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Venezuela's Growth Experience

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ABSTRACT

The standard of living, measured as gross domestic product (GDP) per capita, increased dramatically in Venezuela relative to that of the United States from 20 percent in 1920 to 90 percent in 1958, but since then has collapsed to around 30 percent nowadays. What explains these remarkable growth and collapse episodes? Using a standard development accounting framework, we show that the growth episode is mainly accounted for by an increase in capital accumulation and knowledge transfer associated with the foreign direct investment in the booming oil industry. The collapse episode is accounted for equally by a fall in total factor productivity and in capital accumulation. We analyze Venezuela during the collapse episode in the context of a model of heterogeneous production units where policies and institutions favour unproductive in detriment of more productive activities. These policies generate misallocation, lower TFP, and a decline in capital accumulation. We show in the context of an heterogeneous-establishment growth model that distortionary policies can explain between 80 to 95 percent of the current differences in TFP, capital accumulation, and income per capita between Venezuela and the United States.

JEL classification: O4.

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1 Introduction

The process of economic growth in Venezuela in the last two hundred years represents an interesting development experience since it encompasses periods of remarkable growth and collapse within a short time span. Figure 1 summarizes the growth experience in Venezuela by documenting gross domestic product (GDP) per capita relative to that of the United States from 1820 to 2009.¹ There are three distinct growth periods. First, a period of stagnation from 1820 to 1920 where relative GDP per capita declined at the rate of the increase in the standard of living in the United States.² Second, a period of remarkable growth where relative GDP per capita increased from about 20 percent in 1920 to more than 90 percent in 1958. Third, a period of remarkable decline where GDP per capita decreased from its peak around 90 percent to about 30 percent nowadays. In this paper we focus on the episodes of remarkable growth and decline. More specifically, we ask: What factors explain the remarkable growth episode between 1920 and 1958 and what factors explain the growth collapse after 1958?

We first layout a simple accounting framework to guide our search for the relevant factors accounting for the episodes of remarkable growth and collapse. We find that the growth episode is mostly accounted for by a substantial process of capital accumulation and knowledge transfer associated with the fast expansion of the oil industry. During this period, the oil sector was open to foreign investment and output production expanded at a fast rate. Public infrastructure projects complemented the expansion of the oil industry. We find that the collapse episode is accounted for equally by a fall in total factor productivity (TFP) and a decline in capital accumulation. We present substantial evidence of three sources of misallocation that may be at the core of the fall in TFP and capital accumulation during this period: a government induced movement away from oil activities, the government involvement in “big” industry projects such as steel, aluminium and

¹GDP is measured in international dollars of 1990 and the data are from Maddison (2010).

²The period of stagnation (relative decline) is consistent with theories of differential timing of takeoff of modern growth such as Lucas (2000) and Gollin, Parente, and Rogerson (2002).

other heavy basic industries, and an overall government intervention in the allocation of factors among economic activities through regulations, price controls, and intervention in credit channels. To assess the quantitative impact of these policies, we consider a model of heterogenous producers following Restuccia and Rogerson (2008). We find that policy distortions can explain most of the collapse in productivity and capital accumulation observed in Venezuela after the late 1950s.

Our paper is related to a large literature in macroeconomics and growth trying to assert the importance of factor accumulation and productivity in understanding income differences across countries such as Klenow and Rodriguez-Clare (1997) and to a growing literature on the importance of policy distortions on aggregate productivity such as Restuccia and Rogerson (2008) and Hsieh and Klenow (2009). For the particular case of Venezuela, our paper also relates to the “Dutch disease” literature where the allocation of resources in the economy is affected by a booming exhaustible natural resource sector such as oil.³ There is a debate whether the exceptional growth experience in Venezuela from the 1920s and even the collapse experience since the 1960s can be reconciled with the “Dutch-disease” mechanism.⁴ Our paper differs from this broad literature in that we focus on the (mis) allocation of resources by the government who initially follows misguided public policies and later faces a substantial boom in revenues.⁵

The rest of the paper is organized as follows. The next section summarizes the main economic environment in Venezuela since 1920 to nowadays. Section 3 lays out the accounting framework we use and our main findings. In Section 4 we describe the model and calibration. Section 5 presents

³See for instance Corden and Neary (1982). See also Sachs and Warner (1995) for empirical evidence on the lower income growth rates observed in resource-abundant economies relative to other economies.

⁴See for instance Hausmann (2001). Rodríguez and Sachs (1999) offer an alternative explanation of the growth collapse based on an optimal overshooting to the steady state equilibrium of consumption and investment in resource-abundant economies. Another explanation based on the performance of the oil sector is in Hausmann and Rodríguez (2006) who argue that the growth collapse is the result of the decline in per-capita oil rents, a fall in total factor productivity, and the lack of specialization in alternative exports.

⁵We emphasize that in the “Dutch disease” model the appreciation of the real exchange rate is related to increases in non-traded goods expenditures. Therefore, the focus should be on the impact of the boom in resource allocation. This shift in focus is important in understanding Venezuela’s growth experience because, as we document in the next section, most of the resource allocation associated with the revenue boom was done by the government, as opposed to by a market mechanism. See Bruno and Sachs (1982) for a related argument.

the main experiments and results. We conclude in Section 6.

2 Venezuela's Economic Policies

Before 1920 Venezuela was a poor agricultural country exporting mainly coffee, cocoa, and leather. Starting in the 1920s and prominently since 1926, oil has been Venezuela's most important export. The expansion of the oil industry was done through concessions for extracting oil to foreign companies. The development of the oil industry generated not only a substantial process of capital accumulation and knowledge transfer, but also promoted a process of socio-political modernization and economic growth.⁶ The government received income from the oil industry mainly in the form of revenue taxes and from selling rights (concessions) to private companies.⁷ The government, through the allocation of oil revenues, had an important role in economic activity. For instance, from 1950 to 1957, Venezuela had a military government that encouraged industrialization by devoting a large amount of public expenditures to the development of public infrastructure such as roads, highways, seaports, and electricity plants. Whereas in 1950 Venezuela was among the South American countries with the lowest capacity of electricity generation, by 1959 it had the second highest capacity due to an ambitious government plan of electrification. The plan was thought to be important for the development of a strong manufacturing sector. Additionally, the government provided substantial funds for industrial projects related to early stages of import substitution. Manufacturing and Electricity-Gas-Water were the two sectors with the fastest growth in economic activity, reaching average annual growth rates of 11.2% and 18.1%.⁸ During this period, there were profound changes

⁶See for instance Moron (1964) and Thorp (1998).

⁷In 1976, after negotiations with foreign oil companies, Venezuela's oil industry was nationalized. The concessions of American and European companies were set to expire in 1983 and the Venezuelan government had to pay compensation to the owners of the concessions.

⁸In addition, tax revenues from the oil industry increased during the 50s as a result of strong economic growth in Europe and the US, the war in Korea, and the shut down of the Suez canal in 1956. At that time, the government sold new concessions to compensate for the reduction in oil supply related to the Middle East turmoil which further increased revenues.

in the economy such as the massive movement of population out of rural areas: the proportion of population living in rural areas in Venezuela was 80 percent in 1926 whereas by 1970 only 36 percent.⁹

The period of economic decline in Venezuela can be subdivided in two. In the first period, from 1958 to 1973, the government moved beyond the development of public infrastructure projects to a broad range of interventions in the economy and widespread protection of the domestic industry through heavy regulation and import tariffs and quotas. In 1959, Venezuela's democratic government created the National Planning Office (CORDIPLAN) which postulated an import substitution plan and the use of oil revenue for development that would bring about rapid economic growth and structural social change in the long-term.¹⁰ CORDIPLAN main task was the design of five-year plans. Over the next 35 years, their basic aim changed minimally relative to the first plan, which postulated that the diversification of the economy from petroleum would guarantee both economic and social development. In addition, the government increased its role in the financing of industrial projects through the creation of several public financial institutions such as the Industrial Bank, the Venezuelan Development Corporation (CVF), and the Venezuelan Corporation for the Development of Small and Middle-Sized Industries (CORPOINDUSTRIA). These projects were financed mainly through tax revenues.¹¹

In the second period, from 1974 to nowadays, the government significantly expanded its intervention in the economy. The main factor driving the increase in government intervention was the disproportionate increase in revenues arising from the increase in oil prices and the nationalization

⁹See Baptista (2006).

¹⁰See Werz (1990). During the 1960s, the thinking of the Venezuelan political mainstream was oriented to promote industries different than oil using fiscal revenues. In 1956, Rómulo Betancourt, the main political actor of that period and Venezuelan president from 1959 to 1964, pointed out that one of the main problems of Venezuela's economy was its dependence from oil exports. He suggested that public policy had to be the driving force promoting structural change in the economy. See Betancourt (1979).

