Natural Resources and Economic Growth:  
A Quantitative Exploration  

Francisco Rodríguez  
Harvard University  

Jeffrey D. Sachs  
Harvard University  
and  
Harvard Institute for International Development
1. Introduction

Recent studies have uncovered the fact that resource poor economies tend to outperform resource rich ones\(^1\). In fact, resource abundance is an important determinant of economic failure, with differences of one standard deviation in the share of primary exports in GDP leading to growth rates on average between .7 and 1\% lower\(^2\). And indeed, some of the world’s most tremendous development failures are among oil-exporting countries such as Algeria and Venezuela\(^3\). These are surprising facts, which stand in stark contrast to the optimism with which countries have tended to welcome resource booms\(^4\). They also call for an explanation from economists, especially since simple economic intuition would lead us to expect that, if anything, an increase in the resources a society has access to should raise its rate if growth.

Several explanations have been advanced in the literature for this phenomenon. It has been suggested that greater resource abundance can lead economies to shift away from competitive manufacturing sectors in which many externalities necessary for growth are generated\(^5\). On the other hand, some authors have proposed that the root of the problem is political: resource booms tend to put large amounts of resources in the hands of the state, and thus create an incentive for agents to participate in rent seeking as opposed to productive activities which spur growth\(^6\).

In this paper we explore a simple alternative hypothesis: resource rich countries may grow more slowly because they are likely to be living beyond their means. This is because natural resource industries, which rely on exhaustible factors of production, cannot expand at the same rate as other industries. In the steady state, production of the natural resource will tend to zero. But on the transition to that steady state, the natural resource allows an economy to afford extraordinary consumption possibilities. Thus, typically, a resource rich economy will adjust to its steady state from above, not from below. During the transition, it will display negative rates of growth on

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\(^1\) See in particular Sachs and Warner, 1995.


\(^3\) See the case studies in Gelb, 1988, 1996.

\(^4\) Thus the widely shared view in the early 70s was that oil exporting countries would be able to overcome the savings constraint that kept developing countries in a poverty trap. In Venezuela, Carlos Andrés Pérez advanced the project of creating the “Great Venezuela” while in Iran Shah Reza Pahlevi spoke of building the “Great Civilization.”


average.

If an economy can invest its resource windfalls in international assets which pay permanent annuities, then the problem we are alluding to could not occur. Any economy experiencing a resource boom will invest it and permanently consume the interest it earns on that asset. But if an economy cannot invest its resource revenues in international capital markets, be it because of internal political restrictions, lower or declining expected rates of return abroad, or a preference for holding home assets\(^7\), then it will have to invest them in the home country, generating temporary consumption and production booms. The fact that these booms are temporary means that these economies will sooner or later have to see consumption and production decline.

Our key assumption is that exports of natural resources cannot expand at the same rate as other industries. We model this by specifying a sector whose output is fixed, whereas the rest of the industries in the economy can expand with further use of labor and capital. We believe this is a good characterization of many natural resource intensive industries with a market share that is being continuously eroded by non-natural resource intensive substitutes as well as by pure depletion.

Let us illustrate our argument with a striking numerical example. Estimates of Venezuelan GDP per capita at the beginning of this century put it at 50 US $ (at 1970 prices). This ranked fourteenth out of twenty Latin American countries, a meager 62% of the region’s average, and a little over 25% of the region’s leader. By 1970, before the first oil boom, Venezuela’s per capita GDP of 942 US$ was the region’s second highest, 184% of the region’s average, and just a notch below the region’s leader, Argentina\(^8\). Yet during the intervening period, Venezuela did not undergo a political nor economic process radically different from that of the twelve Latin American countries it surpassed. By the early 70s, the Venezuelan private sector was remarkably uncompetitive even by Latin American standards\(^9\) and the political situation was every bit as unstable as in any other country in the region\(^10\). The only difference was that by 1970 Venezuela had become one of the world’s main exporters of oil.

Our argument applied to Venezuela is that the extraordinary development in the Oil Industry that took off with the Mene Grande discoveries in 1914 and led Venezuela to control 13% of the

\(^7\) Such a preference seems well documented. See Feldstein and Horioka, 1980.

\(^8\) Data are from Tables 9.4 and A.2.1, Bulmer-Thomas, 1994.


\(^10\) The decade of the 60s was marked in Venezuela by repeated failed coup attempts both from the right and from the left which attempted to topple the nascent democratic system, and by a prolonged Cuban-inspired guerrilla insurrection.
world oil market by 1970 11 afforded this country the opportunity to overshoot its steady state in terms of consumption and production. And, simply put, what comes up must come down. Already in 1970, Venezuela's oil exports in per capita terms were declining. As Figure 1 shows, per capita oil revenues in constant US $ fell by over a third during the 1960s. And notwithstanding the magnitude of the oil booms, by the late 1980s oil revenues had already fallen below their pre-boom levels. In other words. The boom It is only logical then to expect, as we indeed observed, a steep fall in Venezuelan GDP per capita over the 1960-1990 period.

Insert Figure 1 Here

Granted our explanation makes theoretical sense, does it make empirical sense? Can the simple dynamics of oil revenues account for the disappointing growth performance of a country like Venezuela? In this paper, we will attempt to answer this question using a dynamic general equilibrium model of the Venezuelan economy. We will calibrate it to the Venezuelan economy and show that the consumption and production booms undergone by this economy during the 1970s can be satisfactorily accounted for in terms of its temporarily rising oil revenues, and that its subsequent fall in income and disappointing overall growth performance can also be attributed to this factor. In sum, we show that the story of natural resource exporters as economies which have overshot their steady states makes quantitative sense in that it can account acceptably well for a typical natural resource exporter's main growth dynamics.

We also use our model to try to gain some insights as to the process of adjustment of an oil exporter to falling oil revenues. We show that Venezuela's recent export boom may be illusory in that it is more the result of the combination of slack demand and a level of the capital stock which cannot be sustained in the long run than a genuine emergence of new export industries. Furthermore, we show that the factor intensities of recently emerging export industries may be a poor guide to the economy's long-run comparative advantage. This conclusion sheds some doubt on attempts to identify the comparative advantage of a natural resource intensive economy by looking at emerging industries during an export boom.

Our paper proceeds as follows. In Section II we sketch a simple theoretical model and use it to illustrate how we expect an economy to respond to an influx of revenues from an export of natural resources. We prove that, given a large enough natural resource sector, one would expect the natural resource intensive economy to overshoot its steady state. In Section III we present our dynamic general equilibrium model of the Venezuelan economy and discuss its calibration. Section IV summarizes the main results of the simulations. Section V shows how we use the model to

analyze the recent Venezuelan export boom and the economy’s dynamic comparative advantage. Section VI concludes.

