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No. 5857

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INTERNATIONAL MACROECONOMICS

Centre for Economic Policy Research

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ISSN 0265-8003

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Discussion Paper No. 5857
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CEPR Discussion Paper No. 5857

October 2006

ABSTRACT

Terms of Trade Shocks in an Intertemporal Model: Should We Worry about the Dutch Disease or Excessive Borrowing?

This paper analyzes the impact of terms of trade and risk-premium shocks on a small open economy in an intertemporal, Dutch disease model, with international capital mobility. It is shown that when the economy experiences a permanent improvement in the terms of trade, the Dutch disease effect (real exchange rate appreciation) goes away in the new steady state, while the economy experiences de-industrialization even stronger than in the short-run. Second, a permanent improvement in the terms of trade coupled with a permanent reduction in the risk-premium leads to pro-industrialization and a real exchange rate appreciation. The mechanism behind appreciation of the real exchange rate in the long-run is different from the Dutch disease story. It occurs because reduction in the risk-premium reduces the costs of the production in the economy, and because (non-oil) traded sector benefits more from cheaper capital than the non-traded sector. The economy also accumulates more debt in response to these two shocks in the long-run.

JEL Classification: E44, F32, F34 and F41
Keywords: capital inflows, Dutch disease, external debt, optimizing models, overborrowing and real exchange rate

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Submitted 21 August 2006

1 Introduction

Developing countries are often exposed to the need for macroeconomic adjustments in response to changes in their terms of trade. For resource-exporting countries, in particular, movements in the terms of trade are key determinants of a country's macroeconomic performance, and have an important impact on real national income. However, favorable terms of trade shocks are not always a blessing for countries that experience them. The literature identifies two problems with positive terms of trade shocks.

First, positive terms of trade can result in the effect known as the Dutch disease, which results in a loss of competitiveness and deterioration of the non-resource exporting industrial sector. The notion of the Dutch Disease has been also the most widespread explanation of the "resource curse" problem, in particular, the cross-country research finding that resource abundance lowers growth[1]. The theoretical explanation of this is often based upon the fact that in the Dutch Disease models resource abundance shifts factors of production from the industrial sectors generating learning-by-doing, which impedes growth in the long-run.

Second, with an improvement in the terms of trade, countries tend to overborrow internationally as they become too optimistic about the longevity of the shocks. For example, Senhadji (2003) shows, in a stochastic dynamic one-sector general equilibrium model, that overborrowing occurs if a transitory improvement in the terms of trade is perceived to be permanent, or if a permanent decline in the terms of trade is perceived to be transitory. Indeed, uncertainty about the longevity of terms of trade shocks may have contributed to overborrowing during mid-1980s in many African countries (Brooks et. al., 1998).

Uncertainty about the longevity of external shocks is only one of mechanisms that can lead to overborrowing. In the 1970s, a number of developing countries (most prominent among them were Mexico and Venezuela) accumulated huge debts following their discoveries of natural resources. Such heavy borrowing behavior has been studied by Mansoorian (1991), within a three sector Dutch Disease model. In his paper, heavy borrowing is used mainly to finance current consumption, and this creates an intergenerational problem. All agents alive at the time of discovery try to consume all income from discovered resources and also to borrow against the future income from these resources, because they have finite life spans. Thus the country's net foreign asset position will worsen over time and external borrowing will increase towards its new steady state level.

This paper examines Dutch Disease effects and borrowing behavior of a small open economy subject to the terms of trade and risk-premium shocks. While there are numerous theoretical analyses of the Dutch Disease effects, they have largely used partial equilibrium and static frameworks. Most of the models in the Dutch disease literature have also ignored international capital mobility and the link between capital inflows and Dutch disease effects. There are related studies that have examined foreign capital dynamics in small open economies within a general dynamic equilibrium framework. Examples of such studies include Serven (1995) and Agénor (1998). The most relevant to our study is a paper by Agénor (1998), who examines the effects

[1] See, for instance, Sachs and Warner (1995, 2001), Gylfason et. al. (1999)

of a fall in world interest rates on capital flows and the real exchange rate in an optimizing framework with imperfect capital markets. However, the study makes no reference to the Dutch disease effects.

The contributions of this paper are as follows. First, we examine Dutch disease effects in a dynamic setting when the economy experiences positive terms of trade shocks. We show that the Dutch disease effect (in particular, the appreciation of the real exchange rate) disappears over time, while the de-industrialization/contraction of non-booming traded sector becomes even larger in the long-run. Second, in our model, a large amount of extra borrowing can arise if the improvement in the terms of trade is coupled with a reduction in the risk premium on lending to the economy – something which can happen if higher commodity prices for exports enable the country to collateralize more borrowing. A permanent reduction in the risk-premium also leads to an increase in the price of non-traded goods relative to the price of traded goods. These effects are different from the Dutch Disease effects, and the outcomes associated with an increase in the price of non-traded goods are hardly the symptoms of a "disease". The mechanism by which this happens is as follows. An increase in the price of oil and corresponding reduction in the risk premium induce a cheaper capital inflow. This capital inflow disproportionally benefits the (non-oil) traded sector, since it is more capital intensive than the non-traded sector, and so the costs of production in the non-oil traded sector will fall by more than the costs of production in the non-traded sector. This causes the price of the non-traded sector to rise relative to the price of the traded goods sector. We call the outcome associated with an increase in the price of non-traded goods relative traded goods due to the reduction in risk-premium, a Dutch "party", as distinct from a "disease".

The long-run outcome when there is both a terms of trade shock and a risk-premium shock is that the production of both traded and non-traded goods rises in the long-run. Often such an increase in the output of the (non-oil) traded sector in an emerging market economy is thought of as a result of the Balassa-Samuelson effect. That effect arises if the rate of technical progress is larger in the (non-oil) traded sector than in the non-traded sector, which is commonly thought to be the case. In such a case, the improvement in productivity enables production in the (non-oil) traded sector to be profitably increased, even though the sector is under cost pressure from the rise in wages that happens as the growth process takes place. However, as shown in our paper, this Balassa-Samuelson effect may not be necessary for there to be an expansion in the (non-oil) traded goods sector. It may result from the cheaper capital, from which capital intensive industries can benefit, if there is a reduction in the risk premium.

The framework which we use is a dynamic stochastic general equilibrium model with three sectors and two factors of production. The sectors are oil, non-oil traded and non-traded. We assume that there is no interaction between domestic factor markets and the oil sector. That is we assume that the oil sector is an enclave. All money coming from the oil sector is treated like transfers from abroad. Capital is sector-specific, although the economy can borrow any amount of capital internationally at the real interest rate, which has an international risk-free component and a country risk component. We assume that the country risk premium does not depend on local economic conditions and exogenously given to the economy. This simple specification allows us to disentangle Dutch "party" effects.

The paper is structured as follows. Section 2 describes the model and defines a competitive equilibrium for the economy. Section 3 discusses calibration and simulations of the model. Section 4 concludes.

2 Model of a Small Open Economy

2.1 Outline of the model

We consider a small open economy that produces non-traded good, traded goods and oil. Production of oil requires no factor inputs, and all its production is exported. Prices of traded goods, including oil, are determined internationally. The traded good can be consumed or invested and imported from the rest of the world. The non-traded good is consumed and used to meet capital installation costs, which are a composite of both non-traded and traded goods in the same mix as the household's consumption basket. Households own production firms, supply labor and accumulate capital that they rent to production firms. The economy can borrow internationally at a given risk premium, which is exogenous in our framework.

