Trade Shocks and Aggregate Fluctuations in an Oil-Exporting Economy

Francisco J. Sáez and Luis A. Puch*

December 2002

Abstract

In this paper we analyze the role of trade shocks in shaping aggregate fluctuations in Venezuela from 1950 to 1995. To this end a stochastic general equilibrium model of a small open economy whose main productive activity rests in the exports of a single basic product is specified. Shocks to the terms of trade which are directly associated to oil price changes are modelled as a foreign transfer. We find that this approach gives predictions that are consistent with the time series properties of Venezuela when *i)* the income effect of consumption more than compensates the substitution effect that generates the oil transfer and, *ii)* there is imperfect capital mobility. In particular, our model specification captures the observed patterns of the main aggregates after the oil resource boom of 1974.

Key Words: trade shocks, aggregate fluctuations, emerging economies.

JEL classification numbers:E32, E37

*Sáez, Universidad Complutense de Madrid and Venezuela Central Bank; Puch, Universidad Complutense de Madrid and ICAE Corresponding Author: Luis A. Puch. Departamento de Economía Cuantitativa, Universidad Complutense de Madrid, Campus de Somosaguas, 28223 Madrid, Spain; E-mail: lpuch@ccee.ucm.es.

1 Introduction

Aggregate fluctuations in emergent countries exhibit a high volatility of the terms of trade (see, for instance, McCallum (1989), Mendoza (1995) and Kose and Riezman (2001) among others). This volatility is particularly intense in petroleum exporting countries (Baxter and Koutparitsas (2000)). Indeed, an important fraction of trade in these economies comes from oil exports and associated oil price changes. In this paper we explore the role of oil price shocks to account for aggregate fluctuations in economies in which a large fraction of output comes from the exports of the oil sector. What it is crucial for this analysis is the propagation mechanism of oil price shocks through the part of income that comes from oil trade: the oil rents. We find that a neoclassical growth model augmented to incorporate a stylized oil sector does well in accounting for business cycle features which are common in economies with an important oil sector. In particular, we test the predictions of the model against time series properties of Venezuela from 1950 to 1995.

Existing literature on the role of oil price fluctuations has mainly focused on the importer country or on macroeconomic models of international trade (Koutparitsas (1996), Backus and Crucini (1998)). Few attempts have been done to analyze the impact of the variability in the oil resource revenue from the point of view of the producer. Alternatively, several papers (Mendoza (1995), Carmichael et al. (1999), Kose and Riezman (2001)) explore the differences in business cycle behavior between emerging economies and industrialized countries. Clearly though, the scope of these analyses is limited by the heterogeneity in export and import patterns that can be found in emerging economies as well as more specific differences in institutional arrangements or the nature of liquidity constraints. Instead, our strategy here focuses in the response of the economy to the oil-exports booms. We show that this response can be relevant to understand oil-exporting economies and their interaction in international goods and financial markets.[1]

One of the main features in the national accounts of petroleum exporting countries (PEC, hereafter) is the international origin of oil revenues. According to Baptista (1997) 72 percent of output in the oil sector is a government's monopoly rental that comes from the ownership of the resource. Thus, one simple strategy can be to incorporate the output of the oil sector in the model as a foreign transfer. This simple strategy has the advantage that isolates the enclave sector from the rest of the economy. However, this approach by itself has counterfactual predictions since a positive oil shock, which is equivalent to an increase in foreign transfers under this modelling strategy, improves the terms of trade which reduces output. For instance, this is exactly the effect Kollintzas and Vassilatos (2000) find when analyzing EU transfers to the Greek

[1] Zimmermann (1995) or Kollintzas and Vassilatos (2000) stress on the analysis of differential aspects between emerging economies and industrialized countries. These differences have to do with movements in volumes of trade, sources of fluctuations, market imperfections or the political economy of the redistribution of rents.

economy. Indeed, under perfect capital mobility the household sector response to a boom in the oil sector would be to accumulate foreign assets and use the proceeds of this investment to increase consumption and leisure permanently. Output and investment will decrease or remain constant depending upon the intertemporal elasticity of substitution of leisure.

This propagation mechanism is not supported by the data. In particular, it is evident that after the 1974 oil shock Venezuela economy experienced a boom in investment and output that lasted for half a decade. Consequently, to capture these patterns we build upon the results in Correia et al. (1995) by considering preferences with no intertemporal elasticity of substitution of leisure as suggested in Greenwood et al (1988). Under this specification consumption and investment tend to move together as in the data, provided the income effect overcomes the substitution effect. Also, and in line with our argument above, it turns out that some degree of imperfect capital mobility has to be incorporated to the model to account for the response of the main aggregates to an exports boom. This assumption can be justified not only by limits to capital outward but also by limited investment opportunities abroad at the time the positive inward shock occurs. Overall, our approach can be seen as a complement to modelling strategies emphasizing traded-based explanations of international business cycle fluctuations. In this context, our model specification avoids the contractionary effect of foreign transfers generated in general equilibrium small open economy models.

The rest of the paper is organized as follows: Section 2 presents relevant evidence for a number of PEC with particular emphasis in Venezuela. Section 3 describes the economic environment and the stochastic processes governing the shocks. In Section 4 we review the calibration of the model and Section 5 discusses the results obtained from the simulation of the model. Section 6 concludes.

2 Emergent Economies: The case of Venezuela

When analyzing the main economic aggregates of Venezuela it is clear the role of the oil-exporting sector. During the period 1950-1995 average output of the oil-exporting sector generates around 30 percent of GDP. By 1970 Venezuela controlled 13 percent of the world oil market although already during the 1960s Venezuela's oil exports had started to decline. Indeed, for the period 1950-1973 the oil sector represented on average 36 percent of GDP whereas the average share of this sector falls to 22 percent afterwards. The oil boom of the seventies, and to a lesser extent the one of the early eighties, can be described as the main source of fluctuations of the Venezuelan economy in the last decades.

Table 1 reports average growth rates (left panel) as well as relevant ratios (right panel) for the main economic aggregates in our database and the subsamples aforementioned. The most striking feature is the tremendous development failure during the period 1974-1995. Even though the growth data reveal the ratios of investment, imports

Table 1: Long-run properties for the reference data set.

	Average annual growth rates(%)			Variable/Total GDP		
	1950-73	1974-95	1950-95	1950-73	1974-95	1950-95
Total GDP	2.35	-2.3	0.13	1	1	1
Non Oil GDP	2.37	-1.85	0.38	0.64	0.78	0.7
Oil GDP	2.31	-3.34	-0.44	0.36	0.22	0.3
Private Cons.	2.81	-1.5	1.32	0.36	0.57	0.46
Private Invt'	3.27	-7.05	-1.98	0.12	0.13	0.12
Public Invt'	10.54	-4.74	-2.73	0.08	0.07	0.07
Total Invt'	1.38	-4.61	-1.72	0.23	0.23	0.23
Private Capital	3.39	-1.13	1.28	1.06	1.94	1.48
Public Capital	3.06	-1.39	0.9	0.77	0.93	0.85
Total Capital	2.17	-0.89	0.75	2.18	3.09	2.61
Exports	1.74	-2.4	-0.66	0.51	0.29	0.4
Imports	-0.03	-1.77	-0.58	0.17	0.18	0.18
Trade Balance	2.71	-2.82	-0.73	0.34	0.11	0.23
Govt' Expenditure	1.07	-2.43	-0.68	0.14	0.17	0.15

and government expenditures over GDP have remained roughly constant across the period, the Venezuelan economy seems to have been far from a balanced growth experience. Private consumption and exports over GDP ratios have dramatically changed. On the one hand the fall in exports' share reflects the decline in oil revenues since 1982, after being booming during the first (1973-74) and, to a lesser extent, second (1979-80) oil shocks. On the other hand, the rise in the private consumption share is mostly explained by the increase in consumption between 1974 and 1984. This temporary character of the consumption boom might suggest some limited opportunities to invest the oil revenues in international capital markets, possibly related to lower or declining expected rates of return abroad during the second half of the 70s.