2 A Simple Theoretical Model

In this section we present a simple stylized theoretical model of a natural resource intensive economy and show that overshooting of the steady state - in the precise sense that the capital stock is likely to converge to the steady state from above even if it starts out below - is likely to occur in these economies. In following sections, we establish that this is the case for more general models which lack analytical closed form solutions, among them a computable general equilibrium model calibrated to the Venezuelan economy.

Our model is a simple extension of the Ramsey growth model which introduces an additional sector with production fixed (and thus declining in per capita terms). It is a one good economy in which exports can be traded in international markets for imported investment goods. The current account is zero so there is no international investment. This effectively constrains the economy to invest the natural resource revenues in domestic capital, thereby generating the overshooting effect.

Consider then the following economy. A representative agent maximizes the intertemporal utility function:

\[ \int e^{-\rho t} \log C_t \, dt \]  

(1)

with \( \rho \) being the subjective discount rate and \( C_t \) period \( t \) consumption. Production is done using a Cobb-Douglas technology in capital and labor:

\[ Y_t = AK_t^\alpha L_t^{1-\alpha} \]  

(2)

resources can be devoted either to investment or consumption:

\[ C_t + I_t^d = Y_t \]  

(3)

and domestic as well as imported investment goods raise the capital stock:

\[ \dot{K} = K(1 - \delta) + I_t^d + I_t^m \]  

(4)

The model is closed with a balance of payments constraints which specifies that Natural
Resource exports can be used to cover the cost of importing investment goods:

$$R = I^m_t$$  \hspace{1cm} (5)

as well as the initial condition

Letting lower case letters denote per-capita values, we can transform the model into:

$$\text{Max} \int_0^\infty e^{-\rho t} \log c_t \, dt$$  \hspace{1cm} (6)

$$y_t = A k^\alpha_t l^{1-\alpha}_t$$  \hspace{1cm} (7)

$$c_t + i^d_t = y_t$$  \hspace{1cm} (8)

$$k_t = k(1 - \delta - n) + i^d + i^m$$  \hspace{1cm} (9)

$$\Re^{-\rho t} = i^m_t$$  \hspace{1cm} (10)

$$k_0 = \bar{k}$$  \hspace{1cm} (11)

This is just a simple Ramsey model with an additional equation, which specifies that the economy gets a decreasing quantity of “free” investment goods. Nothing of what follows changes if consumption imports are introduced$^{12}$.

We believe that equation (10) is an adequate characterization of how many economies using scarce natural resources actually employ them. In it we have set the rate of depletion equal to the rate of population growth, but this assumption can be relaxed without changing our results. Depletion at the population growth rate is likely to occur, for example, if the economy is producing at the maximum possible extraction rate, so that the same output of the natural resource is being shared by more people every period. This could happen if property rights over the common resource

$^{12}$ In fact, if the solution is interior in the sense that $i^m_t > 0$, the problem is formally identical.
are not well defined, as they are likely to be when the natural resource is owned by the public sector. More fundamentally, (10) is meant to capture the fact that the technological possibilities for production of the natural resource cannot expand in line with the growth of the economy’s capital and labor stocks, so that in per capita terms the output of the natural resource must fall. More people are trying to live off of the same stock.

The standard way to solve this model leads us to the following system of differential equations:

\[
\begin{align*}
\dot{c} &= c(Ack^{a-1} - \delta - \rho) \\
\dot{k} &= Ak^a - c - (n+\delta)k + Re^{-at}
\end{align*}
\] (12) (13)

Since the system is not autonomous, usual graphical solution techniques cannot be used. But the system can be linearized around the steady state and solved analytically. This allows us to establish:

**Proposition 1**: Given a sufficiently high R, an economy which starts out with a capital stock lower than its steady state level will overshoot its steady state in the precise sense that there will exist a T such that for all \( t > T \):

\[
\begin{align*}
c_t &> c^s \\
k_t &> k^s
\end{align*}
\]

**Proof**: See Appendix 1

Figures 2 shows the behavior of the capital stock in our model\(^{13}\).

**Insert Figure 2 Here**

The basic intuition here is that even though the natural resource economy has the same steady state as an economy without these resources, its abundance allows it to enjoy abnormally high levels of consumption for an extended period. However, in the long run, it will not be able to sustain its capital stock on the basis of its foreign exchange earnings, since those foreign exchange earnings tend to zero as time advances. Thus the process of adjusting towards the steady state is marked by declining output.

\[^{13}\] These results come from a simulation of a discrete time analog of the model presented above.
To illustrate this phenomenon, think of two economies, A and B, identical up to period $t_0$, and assume A enjoys a resource discovery in that period. Since A cannot save internationally, its only way of saving the resources is to invest domestically. As it starts saving, however, it pushes down its marginal product of capital and therefore raises the price of future consumption, stimulating a consumption boom. Since it is investing more than B, A will reach its steady state level of the capital stock in finite time. However, A will not then be in its steady state because at that moment it will have positive foreign revenue from its natural resource exports which allow it to invest more than it would be able to do in its steady state.; therefore A keeps investing and overshoots its steady state. As time progresses, however, any level of the capital stock higher than the steady state level becomes unsustainable, so that A’s production will tend to equal B’s. It is easy to see that this phenomenon cannot occur if the economy has access to perfect capital markets, as in that case the marginal product of capital would not be able to fall below the international rate of return.

Proposition 1 establishes that what is necessary to generate overshooting is that the initial stock of natural resource be large enough. is for the rate of depletion of the natural resource to be slow enough. In other words, if the economy is sufficiently natural resource intensive, it is likely to overshoot its steady state.

We believe that the dynamics of Figure 2 are a good characterization of the process currently undergone by many natural resource rich economies. The inability of the production of these exports to expand in line with growth of capital and labor inputs, either due to physical constraints or more importantly to stagnant international markets increasingly dominated by synthetic substitutes makes these economies’ growth necessarily temporary unless they can marshal other export industries to take the role of natural resource exports[^14].

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[^14]: The reader will recognize a strand of the arguments from the ECLA school regarding the tendency to fall in the prices of primary exports. We do indeed believe that the empirical evidence supports the predictions of Prebisch in this respect. In general, contemporary work on testing the Prebisch-Singer thesis has centered around the question of whether there is a downward time trend in the prices of primary exports or whether there was just a one time permanent fall in prices during the Great Depression. It is generally accepted that, whatever the answer, prices of primary commodities are nowadays considerably lower than at the beginning of the century. See Spraos, 1983.
case. Despite its many ups and downs, mainly related to OPEC export restrictions, Venezuelan physical production of oil has been approximately constant for the last forty years. Meanwhile, population growth has eroded almost three fourths of this production in per capita terms. In 1956, 4 barrels of oil were produced for every Venezuelan. Today, that figure has gone down to 1 barrel.

