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Amavilah, Voxi Heinrich

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Voxi Heinrich S. Amavilah[1]

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PO Box 38061, Phoenix, AZ 85069-8061, USA

Abstract

This paper pulls together into one practical model two strands of economic theory to assess the impact of baseball player exports on the aggregate economic performance of the Dominican Republic. On one hand, foreign trade theory predicts a strong correlation between a country's exports and economic performance measured as per capita income. On the other hand, microeconomic research finds a positive, but statistically insignificant, impact of sports activities on local economies. Analysis finds a strong correlation between baseball player exports and economic performance for the years 1962-2004, suggesting that both the USA and the Dominican Republic benefit from encouraging baseball player trade and repatriation of baseball export earnings.

Keywords: baseball player exports, sports exports, sports and economic performance, sports export-led growth [O40, L83, O54, F43, F14, R53]

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[1]Amavilah is an adjunct instructor of economics at Glendale College, and a private consultant on resources, technology, and the engineering economy of small open economies. An earlier version of this paper is available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=915817. I am grateful for helpful comments by John Siegfried (Vanderbilt) and Victor Matheson (Holy Cross), and editorial assistance of Tamara Amavilah. As usual blame for errors is indivisible and nontransferable.

1. Introduction

About 80% of the Dominican Republic's exports go to the United States of America (USA), and among these exports are baseball players.[1] For example, Dominican baseball players have attracted the attention of U.S. Major League Baseball (MLB) since Osvaldo "Ozzie" Virgil's debut for the New York Giants in 1956. To-date players from this Caribbean country have risen to the top of their game as evidenced by the performance and popularity of Sammy Sosa in the 1990s and Albert Pujols in the 2000s (Baseball-almanac.com, 2006). In addition, average annual baseball salaries have increased from about US$7,000 in 1962 to US$2.5 million in 2004 (see Sean Lahman for the Associated Press online, and Table 2 below).[2] Yet, there is no systematic study of the impact of baseball player exports on the economic performance of the Dominican Republic. This paper attempts to bridge that information gap. In the next section it scans the two strands of relevant literature in order to justify the theoretical formulations that Section 3 outlines. Section 4 describes measurement issues. The estimations and results are the subjects of Section 5, followed by a conclusion in the last section.

2. Two Strands of Relevant Literature

The framework of this paper draws from the e**x**port-led (**x**-led) growth theory of trade, and it is informed by some of the latest studies of the impacts of sports activities on local economies.

2.1 Exports and Economic Growth

The idea that exports (X) affect economic performance has a firm foundation in the general theory of international trade as outlined by generations of economists from Adam Smith, David Ricardo, Heckscher-Ohlin-Samuelson (H-O-S), and on to the present. The modern versions of trade theory are all based on the notion of specialization on the basis of comparative advantage. The conventional view states that mutual benefits arise from the exchange among nations of national attributes and product characteristics. This is the H-O-S account according to which benefits from trade are automatic so long as comparative advantages exist (cf. Samuelson, 2002, 2004, Krugman, 1988, 1994). One extension of the H-O-S account adds to the production process capital augmenting factors such as skills, technology and knowledge, and the endogenous growth mechanism, while leaving the production process itself unchanged. An alternative extension introduces technology and other technological considerations directly and independently into the production process so as to allow technology to play a larger role than just augmenting capital

(Boskin and Lau, 1991). In the former extension income gains from trade are static; in the latter the gains from trade are dynamic. Hence, one strength of x-led growth models is their recognition of the linkages between structural changes in export growth and economic growth measures in which specialization leads to the usual income gains from trade, and also induces indirect effects on income growth (Grossman and Helpman, 1991, Lucas, 1993, 1988).

Despite the obvious strengths of x-led growth models have been around for a while, only recently did economists begin to seriously identify the mechanisms through which exports determine observed variations in economic performance among nations (Caves, 1971, Corden, 1971, Kindleberger, 1962, cf. Frankel and Romer, 1999). Kindleberger (1962), for example, sees a direct association between trade and economic growth in which exports are an essential determinant, and hence his phrase "export-led growth". In this association exports and economic growth interact in three distinct ways: leading, lagging, and vent-for-surplus. Exports *lead* to domestic economic growth if an outward shift in foreign demand for exports increases domestic income. Exports can be a *drag* on economic performance if either technical, economic and institutional barriers inhibit trade, or productive resources are highly concentrated such that export growth amplifies already skewed income distribution. In contrast, according to the vent-for-surplus model, exports extend domestic output by inducing demand for domestic investment, which in turn stimulates demand for foreign consumer and producer goods, thereby increasing the downward pressure of foreign payments on economic growth resulting in an import cost that affects the country's balance of payments.

The Kindleberger model shows the general mechanics of the export-income connection, but it leaves unexplained the specific mechanisms through which exports affect economic growth. For an explanation Max Corden (1971) assumes a 2-factor (capital and labor) and a 2-good (consumption and investment) economy and argues that trade openness has five systematic effects on economic performance: (1) short-run multiplier effects, (2) capital formation effects, (3) income distribution effects, (4) substitution effects, and (5) factor "weight" effects. While it identifies various types of gains from trade, Corden's model is internally inconsistent in suggesting that a permanent increase in real income has only a temporary positive effect on economic performance that dissipates over time unless the level of capital gain generated by the initial increase in income gains from trade accelerates. Thus, in the long-run economic growth is determined only by the growth of labor as the rate of capital formation falls with capital-output ratio until capital and labor growth rates are equalized. By implication trade does not stimulate technical progress and economies of scale

(EOS) because traders do not learn, or learn fast enough, from trading, and are therefore (permanently) condemned to decreasing returns to scale with low income elasticities (Kravis, 1970).

Caves (1971) adds internal consistency to Corden's structure to study the stability of the functional relationships implied by previous x-led growth models and concludes that it is possible to state these models so that exports only *assist*, rather than *lead*, economic growth. After this point Choi (1983) integrates Caves and Corden into a basic Harrod-Domar (H-D) framework and finds the H-D economy to exhibit a positive correlation between exports and economic performance. But since in a true H-D economy capital formation is the only source of income growth, for a developing country lacking domestic capital, capital imports and goods exports compete for the same savings. Thus, while open export markets motivate exporters to increase production capacity, capacity expansion requires investment expansion which trade must induce. In the long-run only when properly used do income gains from trade generate investment. If that happens, then a rise in foreign demand for exports expands production and export capacities allowing for EOS, if any are present, as well as additional productivity improvement due to competition. Competition and EOS both enforce minimum efficiency and stimulate further growth of exports, export demand, and productivity, thus setting in motion a process of "cumulative causation and circular growth" (Young, 1928, Myrdal, 1957, Dixon and Thirlwall, 1975, Kaldor, 1978, Thirlwall, 1982).