Table 2 reports some moments of interest for the data set in the 1950-1995 period. We use as our measure of economic activity the non-petroleum GDP per capita. We concentrate on it because this variable is not directly affected by oil price changes and it is more readily interpreted in terms of labor, capital and productivity than total GDP. The absolute volatility of the cyclical component (using HP100) of this measure of output is 4.9 percent. This value may seem large. However, Correia et al. (1995) report for instance an absolute volatility of GDP of 3.78 percent with annual

Table 2: Cyclical properties of the Venezuelan economy: 1950-1995.

Variable x	Relative Volatility % σ_x/σ_y	Cross-correlations of Non Oil GDP with x_{-3}	x_{-2}	x_{-1}	x	x_{+1}	x_{+2}	x_{+3}
Non Oil GDP (y)	1.00	0.06	0.39	0.73	1.00	0.73	0.34	-0.02
Total GDP	0.96	0.13	0.42	0.68	0.74	0.39	0.18	-0.07
Oil GDP	2.02	0.19	0.24	0.21	-0.04	-0.21	-0.07	0.03
Private Cons.	2.00	0.30	0.54	0.66	0.61	0.27	0.19	0.17
Govt' Cons.	2.31	0.01	0.26	0.52	0.66	0.53	0.31	0.14
Fixed Invt'	3.32	-0.06	0.20	0.54	0.87	0.71	0.34	0.04
Public Invt'	4.39	-0.03	0.21	0.46	0.60	0.47	0.27	0.09
Private Invt'	4.18	0.00	0.10	0.38	0.72	0.62	0.25	-0.09
XN	4.10	0.11	-0.12	-0.43	-0.74	-0.56	-0.32	-0.24
XN/Non Oil GDP	1.54	-0.11	-0.30	-0.51	-0.71	-0.56	-0.35	-0.23

All statistics are computed after logging and detrending real data (in per-capita terms).
Trade balance corresponds to detrended exports minus detrended imports (cf. Mendoza (1995)).
Non Oil GDP (y) volatility is 4.9%.

Portuguese data for 1958-1991.[2]

The most striking facts are the movements in the output of the oil sector, which are acyclical and exhibit high volatility. It is not surprising then that the relative volatility of all the demand components is above that of non-petroleum GDP. The high volatility of private consumption is partly justified because our measure includes durable consumption, but it is undoubtedly high (again, Correia et al (1995) report 0.84) and slightly leads the cycle. Likewise, the relative volatility of all forms of investment considered as well as that of government consumption are substantially higher than what we are used to see, while the balance of trade is relatively smooth (Correia et al (1995) report 8.49). Indeed, the balance of trade is strongly countercyclical which conforms with the patterns found in most countries. As it is standard, all other variables are procyclical and show a high degree of persistence.

Figure 1 provides a snapshot of Venezuelan Business Cycles during the period 1950-1995. The two top panels display log GDP (peaking in 1978) and its HP trend. The other panels show the evolution of other (detrended) aggregates together with detrended non-petroleum GDP. It is apparent that the expansionary effect of the oil boom of 1973-74 parallels a marked deterioration terms of trade together with a substantial consumption increase. This situation ended in 1983 with a stabilization program that included a severe devaluation and a policy of price liberalizations.

[2]As a matter of fact, there are very few references on business cycle analysis with annual data. Therefore, the interested reader may find useful this comparison here and below.

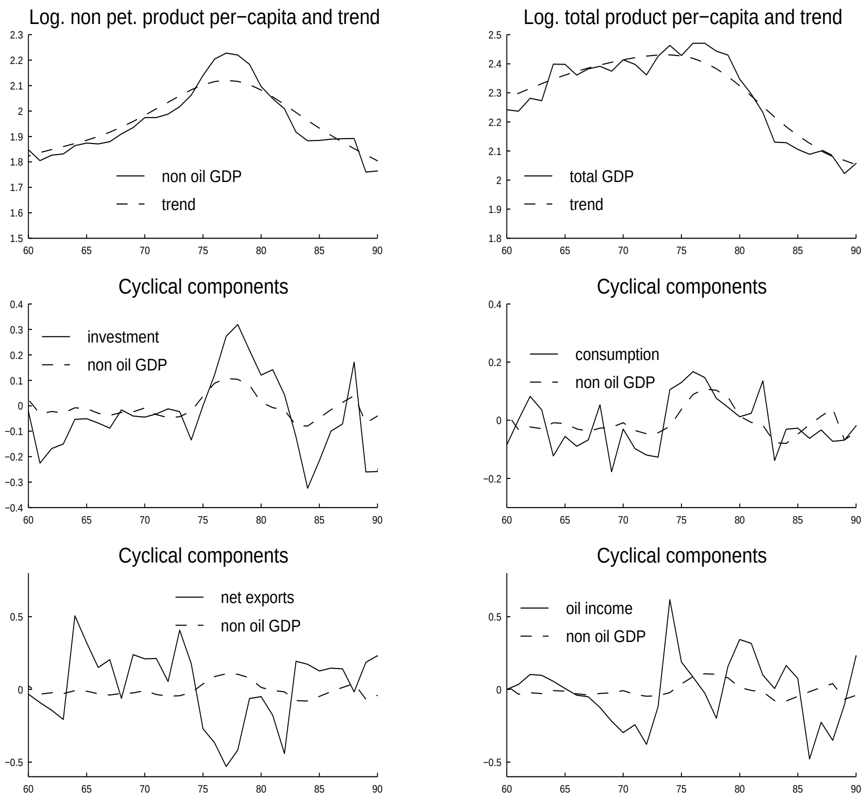

Figure 1: Business cycles in Venezuela: 1950-1995.

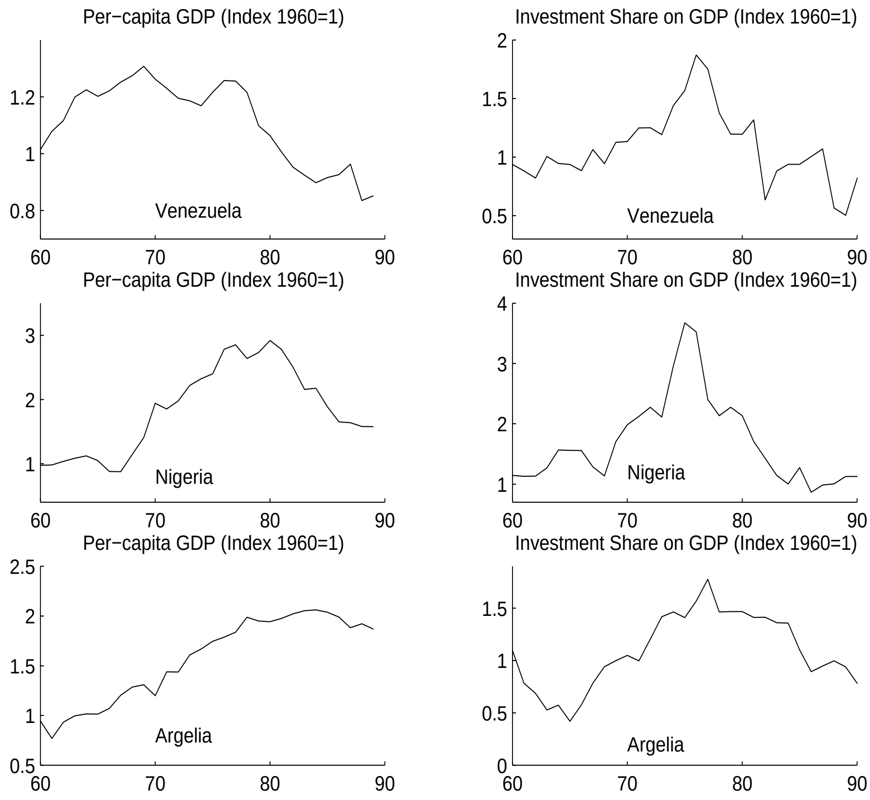

Figure 2: Macroeconomic performance in some oil exporting countries: 1960-1990.