The above argument leaves many questions unanswered. Do these dynamics extend to more complex economies and realistic economies? Do they make quantitative sense, in the sense of enabling us to capture the main swings of the process undergone by a typical natural resource abundant economy? What happens when the economy has the alternative of developing alternative export industries?

In the next section, we explore these issues with a computable general equilibrium model calibrated to the Venezuelan economy. We show that an extension of the model presented in this section that allows for a series of other important factors accounts remarkably well for the main swings of the Venezuelan economy during the 1972-1993 period. We also use that model to analyze Venezuela’s recent export boom and to develop implications about the country’s dynamic comparative advantages.

3. An intertemporal general equilibrium model of the Venezuelan economy

In this section we present a dynamic macroeconomic model and calibrate it to the Venezuelan economy. We will use this model to show that (i) Venezuela does indeed seem to fit the picture of a country which has overshot its steady state and is converging to it from above; this sole fact seems to be the main explanation behind Venezuela’s poor growth performance (ii) The oil shocks of the 70s were able to offset this tendency only temporarily, and the model indicates that Venezuela is at the moment not very far from where it would have been without the oil shock (iii) The recent boom in Venezuelan non-oil exports may be illusory in that it is derived more from the combination of slack demand and an abnormally high capital stock than from the emergence of Venezuela’s long run comparative advantage.

To make this argument, we need to show that our model adequately characterizes the Venezuelan economy, while still being computationally tractable. In this section, we will argue that

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15 Although some of the dip in production during the seventies was due to producing below capacity, in 1993 Venezuela was producing at 87% of capacity (PDVSA, 1993).

16 PDVSA’s planned expansions for the end of the century promise to recover this figure to 1.4 barrels per person by 2006. However, a great part of this expansion will be achieved through profit-sharing agreements with transnationals as well as exploitation of the higher cost reserves of the Orinoco Belt, translating into a much lower surplus per barrel to be distributed between Venezuelans.
the model is indeed a good simple stylized description, both theoretically and empirically. We first present the equations of the model and justify its main assumptions. We also explain some salient facts about the calibration of the model. Then we show that the model is able to track reasonably well the main swings in the fundamental economic indicators of the Venezuelan economy (output, wages, share of non-tradeables, and exports) over the 1972-93 period. In the next section we go on to discuss the main inferences the model allows us to draw about the factors behind Venezuela’s poor growth record.

A. Structure of the Model

The model is an intertemporal dynamic three-sector trade model. The current account is set at zero so we ignore changes in world asset holdings by Venezuelans. As in the standard Dutch Disease model, we have three sectors: Tradeables, Non-Tradeables, and Petroleum. There is no uncertainty in the model, so we look for a perfect foresight equilibrium.

Agents maximize the discounted sum of a CES utility function in consumption. As we will model a perfectly competitive economy, we can find its solution in terms of a social planner’s problem\(^{17}\). As this is the specification we use to solve the model computationally, we present the equations of the planner’s problem below: All variables are in per capita terms.

\[
u = \sum_{t \in T} \text{DISC}_t \frac{c_t^{1-\sigma}}{1-\sigma} + \frac{\text{DISC}_T}{r} \frac{c_T^{1-\sigma}}{1-\sigma}
\]

(2)

where \(\text{DISC}_t = \left(\frac{1}{1+\lambda}\right)^{t-1}\) is the subjective discount factor\(^{18}\). \(\frac{c_T^{1-\sigma}}{1-\sigma}\) is simply the terminal period utility, which is necessary for solving the model computationally. Consumption is a composite of consumption of the three sectors:

where \(c_{it}^d\) refers to consumption of domestic goods and \(c_{it}^m\) is consumption imports. \(i = \{\text{traded, non-traded, petroleum}\}\).

\(^{17}\) Arrow and Hahn (1971), Debreu (1959), Negishi (1972).

\(^{18}\) The discount rate \(r\) is net of felicity effects of population growth.
The Production technology follows a nested CES specification. Thus output \( x_a \) is CES in Value Added and Intermediate Inputs.

\[
x_a = D_i \left( B_i f_a a_i^{\rho_i} + (1 - B_i) h_a a_i^{\rho} \right)^{\frac{1}{\rho}}
\]

(5a)

Value Added \( f_a a_i \) is Cobb-Douglas in Capital and Labor,

\[
f_a a_i = A_i l_i^{\alpha_i} k_i^{1-\alpha_i}
\]

(6)

but the aggregate of intermediate inputs that go into industry \( i \), \( h_a a_i \), is a CES function of the intermediate inputs going into industry \( i \) from industry \( z \),

\[
h_a a_i = G_i \left( \sum N_{iai} \text{int}_{iai} \right)^{\frac{1}{\lambda_i}}
\]

(7)

These intermediate inputs are determined also as a CES function of imported and domestic intermediate inputs, unless the good is not importable (we comment on which goods are importable below).

\[
\text{int}_{iai} = \begin{cases} 
S_i \left( F_i g d_{iai} r_e + (1 - F_i) g m_{iai} r_e \right)^{\frac{1}{\rho}} & \text{if } z \text{ is importable} \\
g d_{iai} & \text{if } z \text{ is not importable}
\end{cases}
\]

(8)

with \( r_e \) denoting use of domestic (imported) intermediates good \( z \) by industry \( i \). Non-tradeables has an alternative labor-only technology which is simply linear:

\[
x_i = \xi_i l_i
\]

A feasibility constraint specifies that Consumption plus investment plus purchases of intermediate imports must equal net domestic aggregate supply.

\[
c_a + iod_a + \sum z g d_{zia} = x'[a] - e_a
\]

(4)

with \( x'[a] = \begin{cases} x_a + x_i & \text{for } i = nt \\
x_a & \text{otherwise}
\end{cases} \)

With \( e_a \) denoting industry \( i \)'s exports, and \( iod_a \) referring to \( i \)'s domestically produced
investment goods. The intertemporal linkage is captured by an accumulation equation expressed in per capita terms:

\[ ks_{t+1} = \frac{ks_t \cdot (1 - \delta) + inv_{t+1}}{1 + \rho} \]  

(11)

Each investment good is composed of an equiproportionate bundle of goods from separate industries:

\[ io_{it} = \gamma_i inv_t \]  

(12)

those goods are a CES bundle of domestic and imported investment goods.