2.2 Consumers

Consider a small open economy inhabited by a continuum of households with mass 1. The representative consumer has preferences given by:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, H_t) \tag{2.1}$$

where C_t is the composite consumption index and H_t is the labor supply. Preferences are described by the following utility function:

$$U(C_t, H_t) = \frac{C_t^{1-\sigma}}{1-\sigma} - \eta \frac{H^{1+\psi}}{1+\psi} \tag{2.2}$$

Composite consumption is a CES function of traded goods and non-traded goods, with $C_t = [a^{\frac{1}{\rho}} C_{Nt}^{(\rho-1)/\rho} + (1-a)^{\frac{1}{\rho}} C_{Tt}^{(\rho-1)/\rho}]^{\rho/(1-\rho)}$ with $\rho > 0$. The parameter σ measures the inverse of the intertemporal elasticity of substitution, and the parameter ρ measures the intratemporal elasticity of substitution between non-traded and traded goods. The implied consumer price index is $P_t = [aP_{Nt}^{1-\rho} + (1-a)]^{\frac{1}{1-\rho}}$, where P_{Nt} is the relative price of non-traded goods with respect to traded goods, those prices are normalized to unity, and P_t is the consumer price index, denominated in units of the traded goods.

Households may borrow and lend in the form of non-state contingent bonds that are denominated in units of the traded goods. We assume that the economy can borrow any amount from international capital markets at a rate r_t, which is decomposed as:

$$r_t = r^* + \Omega \xi_t \tag{2.3}$$

where r^* is the risk-free interest rate, and $\Omega \xi_t$ measures the country spread over r^* paid by borrowers in this particular economy. The risk premium in (2.3) is exogenously given for the economy with a risk premium shock modeled as:

$$\log(\xi_{t+1}) = \log(\xi_t) + \varepsilon^{\xi}_{t+1}, \quad E(\varepsilon^{\xi}_{t+1}) = 0, \quad var(\varepsilon^{\xi}_{t+1}) = \sigma^2_{\xi} \tag{2.4}$$

In this paper we focus on a simple specification of the risk premium. It is quite common in the literature on discussions of capital market imperfections in emerging economies to model the country spread as a function of total debt, or as a function of debt relative to some measure of earning capacity such as output or the stock of capital in the economy (see, for example, Auernheimer and Garcia-Saltos, 2000; Senhadji, 2003; Turnovsky, 1997). The endogenized risk premium of those papers rules out the nonstationary behavior of consumption and the current account presented in unrestricted small open economy models[2]. The nonstationary behavior of variables implies that unconditional variances do not exist, which poses problems for business cycle analysis. However, in this paper we are not interested in such analysis. Another reason for why we use the simple specification (2.3) is that country risk, if defined as a function of domestic fundamentals, amplifies the effects of external shocks on domestic variables, and we wish to abstract from this.

The non-traded good is used for consumption and in the installation of capital. Transforming the quantity of traded investment $I_{Nt}(I_{Tt})$ into the quantity of installed capital goods in the non-traded (traded) sector also requires the use of traded goods, which are composed with non-traded goods in the same mix as the household's consumption basket. Thus, we denote $\phi_{Nt}K_{Nt}$ capital installation costs in the non-traded sector:

$$\phi_{Nt}K_{Nt} \equiv \phi_{Nt}(\frac{I_{Nt}}{K_{Nt}})K_{Nt} = \frac{\psi_I}{2}(\frac{I_{Nt}}{K_{Nt}} - \delta)^2 K_{Nt} \tag{2.5}$$

and in the traded sector:

$$\phi_{Tt}K_{Tt} \equiv \phi_{Tt}(\frac{I_{Tt}}{K_{Tt}})K_{Tt} = \frac{\psi_I}{2}(\frac{I_{T,t}}{K_{Tt,t}} - \delta)^2 K_{Tt} \tag{2.6}$$

Households accumulate capital and rent it out to goods producing firms. Capital stock is assumed to evolve according to the following[3]:

$$K_{Nt+1} = I_{Nt} + (1-\delta)K_{Nt}, \tag{2.7}$$

$$K_{Tt+1} = I_{Tt} + (1-\delta)K_{Tt}, \tag{2.8}$$

The household's budget constraint is:

$$P_tC_t + P_t(\phi_{Nt}K_{Nt} + \phi_{Tt}K_{Tt}) + I_{Nt} + I_{Tt} = W_tH_t + D_{t+1} - (1+r_t)D_t + R_{Nt}K_{Nt} + R_{Tt}K_{Tt} + O_t, \tag{2.9}$$

[2]Other methods used in the literature include finitely-lived households, transactions costs in foreign assets, and endogenous discount factor, see for further discussions of these methods Schmitt-Grohė and Uribe (2002), Arellano and Mendoza (2002)

[3]We make the assumption that households accumulate capital and firms purchase capital services on competitive rental markets purely for convenience. It would be more realistic to assume that each firm accumulates capital for its own use, especially in a model where firms are also price-setters. However matters much more complex. See, e.g. Sveen and Weinke (2004) and Woodford (2005) for an analysis of the consequences of the assumption of firm-specific capital for aggregate dynamics.

where W_t is the wage rate denominated in units of the traded goods; R_{Nt} and R_{Tt} are the rate of returns on capital for households in the non-traded and traded sectors respectively; $\phi_{Nt}K_{Nt}$ and $\phi_{Tt}K_{Tt}$ are capital installation costs in the non-traded and traded sectors respectively; and D_t is external borrowing by the household. Households take as given the money coming from export of oil, those price is determined exogenously at the world markets. As a result, oil income is an exogenous, stochastic variable

$$O_t = O\varepsilon_t \tag{2.10}$$

where

$$\log(\varepsilon_t) = \rho\log(\varepsilon_{t-1}) + \nu_t \tag{2.11}$$

The household optimum is characterized by the following equations:

$$C_t^{-\sigma} = \lambda_t P_t \tag{2.12}$$

$$\eta H_t^{\psi} = \lambda_t W_t \tag{2.13}$$

$$\lambda_t = \beta E_t[\lambda_{t+1}(1 + r_{t+1})] \tag{2.14}$$

$$\lambda_t q_t^T = \beta E_t \lambda_{t+1}\{R_{T,t+1} + P_{t+1}[\phi'_{T,t+1}\frac{I_{T,t+1}}{K_{T,t+1}} - \phi_{T,t+1}] + q_{t+1}^T(1-\delta)\} \tag{2.15}$$

$$\lambda_t q_t^N = \beta E_t \lambda_{t+1}\{R_{N,t+1} + P_{t+1}[\phi'_{N,t+1}\frac{I_{N,t+1}}{K_{N,t+1}} - \phi_{N,t+1}] + q_{t+1}^N(1-\delta)\} \tag{2.16}$$

$$q_t^T = 1 + P_t\phi'_{Tt} \tag{2.17}$$

$$q_t^N = 1 + P_t\phi'_{Nt} \tag{2.18}$$

along with capital accumulation, (2.7)-(2.8), and the budget constraint, (2.9).

