-0.7)	0.427 (+14.6)
Tied Trans $(\lambda = 1, \varphi = 1)$ $G_T = 0.018$, $G_N = 0.067$ $T = 0.05, TR = 0.04$	1.322 (+11.1)	0.199 (+0.8)	6.470 (+16.1)	4.005 (+16.1)	1.142 (-9.2)	0.079 (-19.1)	0.719 (+0.5)	0.167 (-14.8)	0.324 (+25.7)	0.537 (+3.2)	0.197 (+5.9)	0.173 (+16.1)	0.394 (+5.8)

Quantities in parentheses are percentage changes

B. Steady-State Responses to Permanent Changes $\alpha = 0.35$, $\beta = 0.25$ (nontraded sector is more capital intensive)

	K	N	k_T	k_N	p	L_T	I	X	Y	Z	C_T	C_N	C
Benchmark $G_T = 0.018$, $G_N = 0.032$ $T = 0.05, TR = 0.0$	**1.624**	**0.194**	**4.357**	**7.039**	**0.905**	**0.115**	**0.725**	**0.181**	**0.321**	**0.472**	**0.172**	**0.190**	**0.343**
Pure Transfer $(\lambda = 0)$ $G_T = 0.018$, $G_N = 0.032$ $T = 0.006, TR = 0.04$	1.530 (-5.8)	0.183 (-5.8)	4.357 (0.0)	7.039 (0.0)	0.905 (0.0)	0.093 (-19.5)	0.747 (+3.0)	0.146 (-19.5)	0.322 (+0.3)	0.437 (-7.3)	0.177 (+3.0)	0.195 (+3.0)	0.354 (+3.0)
Tied Transfer $(\lambda = 1, \varphi = 0)$ $G_T = 0.055$, $G_N = 0.032$ $T = 0.05, TR = 0.04$	1.672 (+3.0)	0.237 (+22.1)	4.357 (0.0)	7.039 (0.0)	1.073 (+18.5)	0.094 (-18.3)	0.727 (+0.2)	0.176 (-3.2)	0.361 (+12.5)	0.563 (+19.3)	0.204 (+19.3)	0.190 (0.0)	0.408 (+18.7)
Tied Transfer $(\lambda = 1, \varphi = 1)$ $G_T = 0.018$, $G_N = 0.084$ $T = 0.05, TR = 0.04$	2.053 (+26.4)	0.208 (+7.0)	5.440 (+24.8)	8.788 (+24.8)	0.766 (-15.3)	0.092 (-20.0)	0.731 (+0.8)	0.153 (-15.5)	0.443 (+38.2)	0.493 (+4.5)	0.183 (+7.0)	0.238 (+25.3)	0.366 (+6.6)

Table 4. Welfare Analysis
Long-run changes and welfare gains for transfers of 0.04[22]

(A) Traded Sector More Capital Intensive $(\alpha = 0.35, \beta = 0.25)$ Starting from initial allocation: $G_T = 0.018; G_N = 0.032; T = 0.05;\ TR = 0.0$					
	% $\Delta\tilde{p}$	**%** $\Delta\tilde{K}$	**%** $\Delta\tilde{X}$	**%** $\Delta\tilde{Z}$	**% Long-run Welfare Gain**
pure transfer ($\lambda=0$ **):** $G_T = 0.018; G_N = 0.032; T = 0.018$	0.0	-8.7	-18.3	-7.2	11.3
spent on G_T **only (** $\lambda=1; \phi=0$ **):** $G_T = 0.046; G_N = 0.032; T = 0.05$	14.8	-2.9	-5.9	14.1	7.7
spent on G_N **only (** $\lambda=1; \phi=1$ **):** $G_T = 0.018; G_N = 0.067; T = 0.05$	-9.2	11.1	-14.8	3.2	10.3
Opt. alloc. ($\lambda=0.3; \phi=0.8$ **)**[23]**:** $G_T = 0.020; G_N = 0.039; T = 0.027$	-1.3	-3.1	-15.8	-2.6	11.5
(B) Nontraded Sector More Capital Intensive $(\alpha = 0.25, \beta = 0.35)$ Starting from initial allocation: $G_T = 0.018; G_N = 0.032; T = 0.05;\ TR = 0.0$					
	% $\Delta\tilde{p}$	**%** $\Delta\tilde{K}$	**%** $\Delta\tilde{X}$	**%** $\Delta\tilde{Z}$	**% Long-run Welfare Gain**
pure transfer ($\lambda=0$ **):** $G_T = 0.018; G_N = 0.032; T = 0.006$	0.0	-5.8	-19.5	-7.3	12.2
spent on G_T **only (** $\lambda=1; \phi=0$ **):** $G_T = 0.055; G_N = 0.032; T = 0.05$	18.5	3.0	-3.2	19.3	9.3
spent on G_N **only (** $\lambda=1; \phi=1$ **):** $G_T = 0.018; G_N = 0.084; T = 0.05$	-15.3	26.4	-15.5	4.5	13.8
Opt. alloc. ($\lambda=1; \phi=0.8$ **):** $G_T = 0.027; G_N = 0.070; T = 0.05$	-6.8	21.3	-9.7	10.6	14.4

22 A transfer of 0.04 units corresponds to 8% of initial GDP in Case 1 and 9% in Case 2.

23 If TR=0.04 at the beginning, the level of government spending that would maximize intertemporal welfare is G^T=0.025; G^N=0.043 and T=0.068 in Case I; G^T=0.034; G^N=0.062 and T=0.096 in Case II. These numbers are very close to what we find while looking to maximize the % long-run welfare gain. The slight deviation from the optimal level is due to the fact that the size of the transfer is not quite big enough to reach the optimal level of both spendings and taxes.

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