For a while measurement of the correlations between exports and income has relied on time-series and cross-section series for samples of countries (Choi,1983). The correlations assumed that causality ran from exports to income, until Balassa (1978) extended the export-income relation from simple to causal correlations by explicitly recognizing the joint determination of exports and income. The results of Balassa's innovation show exports contributing more than labor to economic growth. Further along Balassa, Feder (1983) separates the export sector and the non-export sector and finds that the export sector enhances economic growth through its high marginal factor productivity as well as its sectoral externalities.[3] To-date research continues to defend the place of trade (exports + imports) in the production function, see e.g., Frankel and Romer (1999), Sprout and Weaver (1994), (Hentschel (1991), Esfahami (1991), and Salvatore and Weaver (1991). The framework of this paper takes advantage of these insights.

2.2. Economic Impact of Sports like Baseball on Local Economic Performance

The Dominican Republic exports many baseball players to the USA. As exports baseball players belong to the country's aggregate production function. This section summarizes a number of recent studies on the impacts of sports activities on local economic performance and then generalizes the insights gained from these studies to building a simple model for the problem at hand. It begins with a general observation that popular press talks up the economic importance of sports activities to local communities. The press claims that local communities benefit from opportunities, say, to host major sports events such as the Super Bowl or World Series at the national level, and the Olympics or World Soccer Cup at the international level. This sports populism underscores public subsidy of these activities, although economic research finds weak evidence for the excitement. Victor Matheson (2002) and his extensive references, for example, puzzles over the frequent assertion that professional franchises generate economic rents commensurate with public spending on sports activities. Like many others, Matheson suspects that proponents of public expenditure on sports activities "boost" (exaggerate) the value of those activities.[4] Indeed, John Siegfried and Andrew Zimbalist (2000) note staggering expenditures on constructing new and maintaining old sports facilities in U.S. metropolitan areas (Tables 1 and 2, pp. 96-97). And after considering many, and failing to find any, possible sources and channels of benefits, Siegfried and Zimbalist ask: "So why do state and local governments subsidize sports facilities?" (p.110). The answer is simply not clear [to economists].

Are these individual studies just wrong in not finding economic support for sports activities? Hudson's (2001) meta-analysis of 13 studies they are not wrong. The analysis clearly shows differing causes and consequences of the sports impacts, and it concludes that the rosey predictions result from effective rent-seeking campaigns. Hudson's conclusion is consistent with Matheson's (2004) which finds that for the 1970-2001 years the Super Bowl has had positive, but nonetheless statistically insignificant, effects on "host" and "victorious" cities.[5]

There is, of course, a difference between the impacts of sports activities on local economies at the microeconomic level and similar impacts at the national level. For a developing country with limited options for making a living like the Dominican Republic, the opportunity costs to players are likely lower than corresponding value of marginal products. The implication is significant economic rents for foreign players. Since there is no need to subsidize these players, the exporting country stands to gain from trade. Moreover, foreign baseball player markets are fairly competitive as players are not subject to the draft. Even so, local sports economic studies are still instructive and relevant to asking whether or not the impact of Dominican baseball player exports to the USA on that country are just

Table 1 - Functional forms of economic activity with baseball player exports

Equation No.	Aggregate GDP	Average per capita GDP
1(*a*) 1(*b*)	$Y=A_0\exp(\lambda t)N^{\alpha}K^{\beta}X^{\gamma}$ $Y=A_0\exp(\lambda t)N^{\alpha}K^{\beta}X_i^{\gamma_i}$	$y=A_0\exp(\lambda t)k^{\beta}x^{\gamma}$ $y=A_0\exp(\lambda t)k^{\beta}x_i^{\gamma_i}$
2	$Y=A_0\exp(\lambda t)N^{\alpha}K^{\beta}X_i^{\gamma_i}$	$y=A_0\exp(\lambda t)k^{\beta}x_i^{\gamma_i}$
3(*a*) 3(*b*)	$Y=A_0\exp(\lambda t+\gamma X)N^{\alpha}K^{\beta}$ $Y=A_0\exp(\lambda t+\gamma_t X_i)N^{\alpha}K^{\beta}$	$y=A_0\exp(\lambda t+\gamma x)k^{\beta}$ $y=A_0\exp(\lambda t+\gamma x_i)k^{\beta}$
4(*a*) 4(*b*)	$Y=[A_0\exp(\lambda t+\gamma X)N]^{\alpha}K^{\beta}$ $Y=[A_0\exp(\lambda t+\gamma_t X_i)N]^{\alpha}K^{\beta}$	$y=A_0\exp(\lambda t+\gamma x)(K/Y)^{\beta/\alpha}$ $y=A_0\exp(\lambda t+\gamma x_i)(K/Y)^{\beta/\alpha}$
5(*a*) 5(*b*)	$Y=[A_0\exp(\lambda t+\gamma X)K]^{\beta}N^{\alpha}$ $Y=[A_0\exp(\lambda t+\gamma_t X_i)K]^{\beta}N^{\alpha}$	$y=A_0\exp(\lambda t+\gamma x)(K/Y)^{\alpha/\beta}$ $y=A_0\exp(\lambda t+\gamma x_i)(K/Y)^{\alpha/\beta}$

as weak.

4. Theoretical Framework

Drawing from the x-led growth models, first we measure the export-augmented aggregate economic activity in the Dominican Republic over time (*t*) as

$$Y(t) = f(A(t), N(t), K(t), X(t)), \tag{1}$$

where Y(t) is real gross domestic product (GDP) in year *t* in 2000 pesos, *t* is time period in years, running from 1962 to 2004, *f* is a technical rule assigning Y(t) to its determinants, $A(t) \equiv A_0 \exp(\lambda t)$ is an exogenous level of technology or efficiency, N(t) is mid-year population in million persons, K(t) is capital stock in year *t* in 2000 pesos, and X(t) is the value of total exports. Assuming that (1) is well-behaved, we impose a Cobb-Douglas topology on it. The result is a number of special cases depending on whether technology, A(t), progresses according to Hicks, Harrod, Solow, or otherwise (Allen, 1967). A few such cases appear in Table 1 and are discussed next.