Equation (2.12) states that in period t, the household chooses consumption in such a way as to equate the marginal utility of consumption to the marginal utility of (real) wealth. Thus, the Lagrange multiplier measures the increase in household utility associated with one additional unit of real wealth. Equation (2.13) equates the marginal disutility of the labor effort to the utility value of the wage rate, and defines the households labor supply curve. Equation (2.14) is a Euler equation that determines intertemporal allocation: it equates the intertemporal marginal rate of substitution in consumption to the real rate of return on bonds. Equation (2.15) is the pricing condition for physical capital in traded sector. It equates the revenue from selling one unit of capital today (q_t^T), to the discounted value of renting the unit of capital for one period, and then selling it, $R_{T,t+1} + q_{t+1}^T$, net of depreciation and adjustment costs[4]. Equation (2.17)

[4] Adjustments are costs stemming from decreasing capital stock. The installation function $\phi_{Tt}K_{Tt}$ as a function of I_{Tt} shifts upward as K_{Tt} decreases, which is represented by $\partial/\partial K_{Tt+1}(\phi_{Tt+1}K_{Tt+1})$ in (2.15).

relates the cost of producing a unit of capital in the traded sector to the shadow price of installed capital, or Tobin's Q, q_t^T. Equations (2.16), and (2.18) are the non-traded sector counterparts of (2.15) and (2.17).

Demands for non-traded and traded goods are given by the following equations:

$$C_{Nt} = a(\frac{P_{Nt}}{P_t})^{-\rho} C_t \tag{2.19}$$

$$C_{Tt} = (1-a)(\frac{1}{P_t})^{-\rho} C_t \tag{2.20}$$

2.3 Production by Firms

Firms in both non-traded and traded sectors operate under perfect competition with production functions given by:

$$Y_{Nt} = A_N K_{Nt}^{\alpha} H_{Nt}^{1-\alpha} \tag{2.21}$$

and

$$Y_{Tt} = A_T K_{Tt}^{\gamma} H_{Tt}^{1-\gamma} \tag{2.22}$$

respectively. We assume that all firms rent capital and labor in perfectly competitive factor markets. Cost minimizing behavior implies the following equations:

$$W_t = P_{Nt}(1-\alpha)\frac{Y_{Nt}}{H_{Nt}} \tag{2.23}$$

$$R_{Nt} = P_{Nt}\alpha\frac{Y_{Nt}}{K_{Nt}} \tag{2.24}$$

$$W_t = (1-\gamma)\frac{Y_{Tt}}{H_{Tt}} \tag{2.25}$$

$$R_{Tt} = \gamma\frac{Y_{Tt}}{K_{Tt}} \tag{2.26}$$

Producers of both non-traded and traded goods are price-takers, so that equations (2.23)-(2.24) and (2.25)-(2.26) describe demand for labor and capital inputs in the non-traded and traded sectors respectively.

2.4 Equilibrium

The equilibrium of the economy is a sequence of prices $\{Þ_t\} = \{W_t, r_t, P_{N,t}, R_{N,t}, R_{T,t}\}$ and quantities $\{\Theta_t\} = \{\{\Theta_t^h\}, \{\Theta_t^f\}\}$ with

$\{\Theta_t^h\} = \{H_t, C_t, C_{Nt}, C_{Tt}, D_t, K_{N,t+1}, K_{T,t+1}, I_{Nt}, I_{Tt}\}$

$\{\Theta_t^f\} = \{H_{Nt}, H_{Tt}, K_{Nt}, K_{Tt}, Y_{Nt}, Y_{Tt}, IM_{Tt}\}$,

such that:

(1) given a sequence of prices $\{Þ_t\}$ and a sequence of shocks, $\{\Theta_t^h\}$ is a solution to the representative household's problem;

(2) given a sequence of prices $\{Þ_t\}$ and a sequence of shocks, $\{\Theta_t^f\}$ is a solution to the problems of representative firms in both the non-traded and traded sectors;

(3) given a sequence of quantities $\{\Theta_t\}$ and a sequence of shocks, $\{Þ_t\}$ clears the markets:

(*i*) Labor market:

$$H_{Tt} + H_{Nt} = H_t \tag{2.27}$$

(*ii*) Capital market:

$$K^S_{N,t} = K^D_{N,t} \quad K^S_{T,t} = K^D_{T,t} \tag{2.28}$$

(*iii*) Non-traded goods sector:

$$Y_{Nt} = a(\frac{P_{Nt}}{P_t})^{-\rho}[C_t + \phi_{N,t}K_{Nt} + \phi_{T,t}K_{Tt}] \tag{2.29}$$

(*iv*) Traded goods sector:

$$A_{Tt} = Y_{Tt} + IM_{Tt} \tag{2.30}$$

where A_{Tt} domestic absorption of traded goods is satisfied via domestic production Y_{Tt} and imports of the traded goods IM_{Tt}:

$$A_{Tt} \equiv (1-a)(\frac{1}{P_t})^{-\rho}[C_t + \phi_{N,t}K_{Nt} + \phi_{T,t}K_{Tt}] + I_{Nt} + I_{Tt} \tag{2.31}$$

(*v*) Foreign loans market:

$$D_t^S = D_t^D \tag{2.32}$$

(*vi*) Balance of Payments:

$$A_{Tt} + (1+r_t)D_t = D_{t+1} + Y_{Tt} + O_t \tag{2.33}$$

(4) Prices are set to satisfy (2.27), (2.28), (2.29) and (2.32).

3 Calibration and Solution

3.1 Calibration

The model calibration involves selecting parameter values that are, as close as possible, consistent with the main features of a representative emerging country's economy. The benchmark parameter choices of the model are described in Table 1, while Table 2 reports macroeconomic ratios implied by the theoretical model. In calibrating the model, the time unit is meant to be one quarter.

Ostry and Reinhart (1992) present GMM estimates of the intertemporal elasticity of substitution in consumption, as well as the elasticity of substitution between non-traded goods and imports in consumption for a group of developing countries. Their estimates of the parameter σ, the inverse of the intertemporal elasticity of substitution in consumption, is 2.6 for all developing countries in their sample. However, as their results reveal, regional differences emerge, with Asian countries showing a greater responsiveness to real interest rate changes, with estimates of

σ at 0.8. Aurelio (2005) uses 1 as the value of the intertemporal elasticity of substitution in her study of optimal monetary and fiscal policy rules for the case of an emerging country. Hence, we also set the value of σ equal to unity.

Ostry and Reinhart's estimates of the elasticity of substitution between non-traded and imported goods in consumption is 1.2 for a sample of 13 developing countries. Mendoza (2001) uses the value of 1.46 as the elasticity of substitution between non-traded and imported goods. Hence we set $\rho = 1.2$.

The estimated values of the discount rate reported by Ostry and Reinhart are within the 0.96-0.99 range. Following Uribe and Yue (2005), we set the steady-state real interest rate faced by the small economy in international markets at 11 percent per annum, with a world interest rate r^* of 4 percent and a country premium of 7 percent. These parameters yield the value of subjective discount factor, β, of 0.973, as $\beta^{-1} = 1 + r$ in the steady state[5]. Steady state value of ξ_t equal 1, so we choose the value of the parameter of the risk premium, Ω, such that it equals 7 percent per annum. The steady state value of oil income, O, was chosen such that oil receipts constitute 25 percent of GDP. We also set the steady state value of foreign borrowing equal to 60 percent of GDP.

The preference specification in (2.2) gives rise to a labor supply elasticity that equals $1/\psi$. Following Devereux, Lane and Xu (2004), we set $\eta = 1$, and following Uribe and Yue (2005), we set $\psi = 0.45$, so the elasticity of labor supply equals 2.22. We assume that the traded sector is more capital-intensive than the non-traded sector, and choose the value of the capital share in traded and non-traded sectors, α and γ, equal to 0.25 and 0.65 respectively.