¹¹Private economic activity was further restricted during this time period since starting in 1962 until 1989 economic rights were suspended and the government could enforce any control on economic activity without threat for compensation.

of the oil industry in 1976. Oil prices (in 2008 dollars) jumped from \$43 per barrel in 1973 to \$139 in 1974 and to more than \$250 in 1980.¹² The increase in oil prices generated not only an increase in government revenues, but also expanded the capability of the public sector to get loans on international financial markets. For instance, between 1973 and 1981 public-foreign debt increased from 7.7% to 14.4% of GDP. The larger influence of the government in the economy was exercised mainly through an expansion of public enterprises, direct and indirect financing of industrial projects, and a wide array of controls on economic activity.

In 1975, an aggressive plan of industrialization based on mega-projects was adopted in industries such as iron, steel, aluminum, and coal, in an attempt to diversify exports and to exploit the comparative advantages that Venezuela supposedly had in the production of these goods. Even though in 1974 the government created the Venezuelan Investment Fund (FIV) in order to isolate the economy from the impact of oil-price shocks, FIV quickly became a major shareholder of public firms in all areas of the economy. In 1970, state enterprises represented 3.2% of GDP whereas in 1982 the proportion increased to 7.2% (29.4% including oil-industry public enterprises).¹³ The government created and reinforced official agencies to lend money for specific projects at interest rates well below market rates. An import-substitution policy was enacted by giving subsidies to industries that would substitute for imports. In addition, the government implemented quotas to private banks for lending money to a sector of “national” interest such as agriculture. The government imposed generalized price controls of goods and services and maintained control on key financial prices such as interest rates and the exchange rate. Also, there were quotas in many sectors and an average tariff of approximately 80%. The effective rate of protection was more than 100%.¹⁴ The government imposed additional distortions by regulating the labor market and imposing firing costs on firms.¹⁵

¹²The nominal price of oil increased from a historical \$2 per barrel to \$7 in 1974 and to more than \$30 in the 80s.

¹³See Kelly (1986).

¹⁴See Hausmann (2001) for a detailed summary of Venezuela’s economic policies.

¹⁵See Bermudez (2006) for a detailed documentation of labor policies.

As a result of these interventions, the share of the public sector in total GDP increased from 15.4% in 1973 to 30.3% in 1980. During the 1974 to 1980 period, employment in government offices as a proportion of total employment increased by 4.2 percentage points. In 1970, public investment represented 24% of total investment whereas in 1982 more than 67%. Relative to public investment, investment by public enterprises represented 46% in 1970 and 81% in 1982.¹⁶ In 1983, for the first time, public investment was greater than private investment. Between 1977 and 1983, private investment decreased by 78.3%. Investment per worker in 2000 was similar to that in 1955. Hence, the government became the economy's main channel of resource allocation.

To summarize, between 1920 and 1958, the evolution of economic activity in Venezuela was determined by a boom in the oil industry and oil-related activities such as the development of large public infrastructure projects. This boom led to a substantial process of capital accumulation and knowledge transfer since at the time the oil industry was open to foreign direct investment. After 1958, a slow process of government intervention in all aspects of economic activity took place and was accelerated after 1974, leading to substantial distortions in the economy. The most significant developments of the time being the nationalization of the oil industry in 1976 and the oil-price shocks in the 70s and 80s that represented a disproportionate amount of resources being allocated by government officials.

3 Development Accounting

3.1 Accounting Framework

We implement a standard development accounting exercise to inquire about the potential sources of growth and collapse in relative GDP per capita in Venezuela since 1900. We first decompose

¹⁶See for instance Hausmann (1985).

GDP per capita into three components: labor productivity, employment to population ratio, and hours per worker as follows:

$$\frac{Y}{P} = \frac{Y}{nE} \times \frac{E}{P} \times n,$$

where Y/P is GDP per capita, Y/nE is GDP per labor hour (labor productivity), E/P is the employment to population ratio, and n is hours per worker. Relative GDP per capita for two arbitrary economies i and j depends on the ratio of the three factors:

$$\frac{(Y/P)_i}{(Y/P)_j} = \frac{(Y/nE)_i}{(Y/nE)_j} \times \frac{(E/P)_i}{(E/P)_j} \times \frac{n_i}{n_j}. \quad (1)$$

We use equation (1) to ask which of these three measurable components of the data explain the evolution of GDP per capita in Venezuela relative to the United States.

We then further decompose labor productivity (GDP per hour) into several components which include physical capital, human capital, and measured total factor productivity (TFP). To make this decomposition we assume a standard Cobb-Douglas production function:

$$Y = AK^\alpha(hEn)^{1-\alpha}, \quad (2)$$

where A is total factor productivity (TFP), K is physical capital, and h is human capital per worker. Following Klenow and Rodriguez-Clare (1997), we use equation (2) to write GDP per hour in intensive form:

$$\frac{Y}{nE} = A^{\frac{1}{1-\alpha}} \left(\frac{K}{Y} \right)^{\frac{\alpha}{1-\alpha}} h.$$

Hence, relative GDP per hour (y) is given by:

$$\frac{y_i}{y_j} = \left(\frac{A_i}{A_j} \right)^{\frac{1}{1-\alpha}} \times \left(\frac{(K/Y)_i}{(K/Y)_j} \right)^{\frac{\alpha}{1-\alpha}} \times \frac{h_j}{h_i}. \quad (3)$$

We use equation (3) to ask which factors: capital intensity, human capital, and TFP explain the

evolution of labor productivity in Venezuela relative to the United States.

3.2 Growth Episode: 1920 to 1958

There is not enough data to do a complete accounting exercise during this period. Nevertheless, the sparse evidence we have suggest that capital accumulation and knowledge transfer were important and that hours and the employment ratio were not important. Venezuela appeared in the map as an oil-producer country at the end 1922 with the bursting of the oil dwell El Barroso II in Cabimas in the state of Zulia.¹⁷ El Barroso II showed the potential of Venezuela's oil industry. In 1922 the production of oil reached 1.8 millions of barrels (mb). The combination of Venezuelan's oil resources with the geographical advantage of being relatively close to the main export market explains why in the following years oil production expanded at a very fast rate, surpassing 200 mb in 1942 and reaching the highest level of 1,353 mb in 1967. (See Figure 2.) From 1920 to 1957, oil production per capita increased at an annual average growth rate of 20.4 percent reaching the highest level in 1957. (See Figure 3.) Notice that during this period of great expansion of the oil industry, oil investment relative to non-oil investment was around 50 percent, reaching more than 70 percent in the late 20s and 40s. (See Figure 4.) The overall investment rate during the 1920 to 1958 period was an average of 27 percent. The expansion of the oil industry took place in the context were the Venezuelan government granted oil concessions to foreign companies.

3.3 Collapse Episode: Since 1958

To understand the process of decline in standard of living starting around 1958, we use data from the Conference Board (2010), Total Economy Database to inquire about the sources of this remarkable

¹⁷The first oil concession in Venezuela was granted in 1865. However, the first important oil field (Mene Grande) was discovered in 1914.

relative decline. We perform a development accounting for 1960 and 2009 and find that TFP and capital accumulation represent substantial factors.

We start by looking at the factors related to labor supply differences. In 1960, GDP per capita in Venezuela relative to that of the United States was 82%. This difference is almost all accounted for by a difference in the employment to population ratio. The difference in labor productivity (GDP per hour) and hours of work were negligible (about 3 to 4% higher in Venezuela), whereas the employment to population ratio was 77% (.29 in Venezuela versus .38 in the United States). Summarizing relative GDP per capita 1960:

$$\underbrace{\frac{(Y/P)_{VEN}}{(Y/P)_{USA}}}_{.82} = \underbrace{\frac{(Y/nE)_{VEN}}{(Y/nE)_{USA}}}_{1.03} \times \underbrace{\frac{(E/P)_{VEN}}{(E/P)_{USA}}}_{.77} \times \underbrace{\frac{n_{VEN}}{n_{USA}}}_{1.04}.$$

By 2009, relative GDP per capita declined to 32%. The employment to population ratio increases both in Venezuela and the United States with the relative factor being 77% which is similar to that observed in 1960. Relative hours of work are almost 11% higher in Venezuela (compared to 4% higher in 1960). Hence, total labor supply (the combination of employment and hours) is only 85% percent of that in the United States and this factor barely changes in 2009 compared to 1960.¹⁸ Instead, the low level of relative GDP per capita in Venezuela in 2009 is due to low relative labor productivity and since relative labor supply is roughly constant, the fall in labor productivity accounts for most of the observed decline in relative GDP per capita. Summarizing relative GDP per capita 2009:

$$\underbrace{\frac{(Y/P)_{VEN}}{(Y/P)_{USA}}}_{.32} = \underbrace{\frac{(Y/nE)_{VEN}}{(Y/nE)_{USA}}}_{.38} \times \underbrace{\frac{(E/P)_{VEN}}{(E/P)_{USA}}}_{.77} \times \underbrace{\frac{n_{VEN}}{n_{USA}}}_{1.11}.$$

We conclude that the fall in relative GDP per capita (and the low relative level observed nowadays)

¹⁸The relative total labor input changes from 0.80 in 1960 to 0.85 in 2009.

is mostly a productivity problem!