- **Economy without factor intra- or inter-actions - Equation 1**

In the first column of Table 1, Equation 1(a) says that aggregate GDP is a function of technology (A) evolving at an exogenous rate of λ over time, population (N), capital stock (K), and total exports (X). In the second column is per capita GDP $\equiv$ y = Y/N which depends on per capita capital, k $\equiv$ K/N, and per capita exports, x $\equiv$ X/N, and A, α, β, and γ are positive parameters to be estimated, with the scale of production given by $\alpha + \beta + \gamma \leq 1$. But since interest is in baseball player exports, we decompose X into X_i, i.e., its baseball (X_1) and non-baseball (X_2) components. The result, Equation 1(b), suggests that the composition of exports is important to economic performance.

- **Economy with intra-active X_i inputs - Equations 2 and 3**

From Feder (1983) we know that X has both direct and indirect effects on Y. To estimate the separate effects we follow Fosu's (1990) study of the effects of manufacturing exports and primary commodity exports on economic performance of developing countries (see also Guaresma and Worz, 2003, and Razmi and Blecker, 2005). We represent X by its parts as,

$$X = X_1^{\eta_1} X_2^{\eta_2}, \quad \eta_1 + \eta_2 = 1, \tag{2.1}$$

where η_i is export weights. Given (2.1) the index of X_2 in terms of X and X_1 is

$$X_2 = X^{\eta_1^*} X_1^{\eta_2^*}, \quad \eta_1^* = 1/\eta_1 \quad \eta_2^* = -\eta_1/\eta_2. \tag{2.2}$$

Hence, plugging (2.2) into (1) gives Equation 2 in the table, which measures the inter-active impact of exports on Y.

- **Economy with and without varying technical change - Equations 4 and 5**

Equation 2 assumes Hicks-neutrality of A(t). Equation 3 takes on a form that allows for exports to affect economic performance indirectly through a technology (A) that evolves over time at a variable rate of $\dot{A} = \lambda + \gamma_i \dot{X}_i, \dot{X} = \frac{1}{X} \frac{dX}{dt}$. Equally likely is for *A(t) = f(t, X$_i$, N)*, suggesting Harrod-neutralilty so that $\dot{A} = \alpha(\lambda + \gamma_i \dot{X}_i)$ - deriving from Equation 4. Harrod-neutrality is a reasonable assumption; while trade is sufficient for A-transfer, successful adoption and diffusion of A ultimately depends on population characteristics. According to Equation 5 A(t) is Solow-neutral such that *A(t) = f(t, X$_i$, K)* and $\dot{A} = \beta(\lambda + \gamma_i \dot{X}_i)$. The problem with Solow-neutrality is that *Y/K* can no longer be expected to be constant, and for this reason we invoke the Swan-Rodriquez-Clare method to derive the corresponding average forms as indicated in Frankel and Romer (1999). Our econometric estimations and analysis deploy these equations.

4. Measurement Issues

In describing essential measurement issues all financial data is in Dominican pesos rebased to year 2000 from either 1985 or 1995 base years using the following formula:

$$Q_{cb}^{t} = Q_{pb}^{t} \times \frac{Q_{cb}^{ct}}{Q_{pb}^{ct}}, \tag{3}$$

where *Q* is the data series, *t* is any year *t* being rebased, *cb* is the current base year = 2000, *pb* is the previous year base year = 1985 or 1995, and *ct* is the current year current data. This rebasing technique is consistent with U.N. National Accounts Systems (see Ning and Hoon, 2000).

Dependent Variable (Y): Y is gross domestic product (GDP) in billion pesos. Source: *International Financial Statistics (IFS) Yearbook* (various years).

Independent Variables: These include:

- **Time index of Technology (t):** ***t*** is a time dummy variable with a value of zero in the first year, and 43 in the terminal year.
- **Population (N):** N is mid-year population in millions of persons. We use N instead of labor (L) because we are interested in the implications of X_1 on welfare, not on how Y itself is produced. Source: *U.S. Bureau of Census, International Data Base* (varoius), http:/www.census.gove/cgi-bin/ipc/idbsprd .
- **Investment (I) and Capital Stock (K):** Normally empirical work of this kind use the "perpetual inventory method" to calculate K as

$$K(t)=I(t)+(1-\delta)K(t-1), \tag{4.1}$$

where I(t) is net investment in year t, δ is a K consumption rate (or depreciation rate), and K(t-1) is K stock in year *t-1*. There is no consistent data on K-formation and K-consumption is readily available, but there is enough data on the percentage of GDP of gross fixed I(t), and so we take and use

$$I(t)=\Theta Y(t),0<\Theta<1 \Rightarrow K(t)\approx I(t)/Y(t), \tag{4.2}$$

where Θ is the propensity to save. To account for the effect on Y of aging (depreciating) K, we include K(t-1) as well. Source: *IFS Yearbook (*various*).*

- **Exports (X):** X is total Dominican exports to the USA, converted to pesos using the market

rate of exchange from the *IFS Yearbooks*. We assume that X includes baseball player exports (X_1) of an unknown value. We calculate the value of X_1 as a product of the number of Dominican baseball players active in U.S. Major League Baseball (MLB) each year (B) *times* the annual average baseball salary in US$ (S) *adjusted* for the pesos/US$ rate of exchange (ξ), i.e.,

$$X_1(t)=[(B(t)\times S(t)]\times \xi(t). \tag{5.1}$$

Table 2 - Exchange rate, Total exports, Players, Average annual salary, and gross and net player export earnings

Net earnings ($X^*_1(t)$) = Gross earnings ($X_1(t)$) - Earnings Consumed ($C(t)X_1(t)$)

Year	$\xi(t)$	X(t)	B(t)	S(t)	$X_1(t)$	$C(t)X_1(t)$	$X^*_1(t)$
1962	1.023000	157542.0	11	7551.20	84973.65	77538.46	7435.20
1963	1.023000	144243.0	15	10434.00	160109.70	146356.30	13753.43
1964	1.023000	0.1309440E+09	15	13317.00	204349.40	186346.20	18003.18
1965	1.023000	0.1135530E+09	16	14738.00	241231.60	202996.40	38235.21
1966	1.023000	0.1309440E+09	17	16159.00	281021.20	244432.20	36588.96
1967	1.023000	0.1370820E+09	16	19000.00	310992.00	278057.90	32934.05
1968	1.023000	0.1595880E+09	16	21955.00	359359.40	316595.70	42763.77
1969	1.023000	0.1687950E+09	20	24900.00	509454.00	473537.50	35916.51
1970	1.023000	0.1882320E+09	20	29303.00	599539.40	554693.80	44845.55
1971	1.023000	0.1790250E+09	20	31543.00	645369.80	585285.90	60083.93
1972	1.023000	0.2373360E+09	19	34092.00	662646.20	649724.60	12921.60
1973	1.023000	0.3140610E+09	18	36566.00	673326.30	660735.10	12591.20
1974	1.023000	0.4818330E+09	23	40839.00	960900.80	922657.00	38243.85
1975	1.023000	0.6485820E+09	20	44676.00	914071.00	984271.60	-70200.65
1976	1.023000	0.5350290E+09	20	51501.00	1053710.00	1036956.00	16754.00
1977	1.023000	0.6516510E+09	25	76066.00	1945388.00	1888777.00	56610.79