The parameter a determines the share of non-traded goods in the CPI, and along with other parameters it governs the share of non-traded goods in GDP. As in Devereux et. al. (2004), the value of a is set equal to 0.65, which implies the share of non-traded goods in GDP in the steady state is 45 percent. We set the depreciation rate at 10 percent per annum, a standard value in the business cycle literature. The value of the adjustment cost parameter, ψ_I is set at 0.1. This number is consistent with empirical estimates of the adjustment cost parameter in the literature, although these estimates are for developed countries. We are not aware of any similar estimates for developing countries. Hall (2002) estimates a quadratic adjustment cost for capital and finds a slightly higher value of 0.91 for ψ_I, on average, across industries. A much closer value of 0.096 is found recently by Groth (2005) for estimates of capital adjustment costs for UK manufacturing covering the period 1970-2000.

Table 1 Calibration of the model

[5] In order for a steady state equilibrium to exist in a small open economy with a perfect capital mobility, the discount rate must equal to the world interest rate (i.e. we require that $\beta^{-1} = 1 + r$). Thus, in case of permanent shock to the risk premium, we must make the discount rate change at the same time with the risk premium to induce determinacy of the long-run equilibrium; this adjustment in the discount factor is not needed in the models with stationary equilibrium dynamics. The literature has proposed different approaches to deal with nonstationarity problem presented in our model. But we do not wish to amend our model in any of the ways suggested there – see footnote 2.

Parameter	Value	Description
σ	1	Inverse of elasticity of substitution in consumption
β	0.973	Discount factor
ρ	1.2	Elasticity of substitution between non-traded and traded goods in consumption
η	1	Coefficient on labor in utility
ψ	0.45	Inverse of elasticity of labor supply ($1/\psi = 2.22$)
γ	0.65	Share of capital in traded sector
α	0.25	Share of capital in non-traded sector
δ	0.025	Quarterly rate of capital depreciation (same across sectors)
a	0.65	Share on non-traded goods in CPI
ψ_I	0.1	Investment adjustment cost (same across sectors)

In this paper we consider two types of external shock: shocks to oil prices and to the risk premium. In particular, we study a *permanent* improvement in the price of oil and a *permanent* reduction in the risk-premium. We do not examine the impact of productivity shocks and we set the values of the productivity parameters, A_N and A_T, in two sectors equal to unity. In the model, shocks to oil prices are represented by shocks to ε_t, and shocks to the risk premium are represented by shocks to ξ_t.

With the benchmark parameters summarized in the Table 1 the model generates an economy that has the following structure in the steady state:

Table 2 Structure of the theoretical economy

External debt/GDP	60%
Traded production/GDP	31%
Absorption of traded goods/GDP	54%
Non-traded production/GDP	44%
Oil/GDP	25%
Investment in non-traded sector/GDP	5%
Investment in traded sector/GDP	9%
Capital in non-traded sector/GDP	2.09
Capital in traded sector/GDP	3.83
Consumption/GDP	84%
Consumption of non-traded goods/GDP	44%
Consumption of traded goods/GDP	40%
Labor income/GDP	44%
Employment in non-traded sector/Total Employment	75%
Employment in traded sector/Total Employment	25%

3.2 Simulations

In this section we present results of simulations of the model under exogenous and independent behavior of oil price and risk premium shocks. In the discussion of responses of the main variables of the model we distinguish between short-run (immediate impact of the shock), transitional path and long-run effects of the shock. We also take the term of "Dutch Disease" to mean a real exchange rate appreciation. As we will show below, the problems which can be caused by a rise in the price of exported oil can be quite different from such the Dutch Disease problem.

3.2.1 Oil Price Shock

Figure 1 shows response to a 1 percentage permanent increase in the price of oil. All figures are expressed in percentage terms of the steady state value except debt-GDP, trade balance-GDP, and the current account-GDP ratios. Their impulse responses are in deviations from the steady state values.

In the short-run, we have a conventional Dutch Disease story without international capital mobility. A rise in real income, stemming from the increased price of oil, leads to an increase in demand for all goods, including non-traded and traded goods. As a result, consumption rises on impact for consumption of both non-traded and traded goods. As demand rises for both types of goods, the relative price of non-traded goods must increase to restore home-market equilibrium. Such an increase in the price of the non-traded goods relative to traded goods causes producers to reallocate production from non-oil traded goods to non-traded goods. With a fixed stock of capital in the non-traded sector, more labor is demanded in that sector, pulling up the wage and causing labor to be reallocated from the traded to the non-traded sector. Hence, employment rises in the non-traded sector, and declines in the traded sector on the impact of the shock. Hence, production of the non-traded goods increases, while production of traded goods decreases. Because of the increase in the price of non-traded goods, households switch intratemporally in the short-run, and as a result consumption of the traded goods overshoots its long-run equilibrium on the impact of the shock, while consumption of the non-traded goods undershoots. Trade balance responds positively to the improvement in the terms of trade. The current account follows a similar behavior in the short-run, where there is no adjustment in the stock of debt and therefore no change in interest payments on external debt.

We should notice that the outcome of the short-run is an increase in the return on capital used in the production of non-traded goods. This is because an increase in the wage rate will be less than the increase in the price of non-traded goods, with diminishing returns in the application of labor to the fixed stock of capital in that sector: the real return to labor paid in that sector must fall and real return on capital must increase. At the same time, there will be a reduction in the return on capital used in the production of traded goods. This is because the traded sector faces a fixed price, determined at the international markets, and yet it faces an increase in the cost of labor. The rise and fall of return on capital in the non-traded and traded sectors will increase and reduce demand for capital in those sectors respectively. As a result, investment, the derived demand for capital, increases on impact in the non-traded sector, and decreases on impact in the traded sector. Thus, an important outcome of the short-run is that the profitability on capital in the two sectors diverge and differ from the rate of return given on international capital markets, which is $r^* + \Omega$ for this economy.

It is worth noting that in our simulations, the reaction of employment in both sectors, consumption of the non-traded goods and output of both sectors is very small in the short-run. One would expect that some of the increased demand for non-traded goods, resulting from the oil shock, would be satisfied by increased production of non-traded goods and that only some of this would be eliminated by a rise in the relative price of the non-traded goods. However, it seems that the rise in the price of the non-traded goods eliminates most of the increased demand for the non-traded goods, as consumption of the non-traded goods increases very little on the impact of the shock. To understand this we, first, analyze reaction of total employment to the shock in the short-run, by considering log-linearized labor supply equation:

$$\widehat{H}_t\left(\frac{1}{\varepsilon_S} - \frac{1}{\frac{H_N}{H}\varepsilon_{dN} + \frac{H_T}{H}\varepsilon_{dT}}\right) = -\widehat{P}_t - \sigma\widehat{C}_t + \frac{\varepsilon_{dN}\frac{H_N}{H}}{\frac{H_N}{H}\varepsilon_{dN} + \frac{H_T}{H}\varepsilon_{dT}}\widehat{P}_{Nt} \tag{3.1}$$

where $\varepsilon_{dT} = -1/\gamma, \varepsilon_{dN} = -1/\alpha$, are the wage elasticities of labor demand in traded and non-traded sectors respectively, and $\varepsilon_S = 1/\psi$ is the wage elasticity of labor supply. There are two channels through which the oil shock affects the labor supply in the short-run. First, a rise in demand for non-traded goods increases the relative price of non-traded goods making non-traded goods firms willing to hire more labor. This increases the economy-wide wage rate, and so the supply of labor increases; this is captured by the third term in (3.1). Secondly, labor supply will tend to fall because the shock makes consumers better off so that they not only wish to consume more but also wish to work less. Thus, the final effect on short-run employment can be positive or negative depending on which of these two effects dominate. For our parameter values, employment falls.