We next investigate the factors behind the differences in labor productivity. We construct stocks of physical and human capital as follows. We use the investment rates in physical capital provided by the Penn World Tables (see Heston, Summers, and Aten 2009) to construct stocks using the perpetual inventory method.¹⁹ We use average years of schooling from Barro and Lee (2010) to construct stocks of human capital using the basic specification of the Mincer returns to schooling (see Bils and Klenow 2000). We use an average returns to schooling of 10 percent. In 1960, the physical capital factor was 1.33 (the capital to output ratio was 3.6 in Venezuela versus 2.1 in the United States) and the human capital factor 0.72 (an average of 3.1 years of schooling in Venezuela versus 9.3 years in the United States). Hence, the TFP factor was 1.08. This implies a TFP in Venezuela relative to that of the United States that was fairly similar (around 5% higher in Venezuela). Summarizing relative GDP per hour in 1960:

$$\underbrace{\frac{(Y/nE)_{VEN}}{(Y/nE)_{USA}}}_{1.03} = \underbrace{\left(\frac{A_{VEN}}{A_{USA}}\right)^{\frac{1}{(1-\alpha)}}}_{1.08} \times \underbrace{\left(\frac{(K/Y)_{VEN}}{(K/Y)_{USA}}\right)^{\frac{\alpha}{(1-\alpha)}}}_{1.33} \times \underbrace{\frac{h_{VEN}}{h_{USA}}}_{.72}.$$

By 2009, relative labor productivity falls to 38% of that in the United States. This low level of relative labor productivity is accounted equally by a low relative TFP factor (0.61) and a low relative factors (0.62). The fall in the contribution of factors is mostly due to a fall in the capital to output ratio (from 3.6 in 1960 to 1.74 in 2009 in Venezuela whereas it increases from 2.1 to 2.6 in the United States, that is the capital to output ratio was 76% higher in Venezuela than in the United States in 1960 and 33% lower in 2009). As a result, the drop in relative GDP per hour in Venezuela is a combination of a fall in relative TFP and in capital accumulation. Summarizing

¹⁹We assume that economies were in steady state in 1950 (to construct the initial stock in 1950) and use the investment rates from 1950 forward to trace the evolution of the physical capital stock. Alternative assumptions about the initial capital stock which are common in the literature yield similar results.

relative GDP per hour in 2009:

$$\underbrace{\frac{(Y/nE)_{VEN}}{(Y/nE)_{USA}}}_{.38} = \underbrace{\left(\frac{A_{VEN}}{A_{USA}}\right)^{\frac{1}{(1-\alpha)}}}_{.61} \times \underbrace{\left(\frac{(K/Y)_{VEN}}{(K/Y)_{USA}}\right)^{\frac{\alpha}{(1-\alpha)}}}_{.82} \times \underbrace{\frac{h_{VEN}}{h_{USA}}}_{.76}.$$

To summarize, the fall in relative GDP per hour in Venezuela is a combination of a TFP problem and a capital accumulation problem. We estimate the TFP ratio to be negligible in 1960 and 0.72 in 2009. Since the fall in capital accumulation in Venezuela cannot be explained by direct distortions to capital accumulation, we seek for an answer to the fall in TFP and capital accumulation that is related to the same source, namely policy distortions that create misallocation.²⁰

3.4 Potential Sources of Misallocation

There are three broad patterns that motivate our characterization of policies and institutions that affected the allocation of resources, productivity, and capital accumulation in Venezuela. First, there was an explicit policy-oriented movement of resource reallocation away from oil activities. This process started as early as in the 1930s with influential thinkers and writers such as Arturo Usler Pietri promoting "sow the oil", a phrase often quoted in the context of a development policy intended to diversify the economy.²¹ Productivity in the oil industry collapsed dramatically starting in the late 60s as illustrated in Figure 5. Venezuela's share in the international oil market fell from 14.5 percent in 1961 to 5.5 percent in 1973.²² The evolution of Venezuela's influence in the world market for oil is related to important changes in domestic policy and in the world market for

²⁰We find a negligible increase in the relative price of investment to consumption in Venezuela during this period suggesting that aggregate distortions to investment cannot explain the large fall in capital accumulation observed, see Restuccia and Urrutia (2001) for the role of investment distortions in explaining capital accumulation across countries.

²¹Arturo Usler Pietri is a well-known Venezuelan writer that participated actively in political life. He was a former interior minister and a candidate to the Venezuelan presidency in the elections of 1959.

²²The share of Venezuela in the international oil market is only 2.9 percent in 2009.

oil. Regarding Venezuela's domestic policy, there were new policy guidelines for the domestic oil industry: preservation of oil reserves and increased fiscal participation. The preservation of reserves implied the non-renewal of concessions. Increased fiscal participation was the first step towards the nationalization of the gas industry in 1971 and the oil industry in 1976.²³ The changes in domestic policy implied that during the 1960-1980 period the oil investment to total investment ratio was below 10 percent, reaching the lowest level at 2.3 percent in 1976. Regarding the world market for oil, there were new entrants in the export market for oil with higher quality and lower cost of production, making the domestic oil industry less competitive and less attractive for foreign investment, see Manzano (2007). In addition, the Organization of Petroleum Export Countries (OPEC) was created in August 1960 with a focus on maintaining high oil prices at the cost of market share.

Second, the first boom in oil prices in 1974 generated substantial fiscal revenues to the government which were quickly allocated by bureaucrats to a variety of investment projects. (See Figure 6 for a time series of the price of oil.) For instance, the ratio of non-oil private to public investment decreased from an average above 4 to less than 2 after the 80s (see Figure 7). The government promoted big investment projects in iron, steel, aluminium, coal to supposedly diversify production and exports. The behavior of the public sector in other oil-price shocks (for instance the 1979 and 2003-2007 price shocks) was similar in that there was an increase in the distortion to price signals and an increasing presence of the public sector in the economy through the establishment of newly created public enterprises and nationalizations.²⁴ Third, regulation/policies that misallocate across productive units, for instance, the reinforcement an industrial policy based on imports substitution, and massive price controls that caused additional distortions to price signals.²⁵

²³The oil concessions of American and European companies would expire in 1983. Nationalization was not a source of conflict: the government had to pay compensation to the firms owning those rights.

²⁴See Schmitz (2001) for an analysis of the negative impact of public enterprises on productivity and factor accumulation.

²⁵Economic rights were suspended in 1962. They were proclaimed in the 1961 Venezuelan Constitution and included social rights such as education, health, and housing and civil liberties such as freedom of speech, association, and press, right to fair trial, among others.

4 A Model of TFP

We consider a model of measured total factor productivity that follows closely that of Restuccia and Rogerson (2008). The model builds from the industry equilibrium framework of Hopenhayn (1992) embedded into a standard neoclassical growth model. The basic ingredient of the theory is heterogeneity in total factor productivity across establishments. In the context of this model, the allocation of factors of production across establishments leads to a role of policy distortions on aggregate measured TFP differences across countries. These policies may also lead to a decline in capital accumulation. The model is extended along the lines of Restuccia (2009) to allow for endogenous investment in productivity and hence giving a role for policy distortions to affect the distribution of efficiencies in the economy.

4.1 Economic Environment

Technology Differently than in the standard neoclassical growth model, the unit of production is the establishment. An establishment is described by a production function

$$f(z, s, k, n) = (zs)^{1-\gamma} (k^\alpha n^{1-\alpha})^\gamma, \quad \alpha, \gamma \in (0, 1),$$

with capital services k and labor services n as factor inputs. The technology parameter s varies across establishments but not over time and can take on a discrete and finite number of values, $s \in S \equiv \{s_1, \dots, s_{n_s}\}$. The other component of total factor productivity z is common across establishments and is determined by an investment decision that we describe below. Establishments are competitive in output and factor markets. An incumbent establishment with productivity zs facing rental prices for capital r and labor w chooses capital and labor demand to maximize per-

period profits $\pi(z, s)$:

$$\pi(z, s) = \max_{n, k \geq 0} \left\{ (zs)^{1-\gamma} (k^\alpha n^{1-\alpha})^\gamma - wn - rk \right\}.$$

We denote the optimal factor demands from this problem by $\bar{k}(z, s)$ and $\bar{n}(z, s)$. A relevant property of these demand functions is that they are linear in (z, s) . Hence, output at the establishment level is linear in (z, s) . It is easy to verify that $\pi(z, s) = (1-\gamma)y(z, s)$ and so profits are also linear in (z, s) . We assume that incumbent establishments face an exogenous and constant probability of exit λ . Exogenous exit realizations are *iid* across establishments and across time. Because establishment-level productivity is constant over time, the discounted present value of an incumbent establishment is given by,

$$W(z, s) = \frac{\pi(z, s)}{1 - \rho},$$

where $\rho = \frac{1-\lambda}{1+R}$ is the discount rate for the plant, R is a constant real interest rate, and λ is the exogenous exit rate. Note that since π is linear in (z, s) , the value of an incumbent establishment W is also linear in (z, s) .