\[ io_{it} = \begin{cases} Y_i \left( H_i iod_{it} + (1 - H_i) iom_{it} \right)^{\frac{1}{\theta}} & \text{if } i \text{ is importable} \\ iod_{it} & \text{if } i \text{ is not importable} \end{cases} \]  

(13)

Imports and exports must satisfy the external constraint:

\[ \sum_i pe_i e_i = \sum_i \sum_z pim_i g_m + \sum_i pkm_i iom_i + \sum_i pcm_i c_i^m \]  

(4)

Factor uses of labor and capital must balance

\[ l_t^s = \sum_i l_i + l_i \]  

(9)

\[ k_t^s = \sum_i k_i \]  

(10)

and we use a standard terminal condition to find a solution:

We close the model by specifying the world demand for Venezuelan oil exports as exogenous \( e_{pet,s} = \bar{e} \), and specifying an initial capital stock \( k_t^s = \bar{k} \). We model Venezuela as a small country, so that \( pe_i, pim_i, pkm_i, \) and \( pcm_i \) are given.\(^{19}\)

\(^{19}\) This assumption is unrealistic only for the case of oil exports. In the case of oil prices and exports, the exogeneity assumption means that OPEC decisions do not depend on the domestic economy.
Our choice of model specification is driven by the desire to write a basic stripped down model which is capable of capturing the key interactions of an economy characterized by strong Dutch disease and which for most of the period under study followed strong import substitution policies.

One of the main characteristics of the model is that it specifies in great detail the intermediates and capital goods technologies, while it doesn’t model the consumption side in much detail. The main reason for this is that, in fact, consumption imports were of little relevance during the period under study. Capital and intermediate goods made up between 75 and 85% of imports\textsuperscript{20}, and commercial policy was explicitly designed to favor intermediate and capital good imports in detriment of consumption imports, following the conventional import substitution wisdom. Thus, even though the unweighted ad valorem tariff rate was 34%, it was as high as 49% for consumer goods. And while a policy of exonerations reduced the effective level of these tariffs for intermediates and capital goods to less than 10%, consumer goods would end up paying tariffs of at least 20-30% if they were granted an exonation, which they often were not. A full 81% of consumer goods were subject to licensing, compared with between 25 and 35% of intermediate and capital goods\textsuperscript{21}. To capture the full impact of these import substitution policies in the stylized framework of the model, we constrain consumption imports to zero during the import substitution period of the model (1972-1988).

Another important feature of the model is the backstop technology for production of non-tradeables. This kind of specification is common in many development models, and tries to capture the feature that developing economies have alternative labor markets which impart the economy with a great deal of wage rigidity without generating the high levels of unemployment common in more advanced economies\textsuperscript{22}. This can be seen as a shortcut for the specification of a fuller model of the labor market along the lines recently advocated by Devarajan, Ghanem and Thierfelder (1996).

As Venezuelan legislation explicitly prohibits imports of oil products by anyone other than the state oil enterprise, and as these imports are typically negligible\textsuperscript{23}, we restrict the imports of Petroleum goods to equal zero. Therefore our Non-Importable industries are Petroleum and Non-Tradeables.

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\textsuperscript{20} Own calculations based on OCEI (Various Years).

\textsuperscript{21} See World Bank, 1987.

\textsuperscript{22} Lewis (1954), Taylor (1983).

\textsuperscript{23} They typically do not exceed 1% of imports. See Antivero, 1992.
B. Model Calibration

We calibrate our model to the 1984 Social Accounting Matrix for Venezuela developed by Clemente and Puente (1987)\textsuperscript{24}. This allows us to retrieve the parameters $\beta_i, D_i, B_i, A_i, \alpha_i, G_i, N_i, S_i,$ and $F_i$. Our elasticity estimates for $\rho_i, \theta_i, \lambda_i, \eta_{il}$ are taken from Hentschel (1991). Appendix 2 shows our Social Accounting Matrix as well as the values taken by the parameters. $\sigma$ was taken from Ostry and Reinhart’s (1992) estimates for Latin American economies. The discount rate $r$ was set to 0.065\textsuperscript{25}. $n$ is taken from Venezuelan demographic statistics. $\psi_i$ is set to equal the average wage rate for informal sector workers in the baseline year.

Our treatment of exports deserves a special comment. In the baseline year (and this is true in general for the period previous to the late 80s) petroleum exports accounted for almost 88% of exports. But exports of petrochemicals, minerals, and the energy-intensive basic industries counted for another 7%, making Venezuela’s percentage of exports which depend either directly or very closely on its comparative advantage in energy production at least 95\textsuperscript{27}. In other words, non-oil exports in the baseline year were next to zero. Economically, this means that there are many potential export industries which are not finding it profitable to produce any exports in the Venezuelan economy as captured by our base year data. We choose thus to modify the base year social accounting matrix so that non-oil exports are equal to zero.

This is more than a stylized description: it actually carries with it an important assumption,

24 The matrix was modified to ensure consistency with the simplifying assumptions of our model (zero consumption imports, zero base year exports of the Artificial Non-Traded sector, as well as no government sector). Thus we estimated our Social Accounting Matrix using a method proposed by Zenios (1996) which sets the components of the matrix by minimizing the sum of squared deviations from the original observations both of the elements of the matrix as of their row and column totals. We imposed the additional restriction that exports of oil should be held at their baseline year level, since one of the elements of the closure is an exogenous series for oil exports. As this introduced certain variations in the data, all of our comparisons with historical data are actually with historical data scaled by the proportion of our estimated value of that variable in the Social Accounting Matrix used to their value in national accounts.


26 Mendoza and Uribe (1996) calculate this as the equilibrium value in an endogenous discount rate calibration to the Mexican economy.

27 An important fraction of the remaining 5% are on transport services, of which a large proportion was probably oil-related also. Own calculations based on Antivero (1992) and Banco Central de Venezuela (Various Years) Anuario de Cuentas Nacionales.
namely, that the export price level is not sufficiently high to induce exports of non-petroleum goods in equilibrium. Usual calibration techniques would assign a relative price (with respect to the numeraire imported intermediates) of 1 to these exports, which would mean that an unit of home production would be assumed to have sold for the same price in international markets than in national markets. We have chosen to model exports as having a price lower than 1 in the baseline year. Our modeling choice is driven by the belief that a 1984 price of exports equal to one would overestimate the value international markets would have put on Venezuelan goods. We believe that the practical insignificance of non-oil exports during the boom years in Venezuela suggests that they would not have been able to sell for the same price which equivalent goods were selling for in domestic markets.