Even though total employment falls it would be expected that by the increasing wage rate, the non-traded sector could attract enough labor to expand production. However, the wage elasticity of labor demand in the traded sector ($1/\gamma = 1.5$) is lower than that in the non-traded sector ($1/\alpha = 4$). Together with relatively low proportion of labor employed in that sector ($H_T/H = 0.25$), this implies that the amount of labor that is released by the traded sector per unit rise in the wage rate is quite low. Thus to attract extra labor to the non-traded sector, firms need to increase the wage rate a lot. Such a high increase in the wage rate (as almost as much as the increase in the relative price P_{Nt}) inhibits non-traded goods firms from hiring more labor. Thus combination of these factors (decline in employment, inability of the traded sector to release enough labor, high increase in the wage rate) leads to a tiny increase in employment in the non-traded sector as well as its production. But the increase in the wage rate also means that firms in the non-traded sector are willing to employ more capital, so capital is accumulated at a high speed in that sector throughout the adjustment period. The increased incentive to hire capital can be also demonstrated by plotting the Tobin's q in both sectors.

It is to explain why the increase in the price of the non-traded goods is able to eliminate most of the rise in demand for those goods by households. This is possible because, although households have a low elasticity of intertemporal substitution, they have a high elasticity of intratemporal substitution ($1/\sigma < \rho$). Households are thus more concerned about the timing of consumption and are less concerned about the distribution between two goods. As a result, total consumption rises in the short-run high enough to be close to its long-run level, while the fraction of traded goods in total consumption rises and the fraction of the consumption of the non-traded goods falls so that although consumption of the traded goods rises by almost 19 percent, the overall consumption rises by only 10 percent.

The short-run divergence on returns on capital in two sectors must equalize in the long-run, so now we turn to analysis of what happens in the long-run after a permanent increase in the price of oil. These rises and falls of return on capital in the non-traded and traded sectors will cause capital inflows into the economy and capital outflows out of the economy. But since the non-traded sector is less capital intensive than the traded sector, the overall demand for capital in the economy as a whole falls. Hence, there will be capital *outflow* out of the economy (foreign borrowing will decrease) as a result of the increase in the price of oil. As the stock of debt is lower in the long-run than before, the trade balance deteriorates in the new steady state as the economy needs less of trade surplus to finance the interest costs of the foreign debt. The current account has a similar pattern: it deteriorates during the adjustment period and converges to zero in the long-run equilibrium. So, since capital is leaving the traded sector and flowing into the non-traded sector, and on balance the amount of capital in the economy is declining, the total demand for labor will be also declining. That causes the wage rate to fall, and it falls all the way back to its original level. This is demonstrated by looking at the production of traded goods. As already noted, the price of these goods is fixed on world markets. Capital will leave this industry until the rate of return has risen to be equal to $r^* + \Omega$. This means that there is only one wage in which there can be an equilibrium in this industry, the same wage as that before the shock hit the economy. If the wage had not fallen back down to where it was before, then the return on capital in this sector would still be below $r^* + \Omega$.

Hence, in the long-run: (i) the rates of return on capital in both sectors return to the rate of return given on world capital markets ($r^* + \Omega$), and (ii) the wage rate returns to where it was before the shock. This means that the cost of production of non-traded and traded goods go back to where it started, and as a result, the equilibrium price of non-traded goods must return right back to where it was before the shock hit the economy. So, in the long-run both the wage rate and the price of the non-traded goods converge to previous equilibrium levels. Overall employment reduces in the long-run as households become richer and supply less labor in a new steady state compared with initial one.

Production of non-traded goods increases throughout the adjustment period towards a new long-run equilibrium. This is because there is (i) more capital in the non-traded sector, and (ii) since the wage is lower more workers are employed for every unit of capital. Production of traded goods shrinks further in the subsequent periods following the shock. This is because (i) less capital is employed in the traded sector, and (ii) less workers are employed for every unit of capital. It is clear that in the case with less capital employed by the traded sector and the same factor prices, the traded sector hire less labor.

Given that consumption of the non-traded goods undershoots on the impact of the shock, C_N adjusts positively throughout the adjustment period towards a new equilibrium level, while the consumption of traded goods adjust negatively in periods following the shock, although it converges a higher long-run value.

Therefore, after the boom in oil prices, in the short-run the economy experiences both real appreciation and de-industrialization, as in conventional Dutch Disease models. However, given perfect capital mobility, in the long-run Dutch Disease effects disappear, while the country experiences further contraction of the traded sector, which employs less factors of production in the new steady state. Increased domestic consumption of traded goods is met via increased imports, paid by the increased price of oil. In the new steady state, the economy also has a bigger non-traded sector than it had originally, resulting from more labor and capital in that industry.

Our model's properties in terms of short- and long-run equilibrium and dynamic adjustment in response to a positive terms of trade shock are similar to those in response to a resource boom resulting from a domestic discovery of a natural resource, in a model with international capital mobility, examined by Neary and Purvis (1982). In contrast to our model, they use the standard Dutch disease framework where the resource sector is an integral part of the economy. The manufacturing and resource sectors compete for capital, and the production of resource requires a specific factor (natural resource) in addition to capital, but not labor. Similar to our analysis, for instance, in the long-run output of manufacturing falls and real exchange rate returns to its initial value, the stock of manufacturing capital falls and the stock of capital in the resource sector rises. The only difference between these two model in the long-run response to the shocks is that the long-run impact on the total capital stock in the Neary and Purvis economy is ambiguous, depending on the capital intensity of the manufacturing sector relative to the resource sector. By contrast, it is unambiguous given that the traded sector requires more capital relative to the non-traded sector. In contrast to our model, Neary and Purvis do not impose intertemporal solvency condition.

3.2.2 Risk Premium Shock

We have analyzed the responses of the economy to an increase in the price of oil. However, this analysis might not be complete, as a rise in the price of oil is likely to reduce the risk premium attached to the country. This is because such a rise in prices causes oil reserves worth more, and they can be used as collateral against a higher level of foreign borrowing. Hence, our ultimate goal is to study the impact of an increase in oil prices coupled with a decline in the risk premium attached to the country. But before that, we want to quantify the impact of risk-premium shock alone on the economy. So, we first focus on simulations of the model for risk-premium shock. Figure 2 presents response functions for the case of a 1 percentage permanent reduction in the risk premium.

A permanent reduction in the risk-premium stimulates consumption in the economy. With a reduction in the external interest rate on foreign debt more resources are available for consumption of both non-traded and traded goods. As a result, similar to the case of permanent increase in the price of oil, demand for both traded and non-traded goods increases. Higher demand for two goods causes the relative price of the non-traded goods to rise on the impact of the shock. This pulls up the wage rate and induces workers to migrate to the non-traded sector, with a consequential increase in employment in the non-traded sector and decline in employment in the traded sector. Respectively, production of non-traded goods rises, while output in the traded sector declines on the impact of the shock. In the short-run, prior to any adjustment in the stock of debt, debt servicing requirements are reduced. At the same time, absorption of traded goods increases in the short-run. The cumulative effect of these changes is that in the short-run the trade balance deteriorates as well as current account.