Apart from this features, it is worth noting that in 1958 a democratic movement turn over political power and oil policy became less encourage of foreign investment. It should be stressed that other oil-exporting countries displayed similar patterns in their macroeconomic aggregates during this period. For instance, Nigeria and Algeria exhibited a substantial increase in the investment output ratio during the 60s. However, this trend reverted just after the oil boom of 1974 and output per capita started to remain stagnant (see Figure 2).[3]

3 The model

We propose a stochastic general equilibrium model for a small open economy augmented to incorporate the income of the oil sector. We assume that the oil resource can be treated as a pure rent associated to transfers from abroad. Also, in order to capture the investment response to the oil boom of 1974 we consider imperfect financial assets substitutability. More precisely, we incorporate a preference for holding home assets as in Bruno and Portier (1995). The degree of imperfect capital mobility implied by this specification is consistent with the evidence reported by Rodríguez and Sachs (2001) in the case of Venezuela. These authors, based in the results of a computable general equilibrium model, argue that the restrictions of capital markets seems to hold in practice in this economy. In addition, this a convenient way to deal with small open economy models with a constant rate of time preference.

Next, we briefly describe the environment beginning with our assumptions regarding the oil sector. In light of these assumptions we appeal to market completeness and to the welfare theorems to present the social planner's problem whose solution we use as the prediction of the model.

3.1 The oil sector

We assume that the oil sector does not bid for production inputs in factor markets which are competitive. Further, the output of the oil sector is entirely sold in an international market at an exogenously given price p_t. Therefore, from the point of view of the economic agents, the oil price follows a stochastic process. Figure 3 suggests that this simple modelling approach can be justified by observations. In this figure we show that most part of oil revenue fluctuations come from variation in oil prices rather than any quantity changes. Part of this income is assigned to finance the public expenditure. Consequently, we fix the output of the oil sector, Y^p,. to one half of the average for the sample period under consideration. Finally we specify the process for oil price shocks as:

[3] These data are taken from Penn World Table (Mark 4). See Summers and Heston (1988).

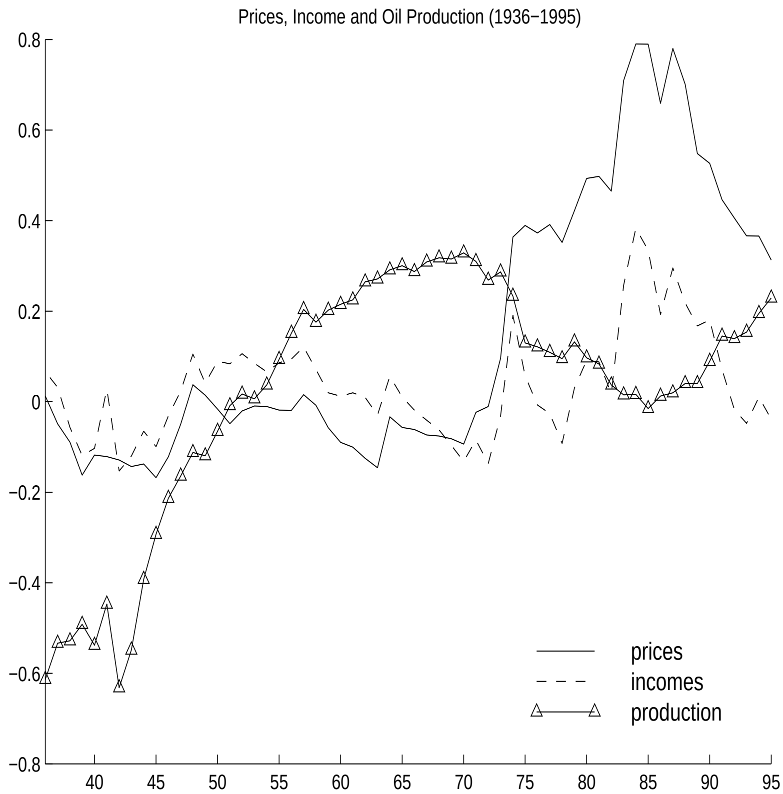

Figure 3: Oil price, oil rent and oil output (1936-95). Price: price in *Bolívares* of the oil basket over GDP deflator. Rent: Income in Bolívares as oil exports over GDP. Output: oil production (thousand of barrels). All variables are in logs and demeaned.

$$\log(p_{t+1}) = \rho_p \log(p_t) + \varepsilon_t^p \ , \ \varepsilon_t^p \sim N(0, \sigma^p), \tag{1}$$

Also, we will assume that economic agents have access to an international financial market. They hold a foreign financial asset (B_t) that yields the world real interest rate r^* which is exogenous since we assume perfect international financial integration. Thus, under market completeness, the second welfare theorem applies and we can restrict our attention to efficient allocations.

3.2 Preferences and Technology

The economy is populated by a large number of infinitely lived households whose total measure is one. As it has been stated above, a key issue is whether the response in the model to oil price shocks is consistent with some salient features of the data. To this purpose we explore several assumptions regarding the intertemporal substitution of leisure and we compare their predictions with those corresponding to standard preferences. More precisely, we consider four alternative specifications for households' instantaneous utility:

$$U_{sep}(C_t, H_t, B_t) = \frac{C_t^{1-\sigma}}{1-\sigma} + v\frac{(1-H_t)^{1-\eta}}{1-\eta} - \gamma B_t^2 \tag{2}$$

$$U_{il}(C_t, H_t, B_t) = \frac{C_t^{1-\sigma}}{1-\sigma} + v\,(1-H_t) - \gamma B_t^2 \tag{3}$$

$$U_{cd}(C_t, H_t, B_t) = \frac{\left[C_t^a (1-H_t)^{1-a}\right]^{1-\sigma}}{1-\sigma} - \gamma B_t^2 \tag{4}$$

$$U_{ghh}(C_t, H_t, B_t) = \frac{\left[C_t - vH_t^{\eta}\right]^{1-\sigma}}{1-\sigma} - \gamma B_t^2 \tag{5}$$

In all of the cases it is assumed that foreign liabilities enter negatively in the utility function. This can be interpreted as capturing some form of domestic capital controls rather than any aversion to foreign specific risks. In any case this reflects the aforementioned imperfect assets substitutability.