Year	ξ(t)	X(t)	B(t)	S(t)	$X_1(t)$	$C(t)X_1(t)$	$X^*_1(t)$
1978	1.023000	0.5493510E+09	30	99876.00	3065194.00	2910096.00	155098.80
1979	1.023000	0.6823410E+09	30	113558.00	3485095.00	3386118.00	98976.70
1980	1.023000	0.8051010E+09	28	143756.00	4117747.00	3903212.00	214534.60
1981	1.023000	0.9472980E+09	28	185651.00	5317787.00	5251847. 00	65940.56
1982	1.023000	0.6434670E+09	28	241497.00	6917440.00	6729977.00	187462.60
1983	1.023000	0.8327220E+09	31	289194.00	9171209.00	9249165.00	-77955.28
1984	1.023000	0.1041414E+10	31	329408.00	0.1044652E+08	0.1124359E+08	-797069.20
1985	3.009000	0.2954838E+10	32	371571.00	0.3577783E+08	0.3494063E+08	837201.20
1986	3.148000	0.3415580E+10	33	412520.00	0.4285423E+08	0.4265281E+08	201414.90
1987	5.074000	0.5901062E+10	37	412454.00	0.7743329E+08	0.7761913E+08	-185839.90
1988	6.480000	0.9182160E+10	41	438729.00	0.1165615E+09	0.1196854E+09	-3123849.00
1989	6.486000	0.1067596E+11	38	513084.00	0.1264588E+09	0.1244228E+09	2035986.00
1990	11.61100	0.2034247E+11	41	578930.00	0.2756002E+09	0.2649069E+09	0.1069329E+08
1991	12.95100	0.2612217E+11	44	891188.00	0.5078381E+09	0.4825986E+09	0.2523956E+08
1992	12.86400	0.3051341E+11	56	1084408.00	0.7811902E+09	0.7338500E+09	0.4734012E+08
1993	13.06100	0.3489899E+11	62	1120254.00	0.9071615E+09	0.9043493E+09	2812201.00
1994	13.36500	0.4131121E+11	63	1188679.00	0.1000862E+10	0.9837470E+09	0.1711474E+08
1995	13.77500	0.4682122E+11	73	1071029.00	0.1077000E+10	0.1060522E+10	0.1647810E+08
1996	14.38500	0.5142637E+11	82	1176967.00	0.1388315E+10	0.1329173E+10	0.5914222E+08

Year	$\xi(t)$	X(t)	B(t)	S(t)	$X_1(t)$	$C(t)X_1(t)$	$X^*_1(t)$
1997	14.69600	0.6358959E+11	92	1383578.00	0.1870642E+10	0.1793197E+10	0.7744457E+08
1998	15.61800	0.6939077E+11	95	1441406.00	0.2138628E+10	0.2039182E+10	0.9944623E+08
1999	16.40200	0.7031537E+11	101	1720050.00	0.2849438E+10	0.2736885E+10	0.1125528E+09
2000	16.79300	0.7360372E+11	110	1988034.00	0.3672356E+10	0.3665379E+10	6977476.00
2001	16.95200	0.7091022E+11	111	2264403.00	0.4260864E+10	0.4196525E+10	0.6433904E+08
2002	18.61000	0.7758509E+11	113	2383235.00	0.5011776E+10	0.5633738E+10	-0.6219614E+09
2003	30.83100	0.1373521E+12	113	2555476.00	0.8903031E+10	0.8959120E+10	-0.5608909E+08
2004	42.12000	0.1907194E+12	124	2486609.00	0.1298726E+11	0.1348597E+11	-0.4987108E+09

Note: In some years net earnings repatriated are negative because the opportunity costs of repatriation were higher than the benefits.

Table 3 - Events indicating economic instability (Z) in Dominican Republic, 1962-2004

(Z = 0 in all these years and Z = 1 everywhere else)

Year	Event
1963	Coup against President Juan Bosch Gavino
1965	Wide-spread revolt and U.S. military intervention
1973	Attempted querilla invasion and state of emergency
1978	Failed attempted coup
1981	Elections uncertainty and president commits suicide
1984	Public protests against high cost of necessities and arrests
1985	Price hikes, violent protests, and unacceptable IMF terms for financial aid, general strike for wage increases
1986	Elections dispute and ensuing violence
1987	Cabinet resignation and 35,000 job posts abolished
1988	Protests against increases in prices of foodstuff
1989	General strike over deteriorating public utilities (water and electricity), demands for doubling minimum wage, and reducing prices of foodstuff
1990	Austerity measures, doubling of prices, and subsequent strikes
1991	Ex-president sentenced to 20-year jail term for corruption
1992-1993	Resignations of many political party members and uncertainty which there created
1994	Post-elections crises
1995	Protests and a general strike
1996	Presidential election uncertainty
1997-2000	Violence over fiscal measures
2004	Looming crisis over constitutional change. Averted

Source: *The Europa World Yearbook*, Volume 1, 45th Edition, Europa Publications, Taylor and Francis Group, 2005.

Sources: X is from *The Statistical Abstract of the United States* (various years); B is from Base-almanac.com; and S is from the Associated Press and own calculations from different sources; and ξ is from *IFS Yearbook* (various).

Given (5.1) non-basebal exports (X_2 (t)) is the difference

$$X_2(t)=X(t)-X_1(t). \tag{5.2}$$

In reality both (5.1) and (5.2) overstate X because while active Dominican baseball players live in the USA, implying that not all earnings are repatriated. For this reason we suppose that Dominican players have a target (theoretical) marginal propensity to consume, C(t), which represents the marginal propensity to consume of the average U.S. resident. relative to that of the typical Dominican.[6] We approximate C(t) as

$$C(t)=CGDP_d(t)/CGDP_u(t), \quad 0<C(t)\leq 1,$$

where $CGDP_d$ is percentage of Dominican Republic's GDP that goes to final consumption and $CGDP_u$ is the U.S. share of GDP that goes to final consumption.[7] If C(t) > 1, then the general tendency will be for players to retain more earnings in the USA and repatriate less to the Dominican Republic. If C (t) < 1 players would likely repatriate most of their earnings to the Dominican Republic; and only if C = 1 are they indifferent. This all means that the consumption-adjusted X_1 is net of C(t)X(t), i.e.,

$$X_1^*(t)=(1-C(t))X_1(t)\Rightarrow X_2^*(t)=X_1(t)-X_1^*(t). \tag{5.3}$$

Table 2 is an approximate layout of (5.3).[8]