Now we analyze what happens to the rates of return on capital used in production of both non-traded and traded goods. Now two factors are at work. First, as in the case of permanent oil price shock discussed earlier, the increased price of the non-traded goods tends to increase return on capital in the non-traded sector and to reduce return on capital in the traded sector. Secondly, the risk-premium shock reduces the cost of capital, and therefore increases return on capital in both sectors. Thus, the effect on the return on capital used in production of non-traded goods is clear – it becomes $R_N > r^* + \Omega > r^* + \Omega'$. By contrast the overall effect on the return on capital in the traded sector is *a priori* unclear. There are two possible outcomes for the return on capital in traded sector, R_T, depending upon which of these two factors dominate: (i) the rate of return on capital can decrease, so $R_T < r^* + \Omega' < r^* + \Omega$, if the first factor dominates, and (ii) if, in contrast, the second effect dominates the first one, then profitability on capital increases and outcome is $r^* + \Omega' < R_T < r^* + \Omega$. For our parameter values, the second effect dominates the first one and the return on capital in the traded sector, on balance, rises.

So, contrary to the case of a permanent increase in the price of oil, the short-run outcome of the permanent reduction in the risk premium is that the profitability on capital rises in both sectors. The rise of the return on capital in both sectors increases investment in these sectors on the impact of the shock.

These rises of return on capital in both sectors will cause capital inflows into the economy. Capital inflows into the economy result in a higher stock of debt in the economy. A higher level of foreign debt dominates the lower interest rate faced by the country on the international capital markets and overall interest payments increase in the long-run. As a result, in the long-run the trade surplus increases to meet the economy's increased interest obligations. Capital inflows to both non-traded and traded sectors increase demand for labor, which pulls up the wage rate and increases the level of total employment in the economy. So, the wage rate as well as employment rises during the transition period on their way to the higher new steady state level. Capital inflows until the rate of return has fallen to be equal to $r^* + \Omega'$ in both sectors. This capital inflow disproportionally benefit the (non-oil) traded sector, because it is more capital-intensive of the two sectors. Thus the costs of production in the traded sector will fall by more than the costs of production in the non-traded sector, which will cause the price of the non-traded goods to rise relative to the price of traded goods. Thus, in the long-run both the wage rate and the relative price of the non-traded goods increase compared with initial steady state level.

There are two countervailing factors that affect production of the non-traded goods in the long-run: (i) relative price effect (that is an increase in P_N in the long-run) and (ii) risk-premium effect (reduction in the cost of capital). The first effect tends to increase price of the non-traded goods in the new steady state and thus reduce demand for those goods. The second effect reduces costs of production in the non-traded industry and tends to increase production of the goods. As the first effect dominates, the production of the non-traded goods declines on balance in the long-run.

Now we discuss transitional dynamics of the series towards a new long-run equilibrium. The main feature of adjustment is a hump-shaped response of the series in the non-traded sector (output, consumption, relative price of the non-traded goods), which can be explained as follows. As discussed earlier, capital is accumulated with relatively higher speed in the non-traded sector compared with the traded sector. Cheap capital inflows enables the sector to expand its production, which peaks about 7 quarters after the shock, with consequent fall in the price of the non-traded goods and an increase in the consumption of the non-traded goods. However, there is monotonic increase in the real wage rate throughout the adjustment period, which occurs because ultimately a higher proportion of consumption demand for home-produced goods is directed towards traded goods, which require more labor as they accumulate more capital. This rise in the wage rate is damaging for the production of the non-traded goods, which given that it accumulated its additional capital quickly no longer accumulating additional capital. The relative price of non-traded goods rises, reducing demand for non-traded goods, resulting in contraction of the non-traded sector. This overall process explains the hump-shaped reaction of these series in the non-traded sector. Overall consumption also follows hump-shaped behavior throughout adjustment period due to the hump-shaped response of the consumption of non-traded goods.

Thus, the one of impacts of the reduction in the risk-premium is that the traded sector is not shrinking in the long-run. In the new steady state output of the traded sector is larger than it was before reduction in the external interest rate, because it employs more capital and labor. In the long-run the economy also experiences a real exchange rate appreciation because costs of production fall more in the traded sector than they do in the non-traded sector. This outcome of a higher price of the non-traded goods relative to the price of traded goods caused by the reduction in the risk-premium, is hardly the symptom of a "disease", and we call it a Dutch "party" effect to distinguish it from a Dutch Disease effect. In the long-run the country also experiences a contraction of the non-traded sector even though it accumulates more capital. External indebtedness rises in the long-run because costs of borrowing fall.

3.2.3 Both Shocks: oil price and risk-premium shocks

A reduction in the risk-premium that we analyzed above is caused by factors which are external for the country, given our specification of the risk-premium function. But it is possible that an improvement in the terms of trade might itself cause such a reduction in the risk premium. Indeed, as empirical analysis demonstrates, improved terms of trade are associated with lower yield spreads (see Min, 1998), and terms of trade volatility plays an important role in explaining spread variation (see Malone, 2005). Hence, we extend the previous analysis to examine the model's properties when the boom in oil prices is accompanied by a reduction in the risk-premium attached to the country on international capital markets. Figure 3 presents response functions for the case of a 1 percentage permanent increase in the price of oil coupled with a permanent, 1 percentage decline in risk premium on lending to this economy.

It is clear that when there are two sources of changes in the economy, the outcome will depend upon the effects of both shocks and their relative sizes. As an example, we discuss the short-run impact on our economy when these two shocks are coupled. We should note that in the short-run two factors are at work. First is a income effect resulting from higher oil prices, and second is income effect coming from the fact that a reduction in the risk-premium increases resources available for spending. So, the impact effect of each of these two shocks tends to move variables in the same direction such that, on balance, responses of the variables are more pronounced when both shocks hit the economy.

However there are variables (e.g., investment in the traded sector), for which we are unable to establish unambiguously their initial responses when both shocks are coupled. The reason is that oil shock and risk-premium shock move those variables in opposite directions and the net effect depends upon which of two shocks dominate in affecting the variables. For example, when the economy is hit by 1 percentage point permanent oil shock along with 1 percentage permanent risk-premium shock investment in traded sector increases on impact (figure 3), resembling the response to risk-premium shock depicted in figure 2. On the other hand, when the economy is hit by 2.4 percentage point oil shock and 1 percentage risk-premium shock (not shown), investment in traded sector falls on impact of the shocks, imitating the response to oil shock as in figure 1[6]. Thus analysis of adjustment dynamics and long-run responses of the economy should take into consideration the effects of each individual shock as well as the relative sizes of the shocks. In this section when we present impulse responses of the economy to oil and the risk-premium shocks, we simply wish to rise the possibility that the economy might borrow excessively in that case. Our discussion earlier suggests that after a rise in oil prices, the foreign borrowing of the country will actually fall, which is not what seems might be going on in reality in many oil-exporting countries. Instead, higher oil prices reduces the risk-premium attached to the lending to the economy, which leads to a large amount of extra borrowing.

4 Conclusion

This paper analyzes the impact of the terms of trade shocks on a small open economy that borrows internationally at an exogenously given interest rate. It is shown that, given such perfect capital mobility, when the economy experiences an improvement in the terms of trade, the Dutch Disease effect (i.e. the real exchange rate appreciation) goes away in the long-run and the economy experiences de-industrialization even stronger than in the short-run. The contraction of the (non-oil) traded sector, rather than constituting a macroeconomic problem, simply reflects the appropriate resource allocation responses to the permanent change in transfer payments from abroad caused by the improvement in the price of oil.