Households own capital (K_t) and labor (H_t) and receive their proceeds. Also, they receive the revenues of the oil sector as well as the return on their holdings of foreign bonds. All this income is devoted to consumption and investment both in physical capital and financial assets. As it is standard in open economy models of the business cycle we assume quadratic costs to capital adjustment according to

$$\Phi\left(K_t, K_{t+1}\right) = \frac{\phi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 \tag{6}$$

The technology of the non-petroleum sector is specified as

$$Y_t = A_t K_t^{\alpha} H_t^{1-\alpha} \tag{7}$$

where α is the capital's share and A_t describes the state of technology, which follows the stochastic process:

$$\log(A_{t+1}) = \rho_a \log(A_t) + \varepsilon_t^a \ , \ \varepsilon_t^a \sim N(0, \sigma^A), \tag{8}$$

Finally, we assume that domestic and foreign rates of return may differ in steady state according to the arbitrage condition $r^* + \tau = r$, where τ is the premium and r is the domestic interest rate. Thus,

$$z_t - \delta = r^* + \tau$$

where z_t is the real return of capital and δ is the depreciation rate. Correspondingly, the balance of trade is defined as[4]

$$xn_t = B_{t+1} - B_t(1 + r^*). \tag{9}$$

3.3 The social planner's problem

We can define a social planner's problem recursively as:

$$V(K_t, B_t) = \max_{C_t, H_t, B_{t+1}, K_{t+1}} \left\{u(C_t, H_t, B_t) + \beta E_t \left[V(K_{t+1}, B_{t+1})\right]\right\}$$

Subject to

$$I_t - K_{t+1} + K_t(1 - \delta) = 0 \tag{10}$$

[4]It will be convenient to distinguish between the balance of trade in foreign and domestic units. The later takes into account the changes in oil prices and therefore net exports deviations with respect to their non-stochastic steady state can be expressed as

$$xn_{ss}\widetilde{xn}_t = B_{ss}\widetilde{B}_{t+1} - B_{ss}r^*\widetilde{B}_t - Y^p\widetilde{p}_t$$

where Y^p are steady state oil product and $\widetilde{p}_t$are oil price changes.

$$A_t K_t^{\alpha} H_t^{1-\alpha} + p_t Y^p - C_t - I_t - \frac{\phi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 - B_{t+1} + B_t(1+r^*) = 0 \qquad (11)$$

Where (10) is the law of motion of the accumulation of capital stock and (11) is the aggregate resource constraint of the economy.

The first order conditions of this program under the utility functions (2) – (5) and stochastic processes (8) – (1) are:

$$U_{ct} - \lambda_t = 0 \qquad (12)$$

$$U_{ht} + \lambda_t (1-\alpha) A_t K_t^{\alpha} H_t^{-\alpha} = 0 \qquad (13)$$

$$\beta E_t \left[\lambda_{t+1}\left(1+r^*\right) - 2\gamma B_{t+1}\right] - \lambda_t = 0 \qquad (14)$$

$$\beta E_t \left[\alpha A_{t+1}\left(\frac{H_{t+1}}{K_{t+1}}\right)^{1-\alpha} + 1 - \delta + \frac{\phi}{K_{t+1}}\left(\frac{K_{t+2}}{K_{t+1}} - 1\right)\left(\frac{K_{t+2}}{K_{t+1}}\right)\right]\lambda_{t+1}$$

$$-\lambda_t - \lambda_t \frac{\phi}{K_t}\left(\frac{K_{t+1}}{K_t} - 1\right) = 0 \qquad (15)$$

4 Calibration

Our reference data set is taken from the National Accounts of Venezuela as homogeneized by Baptista (1997) for the period 1950-95. This database contains reliable information for the main economic aggregates. We calibrate the model so that its non-stochastic steady state is consistent with the long-run information contained in the time series of the Venezuelan economy. Among the long-run information contained in the time series are a private capital to non-petroleum output ratio of 3.68. With this information we obtain $\beta = 0.943$. Also we measure an average capital share income $\alpha = 0.55$[5], and the average of oil to non-oil GDP ratio that goes to households $Y^p/Y = 0.22$.

[5]This parameter value might be overestimate since we do not consider the share of revenues corresponding to self-employed worker. However, a high α, may reflect that the economy is a net manufacturing importer (see, for instance, Mendoza, 1995).

Given the limited availability of macroeconomic data and the lack of microeconomic empirical studies we borrow some of the model parameters from other studies. We do not have data for hours worked. Thus, the average of the time spent in the market is set equal to 0.3. Also, the intertemporal elasticity of substitution σ is set equal to 2.61, which is the estimation obtained by Ostry and Reinhart (1995) for a group of developing countries. The parameter γ is obtained in order to obtain de observed volatility of the ratio investment-non oil GDP. Finally, we introduce small adjustment costs by choosing the elasticity of marginal adjustment cost to be 1.1. Table 3 summarizes parameter values at this stage.

The preference for leisure is chosen so that average hours in the steady state are 0.3. This is enough to complete our specification of preferences when labor is indivisible. In the rest of the cases we follow Correia et al. (1995) to complete our preference parameterization. Their strategy consists in choosing parameters so that the elasticity of labor supply remains the same in the steady state regardless the specification for households' preferences. This elasticity can be directly computed under the Cobb-Douglas preference specification to be 1.44. This in turn allows us to obtain $\eta = 1.62$ and $\eta = 1.69$ for the separable and GHH preference cases, respectively.

To calibrate the stochastic process for the state of technology we choose the serial correlation and the standard deviation of the shock so that the model with oil price shocks already in reproduces the persistence and volatility of output. Thus, we follow Kydland and Prescott (1982) strategy but taking into account here the stochastic process for oil price shocks across the alternative specifications for preferences we use.[6] Finally, the balance of trade is defined by the capital outlets in steady state ($B_{ss}r^*$). Thus, the calibrated economy's parameters imply that the capital account represents 35% of the non-oil output.

Table 4 summarizes our selection for those parameters that are changing under alternative specifications.

5 Results

To assess the ability of our model to account for aggregate fluctuations of the Venezuelan economy we proceed in three stages. First, we consider the role of technology shocks. For these shocks we compute the second moments properties of our model economy under alternative specifications for preferences. In addition, we discuss the evidence in favor of impulse-responses to technology shocks in each case. We find that the GHH specification does relatively a better job to account for the cyclical patterns of the Venezuelan economy. Second, we consider the role of oil price shocks. Likewise, we compute second moments properties and impulse-responses to these shocks and we

[6] Since there are no series on hours worked for Venezuela we cannot compute the Solow residual. In any case, following Kydland and Prescott (1982) strategy without taking into account oil price shocks we find that the serial correlation of $\log A_t$ is 0.6 and the standard deviation of the shock is 0.02.

Table 3: Calibrated economy model parameters.

Preferences			
Discount Factor	(3)	β	0.943
Hours worked in steady state	(1)	H	0.3
Risk aversion parameter	(1)	σ	2.61
Capital Adjustment Costs	(1)	ϕ	1.1
Technology			
Depreciation Rate	(3)	δ	0.0896
Capital share	(2)	α	0.55
Capital/non oil GDP	(2)	K/Y	3.68
Oil Sector			
Oil GDP/non oil GDP	(2)	Yp/Y	0.22
Standard deviation oil shock	(4)	ε	0.23
Oil shock autocorrelation coefficient	(4)	ρ	0.97

Calibration criteria:(1) External information, (2) sample averages, (3) steady state, and (4) targeting the volatility and persistence of non oil GDP.

Table 4: Calibrated economy model parameters: alternative models.