- **Instability Index (Z):** In 2003 the Index of Economic Freedom ranked the Dominican Republic at 85 out of 156 countries as one of the most unstable countries in the world. Although there is no consistent measure of instability for the entire study period, in reviewing the performance of the economy two main sources of instability stand out: high inflation and income inequality, and the obvious implications of both for foodstuff prices and wages (see Table 3). Hence, it is reasonable to describe instability as

$$Z(t)=f(Inflation(t),\ Inequality(t)). \tag{6.1}$$

Table 4 - Estimated Indices of Instability in Dominican Republic, 1962-2004

(Parentheses are standard errors at 5% significance level)

Variable	**Probit Estimate**	**Logit Estimate**
Constant	1.330 (3.195)	2.304 (5.5734)
CPI(t)	0.010 (0.0134)	0.016 (0.0208)
*t*ime dummy	-0.079 (0.2121)	-0.135 (-0.3445)
LM	10.6065	10.8214
LLF	-24.397	-24.290
% right predictions	72.09	74.42
Adj. McFadden R-square	0.13749	0.18217
DW (ρ)	1.6795 (0.14854)	1.6932 (0.14199)

Put Figure 1a and 1b around here

Due to the lack of data on income distribution, we use a time dummy variable on the assumption that inequality either improves or deteriorates over time. We utilize probit and logit models to run 0-1 instability variable (Z(t)) on the CPI(t) base of inflation and the time dummy variable, and then construct indices of instability from that, i.e.,

$$\begin{aligned} &Probit\text{: } Z(Pt) = \sigma_0 + \sigma_1 CPI(t) + \sigma_2 t, && (a) \\ &Logit\text{: } Z(Lt) = \frac{1}{1+e^{-(\phi_0+\phi_1 CPI(t)+\phi_1 t)}}, && (b). \end{aligned} \tag{6.2}$$

The results from estimating (6.2) are in Table 4 and Figures 1a and 1b. In the figure Index Probit and Index Logit refer to raw indices, while Predicted Probit Z and Predicted Logit Z are estimated and normalized indices, $\hat{Z}'s$,

i.e., $0 \leq \hat{Z} \leq 1$. The results are good; they show the log likelihood of instability rising with increasing CPI(t), and instability falling over time, which we interpret as representingimproving income distribution. Subsequent estimations utilize the Logit model estimate of Z(t) because it is a litlle bit more statistically stronger than the Probit estimate. Thus, (1) becomes

$$Y(t) = [f(A(t),\ N(t),\ K(t),\ X(t),\ \hat{Z}(t))]\exp(\mu) \quad \mu \sim N(0,\sigma^2) = noise. \tag{7}$$

5. Estimations and Results

The estimations focus on per capita equations because the interest of this paper is in the implications of baseball player exports on economic performance.

5.1. Estimations

All the equations in Table 1 are linear in the parameters, and by taking their natural logarithms (ln) an OLS estimator is applicable. However, let's expand on Equations 2, 4, and 5 in order to stress their richness. Using (2.1) and (2.2) we can restate Equation 2 as

$$Y=A_0\exp(\lambda t)N^{\alpha}K^{\beta}X_1^{*\gamma_1^*}X^{*\gamma_2^*}, \quad \gamma_1^*=[\gamma_2(\gamma_1-\eta_1)]/\gamma_2, \quad \gamma_2^*=\gamma_2/\eta_1. \tag{8.1}$$

Dividing through by N and taking the logs of (8.1) gives

$$\ln y = lnA_0+\lambda t+\beta\ln k+\gamma_1^*\ln x_1^*+\gamma_2^*\ln x^*, \tag{8.2}$$

where $k = K / N$, $x^* = X / N$, and $x_1^* = X^*{}_1 / X$.

From (8.2) $(\gamma_1 - \eta_1)\ln x^*{}_1 = \gamma_1 \ln x^*{}_1 - \eta_1 \ln x^*{}_1$, implying that X has direct and indirect effects on *y*.

As in Equation 1 the rate of technical change, $\dot{A} = {}^{dA(t)}\!/_{Adt} = \lambda$, is Hicks-neutral and constant.[9] In Equation 3, $A = f(t, X) \Rightarrow \dot{A} = \lambda + \gamma\dot{X}$, still Hicks-neutral, but now variable. Moreover, Equation 4 in Table 1 is Harrod-neutral and, after substituting for A(t) and simplifying, it can be rewritten as

$$lnY=\alpha lnA_0+\alpha\lambda t+\alpha\lambda X+\alpha\ln N+\beta\ln K. \tag{8.3}$$

Again representing the rate of change of a variable by a dot over it, we have

$\dot{Y} = Y' / Y = \frac{1}{Y}\cdot\frac{dY}{dt}$. The growth equation becomes

$$\dot{Y}=\dot{A}+\alpha\dot{N}+\beta\dot{K}. \tag{8.4}$$

In other words, the time derivative of (8.3) is

$$Y'=Y\times\dot{Y}. \qquad (8.5$$

From (8.5) the Harrod rate of technical change is

$$\dot{A}(\lambda,\gamma,\alpha)=A'A^{-1}=\alpha\lambda+\alpha\gamma\dot{X}=Y^{1/\alpha}K^{-\beta/\alpha}, \tag{8.6}$$

where $A' = {}^{dA(t)}/_{dt} = A \times \dot{A} \Rightarrow A(t, X, N)$. Solow-neutrality of technical change emerges from Equation 5 in Table 1 because there it can be shown that

$$Y=N^{\alpha}(AK)^{\beta}, \tag{8.7}$$

such that in log terms

$$\ln Y=\alpha\ln N+\beta lnA_0+\beta\lambda t+\beta\gamma X+\beta\ln K \Rightarrow \dot{Y}=\dot{A}+\alpha\dot{N}+\beta\dot{K}. \tag{8.8}$$

Eqs. (8.4) and (8.8) have the same appearance but different contents and meanings because in the latter case

$$Y'=Y\times\dot{Y},\quad A'=A\times\dot{A},\ \dot{A}=A'A^{-1}=\beta\lambda+\beta\gamma\dot{X},\ A=A'\dot{A}^{-1}=Y^{1/\beta}N^{-\alpha/\beta}. \tag{8.9}$$

The next pages present and comment on estimation results.