By not restricting the relative price of exports in the base year to equal one, we are creating an unobservable parameter. Our admittedly questionable solution to calculating the relative price of exports in the base year is to look closely at the price that export industries which were indeed forced by slack domestic demand to export were able to fetch on international markets. A great quantity of exports is indeed countercyclical in Venezuela: goods are only exported to international markets if there is no domestic demand for them. We thus look at the price levels at which manufacturing\textsuperscript{28} industries with very countercyclical\textsuperscript{29} exports were selling their exports during the 1989-90 recession so as to get an indicator of what price international markets were willing to pay for Venezuelan exports. The fact that the 1989 recession was particularly deep and unexpected makes it almost a natural experiment for finding out the price which international markets would have paid for Venezuelan products. This calculation gives us an export price level of .625, that is, 62.5\% of the price of tradeables in the domestic market in the baseline year.

The simulations are run with all price and total factor productivity levels, as well as the level of petroleum exports, detrended using the Hodrick-Prescott filter\textsuperscript{30}. This comes from our desire to capture the main swings in the relevant variables, and not the high frequency fluctuations. The only series which, after filtering, have considerable variation left are petroleum exports and petroleum export prices.

The model was solved using GAMS Release 2.25. A code for the model is available from

\textsuperscript{28} We exclude agriculture because the perishability of its products may indeed force it to accept a price decline much greater than the price it would be able to get in the long run if it wants to sell output which it has not been able to place in the home market.

\textsuperscript{29} We defined an industry as very countercyclical if it observes a fall in its volume of exports during the 1986-88 expansion relative to both the 1984-85 and 1989-90 recessions.

\textsuperscript{30} As we are using annual data, the value $\lambda = 10$ was used for the Hodrick-Prescott filter. This value is common in studies with annual data.
the authors upon request.

C. Overshooting Tendency

Figure 4 shows that this more complex model is indeed characterized by the same overshooting tendency of the simple analytical model sketched previously. In it, we draw the transition paths of two economies which start out from an identical capital stock of just under 60% of its steady state value. One of them has no natural resource earnings, while the other one has export earnings from the natural resource industry of approximately 1/3 of initial year GDP. Similar figures obtain in terms of output or consumption per worker.

Insert Figure 4 Here

D. Historical Simulations

Figures 5-9 show the model’s prediction of the economy’s key variables, plotted against the historical data. Since we are making no attempt to explain high frequency fluctuations, we show the long run component of the historical data as derived from passing it through a Hodrick-Prescott filter. These figures show that the model is able to predict the main swings undergone by some key variables in the Venezuelan economy, getting the magnitude and timing of the boom right. This is encouraging, as it suggests that our model captures the key underlying forces driving Venezuelan economic fluctuations.

Figure 5 shows that the apparent “lack of Dutch Disease” in the Venezuelan economy which has been documented by previous authors is accountable for in the context of a general equilibrium model. The claim of Gelb (1988) that the lack of response of non-tradeables as a proportion of GDP to the revenue influx of the seventies was due to the fact that the Venezuelan economy was already way too specialized in non-tradeables for there to be a much greater expansion of that sector seems sensible. Indeed, the model predicts that non-tradeables expands very little as a reaction to the influxes. It also predicts the contraction of non-tradeables that indeed occurred during the mid 1980s, as well as the subsequent expansion due to the growth of informal sector employment.31

The model is also able to predict the main swings in GDP (Figure 7 and 8) and non-petroleum exports (Figure 9) pretty accurately. It seems poorest in accounting for the wage rate’s

---

31 The model does have a tendency to predict that downturns in the economy (and in the share of non-tradeables) would come later than expected. The Venezuelan economy did indeed fail to be stimulated much by the second oil shock, mainly because of the contractionary policies of the Herrera administration. See Rodriguez, 1986 for an account of the political economy of the Herrera contraction.
behavior. Even though it tracks the wage rate’s decline during the 1980s accurately, it fails to predict their low pre-boom levels. The reason for this can be traced to the cutbacks in petroleum production during the early 70s which were made in order to fulfill new OPEC quotas. For the effects of the model, this translates into an abnormally high level of Total Factor Productivity during 1972-73 compared to the rest of the period. Historically, the effects of wages of this fall in TFP were more than offset by the rise in international prices; but in our model exports are set exogenously and domestic production is set competitively so that international oil prices are precluded from having any effect on the wage level. However, except for the failure in predict the low beginning of period wages, the model tracks the wage rate reasonably well for the rest of the time period.

Insert Figure 5 Here
Insert Figure 6 Here
Insert Figure 7 Here
Insert Figure 8 Here
Insert Figure 9 Here

In sum, our model’s performance in capturing the main swings in the Venezuelan economy is satisfactory, though not perfect. It does seem to capture the key tendencies in output, exports, and the sectoral composition of production. In the whole, it lends support to our thesis that the behavior of the Venezuelan economy during the past two decades can be understood as the response of an economy that is depleting its natural resources to a temporary rise in its oil exports. In the next section, we turn to see what our model tells us about the position of the economy with respect to its long run equilibrium.

4. Experiments with the intertemporal model

A. Understanding Venezuela’s Growth Performance

The central contention of this paper is that a typical natural resource exporter is likely to be converging from its steady state from above and will therefore perform poorly in terms of GDP per
capita growth. Figures 8 and 9 show the levels of per capita GDP and per-period Utility \textsuperscript{32} achieved in the model simulation and in an alternative simulation in which oil exports, prices and TFP are kept fixed at their 1972 levels. All three figures underscore the fact that Venezuela is at this moment not very far from where it would have been without an oil shock. They also show that the country’s poor growth is due to the fact that it is converging to its steady state from above. In fact, the figures suggest that per capita output in Venezuela is at the moment more than twice as high as its steady state level.

Our simulations also suggest that the slight recovery in output towards the late 80s and early 90s is due to a mix of improving TFP and more favorable international prices of imported intermediates. Thus, even at constant oil prices, the model predicts a temporary halt to the fall in output at the end of the 1980s. This corresponds to an upward shift of the steady state level of output (not shown). This recovery should not distract from the fact that the overall tendency of per capita GDP is to decline. Indeed, augmented Dickey-Fuller tests for non-stationarity of TFP and international prices faced by the Venezuelan economy did not allow us to reject the unit root hypothesis, indicating that further improvements in these factors cannot be expected to revert the tendency of the Venezuelan economy to decline towards its steady state levels. This point is driven home by Figure 12, which shows that the model projects that Venezuelan GDP per capita will fall by over a quarter during the next twelve years.

\textbf{Insert Figure 10 Here}  
\textbf{Insert Figure 11 Here}  
\textbf{Insert Figure 12 Here}

In a certain sense, the Venezuelan economy’s predicted decline will be due as much to depletion of natural resources as it is to Venezuela’s lack of productivity growth. The projections of Figure 12 are based on an assumption of constant TFP from 1994 to 2005. What is surprising is that this is actually a reasonable assumption. As shown in Figure 13, Venezuelan TFP has been approximately constant for the past 20 years in non-tradeables as well as in tradeables\textsuperscript{33}. This stands in contrast to the high TFP growth rates achieved by the strongest emerging economies in the same

\textsuperscript{32} This is just an index of consumption.

