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Date: June 8, 2004



# **ESSAYS ON THE HISTORY OF ECONOMIC GROWTH IN MEXICO**

A thesis presented by

**Carlos Alejandro Ponzio**

to

The Economics Department in partial fulfillment of the requirements for the degree of  
Doctor of Philosophy in the subject of Economics

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# ESSAYS ON THE HISTORY OF ECONOMIC GROWTH IN MEXICO

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## **Abstract**

This thesis concerns various aspects of economic growth in the Third World using historical evidence from eighteenth and nineteenth century Mexico. Economists and historians believe that economic stagnation dominated the last decades of colonialism in Mexico, just before the start of the independence war. Chapter 1 explores the plausibility of a Dutch Disease case in late colonial Mexico. Dutch Disease is a case in which a boom in primary exports fails to stimulate development. Late colonial Mexico accomplished a boom in its main export, silver, and it was accompanied by an increase in the price of non-tradables. I argue that tax incentives in the late 1760s and the Free Trade Agreement of the late 1780s caused the export boom. I study a trade model in which these policies generate an increase in exports and a rise in the price of non-tradable goods. Using data on government income, I estimate an index of total output for the late colonial period. I find mixed evidence of a slowdown in economic growth after the export boom.

Chapter 2 studies the connection between globalization and economic growth in eighteenth-century Mexico. This was a period of globalization in Mexico, characterized by market integration and growth in international trade. I estimate economic growth at that time and explore its relationship with the dominant export of the epoch, silver. The results show that Mexico experienced rapid economic growth in the eighteenth century and, furthermore, that exports caused that growth. During the period of Bourbon reforms, economic growth improved, but not sumptuously. Mining ceased to be the engine of growth by the end of the century.

Chapter 3 studies the connection between economic growth and political instability during the most turbulent period in Mexican history, the post-independence period in the nineteenth century. Political instability implied policy uncertainty, no public programs for development, but most important, violence, lack of property rights, and other forms of disorder that led to risk of loss for economic actors. Political differences were based on ideological disagreement among political agents. I measure political instability by a combination of four variables: changes in the executive post; internal wars; number of parallel governments; and most importantly, foreign wars. The evidence is very strong. There is a negative link between political instability and growth. The result is robust to different control variables, equation dynamics, estimation methods, and growth measurements. I show that between 50 and 100 per cent of the decline in the growth rate during the four or five “lost decades” after independence can be attributed to political instability. And furthermore, political stability is responsible for about 50 to 88 per cent of the increase in the growth rate during the Belle Époque. And most important, there is no systematic difference in the growth rate after 1867 when I control for political stability. Political instability is the single most important factor in explaining why Mexico lagged behind during the nineteenth century.

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For

Laura Karina Alvarado Fonseca

Carlos Ponzio Elizondo and Olga de León de Ponzio

## CHAPTER 1

# EXPORT BOOM AND RISING PRICES IN LATE COLONIAL MEXICO: A DUTCH DISEASE ?

### 1.1 Introduction

The failure of a boom in primary exports to stimulate development is often called “Dutch disease”. The boom in a country’s raw material exports renders other sectors less competitive and hence less profitable. These other sectors, like manufacturing and agriculture, reduce production and employment, thus releasing resources to be used in the booming export sector. Depression in those sectors will offset some of the effects of the boom in primary exports, resulting in a lower rate of economic growth.

Evidence accumulated in the last two decades by economic historians of Mexico (New Spain) in the late colonial period points very clearly towards a possible case for Dutch disease. Tax and trade policies during the last 30 years of the eighteenth century reanimated silver production, the dominant export product of the epoch. The policies refer to the 1770’s tax incentives in the silver sector, along with the 1789 free trade policy implemented in New Spain. These policies created a boom in mining. Furthermore, an increase in the prices of non-tradable goods like maize, wheat and sugar accompanied the boom in silver production.<sup>1</sup>

Economists may interpret the evidence of rising prices of non-tradable goods when accompanied by an export boom as a case for Dutch disease. Therefore, this paper presents economic growth estimates for colonial Mexico during both the 1750-1770 and the 1770-1800 periods, in order to answer the question: Was there a slowdown in economic growth or the level of GDP after the boom in silver production? The answer is ambiguous. For

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<sup>1</sup> This is not a “classic” case of Dutch Disease since supply side domestic change triggered the boom, not a favorable price shock or “discovery” of silver.

some parameter values, the answer is “no”, for other parameter values, the answer is “yes”. A slowdown in economic growth not necessarily occurred in late colonial Mexico.

Coatsworth (1986) first explored the plausibility of an economic decline during the last 30 years of eighteenth century Mexico. He used available maize price series to deflate production of the main export of the epoch, silver. The result was that instead of prosperity, there was a decline in the value of silver in terms of maize during the late colonial period in Mexico. This result was interpreted as signaling a general decline of the whole economy. Other scholars have since confirmed Coatsworth’s finding in other sectors. For instance, living conditions in agriculture seem to have worsened by the end of the eighteenth century (Van Young, 1992). This paper will argue that the conditions necessary for a Dutch Disease seem to be present in late colonial Mexico and it will study the possibility of a decline in total output during the last 30 years of eighteenth century Mexico.