5.2. Results

Tables 5 and 6 and Figures 2 and 3 present the results of the estimations. One common feature of all these estimations is that the variable Z(t) has a positive impact on per capita GDP in the Dominican Republic over the period in question. Superficially it would seem strange to think of instability as a good thing when generally empirical evidence has supported instability as a negative shock to economic activities, see e.g. Ades and Chua (1997) and Barro (1991). However it is not unusual to find a positive correlation between measures of instability and some economic activity. In Barro (1991) there is some direct relationship between fertility and domestic instability, while in Murphy, Shleifer and Vishny (1991) “revolutions and coups” are positively related to engineering output. In our case a positive correlation between Z(t) and GDP per capita can be explained in four ways. First, the events in Table 4 which we used to construct the Z(t) variable may be biased toward the urban areas where they occurred, and the rural places where exports originate have been relatively calm. Second, as Z(t) rises people flee the country for a better living elsewhere at a higher rate than the GDP falls, and so the ratio increases. Third, for an agrarian country whose economy depends heavily on primary

Table 5 -Per capita exports (x_i), instability (Z), and GDP (y), Dominican Republic, 1962-2004

(Parentheses are standard errors at 5% significance level)

Variable	$y = f(t, Z, x^*_i, k, other)$	$y = f(Z, x^*_i, k, other)$	$y = f(t, x^*_i, k, other)$
Constant	9.4321 (1.0021)	9.5995 (0.6038)	10.246 (0.8121)
t	0.0041 (0.0119)		-0.0183 (0.0082)
Z(t)	0.4816 (0.2152)	0.4316 (0.1488)	
ln x^*_1(t)	0.0279 (0.0101)	0.0272 (0.0108)	0.0183 (0.0107)
ln x^*_2(t)	-0.0041 (0.0167)	-0.0029 (0.0154)	-0.0011 (0.0164)
ln k(t)	0.3783 (0.08237)	0.3901 (0.0569)	0.4194 (0.7768)
ln k(t-1)	0.2308 (0.0192)	0.2343 (0.0245)	0.2543 (0.0216)
ln y(t-1)	0.3657 (0.0388)	0.719 (0.0489)	0.4089 (0.0422)
Adj. R2	0.9974	0.9975	0.9970
SEE	0.0795	0.0797	0.0862
LLF	47.8419	47.7707	44.3866
Durbin H	3.2831	3.2635	3.8016
F(at mean)	2825.382	3285.363	2805.846

Table 6 - Intra-active exports and GDP in Dominican Republic, 1962-2004

(Parentheses are standard errors at 5% significance level)

Variable	$y = f(t, Z, x_i, other)$	$y = f(t, Z, x_i, other)$	$y = f(t, Z, x_i, other)$
Constant	6.6486 (2.4571)	6.8845 (1.7149)	6.7703 (1.7357)
t	0.0298 (0.0129)	0.03924 (0.0110)	0.4132 (0.0111)
Z(t)	0.7155 (0.2716)	0.8135 (0.1755)	0.8576 (0.1745)
x1(t)	0.0324 (0.0118)		
x2(t)	-0.0103 (0.0209)		
xy(t)		1.4478 (0.2887)	1.4006 (0.2848)
xx(t)		0.3358 (0.02436)	6.006 (0.3567)
ln ky (t)	0.0771 0.1582	0.1193 (0.1095)	0.1149 (0.1104)
lnky (t-1)	0.3196 0.0258	0.2886 (0.0242)	0.2874 (0.0242)
ln y(t-1)	0.8406 0.0797	0.7529 (0.0642)	0.7498 (0.0642)
Adj. R^2	0.9955	0.9974	0.9973
SEE	0.10469	0.0802	0.0832
LLF	36.0253	47.4823	47.4180
Durbin H	1.7172	-0.3686	-0.38206
F(at mean)	1628.146	2778.418	2770.103

Note: ky = K/Y; xy = X_i/Y, and xx = X_i/X.

Put Figures 2 and 3 around here

commodities, foreign, rather than domestic market instability that is important to domestic performance. Fourth, the measured impact suggests that per capita GDP rose as instability declined over time. This can be inferred from the fact that Z(t) increased with increased CPI(t).

Overall the results are reasonable. For example, Table 5 shows that baseball player exports and per capita GDP are positively related, and that the relationship between the two is significant at the 5% level. A one-percent increase in baseball exports generates an increase in income ranging from 1.8% to 2.8%. Non-baseball exports tend to reduce income, while the short-run impact of per capita capital stock on economic performance ranges from 0.37 to 0.42 and translates into 0.59 - 0.72 in the long run. The effect remains strong even after controlling for depreciation, and the explanatory (adjusted R^2) and predictive (SEE/Mean) powers of the models are both good (see Figures 2 and 3). However, interpretation of the results should proceed cautiously because, although the models were corrected for serial correlation and "*Whitened*" for an unknown form of heteroskedasticity, we still cannot reject the presence of statistical problems as the high Durbin H statisitic indicates.[10]

The results in Table 6 allows for resource intra- and inter-actions, and represent the best estimation of the intensive form of (8.2). The results of Column 2 are consistent with those of Table 5. The difference is unmistakable in Columns 3 and 4. Here a dollar's worth of baseball player exports indirectly raises per capita GDP by an amount anywhere between 29 cents to 144 cents.

6. Conclusion

This paper examines the impact of Dominican baseball player exports to the USA on economic performance in the Dominican Republic during the 1962-2004 years. Using a simple production function approach it generates interesting results. For example, neither discussed nor shown in this paper, preliminary estimations find that total exports have a negative and statistically insignificant effect on per capita GDP. However, the negative and weak correlation between total exports and per capita GDP breaks down into a strong and positive association between baseball player exports and GDP per capita, and a negative relationship between per capita GDP and non-baseball exports. The results carries a mixed message insofar as they suggests that exports can be both a "handmaiden" and an "engine" of economic performance. A negative impact of non-baseball exports most likely reflects the fact that most exports to the USA from this country are primary commodities subject to price and foreign demand fluctuations (Love, 1992). A positive correlation between exports and economic performance counters the claim by sports economists that sports activities have had positive, but nonetheless statistically insignificant, effects on local economies. In this case, the correlation is undoubtedly strong, keeping in mind that the difference may also be due to the aggregation effect since one case is microeconomic while the other is macroeconomic.

The two implications of the results suggest that whatever Dominicans have been doing to produce baseball player exports for the U.S. market is worthwhile. They also mean that trade (here exports) between the USA and the Dominican Republic is good for both parties, and both countries would continue to benefit from increased baseball player exports, and repatriation of export earnings. It is best if the government of the Dominican Republic refrained from levying a tax on the flow and/or stock of baseball player exports. Doing so would not only distort incentives to play baseball, as well as discourage foreign and domestic investment in the production of baseball players in the Dominican Republic (cf. Sanderson and Siegfried, 2006).