However, when the country experiences both an improvement in the terms of trade and a reduction in the risk-premium, the (non-oil) traded sector which is normally thought of as squeezed as part of the Dutch-disease story can actually expand its size in the new steady state. Often such an increase in the output of the (non-oil) traded sector in an emerging market economy is thought of as coming from the Balassa-Samuelson effect. That effect arises if the rate of technical progress is larger in the (non-oil) traded sector than in the non-traded sector, which is commonly thought to be the case. In such a case the improvement in the productivity enables production in the (non-oil) traded sector to be profitably increased, even though the sector is under cost pressure from the rise in wages that happens as a result of an increase in oil

[6] 1 percent increase in risk-premium operates both through a reduction of the debt-servicing costs by 0.6 percent of GDP and by inducing more borrowing (because its costs are lower); while 1 percent increase in the price of oil oil works through increase of oil transfers from abroad only by 0.25 percent of GDP. So, 2.4 percentage oil shock has "the same" impact on the economy, measured as percentage to GDP, as the 1 percentage risk-premium shock.

revenues. However, as it is shown in this paper the Balassa-Samuelson-effect story may not be necessary for there to be an expansion in the (non-oil) traded-goods sector. It may just happen as a result of cheaper capital from which the capital-intensive traded-goods industry can benefit.

Another implication of the permanent reduction in the risk premium, coupled with the permanent improvement in the terms of trade, is that the economy can accumulate more debt in the long-run. Excessive debt accumulation of the country increases its vulnerability to the volatile changes in the price of oil and exogenous changes in the world interest rates. Suddenly when the terms of trade go down, or the interest rate rises, the country will not have the means to pay the interest on capital, which has been imported from abroad. Real financial difficulty might well emerge. Hence the argument that we are trying to make, by using this simple model, is that we think that focusing on the Dutch disease problem is to focus on more or less exactly the wrong issue. The positive terms of trade shock will not cause a Dutch disease problem, when the terms of trade shock is coupled with the risk premium shock. It is true that the price of non-traded goods rises anyway. But this outcome occurs only because costs in the (non-oil) traded sector have gone down by more than they have in the non-traded sector. It is not a problem. A potential problem may instead be that of having an over-geared economy, which has been tempted, because its costs have fallen, to borrow more, and possibly too much more.

A full analysis of the risks of too much borrowing would need a fully stochastic model and a formal discussion of the costs of being overborrowed when, for example, the terms of trade worsen or interest rate rise. We do not do that here. We simply wish to rise the possibility that the economy might overborrow.

In conclusion we can say that strong terms of trade can lead not just to relative price changes It can lead, as well as this, or even instead of this, to financial vulnerability. In this sense the question asked in the title – should we worry about Dutch disease or excessive borrowing? – should be answered negatively to the first part of the question, and affirmatively to the second part.

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5 Appendix

This section presents the dynamic responses of the model to different shocks. We examine responses of the following main variables of the model:

K_N	capital stock in the non-traded sector	C_N	consumption of non-traded goods
K_T	capital stock in the traded sector	C_T	consumption of traded goods
I_N	investment in the non-traded sector	D/Y	debt-to-GDP ratio
I_T	investment in the traded sector	A_T	domestic absorption of traded goods
Y_N	production of the non-traded goods	P_N	relative price of the non-traded goods
Y_T	domestic production of traded goods	W	wage rate
H_N	employment in the non-traded sector	TB/Y	trade balance-to-GDP ratio
H_T	employment in the traded sector	CA/Y	current account-to-GDP ratio
C	consumption	H	total employment
q_N	Tobin's q in the non-traded sector	q_T	Tobin's q in the traded sector
Y	GDP		