Entrants Entering establishments pay a set-up cost of c_e measured in units of labor. After paying this cost a realization of the establishment-level productivity parameter s is drawn from an exogenous and time invariant distribution with cdf $G(s)$ and pdf $g(s)$. Entering establishments can invest in the level of productivity z at a cost. We parameterize this cost function as

$$c(z) = Bz^\phi, \quad B > 0, \phi \geq 1.$$

An entrant chooses the level of productivity z to maximize the expected value of discounted profits net of investment cost:

$$W_e = \max_z \left\{ \sum_{s \in S} W(z, s)g(s) - c(z) \right\},$$

where W_e is the value of an entering establishment and the maximization problem determines the optimal level of productivity z which we denote by \bar{z} . We exploit the property of W being linear in z to write $W(z, s) \equiv z\hat{W}(s)$ for all (z, s) . Hence, the first order condition with respect to productivity z yields:

$$\bar{z} = \left(\frac{\sum_s \hat{W}(s)g(s)}{B\phi} \right)^{1/(\phi-1)}.$$

Notice that \bar{z} is increasing in the (expected) value of an incumbent establishment and decreasing in the cost of investment. There is a continuum of potential entrants that evaluate W_e relative to the entry cost $c_e w$. We denote the mass of entry by E .

Preferences and Endowments There is an infinitely-lived representative household with preferences over streams of consumption goods at each date described by the utility function,

$$\sum_{t=0}^{\infty} \beta^t \log(C_t),$$

where C_t is consumption at date t and $0 < \beta < 1$ is the discount factor. Households are endowed with one unit of productive time in each period and $K_0 > 0$ units of the capital stock at date 0. As in the standard neoclassical growth model, the aggregate law of motion for capital is given by:

$$K_{t+1} = (1 - \delta)K_t + X_t.$$

Feasibility The resource constraint for output is given by:

$$C_t + X_t + c(z)E_t = Y_t, \tag{4}$$

where C_t is aggregate consumption, X_t is aggregate investment in physical capital, $c(z)$ is the investment cost in productivity z , E_t is aggregate entry, and Y_t is aggregate output. The demand

and supply of capital must be equal,

$$K = \sum_s \bar{k}(\bar{z}, s)\mu(s), \quad (5)$$

and the demand and supply of labor must be equal,

$$\sum_s \bar{n}(\bar{z}, s)\mu(s) + Ec_e = 1, \quad (6)$$

where μ is the distribution of establishments in the economy.

4.2 Equilibrium

We focus on the steady-state competitive equilibrium of the model. In a steady-state equilibrium the rental prices for labor and capital services are constant as well as all aggregates in the economy including the distribution of establishments. The important aspect to keep in mind from the consumer's problem is that the real interest rate in the economy is pinned down by preference parameters and the depreciation rate of the capital stock, i.e., in steady state the real interest rate, denoted by R , is given by

$$R = r - \delta = \frac{1}{\beta} - 1.$$

Definition of Equilibrium A *steady-state competitive equilibrium* with entry is a wage rate w , a rental rate r , an aggregate distribution of establishments $\mu(s)$, a mass of entry E , value functions $W(z, s)$, $\pi(z, s)$, W_e , policy functions $\bar{k}(z, s)$, $\bar{n}(z, s)$, \bar{z} for individual establishments, and aggregate levels of consumption C and capital K such that: (i) (Consumer optimization) $r = 1/\beta - (1 - \delta)$; (ii) (Establishment optimization) Given prices (w, r) , the functions π , W , and W_e solve incumbent and entering establishment's problems and \bar{k} , \bar{n} , \bar{z} are optimal policy functions; (iii) (Free-entry)

$W_e - c_e w = 0$; (iv) (Market clearing) Equations (4), (5), and (6) are satisfied; and (v) (μ is an invariant distribution)

$$\mu(s) = \frac{E \cdot g(s)}{\lambda}, \quad \forall s \in S.$$

4.3 Calibration

We calibrate the model to data for the United States. The general strategy follows Cooley and Prescott (1995) in calibrating the neoclassical growth model. A period in the model corresponds to one year in the data. The discount factor is selected to match a real rate of return of 4 percent, implying $\beta = 0.96$. The parameter controlling decreasing returns to scale at the establishment is quantitatively important. We assume $\gamma = 0.85$. Recent related studies have argued for values around this level. Given this value, we select α to match an income share of capital of 0.33. The depreciation rate of capital δ is chosen so that the capital to output ratio is equal to 2.35 as in the U.S. economy, implying $\delta = 0.10$. The exit rate λ is assumed to be 10 percent consistent with the evidence of job destruction rates in Davis, Haltiwanger, and Schuh (1996) and exit rates of plants in Tybout (2000).

In the economy with no distortions there is a simple mapping between establishment-level productivity and employment. Hence, we choose the range of productivity to match the range of employment levels in the data. With the lowest establishment productivity normalized to one, this calibration implies that the highest productivity is 3.98.²⁶ We use a log-spaced grid of establishment productivity s with 100 points, i.e., $n_s = 100$. The next step is to restrict the probability distribution. We choose $g(s)$ to match the distribution of establishments across employment sizes (see Figure 8). For the cost function $c(z)$, we set $\phi = 2$ and then choose $B = 1$ as a normalization. An important property of the U.S. establishment data is that there is a large number of establishments

²⁶The range of employment in the data is from 1 to 10,000 employees. Since n is linear in s , the range of s is the same as employment. Relative TFP at the establishment level is given by $s^{1-\gamma}$.

Table 1: Distribution of Establishments and Employment Size

	Employment Size		
	Less than 5	Between 5 and 50	50 or more
Share of establishments (%)	56	39	5
Share of employment (%)	7	33	57
Share of output (%)	7	34	59
Average employment size	2	15	186

with a small number of workers and therefore these establishments account for a small share of the employment in the economy. About 50 percent of the establishments have less than 10 employees and these establishments account for only 15 percent of the employment, while only 2.6 percent of establishments have more than 100 employees but account for 45 percent of the employment. The benchmark economy broadly reproduces this pattern even though it was only calibrated to the share of establishments in the data. Table 1 reports distributional statistics from the benchmark economy. Table 2 summarizes the parameter values and targets for the calibrated economy.

Table 2: Calibration

Parameter	Value	Target
α	0.28	Capital income share
γ	0.85	Literature
β	0.96	Real rate of return
δ	0.10	Capital to output ratio
c_e	1.0	Normalization
λ	0.1	Annual exit rate
$\{s_1, \dots, s_{n_s}\}, G(s)$	see text	Size distribution of establishments
ϕ	2	Baseline
B	1	Normalization

5 Quantitative Analysis

We use the model as a framework to study productivity and capital accumulation in Venezuela. We consider departures from the previous economic environment to accommodate two broad institutional and policy features of the Venezuelan economy after the 1960s, namely policy distortions that induce reallocation away from productive activities and a high level of regulations and cost of doing business.

The motivation for studying policy distortions that create misallocation comes from micro-level studies and our own calculations using micro-level data for Venezuela that indicate that Venezuela ranks among the countries with the highest levels of distortions in Latin America, a much higher level than in the United States (see for instance Figure 9).²⁷ To introduce policy distortions we follow Restuccia and Rogerson (2008) by considering a general form of output taxes. We also consider an experiment where the cost of investment in entry productivity differs by the factor indicated in the World Bank (2010), Doing Business Database. According to Doing Business, Venezuela ranks among the countries with the highest costs of setting up and starting a business, with an average cost of 30 percent of GDP per capita whereas for the average OECD country this cost is only 5 percent. Table 3 summarizes the results.

Entry Costs To start, we consider an experiment where the entry-productivity cost is increased by a factor of 6 relative to the benchmark economy.²⁸ This factor difference in the cost of entry productivity is consistent with the actual cost of doing business in Venezuela relative to the average of OECD countries according to World Bank data. The impact of this higher cost of entry productivity is reflected in a lower level of \bar{z} , a level which is 36 percent of that in the benchmark economy.

²⁷See also the detailed study of Latin American countries in Pages (2010).

²⁸Recall that the entry-productivity cost is assumed to have the following form $c(z) = Bz^\phi$ with B normalized to 1 in the benchmark economy. In the entry-cost experiment we increase B to 6.

This lower level of entry productivity implies a TFP for the establishment that is 86 percent that of the benchmark economy for a comparable establishment. Since entry costs apply to all entering establishments, this policy does not produce any additional size distortions at the establishment level and the aggregate effect of TFP is the one implied by the lower level of \bar{z} . Similarly, the higher entry cost does not affect capital accumulation, leaving the capital to output ratio the same as in the benchmark economy. A lower TFP translates into lower output per capita which is 80 percent of that in the benchmark economy.²⁹ Notice that in this experiment (as well as in the experiments that will follow) the level of entry is the same as in the benchmark economy even though the real wage rate is lower. While a lower wage rate encourages more labor demand by establishments, the lower productivity discourages it and these effects cancel each other so aggregate entry remains the same. As a result, the average establishment size is unaffected by the higher cost of entry.³⁰

Table 3: Results from Experiments

	Relative to B.E.					
	Y	TFP	K/Y	E	w	\bar{z}
Experiments:						
(1) Entry cost	0.80	0.86	1.00	1.00	0.80	0.36
(2) Idiosyncratic distortions	0.67	0.85	0.72	1.00	0.48	0.70
(3) Both (1) and (2)	0.53	0.73	0.72	1.00	0.39	0.25

Note: (1) Entry cost is as in the benchmark economy (B.E.) except the parameter for the entry-productivity cost B is set to 6 instead of 1 (6-fold increase). (2) Idiosyncratic distortions is an output tax of 40 percent to establishments in the top 70% of productivity distribution. (3) Refers to both entry cost and idiosyncratic distortions.