\textsuperscript{33} Our results confirm those of Paredes, who found that “in contrast with the experience of the industrialized countries and of the rapidly growing LDCs, the contribution of TFG to overall economic growth in Venezuela has been negligible since the 1950s...with the exception of the early 1990s, productivity growth has been negative since the 1970s.” (1993, p.12)
period, although it falls in line with the experience of the rest of Latin America\textsuperscript{34}. Our model extrapolates this trend, and is therefore able to derive a low level of the capital stock.

**Insert Figure 13 Here**

However, our simulations suggest that Venezuela would need TFP growth of approximately 1.1\% a year simply to offset the declining tendency for output seen in Figure 13. This productivity growth would be roughly equal to that which was experienced by the best performing developing economies of the world over the last thirty years. But, where in the case of countries like South Korea such productivity growth has brought about higher living standards, in Venezuela it would simply offset the fall in oil revenues. For Venezuelan GDP per capita to increase significantly, Venezuela would need to achieve rates of TFP growth equal to those of the strongest performing emerging economy in the last thirty years, China.

In the whole, our model suggests that the fact that per capita non-oil GDP was in 1993 not far above its 1972 level (and total per capita GDP was indeed lower) is not surprising despite the influxes of oil revenues that the Venezuelan economy enjoyed during the seventies and eighties. The first tendency of an economy receiving these influxes is to invest them nationally if it cannot internationally. This will generate abnormally high levels of the capital stock, production and consumption which cannot be sustained in the long run. When time comes to start drawing down this level of the capital stock, the economy will end up not very far from where it was if it received no influx of revenues. Indeed, its long run steady state has not changed. Thus, despite the positive effects of the oil shock for the Venezuelan economy, it did not serve to counter more than temporarily the tendency of output to fall towards its steady state level. According to our model, unless international prices or productivity can be counted on to move favorably, the Venezuelan economy has a long decline in front of it.

Table 1 shows the results of sensitivity analysis carried out with respect to our parameters. Our results do not seem sensitive to our parameter assumptions. The steady state levels of output and the capital stock is hardly changed by altering the values of the elasticities. The discount rate, the price of exports and the productivity of the informal sector all have a moderate effect, but do not take away from the main conclusion that the steady state levels of output and the capital stock are considerably lower than their present day levels.

**Insert Table I Here**

B. *Venezuela’s Export Boom: Will it Last?*

\textsuperscript{34} Collins and Bosworth (1996) calculate an annual TFP growth rate of -.8 for Latin America over the 1973-1994 period.
Figure 7 shows that Venezuelan exports have expanded recently, and the model predicts this expansion quite accurately. And indeed, it is precisely what one would expect to see on the basis of simple intuition about the Dutch Disease: as export revenues from the boom industry fall, it is necessary for alternative industries to expand while the non-tradeables industry contracts.

In our model, this fact is complicated by the fact that we expect the Venezuelan economy’s capital stock to decline, not rise, towards its steady state level. This fact is particularly important if the economy experiences a downward shock in its oil export price as the Venezuelan economy did during the second half of the 80s. The first tendency of the economy will at that moment to export more non-tradeables to import intermediates and to keep production going given the existing capital stock. In the long run, the economy’s tendency is to draw down its level of the capital stock, thus allowing for a fall in exports.
Insert Figure 14 Here

Figure 14 gives support to this view. After an initial export boom in the late 80s, the fall in the capital stock brings down with it the export requirements of the economy. Therefore oil and non-oil exports go down together. Our model thus casts doubt on the long run prospects of the Venezuelan export industry. Although this industry will tend to expand as a proportion of the economy's output, it can be expected to decline in absolute terms in line with the rest of the economy. Our model paints a pessimist picture of the prospects for Venezuela's exports.

In order to gain insight as to the dominant factor intensities of the nascent export industries, we now use the model to attempt to discriminate between several export industries. To do this, we run simulations with tradeable export industries substituted by four alternative export industries. These industries are characterized by the same parameters as the tradeables industry we have been using except as respects their labor intensity. Several degrees of labor intensities are selected by choosing production functions that have more convex isoquants placed along the isoquant for the baseline industry (See Figure 15). This is equivalent to considering the baseline industry's isoquant an "outer envelope" of isoquants for many alternative export industries.

Insert Figure 15 Here

Table 2 shows our results. They indicate a changing dynamic comparative advantage from more capital intensive to more labor intensive industries. The first export boom is characterized by production in medium and moderate labor intensive industries, whereby our model predicts that by the late 90s export production will have shifted to more labor intensive industries.

Insert Table 2 Here

The results of Table 2 suggest that the usual strategy used in many studies of competitiveness of looking for the most efficient industries given the static general equilibrium of the economy may be a poor guide to a nation's long-run comparative advantage in the case of a natural resource intensive industry. This fact is well known in the case of countries that are converging to their steady states from below and can be traced back to Chenery and Syrquin's (1986) description of the trends in sectoral composition of output and exports during the path of development, which suggested increasing capital intensity of export industries through time. What is less well understood is that for natural resource intensive economies the tendency may be for more labor intensive industries to dominate in the long run, as their capital stock may be falling.

35 Technically, we set tradeable export to zero and introduce four alternative export industries.

36 See for example, Findlay 1995 for a description of this technique.
This fact may be illustrated with reference to recent studies of competitiveness in Venezuela (see Enright, Francés and Saavedra, 1994). These studies conclude that Venezuela’s most competitive industries are in skilled labor and human capital intensive industries. Although our model does not have several types of labor, it does suggest that this conclusion may be mistaken insofar as human and physical capital are complementary in production. The suggestion is that the nation’s comparative advantage may shift through time so that more labor intensive industries will become dominant. This is a straightforward consequence of the economy’s need to draw down its capital stock. Studies of competitiveness based on static comparative advantage may mistakenly pick out the wrong industries as the most competitive ones. This mistake is caused by considering static comparative advantage instead of the more useful dynamic comparative advantage that our model illustrates.

5. Concluding Remarks

This study shows that a story of natural resource economies as converging to their steady states from above makes both theoretical and empirical sense. It makes theoretical sense insofar as it is a natural feature of the transition path of a neoclassical growth economy which also exports natural resources. It makes empirical sense in that a simple stylized model with this feature calibrated to a natural resource exporting economy is well able to track the main swings in that economy’s output and its sectoral composition.