While the findings highlight important policy issues, they should still be interpretted cautiously as a number of areas call for further research. For example, this exercise did not test for alternative functional forms, and both the robustness and technical efficiency of estimated parameters may be weak relative to alternative models. In addition, calculating the value of baseball player exports assumes identical average salaries. The results may be different if players' salaries differ because their value of marginal products differ. Some have argued that salaries in the sports industry are highly stratified because the marginal player cost is always lower than the corresponding value marginal product, such that only free agency can bring the cost and value of baseball in equilibrium (Scully, 1995, Downward and Dawson, 2000, Forst, 2003, Noll and Zimbalist, 1997). To strengthen the relevance of these results there is a need to look into these matters, and especially for demand and supply studies to consider if baseball player exports act on performance as human capital, social capital, technology, physical capital, along with all those benefits and costs that Siegfriend and Zimbalist outline in their study.

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Notes

1. These exports include mainly primary and semi-processed commodities such as ferro-nickel, sugar, gold, silver, coffee, cocoa, tobacco, and meat. However, the country exports more baseball players to U.S. professional leagues than any other country of a comparable size.

2. Dominican U.S. residents remitted about US$1.5 billion to their home country in 2003 according to the U.S. CIA Factbook - http://www.cia.gov/publications/factbook/geos/dr.html . Mostlt likely baseball players contributed a large share on a per capita basis.

3. Although there are both early and more recent minimalist arguments for and against the export-income nexus, none of them denies the importance of exports in economic performance, see, for example, Tamura, 1969, Kravis, 1970, Smith, 1975, Michaely, 1977, 1979, Krugman, 1988, 1994).

4.Most economists would agree with Matheson's (2002) assertion that the "economic impact studies of large sporting events may overstate the true value impact of the events, but in practice the *ex ante* estimates of economic benefits far exceed the *ex post* observed economic development of host communities following mega-events or stadium construction" (p.2).

5.For the non-U.S. reader: a *host city* is one that hosts the Super Bowl. Cities bid for the honor. A *victorious city* is a city of the winning team.

6.Some players continue to live in the USA long after retirement from baseball. Others retain partial residence in the USA; e.g., "Ozzie Virgil visits Phoenix (Arizona) every spring partly because he lived there and partly because his children still live there (See "Alums among us" by Joseph A. Reave, *Arizona Republic*, April, 2006).

7.The rationale is that consumption habits do not change immediately, and in any event adjustment to new habits require comparison of old to new habits with the speed of adjustment faster the smaller the difference in the habits. The differences in habits are likely a function of culture.

8. Moreover, recently the Dominican government has imposed a 5%-35% import tax on consumption goods and 5%-80% tariff on some luxury imports. Assuming τ is the tax rate, the relevant baseball player export

becomes, $X^{**}{}_{1}(t) = (1-\tau)X_{1}^{*}(t)$.

9. Estimations in this analysis are at the per capita level, however, at this stage it is more informative and effective for the discussion to proceed at the aggregate level since transformations to the per capita level are easy to do.

10. By "Whitening" I refer to White (1980).

Figure 1a - Raw and Predicted Indices of Instability in Dominican Republic, 1962-2004

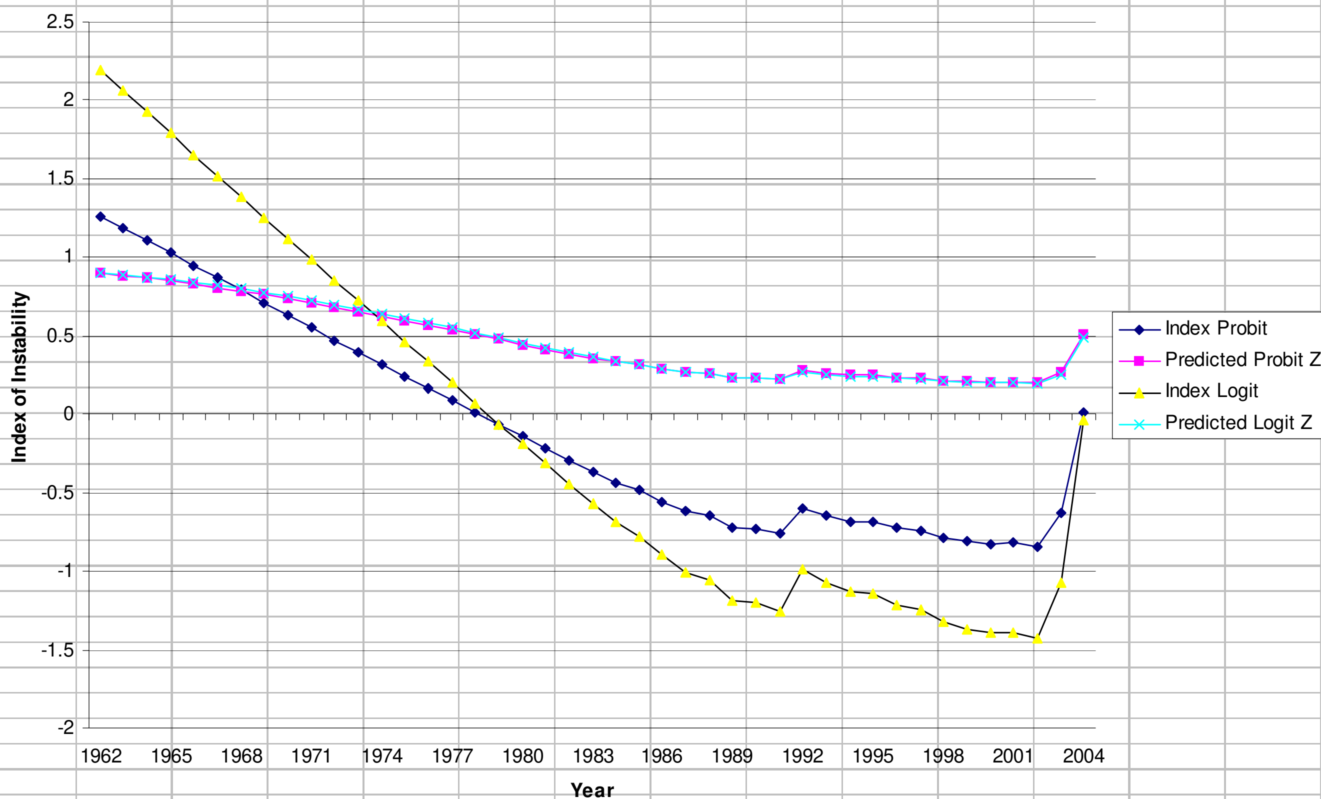

Figure 1b - Predicted Instability Indices and CPI in Dominican Repulic, 1962-2004