Idiosyncratic Distortions We introduce policy distortions as follows. We impose an output tax of 40 percent to establishments in the top 70% of the productivity distribution while the

²⁹Note that while in this experiment relative TFP is 0.85, relative output per capita is 0.80. The larger effect on output per capita is due to the impact of lower TFP on the capital stock, however, lower TFP in this experiment does not change the capital to output ratio.

³⁰This is in contrast to alternative models of the cost of entry that abstract from investment in entry productivity that predict a decline in aggregate entry and therefore an increase in average establishment size.

remaining establishments are neither taxed nor subsidized. This particular policy configuration is motivated by the evidence from micro data of manufacturing establishments in Venezuela. We use data on manufacturing plants drawn from the Venezuelan Industrial Survey (Encuesta Industrial de Venezuela). This is an annual survey of manufacturing conducted by the Venezuelan Statistics Agency: Instituto Nacional de Estadística (INE).³¹ Using these data we calculate productivity at the plant level and from the first order conditions of establishments in the model the implied levels of output and capital taxes. Essentially, the model implies that establishments with different productivity should demand factors to equalize both the capital to labor ratio and the marginal product of capital to some optimal levels. Hence, we infer taxes (wedges) from departures of these optimal conditions. We find that tax rates on output are around 40 percent for the top 70% of establishments.³² We also find that there are no substantial differences in the capital taxes across establishments (taxes that distort the capital labor ratio across establishments). While the impact of this policy on the entry productivity is weaker than in the previous experiment with entry costs (\bar{z} is 70 percent of the benchmark economy versus of 36 percent), the aggregate effect on TFP is as large (0.85 versus 0.86). The lower TFP reflects two effects in this experiment: a lower establishment-entry productivity (0.95) and a reallocation across establishments (from high to low productivity establishments) that induces a drop in productivity (0.89). Hence, misallocation explains 70 percent of the low TFP in this experiment and low entry productivity explains the remaining 30 percent. Whereas in the economy with high entry costs distributional statistics are as in the benchmark, policy distortions induce a reallocation across establishments. Establishments with 5 to 50 employees produce 60 percent of the output compared to 34 percent in the benchmark

³¹The survey covers manufacturing plants that employ at least five individuals and collects detailed information on plant characteristics such as geographic location, manufacturing industry, production, value added, employment, intermediate inputs and investment. The survey also reports the book value of fixed capital at the beginning of the year which we use as the capital stock. We use data corresponding to the year 2000.

³²We find that for the bottom 30% of establishments only the bottom 10% feature a negative output tax (a subsidy). However, the level of output subsidy is not consistent with the observed low employment size of these establishments. Hence, we think that the implied output subsidies are keeping these low productivity establishments in business, a feature that is not present in our model. In fact, the productivity gap between the top and bottom deciles in the data is much larger than that in the United States and hence our calibrated economy. As a result, we ignore these subsidies in the experiment.

economy and large establishments (those with more than 50 employees) produce 35 percent of the output compared to 60 percent in the benchmark. Contrary to the entry cost experiment, policy distortions also induce a drop in capital accumulation, with the capital to output ratio being 72 percent of the benchmark economy.

Entry Costs and Idiosyncratic Distortions Experiment (3) in Table 3 combines the entry cost and policy distortions experiments as described previously. The effects on TFP, capital accumulation, and output per capita are quite substantial and account for a large portion of the observed differences in these variables in Venezuela relative to the United States in the collapse period. Aggregate TFP drops to 73 percent of the benchmark economy. Note that in 2009 the implied TFP ratio between Venezuela and the United States is 0.72. Hence, this experiment accounts for 96 percent ($\log(0.73)/\log(0.72)$) of the difference in measured TFP between Venezuela and the United States in 2009. Similarly, the experiment explains 82 percent of the difference in the capital to output ratio between Venezuela and the United States in 2009 ($\log(0.72)/\log(0.67)$). The experiment explains 92 percent of the difference in output per capita between Venezuela and the United States in 2009 ($\log(0.53)/\log(0.50)$).³³

6 Conclusions

We showed that GDP per capita in Venezuela increased dramatically relative to that of the United States from 20 percent in 1920 to 90 percent in 1958, but then collapsed to around 30 percent nowadays. In a development accounting exercise, we argued that the growth period is mainly accounted for by an increase in capital accumulation and knowledge transfer associated with foreign

³³The calculation for GDP per capita in the data abstracts from the human capital factor that is not present in the model. Without the human capital factor, the ratio of GDP per capita in the data between Venezuela and the United States is 0.50 (0.38/0.76).

investment in the booming oil industry whereas the collapse period is accounted for equally by a fall in total factor productivity and in capital accumulation. To understand the episode of collapse, we extended a model of heterogeneous establishments in Restuccia and Rogerson (2008) to allow for endogenous investment in entry-level productivity. We showed that, in the context of this model, policies and institutions that favour unproductive in detriment of more productive activities can generate substantial negative effects in TFP and in capital accumulation. In particular, we find that reasonable idiosyncratic policies and entry costs can account for between 80 to 95 percent of the lower capital accumulation, TFP, and GDP per capita observed in Venezuela relative to the United States in the collapse period. Removing the barriers that affect business investment and create misallocation across productive activities can substantially increase income per capita in Venezuela.

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Figure 1: Relative GDP per Capita in Venezuela