We have used this model to study Venezuelan economic performance. Besides finding that Venezuela seems to have overshot its steady state considerably, and that barring high productivity growth we can expect per capita GDP to decline steadily in the future, we have also used our model to argue that Venezuela’s recent export boom may be more a consequence of slack demand combined with an abnormally high level of the capital stock than of the emergence of industries which will in the long run substitute for oil exports. As a matter of fact, our model suggests that the industries which will substitute for oil will tend to be much more labor intensive than those which have emerged during the recent export boom. This is due to the fact that the economy’s comparative advantage changes through time, a factor not always considered in studies of comparative advantage.

The decline in GDP per capita is of course a politically difficult process in which expectations of living standards must continuously adjust downwards for various generations. It creates frustration and sparks social resentment, as Venezuelans see themselves enjoying lower living standards than their parents. Indeed, a recent Gallup survey of several countries found Venezuela to be the one with the greatest proportion of people who claimed that they would like to leave.

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Our model suggests that Venezuela’s poor growth performance has more to do with the fact that it is living beyond its means rather than with other factors which the literature has emphasized. What does our model have to say about the growing literature which has put political factors at the root of the failure of oil exporting countries? One interesting interpretation is that the political dimension enters precisely in the impediment for the economy of investing its oil revenues internationally. This suggests a role for recent work which shows that the equilibrium response of an economy to positive terms of trade shock may not be to raise its holdings of foreign assets, due to the interaction of political and economic forces. Putting together our work with these models is a promising avenue for future research.

Our model presents bleak prospects for the Venezuelan economy. Most striking is the prediction that Venezuela’s capital stock and production is bound to keep falling as it converges back to its steady state capital stock, which according to our model is substantially lower than present day levels. But this is due as much to Venezuela’s lack of productivity growth than to its natural resource abundance. What is really striking is that a constant rate of productivity growth is not an unreasonable assumption for Venezuela, as shown in Figure 12. If Venezuela were able to achieve rates of productivity growth similar to those undergone by the strongest performing developing countries, the downward tendency in the growth rate could be reversed.

Modern growth theory suggests that there are indeed many reasons, some of them policy induced, that can sustain a process of endogenous productivity growth. Figure 12 suggests that, whatever those things are, Venezuela has not been doing them. Although this is not the place for setting out a growth strategy for Venezuela, it is clear that the design of such a strategy with emphasis on recovering productivity is key for the well-being of future Venezuelans. After forty years of democracy, the relevant question is still how to sow the petroleum. But time is pressing, and Venezuela is running out of petroleum to sow.

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7. Appendices

A. Appendix 1: Proof of Proposition 1

Since a steady state must be stable asymptotically, it must be the case that if it exists \( \text{Re}^{-n} = 0 \) in it. But then the steady state levels of consumption and the capital stock are the same as in the classical case:

\[
k^{ss} = \left( \frac{\delta + \rho}{A \alpha} \right)^{\frac{1}{\alpha - 1}}
\]

\[
c^{ss} = A k^{ss} (n + \delta) k^{ss}
\]  

(A1)\hspace{2cm} (A2)

We can now linearize (12) and (13) around the steady states:

\[
\begin{align*}
\delta^c &= c^{ss} A \alpha (\alpha - 1) k^{ss} (k - k^{ss}) \\
\delta^k &= (\rho - n) (k - k^{ss}) - (c - c^{ss}) + \text{Re}^{-n}
\end{align*}
\]

We now have a linear system we can express in matrix form:

\[
\begin{bmatrix}
\delta^c \\
\delta^k
\end{bmatrix} = \begin{bmatrix}
0 & c^{ss} A \alpha (\alpha - 1) k^{ss} (\alpha - 2) \\
-1 & \rho - n
\end{bmatrix} \begin{bmatrix}
c \\
k
\end{bmatrix} + \begin{bmatrix}
-c^{ss} A \alpha (\alpha - 1) k^{ss} (\alpha - 1) \\
-(\rho - n) k^{ss} + c^{ss} + \text{Re}^{-n}
\end{bmatrix}
\]

\[
= A \begin{bmatrix}
c \\
k
\end{bmatrix} + B(t)
\]

(A3)\hspace{2cm} (A4)

(A5)

Solving for the eigenvalues of \( A \):

\[
\begin{vmatrix}
0 - \lambda & c^{ss} A \alpha (\alpha - 1) k^{ss} (\alpha - 2) \\
-1 & \rho - n - \lambda
\end{vmatrix} = 0 \Leftrightarrow \lambda^2 - (\rho - n) \lambda + c^{ss} A \alpha (\alpha - 1) k^{ss} (\alpha - 2) = 0
\]

27
\[ \lambda^2 - (\rho - n)\lambda + c^{\alpha} A\alpha(\alpha - 1)k^{x\alpha - 2} = 0 \]  
(A6)

with roots:

\[ \lambda_1 = \frac{\rho - n}{2} + \frac{\sqrt{(\rho - n)^2 - 4c^{\alpha} A\alpha(\alpha - 1)k^{x\alpha - 2}}}{2} \]
\[ \lambda_2 = \frac{\rho - n}{2} - \frac{\sqrt{(\rho - n)^2 - 4c^{\alpha} A\alpha(\alpha - 1)k^{x\alpha - 2}}}{2} \]  
(A7)

The associated matrix of eigenvectors will be:

\[ V = \begin{bmatrix} \lambda_2 & \lambda_1 \\ 1 & 1 \end{bmatrix} \]  
(A8)

with inverse:

\[ V^{-1} = \frac{1}{\lambda_2 - \lambda_1} \begin{bmatrix} 1 & -\lambda_1 \\ -1 & \lambda_2 \end{bmatrix} = \begin{bmatrix} V_{11}^{(-1)} & V_{12}^{(-1)} \\ V_{21}^{(-1)} & V_{22}^{(-1)} \end{bmatrix} \]  
(A9)

Premultiplying (18) by \( V^{-1} \) allows us to diagonalize the system:

\[ \begin{bmatrix} z_1' \\ z_2' \end{bmatrix} = \begin{bmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{bmatrix} \begin{bmatrix} z_1 \\ z_2 \end{bmatrix} + \begin{bmatrix} -V_{11}^{(-1)}c^{\alpha} A\alpha(\alpha - 1)k^{x\alpha - 1} - V_{12}^{(-1)}((\rho - n)k^{x\alpha} + c^{\alpha}) + V_{12}^{(-1)}Re^{-\alpha t} \\ -V_{21}^{(-1)}c^{\alpha} A\alpha(\alpha - 1)k^{x\alpha - 1} - V_{22}^{(-1)}((\rho - n)k^{x\alpha} + c^{\alpha}) + V_{22}^{(-1)}Re^{-\alpha t} \end{bmatrix} \]

\[ = \begin{bmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{bmatrix} \begin{bmatrix} z_1 \\ z_2 \end{bmatrix} + \begin{bmatrix} K_1 + V_{12}^{(-1)}Re^{-\alpha t} \\ K_2 + V_{22}^{(-1)}Re^{-\alpha t} \end{bmatrix} \]  
(A10)