			Sep	Ti	CD	GHH
External Interest Rate	r*	(3)	5.54%	5.54%	5.54%	6.54%
Leisure Preference	ν	(3)	1.39	2.49	-	2.98
Labour Supply Elasticity	η	(5)	1.62	-	0.38 (*)	1.69
Premium	τ	(1)	5.E-03	5.E-03	5.E-03	-5.E-03
External Assets Preference	γ	(3)	2.E-04	2.E-04	3.E-04	-1.E-03
Standard deviation of tec. shock	ε	(4)	0.028	0.017	0.02	0.02
Autocorrelation coefficient tec. shock	ρ	(4)	0.75	0.6	0.7	0.9

Alternative models correspond to parameter "a". Calibration criteria: (1) External information, (2) sample averages, (3) steady state, (4) targeting the volatility and persistence of non oil GDP, and (5) targeting the same labor supply elasticity (1.44) across model specifications.

discuss the predictions of the model in light with evidence. This analysis illustrates on the prominent role of oil price shocks in driving aggregate fluctuations in Venezuela in the late nineties. Finally, we simulate our benchmark model, feeding in the data on the oil price to obtain predictions for the time paths of the cyclical components of the main macroeconomic aggregates. We find that taking into account the level effect of the first major oil price shock is enough for the predictions of the model to be in conformity with the observations in: *i)* the oil exporting stability period prior to 1974 and, *ii)* the period of high volatility in the petroleum markets after the first oil shock.

5.1 Responses to technology shocks

Figure 4 shows the responses to a 1% productivity shock under GHH preferences. The impulse-responses in all other cases are jointly summarized in the Appendix. Following King and Rebelo (1999) a purely transitory together with a correlated shock are compared. This allows us to identify eventual changes in the comovements due to a higher degree of persistence of the shock.

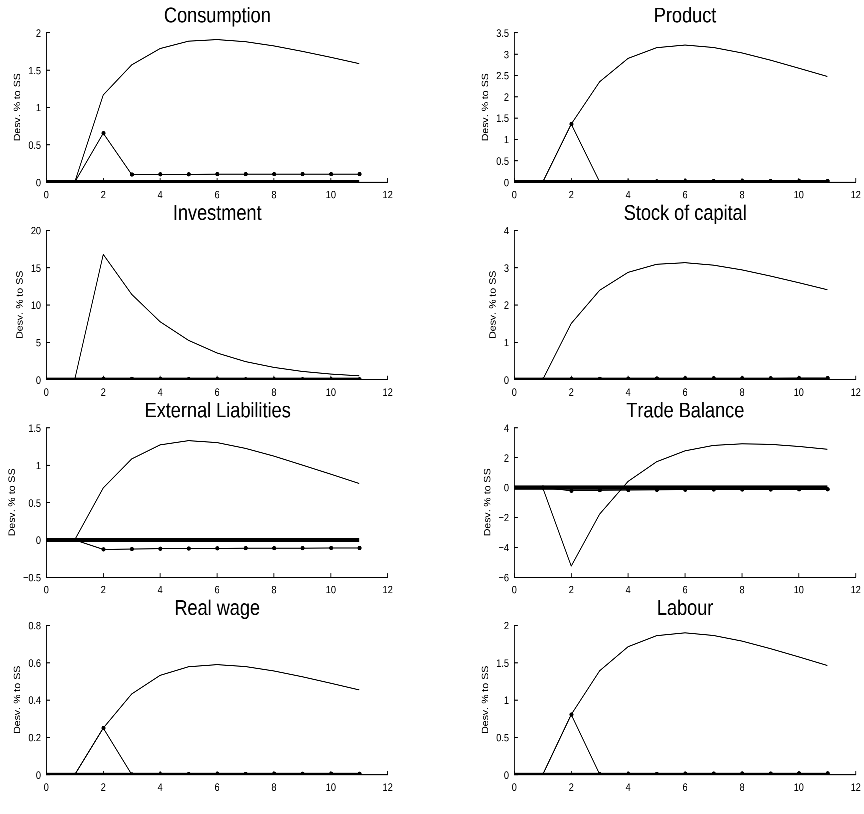

Figure 4: Impulse-responses to a 1% technology shock under GHH preferences. Solid line: persistent shock; Dotted line: transitory shock.

A transitory technology shock decreases investment under standard preferences.

The reason is that a positive shock makes agents serve external debt so that they can afford higher consumption and leisure with less output. Also, with enough persistence investment becomes procyclical. In this case, the real return on domestic capital compensates the return on servicing external debt so much so that agents might prefer to borrow abroad to take advantage from the return of domestic assets. With GHH preferences, the intertemporal elasticity of substitution of leisure is null. Consequently, labor supply decisions depend only upon the real wage. Therefore, contrary to what occurs under standard preferences, investment does not fall in response to a positive productivity shock which is transitory. In fact, because of imperfect capital mobility investment increases as a result of increased marginal disutility of external assets, and therefore the real wage and labor supply go up too.

Table 6 in the Appendix reports a selection of second-moment properties for the data corresponding to simulations of the calibrated economies with technology and terms of trade shocks. Indeed, the specification with GHH preferences captures the strongly countercyclical character of the balance of trade. In addition, this particular specification contributes to account for the degree of correlation of consumption and investment observed in data. Finally, it is clear that technology shocks are not enough to justify the magnitude of observed volatility of consumption (standard deviation of 9.8 percent in the data versus 3.4 percent observed using GHH utility function). Interestingly though, the GHH specification smoothes output fluctuations at the same time that increases the volatility of consumption, investment and the balance of trade. This turns out to be more in conformity with data and is due in part to the countercyclicality of the balance of trade.

5.2 Responses to trade shocks

A positive oil price shock increases the trade surplus. In addition, it makes less tight the budget constraint since households perceive the oil income as a foreign transfer. As with technology shocks, consumption smoothing is associated with a willingness to reduce external debt. Again, consumption and investment go up with a positive oil shock only under GHH preferences. Likewise, the income effect in consumption of the oil rent dominates the intertemporal substitution effect generated by the fall in the interest rate. Under standard preferences with perfect capital mobility an increase in transfers increases consumption and leisure. Increased leisure and lower holdings of external assets reduce output.

Under GHH preferences consumption goes up but the labor supply does not move since labor supply decisions are independent of consumption allocation. Incorporating imperfect capital mobility implies an incentive for investment and the labor supply and increases labor productivity. In this respect, the income effect in leisure of the oil rent is dominated by the intratemporal substitution effect generated by the increase in the real wage. Under standard preferences with perfect capital mobility an increase in transfers increases consumption and leisure.