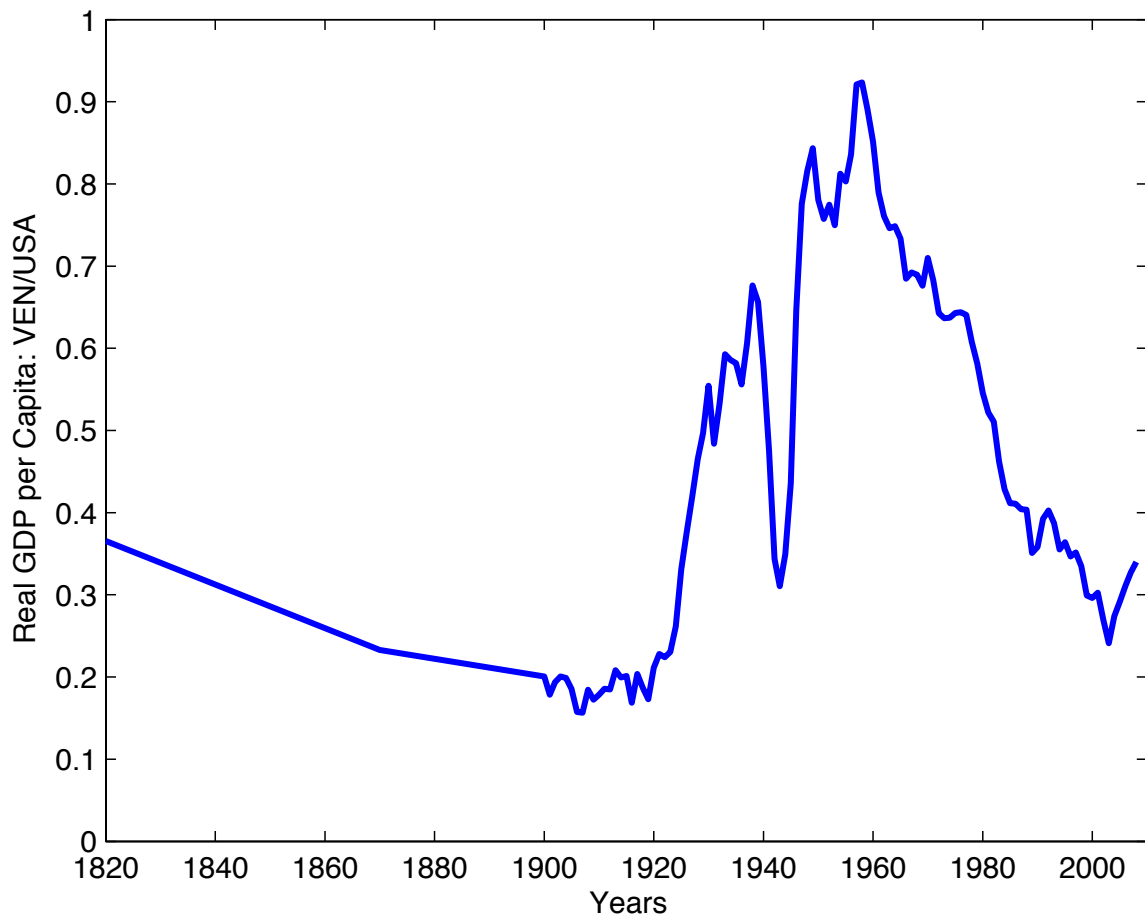


Figure 2: Oil Production in Venezuela

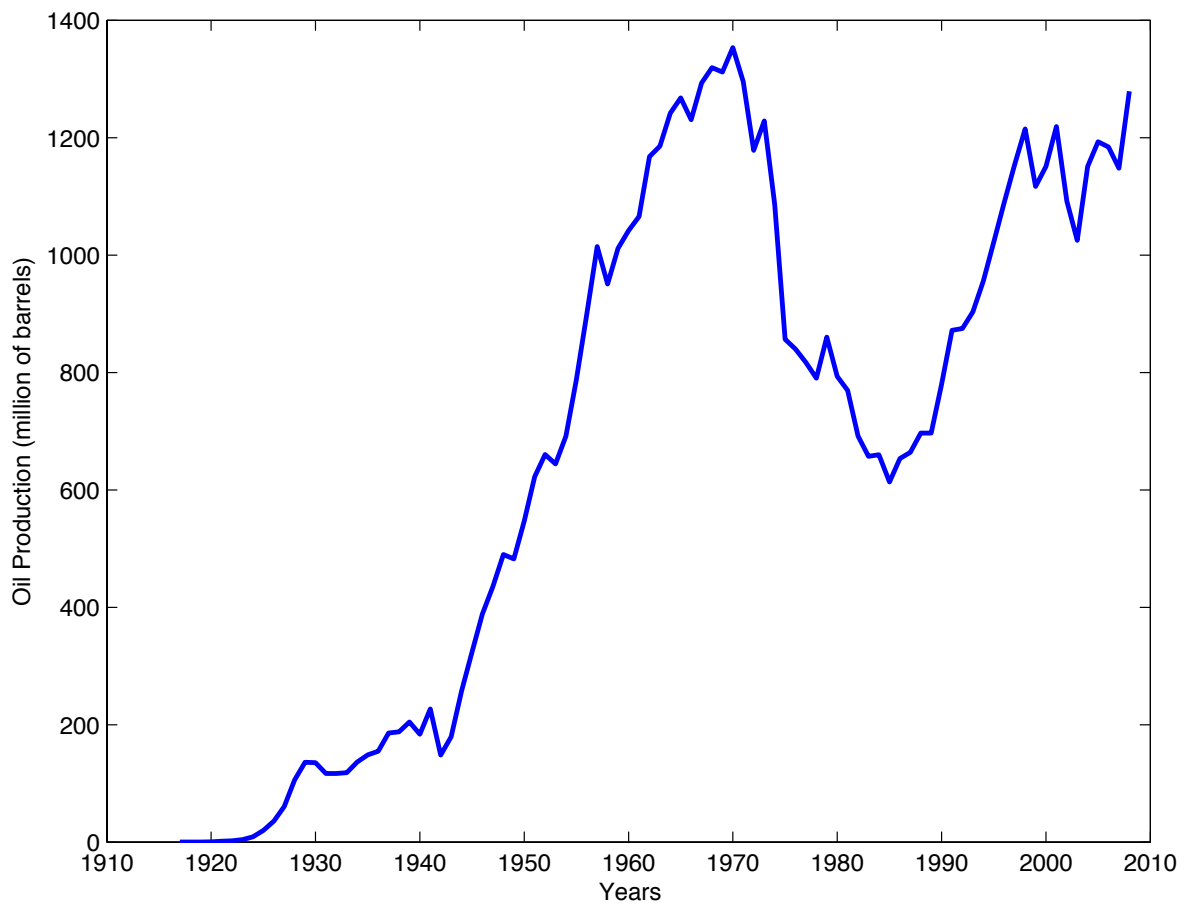


Figure 3: GDP and Oil Production per capita

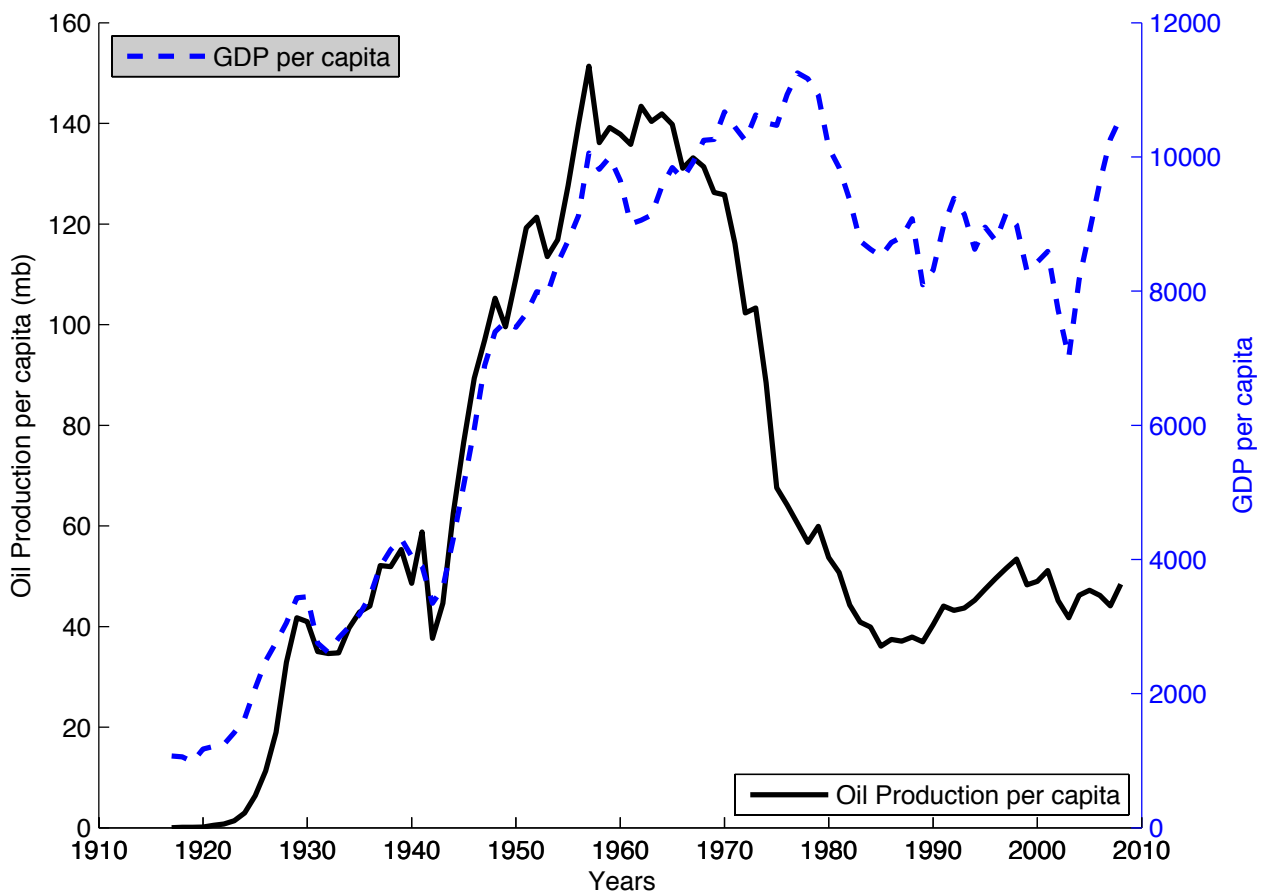


Figure 4: Oil to Non-Oil Investment Ratio