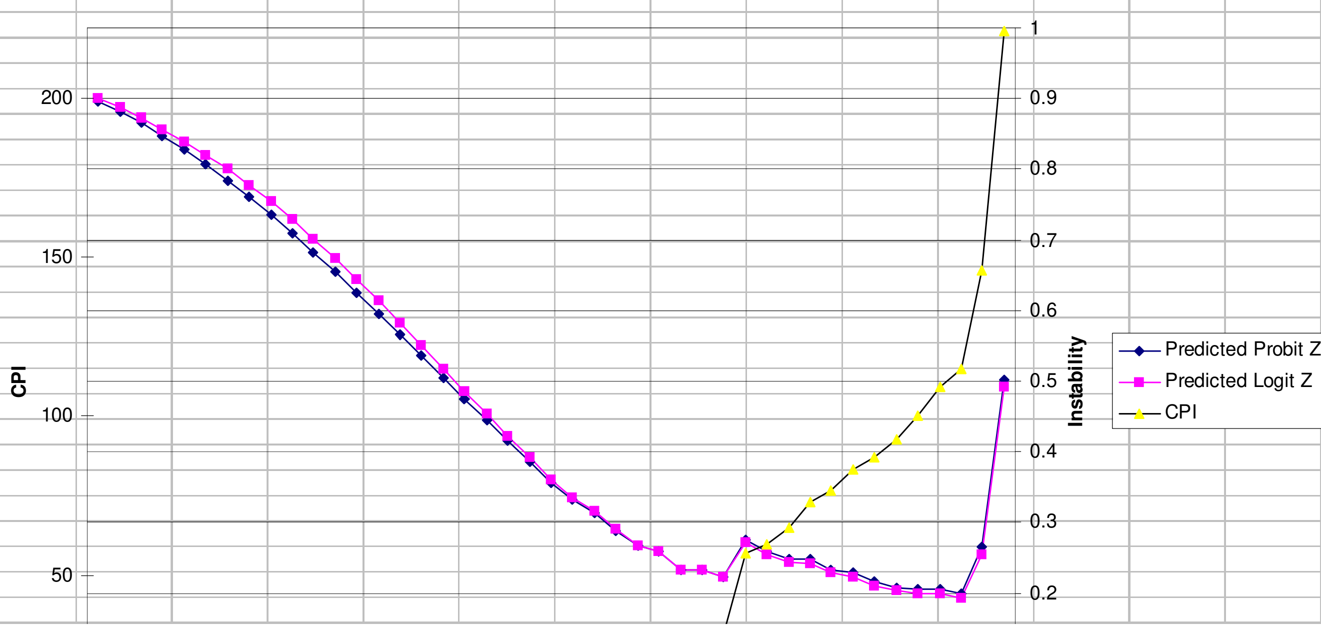

Figure 2 - Actual and estimated per capita GDP in Dominican Republic, 1962-2004 - Table 5

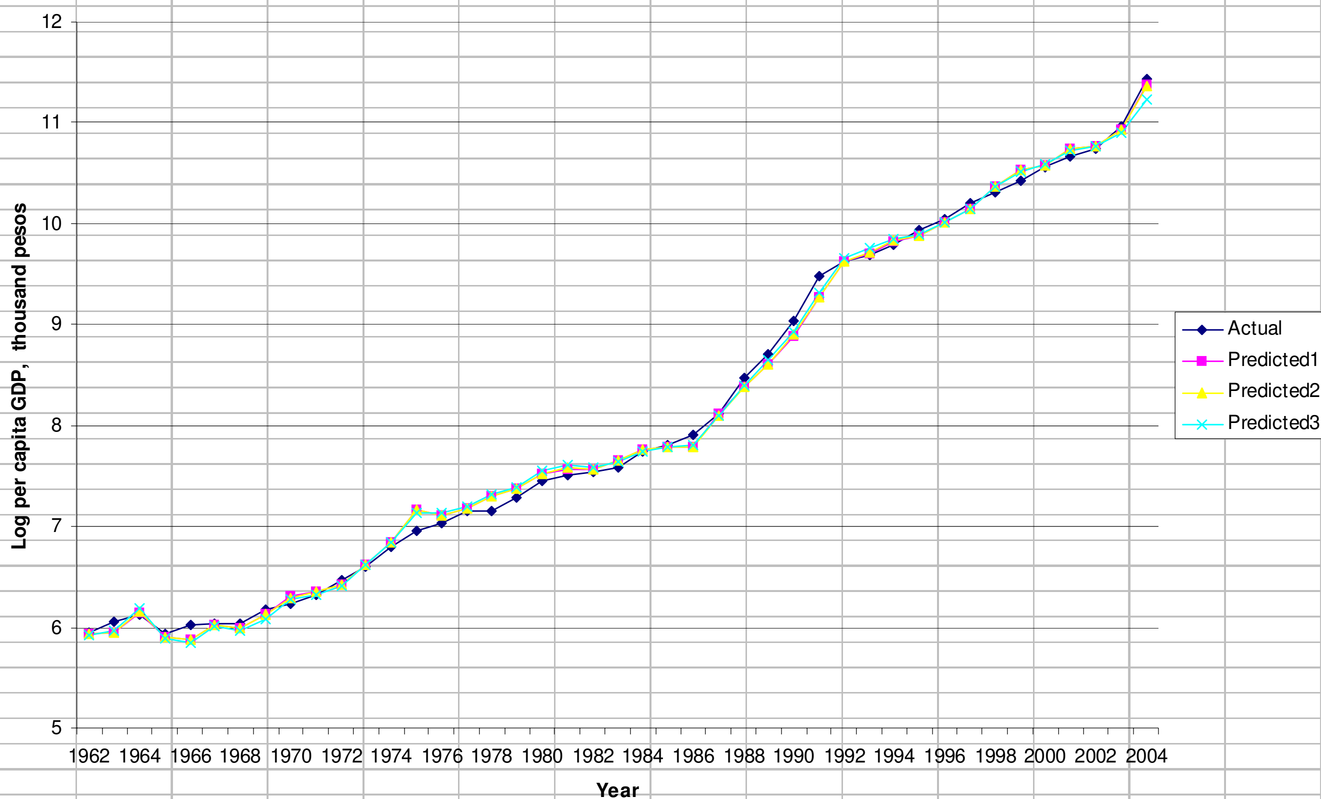

Figure 3 - Actual and predicted per capita GDP, Dominican Republic, 1962-2004 - Table 6