GDP is defined as: $Y_t = Y_{Tt} + P_{Nt}Y_{Nt} + O_t$

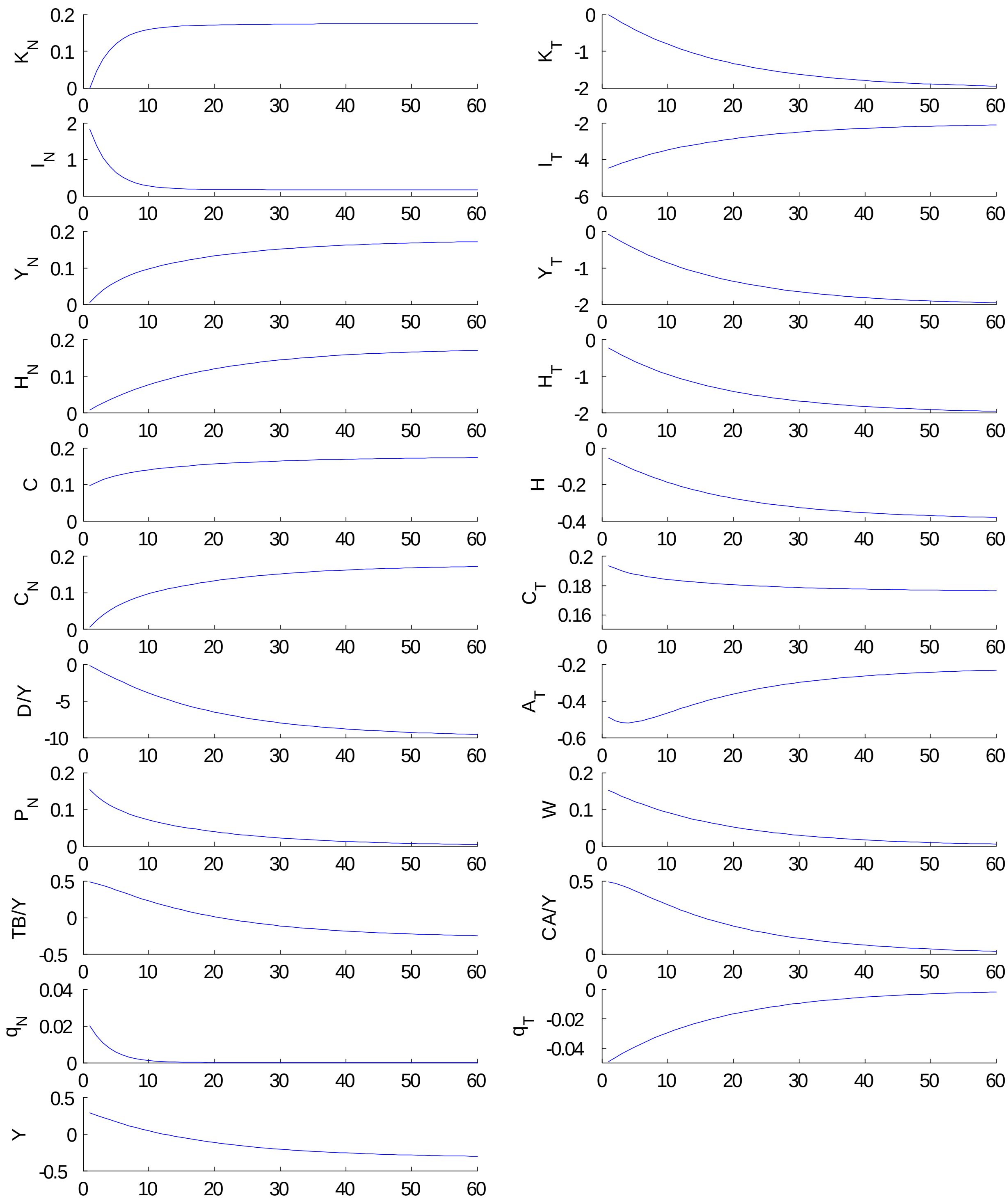

Figure 1: Permanent increase of 1 percentage in the price of oil

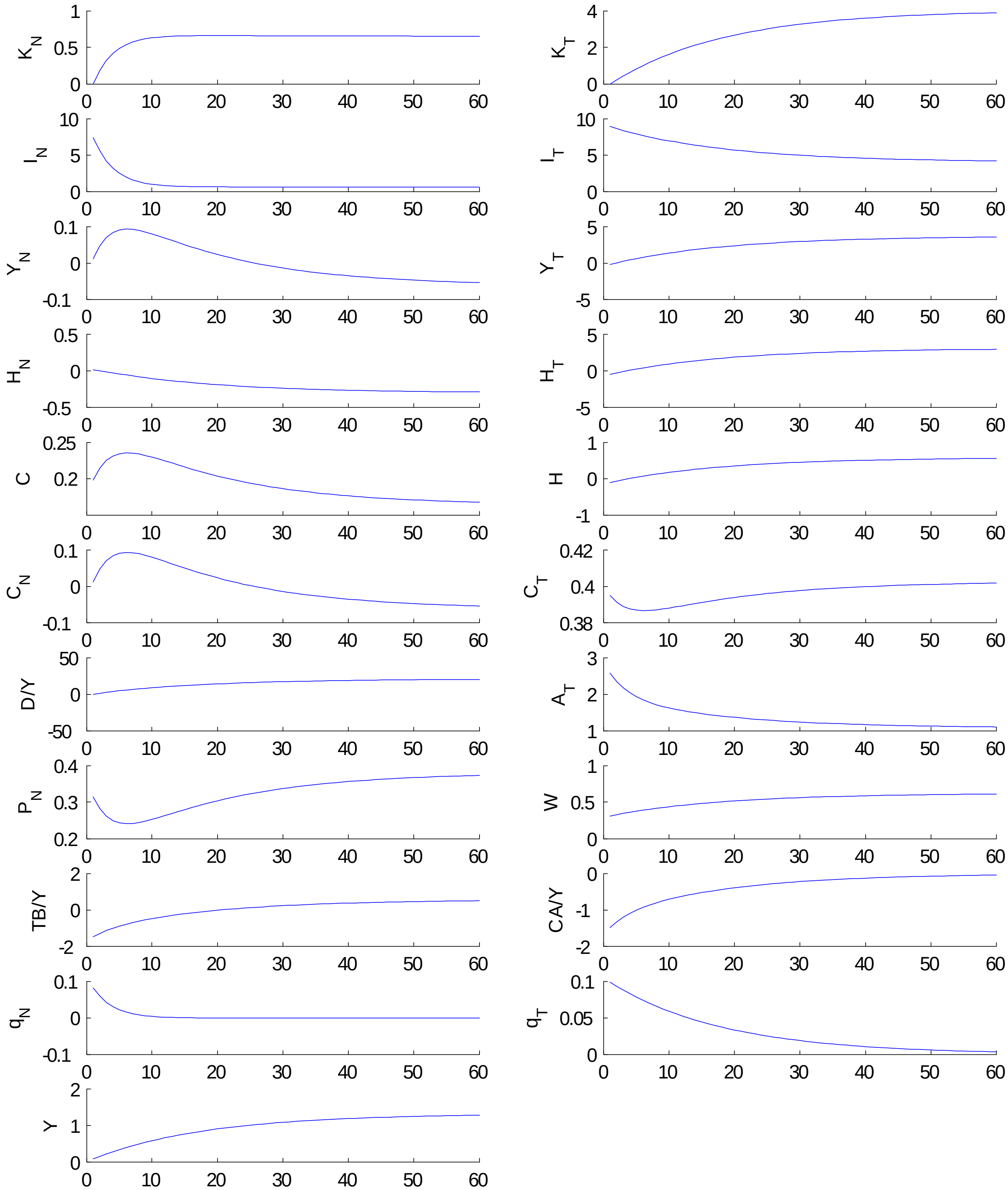

Figure 2: Permanent reduction of 1 percentage in the risk-premium

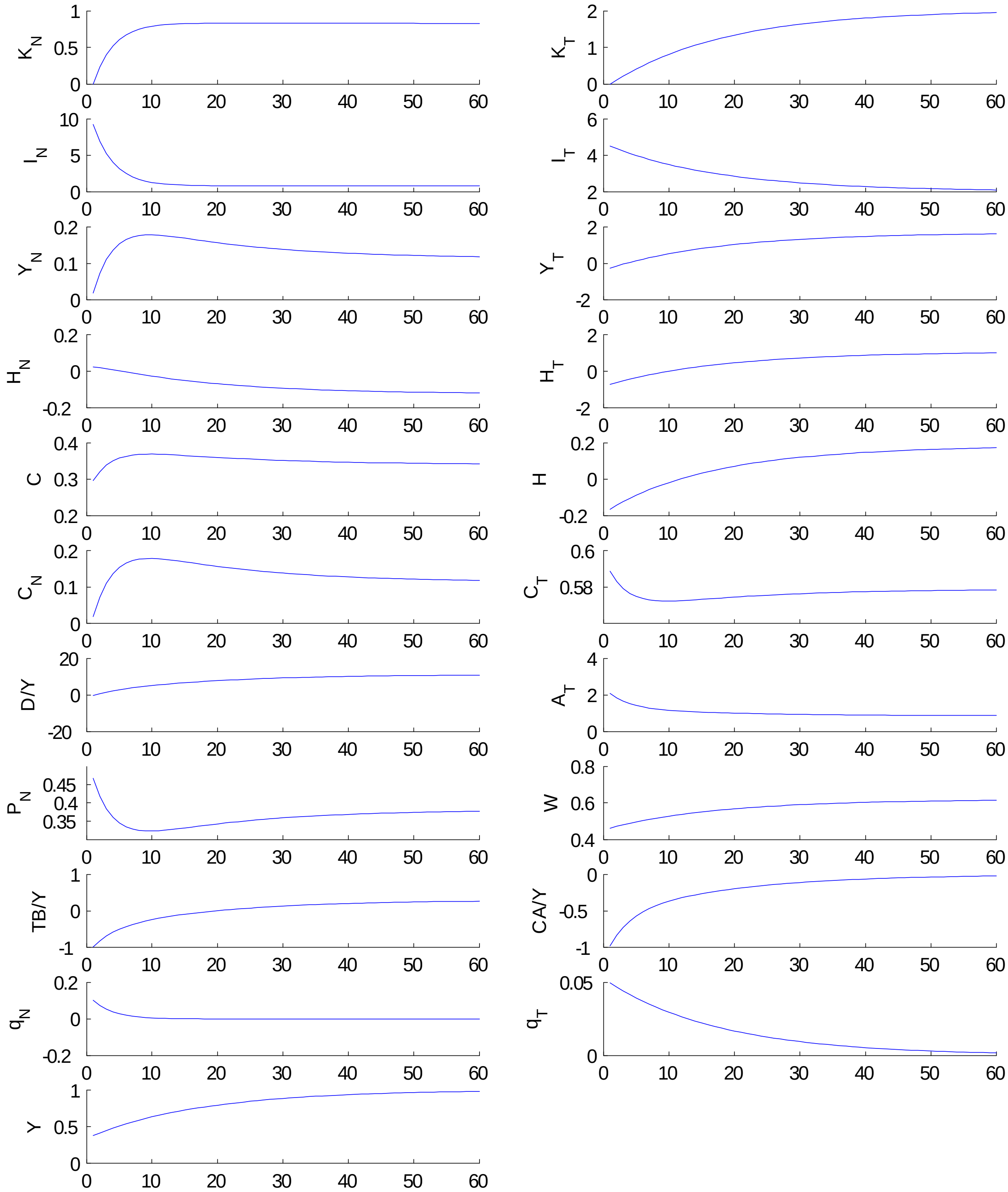

Figure 3: Permanent increase of 1 percentage in the price of oil and permanent reduction of 1 percentage in the risk-premium