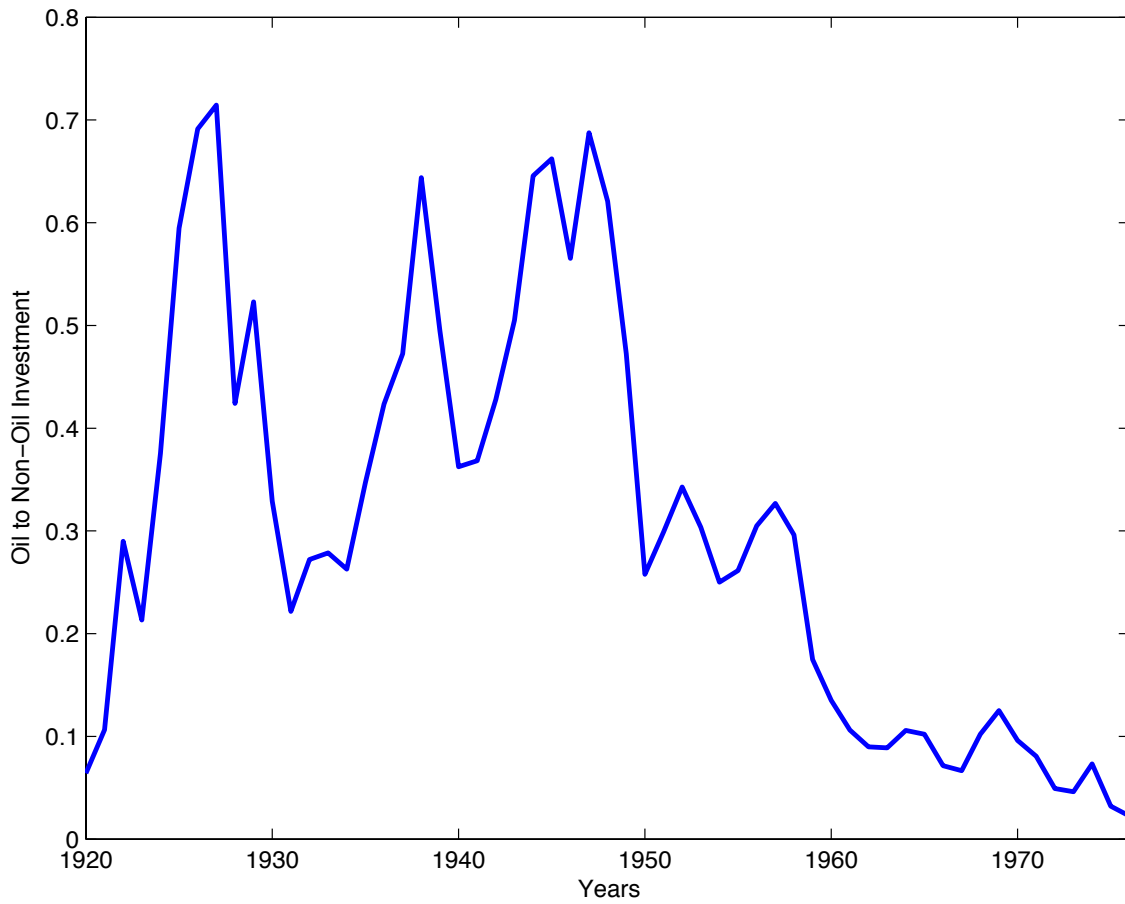


Figure 5: Labor Productivity in the Oil Industry

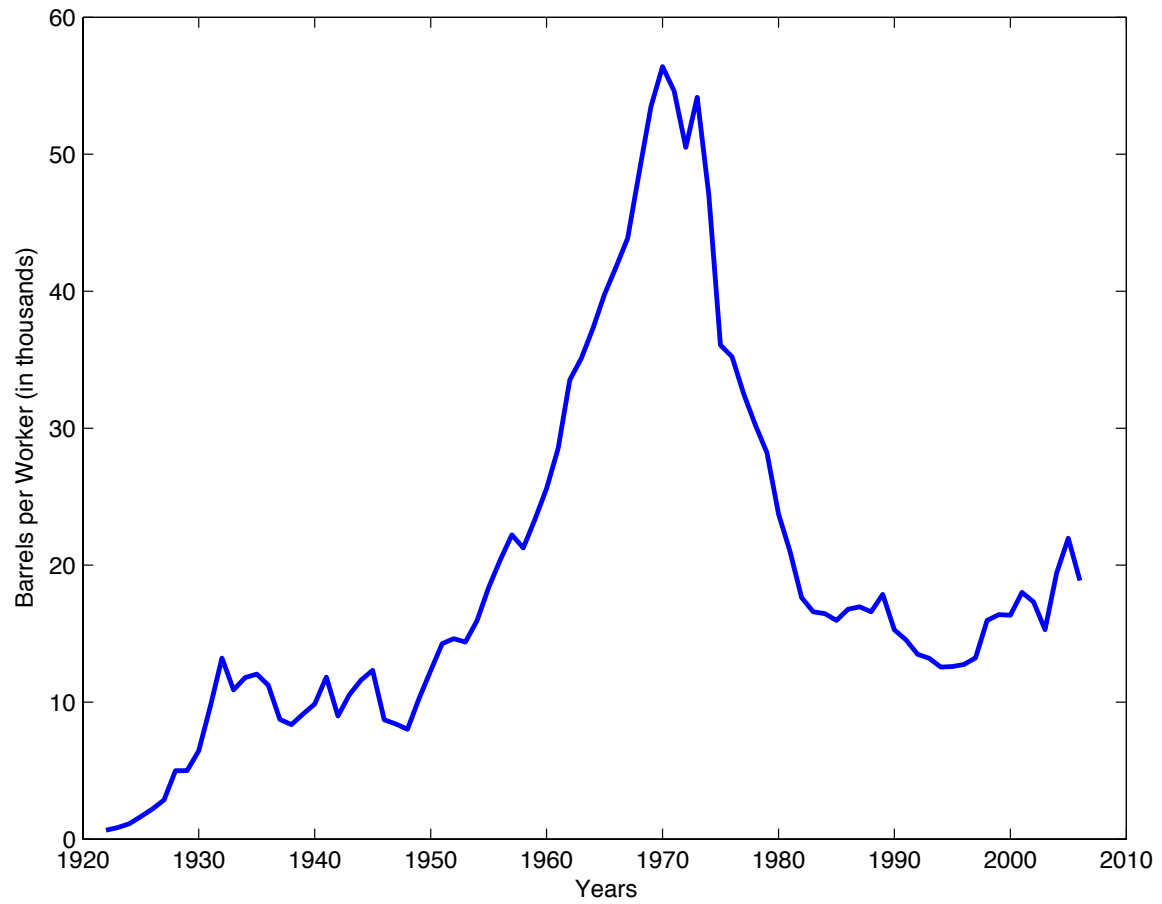


Figure 6: Price of Oil

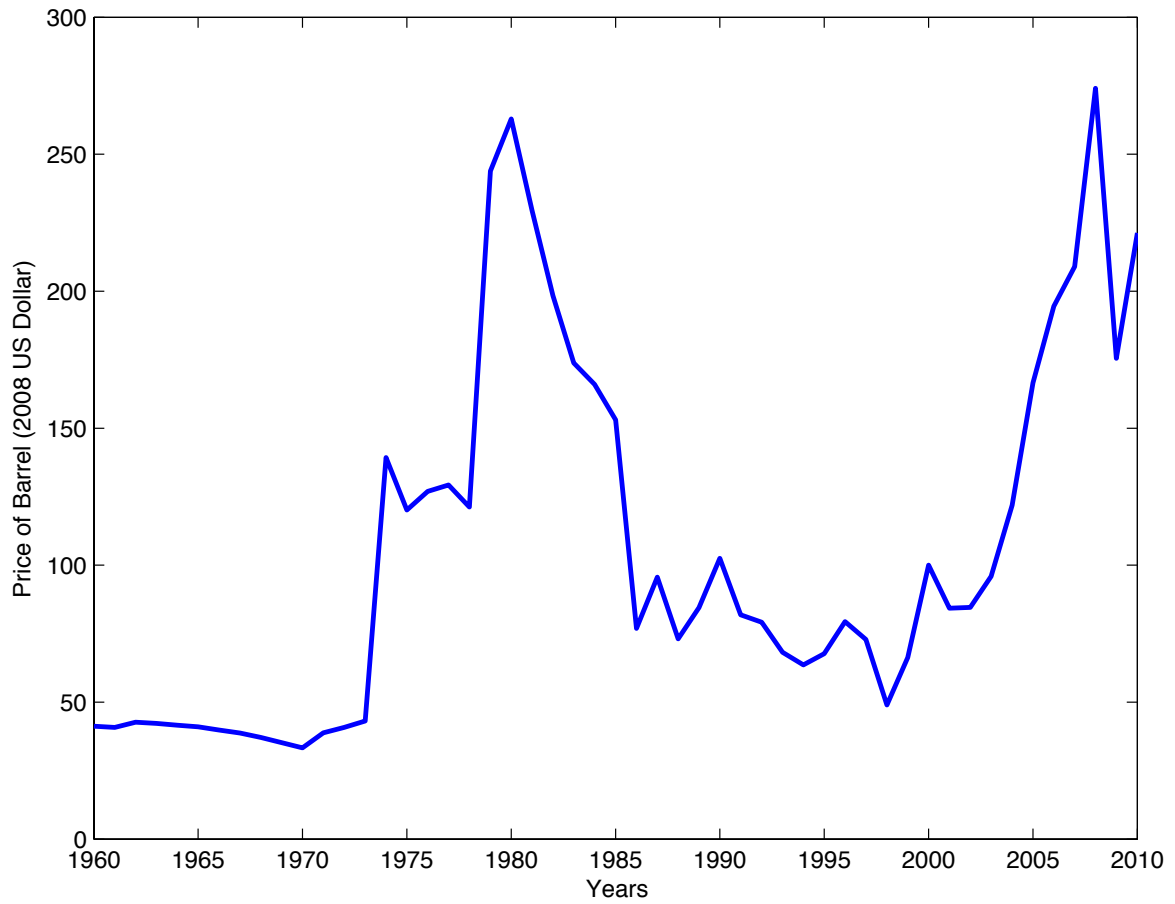


Figure 7: Private to Public Investment Ratio (Non-Oil)