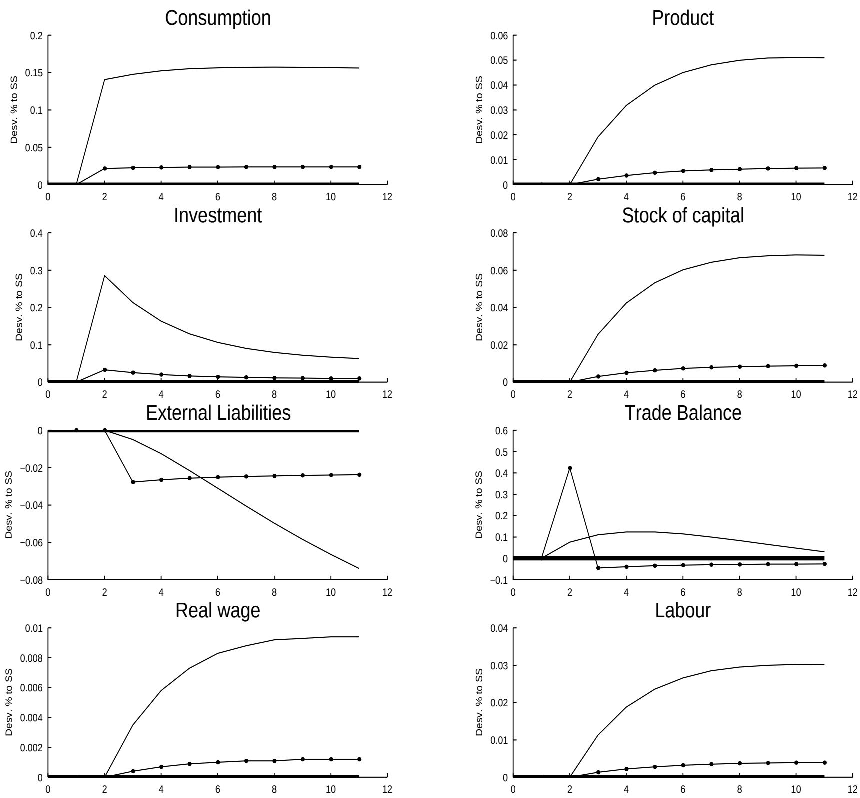

Figure 5: Impulse-responses to a 1% trade shock under GHH preferences. Solid line: persistent shock; Dotted line: transitory shock.

Table 5 shows the second moment properties of the model under GHH preferences and terms of trade shocks only. The implied volatility of output in this case is 22 percent of that in actual data. This result should be interpreted as a lower bound notwithstanding since the model does not incorporate any strong propagation mechanisms for oil price shocks which are further assumed independent of technology shocks.

Table 5: Second moment properties of the model under GHH preferences and trade (oil price) shocks only.

	Volatility (%)		Cross-correlations of output with				
	σ_x	σ_x/σ_y	x_{-2}	x_{-1}	x	x_1	x_2
Output (y)	0.011	1.00	0.36	0.76	1.00	0.76	0.37
Consumption	0.052	4.57	0.55	0.80	0.80	0.22	-0.14
Investment	0.111	9.70	0.56	0.64	0.47	-0.22	-0.48
Net Exports	0.141	12.34	-0.58	-0.75	-0.68	-0.10	0.43
Labor input	0.007	0.59	0.36	0.76	1.00	0.76	0.37

5.3 Time series responses and structural change

In this section we discuss our empirical results on the role of oil price shocks for the benchmark model under consideration. The aim of this section is twofold. First, we would like to evaluate the role of oil price shocks in shaping aggregate fluctuations in oil exporting economies, and in particular, in Venezuela. Second, we would like to understand the observed cyclical patterns in this economy from the impact of the major oil shocks.

We simulate the model, feeding in the data on the oil price shocks to obtain predictions for the time paths of the main macroeconomic aggregates. Figs. 6-8 suggest that the predictions of the model are consistent with the observed patterns for consumption and net exports. In particular, the model does particulary well in accounting for the response of these variables after the first major oil-price shock. The model does not do so well in accounting for the time series behavior of investment. This can be justified by the way in which the oil-sector income was administered by the government. The foreign reserves management as well as the behavior of government expenditures are relevant to understand the channels through which this income was transferred to the households. This figure also shows that the volatility in simulated data is somewhat underestimated at the beginning of the sample. But remember that we are only considering realized oil price shocks. Also, from 1983 the model slight overestimates the level of investment. It is worth noting that this period is one of an important decline in government investment. Finally increasing political unstability accompanied by a debt crises in the later years are features the model is obviously abstracting of.

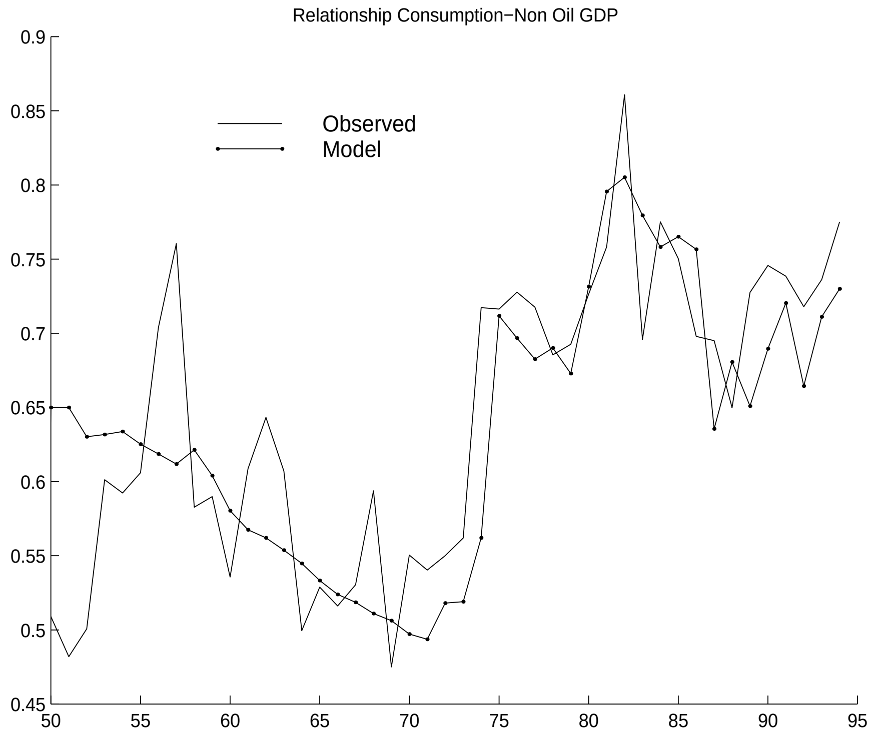

Figure 6: Consumption to non-oil output ratio in the model and in the data.

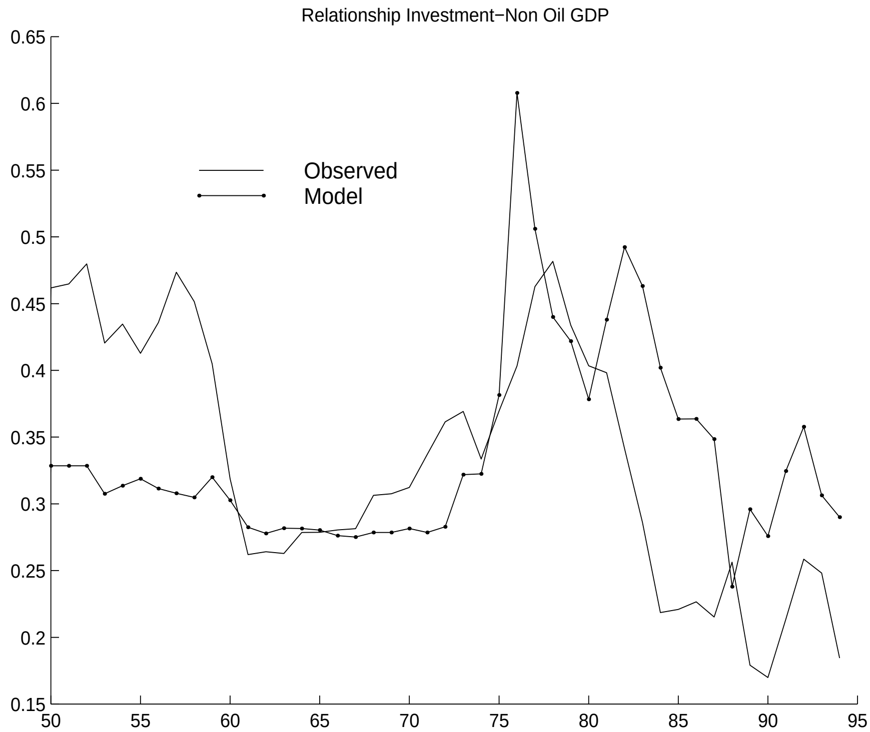

Figure 7: Investment to non-oil output ratio in the model and in the data.