This system has solution:

\[ z_1 = be^{\lambda_1 t} + \frac{K_1}{\lambda_1} - \frac{V_{12}^{(-1)}Re^{-\alpha t}}{\lambda_1 + n} \]  
(A11)
\[ z_2 = b_2 e^{\lambda_2 t} + \frac{K_2}{\lambda_2} - \frac{V_{22}(-1) \text{Re}^{-rt}}{\lambda_2 + n} \]  
\[(A12)\]

for

\[ K_1 = V_{11}(-1) c^{ss} \alpha(\alpha - 1) k^{ss\alpha - 1} + V_{12}(-1) ((\rho - n) k^{ss} + c^{ss}) \]  
\[(A13)\]

\[ K_2 = V_{21}(-1) c^{ss} \alpha(\alpha - 1) k^{ss\alpha - 1} + V_{22}(-1) ((\rho - n) k^{ss} + c^{ss}) \]  
\[(A14)\]

with the solution for the original variables satisfying:

\[
\begin{bmatrix} c \\ k \end{bmatrix} = \begin{bmatrix} z_1 \\ z_2 \end{bmatrix} = \begin{bmatrix} \left( b_1 e^{\lambda_1 t} + \frac{K_1}{\lambda_1} \right) - \frac{V_{12}(-1) \text{Re}^{-rt}}{\lambda_1 + n} + \frac{b_2 e^{\lambda_2 t} + \frac{K_2}{\lambda_2} - \frac{V_{22}(-1) \text{Re}^{-rt}}{\lambda_2 + n}}{\frac{V_{21}(-1) \text{Re}^{-rt}}{\lambda_1 + n} + \frac{b_2 e^{\lambda_2 t} + \frac{K_2}{\lambda_2} - \frac{V_{22}(-1) \text{Re}^{-rt}}{\lambda_2 + n}}{A13} + n} \end{bmatrix}
\]

The transversality condition implies \( b_1 = 0 \), whereas the initial condition implies

\[ b_2 = k_0 - \frac{K_1}{\lambda_1} + \frac{V_{12}(-1) R}{\lambda_1 + n} - \frac{K_2}{\lambda_2} + \frac{V_{22}(-1) R}{\lambda_2 + n} = k_0 - k_{ss} - \frac{R n}{(\lambda_1 + n)(\lambda_2 + n)} \]  
\[(A16)\]

For the capital stock to exceed its steady state level it must hold that:

\[ k_i > k_{ss} \iff b_2 e^{\lambda_2 t} - \frac{V_{22}(-1) \text{Re}^{-rt}}{\lambda_2 + n} - \frac{V_{12}(-1) \text{Re}^{-rt}}{\lambda_1 + n} > 0 \]  
\[(A17)\]

Substituting (A16) into (A17) we get:

\[ \left( k_0 - k_{ss} \right) e^{\lambda_2 t} + \frac{R n}{(\lambda_1 + n)(\lambda_2 + n)} \left( e^{-rt} - e^{\lambda_2 t} \right) > 0 \]  
\[(A18)\]

The second term on the right-hand side of (A18) will always be positive, since \( \lambda_2 > -n \) if and only if \( e^{-rt} > e^{\lambda_2 t} \). Therefore, for a given \( \left( k_0 - k_{ss} \right) \), \( R \) sufficiently large will ensure that (A18) will hold, proving our claim.
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Table A.1: Social Accounting Matrix for 1984 (Unbalanced)
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**Table A.2**: Social Accounting Matrix for 1981 (Balanced)
Figure 1

Oil Revenues and Per Capita Consumption, 1960-1993

Figure 2

Transition to Steady State in Natural Resource and Ramsey Economies
Figure 3
Yearly and Per Capita Production, 1956-1993

Figure 4
Overshooting Tendency of Capital Stock in Model
Figure 5
Non-Tradeables as a Percent of Non-Petroleum GDP

Figure 6
Wage Rate
Figure 7
Non-Petroleum GDP

Figure 8
Non-Petroleum GDP Per Capita
Figure 11
Per Period Utility in Oil and Non-Oil Model

Figure 12
Per Worker GDP Projections, 1994-2005
Table 1: Sensitivity Analysis: Non-Oil GDP per capita under alternative parameter assumptions

<table>
<thead>
<tr>
<th>Elasticities of Substitution</th>
<th>High</th>
<th>Baseline</th>
<th>Low</th>
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<tr>
<td>Domestic and Imported Intermediates</td>
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<tr>
<td>Parameter Value</td>
<td>0.50</td>
<td>0.25</td>
<td>0.17</td>
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<tr>
<td>Per Worker GDP</td>
<td>17.75</td>
<td>17.71</td>
<td>17.71</td>
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<tr>
<td>As % of 1993 Level</td>
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<td>Per Worker GDP</td>
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<tr>
<td>As % of 1993 Level</td>
<td>46.85</td>
<td>46.80</td>
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<td>Value Added and Intermediates</td>
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<td>17.73</td>
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<td>0.07</td>
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<td>Per Worker GDP</td>
<td>16.75</td>
<td>17.71</td>
<td>19.27</td>
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<tr>
<td>As % of 1993 Level</td>
<td>44.28</td>
<td>46.80</td>
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<td>Price of Exports</td>
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<td>As % of 1993 Level</td>
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<td>Productivity of Informal Sector</td>
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<td>12.10</td>
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<td>As % of 1993 Level</td>
<td>57.97</td>
<td>46.80</td>
<td>31.98</td>
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</table>

Values refer to non-oil GDP per capita, in thousands of 1984 Bs. per worker.

Table 2: Intensities of Emerging Export Industries

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<th>% of Total Export Production</th>
<th>Moderate Capital Intensity</th>
<th>Middle Intensity</th>
<th>Moderate Labor Intensity</th>
<th>High Labor Intensity</th>
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<td>1990-92</td>
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<td>0%</td>
<td>100%</td>
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<tr>
<td>1992-95</td>
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<td>0%</td>
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<td>10%</td>
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<td>1996-98</td>
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<td>0%</td>
<td>62%</td>
<td>38%</td>
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<td>1999-01</td>
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<td>0%</td>
<td>66%</td>
<td>34%</td>
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