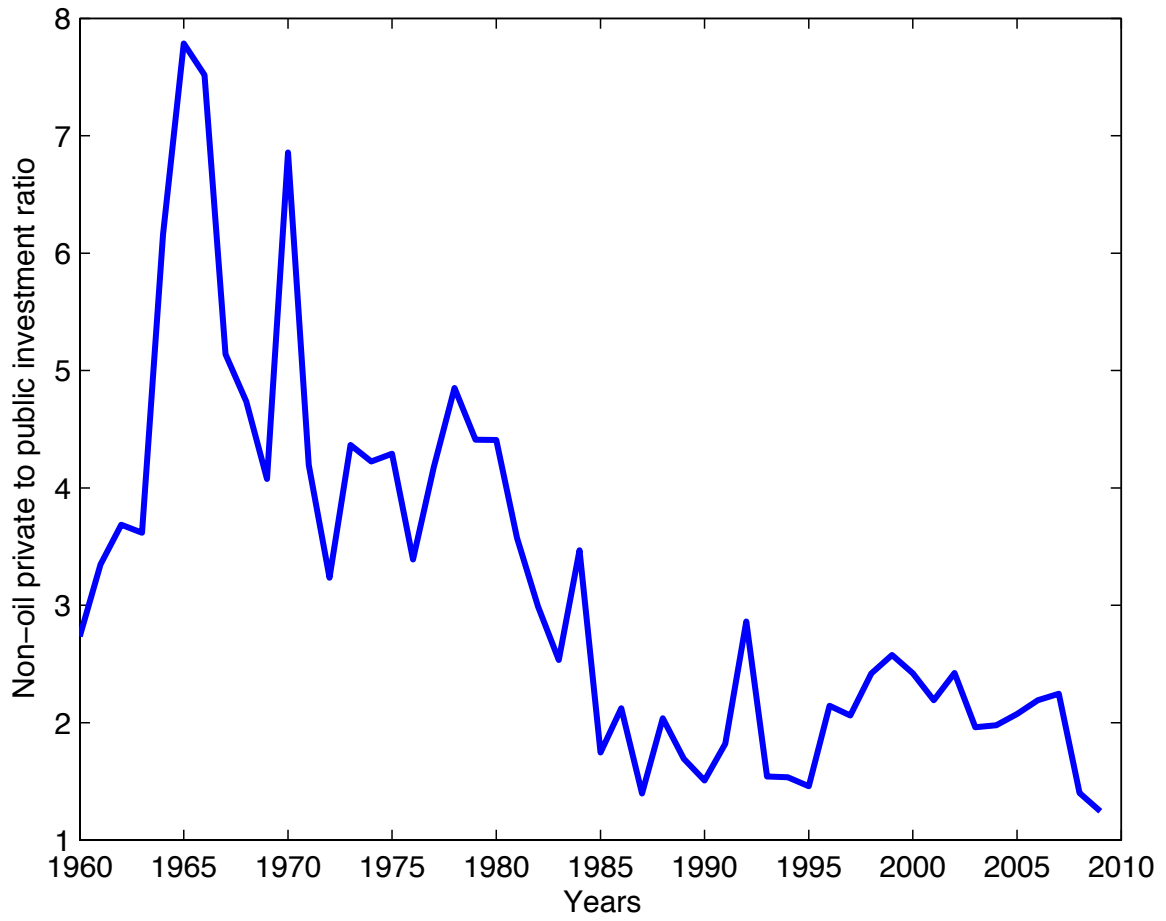


Figure 8: Size Distribution of Establishments

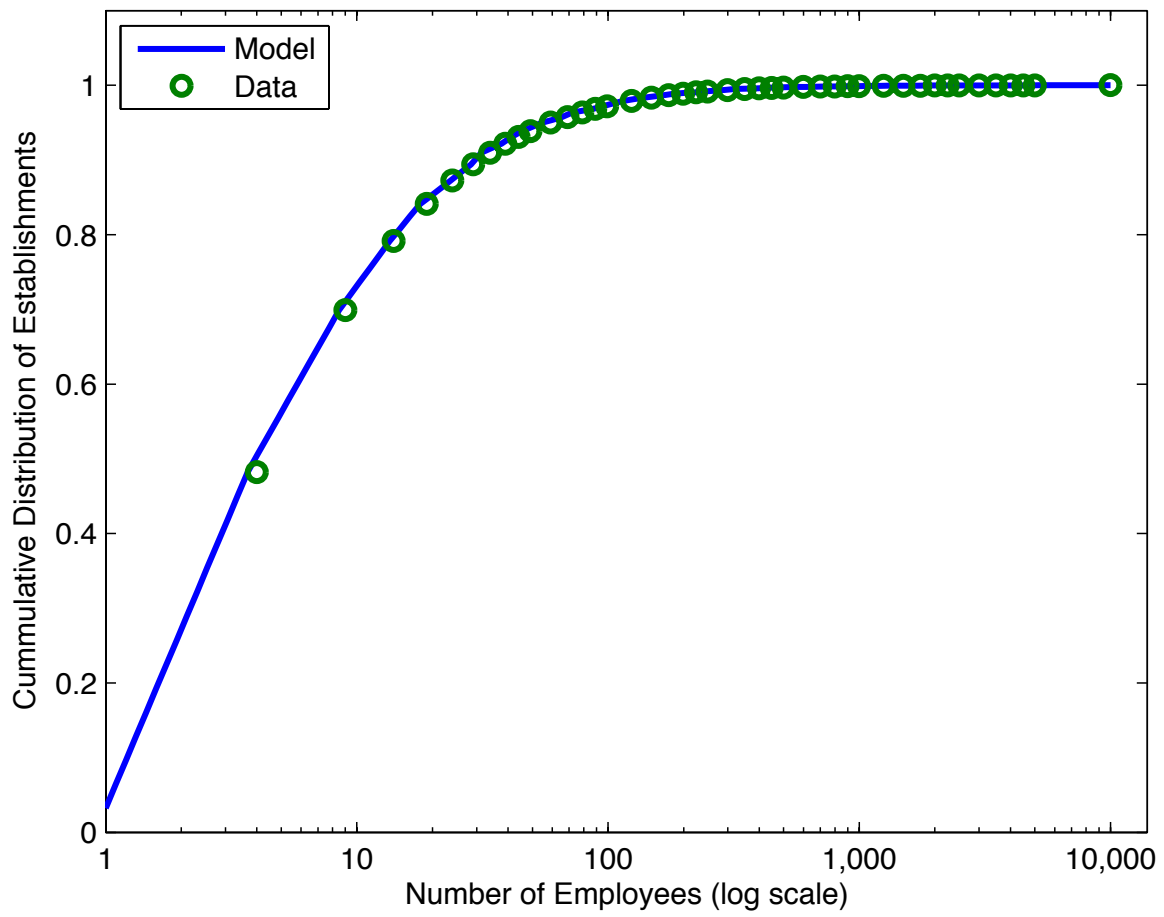
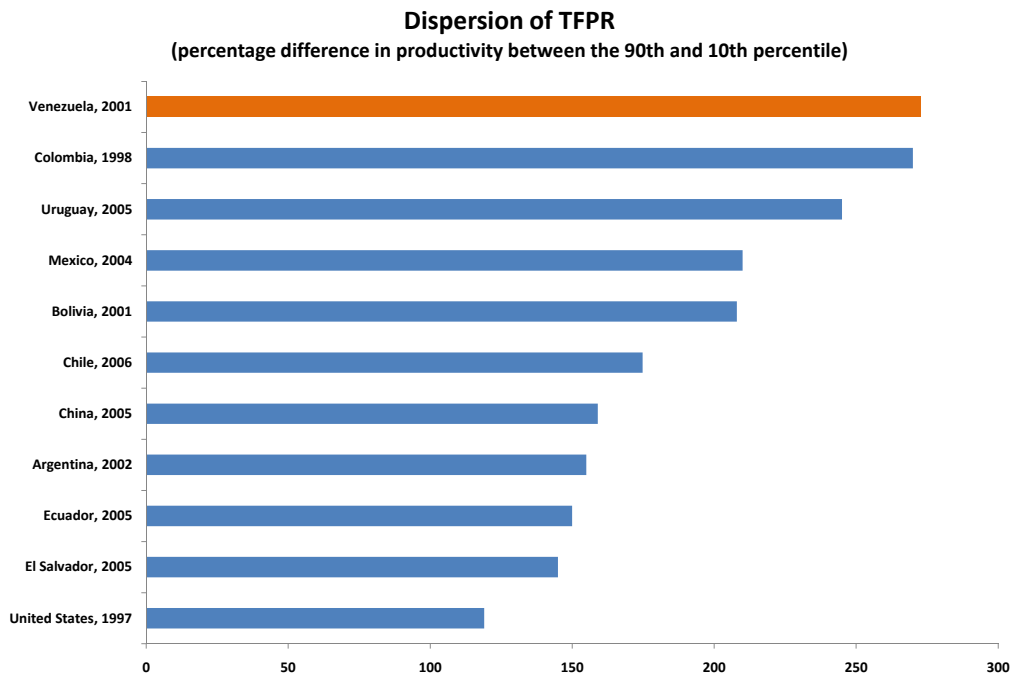


Figure 9: Dispersion in Marginal Revenue Products



Source: Author's calculations (Chile, Venezuela); IDB, 2010 (Colombia, Mexico, El Salvador, Uruguay, Bolivia, Ecuador, Argentina, China and US)