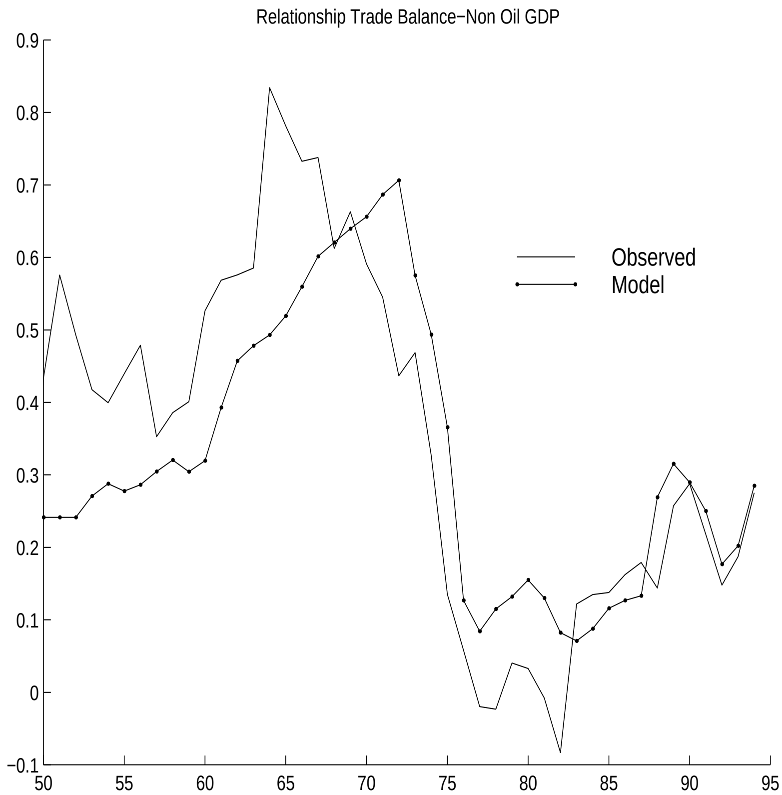

Figure 8: Trade balance to non-oil output ratio in the model and in the data.

6 Conclusions and extensions

A simple neoclassical growth model for a small open economy with oil price shocks can account for aggregate fluctuations of Venezuelan economy from 1950 to 1995. To this end it is important to deal with the recessive character that a fiscal transfer generates under standard preferences. A modified version of GHH preferences augmented to incorporate a preference for holding home assets has been shown to be useful for this purpose.

The model is able to justify two salient features of the data: First, the countercyclical response of the balance of trade when the economy is hit by technology shocks. Second, the expansionary response of aggregate demand to a positive shock in the terms of trade. Indeed, consumption and investment go up when an oil exports boom occurs. This particular feature of the data requires also some degree of imperfect capital mobility in the model, in particular, for investment to have the observed magnitude of fluctuations. The standard features of the neoclassical growth model were otherwise preserved.

The time series behavior of oil prices has been shown to be crucial to justify the patterns of expansion and recession in Venezuela. Clearly, though, our model specification overestimates the response of investment from 1983. A variety of shocks associated to a erratic economic policy management together with a deep worsening of market institutions can not be disregarded. In particular, the costs originated by exchange rate controls, the decline of financial intermediation and the banking crises of 1994, and the two attempts of coups d'état in 1992 are of course relevant events.

Another interesting issue relates to characterizing the potential spillovers between shocks to total factor productivity and trade shocks. These shocks seems to play a prominent role in business cycle fluctuations in Venezuela. However, the lack of available data complicates this analysis. We consider our model specification a promising tool for subsequent research devoted to improve our understanding of the intrinsic macroeconomic unstability identified in enclave economies.

References

Backus, D. and M. Crucini (1998), "Oil prices and the terms of trade," *NBER Working Paper* 6697.

Baptista, A. (1997), "Bases cuantitativas de la economía Venezolana," Fundación Polar.

Baxter, M. and M. Koutparitsas (2000), "What can account for fluctuations in the terms of trade?" *Federal Reserve Bank of Chicago.*

Bruno, C. and F. Portier (1995), "A small Open Economy RBC Model: the French Economy Case," in Pierre-Yves Henin (1995), Ch. V, "Advances in Business Cycle Research," Springer.

Calvo, G. and C. Végh (1999), “Inflation Stabilization and BOP crises in Developing Countries,” *Handbook of Macroeconomics*, Vol. 1, J.B. Taylor and M. Woodford eds. Ch. 24.

Cardia, E. (1991),“The dynamics of a small open economy in response to monetary, fiscal, and productivity shocks,” *Journal of Monetary Economics* 28, 411-434.

Carmichael, B. and K. Sikoro (1999),“Liquidity Constraints and Business Cycles in Developing Economies,” *Review of Economics Dynamics* 2, 370-402.

Correia, I., J. Neves and S. Rebelo (1995),“Business cycle in a small open economy” *European Economic Review* 39, 1089-1113.

Greenwood, J., Z. Hercowitz and G. Huffman (1988), “Investment, capacity utilization and the real business cycle,” *American Economic Review* 78, 971-987.

Hansen, G. D. (1985), “Indivisible Labor and the Business Cycle,” *Journal of Monetary Economics* 16, 309-327.

King, R. and S. Rebelo (1999), “Resuscitating Real Business Cycles,” *Handbook of Macroeconomics*, Michael Woodford y John Taylor eds.

Kydland, F and E.C. Prescott (1982), “Time to Build and Aggregate Fluctuations,” *Econometrica* 50 (6), 1345-1370.

Kollintzas, T. and V. Vassilatos (2000), “A small open economy model with transaction cost in foreign capital,” *European Economic Review* 44, 1515-1541.

Kose, M. A. and R. Riezman (2001), “Trade Shocks and Macroeconomic Fluctuations in Africa,” *Journal of Development Economics* 65, 55-80.

Kouparitsas, M. (1997), “North-South Terms of Trade: An empirical investigation,” *Federal Reserve Bank of Chicago.*

McCallum, B. (1989) “Real BusinessCycle Models,” Ch. I in Modern Business Cycle Theory, Robert Barro ed., Harvard University Press. Cambridge Massachusetts.

Mendoza, E. (1991) “Real Business Cycles in a Small Open Economy,” *The American Economic Review* 81 (4).

Mendoza, E. (1995) “The Terms of Trade, The real Exchange Rate, and Economic Fluctuations,” *International Economic Review* 36 (1), 101-137.

Ostry, J. D. and C. M. Reinhart (1995), “Private Saving and terms of trade shocks,” *IMF Staff Papers* 39, 495-517.

Prescott, E.C (1986), “Theory ahead of business cycle measurement,” *Federal Reserve Bank of Minneapolis* Quarterly Review 10 (4), 9-22.

Rodríguez, F. and J. D. Sachs (2001), “Why do resource abundant economies grow more slowly. A new explanation and a application to Venezuela,” *Journal of Economic Growth* 4, 277-303.

Rogerson, R. (1988), “Indivisible Labor, Lotteries and Equilibrium,” *Journal of Monetary Economics* 21, 3-16.

Sáez, F. (2001), "Patrones cíclicos de la economía venezolana," Ph.D. Thesis, Universidad Complutense de Madrid, mimeo.

Stokey, N.L. and S. Rebelo (1995), "Growth effects of flat-rate taxes," *Journal of Political Economy* 103, 519-550.

Zimmermann, C. (1995), "International Trade over de Business Cycle," mimeo.

Appendix: Properties of the models under alternative utility functions.

Table 6: Properties of the model with both technology and trade shocks.

Separable Utility Function							
	Volatility (%)		Cross-correlations of output with				
	σ_x	σ_x/σ_y	x_{-2}	x_{-1}	x	x_1	x_2
Output (y)	0.049	1.00	0.28	0.73	1.00	0.73	0.29
Consumption	0.015	0.32	-0.18	-0.21	-0.15	0.01	0.11
Investment	0.310	6.82	0.32	0.52	0.62	0.45	-0.27
Net Exports	0.226	4.97	-0.15	-0.26	-0.33	-0.33	-0.15
Labor input	0.035	0.77	0.35	0.64	0.75	0.47	0.12
Indivisible Labor							
	Volatility (%)		Cross-correlations of output with				
	σ_x	σ_x/σ_y	x_{-2}	x_{-1}	x	x_1	x_2
Output (y)	0.049	1.00	0.32	0.73	1.00	0.73	0.34
Consumption	0.002	0.06	-0.45	-0.42	-0.21	0.20	0.33
Investment	0.266	5.97	0.41	0.55	0.56	0.31	-0.30
Net Exports	0.232	5.20	-0.35	-0.45	-0.43	-0.27	0.13
Labor input	0.044	0.98	0.39	0.77	0.99	0.69	0.29
Cobb-Douglas Utility Function							
	Volatility (%)		Cross-correlations of output with				
	σ_x	σ_x/σ_y	x_{-2}	x_{-1}	x	x_1	x_2
Output (y)	0.049	1.00	0.26	0.73	1.00	0.73	0.27
Consumption	0.020	0.43	-0.29	-0.19	0.05	0.38	0.42
Investment	0.312	6.57	0.32	0.52	0.61	0.44	-0.28
Net Exports	0.226	4.77	-0.14	-0.26	-0.35	-0.37	-0.16
Labor input	0.040	0.84	0.37	0.73	0.90	0.56	0.15
GHH Utility Function							
	Volatility (%)		Cross-correlations of output with				
	σ_x	σ_x/σ_y	x_{-2}	x_{-1}	x	x_1	x_2
Output (y)	0.049	1.00	0.31	0.73	1.00	0.73	0.32
Consumption	0.060	1.25	0.14	0.37	0.55	0.50	0.25
Investment	0.351	7.37	0.34	0.54	0.62	0.41	-0.27
Net Exports	0.264	5.54	-0.27	-0.41	-0.49	-0.41	-0.12
Labor input	0.028	0.59	0.31	0.73	1.00	0.73	0.32

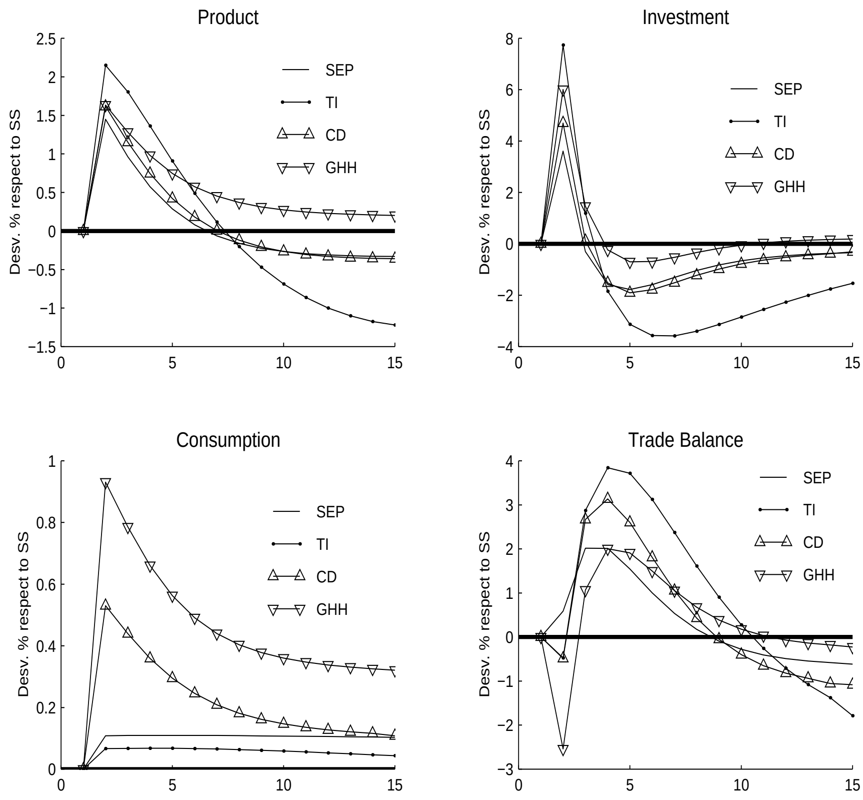

Figure 9: Impulse-responses to a 1% technology shock. Persistence 0.50.

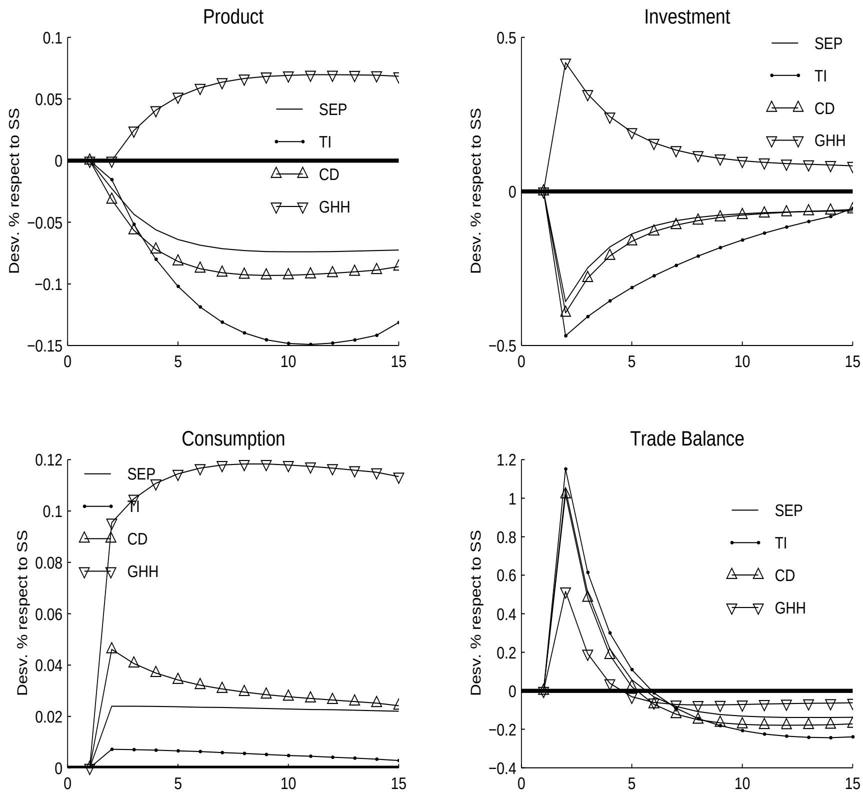

Figure 10: Impulse-responses to a 1% trade (oil-price)shock. Persistence 0.50.