The exposition is organized as follows: Section 1.2 presents available evidence on silver production and the price of non-tradable goods, which suggests the possibility for a Dutch Disease in late colonial Mexico. After 20 years of mining stagnation during the 1750-1770 period, silver production increased by more than 50 per cent during the next 30 years (1770-1800). Accompanying the silver boom, there was an increase in prices during the last 30 years of eighteenth century Mexico. In Mexico City, the maize price remained constant in the 1760s, but it increased by 100 per cent during the 1770-1800 period. Similar increases in the wheat and sugar prices in the center of Mexico can be found. Furthermore, price increases are repeated for a broader range of products in regions outside Mexico City.

Section 1.3 reviews the theoretical literature on the Dutch Disease, and serves to place the model of this paper in perspective to its related work. Dutch Disease usually refers to an output decline in one sector of the economy (Corden and Neary, 1982; Corden, 1984; Van Wijnbergen, 1984; and Krugman, 1987). In more recent models, however, it can create a decline in the rate of economic growth of the economy as a whole (Matsuyama, 1992; Sachs and Warner, 1995; Torvik, 2001). Dutch Disease may derive from an

exogenous shock in prices, productivity, or discovery in the natural resource sector. In this paper, Dutch Disease has its source in supply side domestic policies.

Section 1.4 presents a model in which tax incentives to the production of silver and a policy of free trade can explain the late colonial period evidence on silver and prices. The home economy produces a non-tradable and an exportable good, while it consumes the non-tradable and an importable good. Both the 1769 tax incentives and the 1789 Free Trade policy are modeled as a reduction in taxes paid by the exportable (mining) sector. The first effect of these policies is to increase the supply of silver and reduce its price in terms of non-tradables, making non-tradable goods more expensive in terms of silver. The second effect occurs in the international market, where there is an increase in exports, so that imports become more expensive in terms of silver. The effect of this worsening in the terms of trade on the domestic market will depend on the aggregate elasticity of substitution in demands for imports and non-tradables. If this elasticity is less than one, the increase in the price of imports will rise the home relative demand for silver, so that the first increase in silver production is reinforced. However, the increase in the relative demand for silver will tend to increase the relative price of silver, and therefore to reduce the price of non-tradables, counteracting the first effect. Using this model I find that the tax and trade policies of the late colonial period are consistent with, and can potentially explain, observed historical data.

Section 1.5 presents the methodology used to estimate the rate of economic growth in late colonial Mexico. Our point of departure is government income in the treasury of Mexico City as reported by TePaske (1985). I use government income decade averages from Klein (1998) to estimate the share of the treasury of Mexico City in all treasuries of New Spain. To deflate the resulting series I use a price index from maize price data presented by Garner and Stefanou (1993). A moving median is used to smooth the maize price series. These three pieces of evidence allow us to calculate the size of government in real terms in colonial Mexico. Finally, I propose two general equations for the behavior of the share of government income in total output during the second half of eighteenth century

Mexico. These equations permit us to estimate an index of GDP from the estimated government income in New Spain.

Section 1.6 presents the results of our calculations for the annual rate of economic growth between 1750-1770 and 1770-1798. For some parameter values, I find no significant decline in the rate of economic growth between these two periods, and I find no one-time reduction in the level of GDP. In fact, I calculate there was an increase in the rate of economic growth after the boom in silver production and the rise in prices. For other parameter values, I find a decline in the rate of economic growth after 1769. I cannot conclude that Dutch Disease did or did not occur in late colonial Mexico. Final comments are summarized in section 1.7.

## **1.2 Silver Production and Prices**

This section reviews two results from the economic historiography of the late colonial period in Mexico. The first is the boom in silver production during the last 30 years of the eighteenth century (Humboldt, 1966 [1817]; Orozco, 1856; Brading, 1971, 1985; TePaske, 1985). The second refers to the 1770-1800 increase in the prices of maize, wheat and sugar in Mexico City, and a similar rise in prices for a broader range of alimentary products in other regions of New Spain during the same period<sup>2</sup> (Florescano, 1969; Hurtado, 1974; Galicia, 1975; Rabell, 1986; García, 1988; Crespo, 1988).

The available measure for New Spain's silver production is the quantity of coined silver. Private firms extracted silver, and most of it was then conducted to Coinage Houses (Casas de la Moneda). Figure 1.1 presents this quantity in annual million pesos during the 1750-1800 period, according to Orozco (1857). The results are exactly the same if I were to use the other main source for coined silver in the economic historiography. Figure 1.1 presents coined silver at current pesos, and there are two reasons for not deflating these figures. First, the silver content of each peso remained practically constant during the

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<sup>2</sup> On the prices of eighteenth century Mexico, see also Garner and Stefanou (1993) and García (1995).

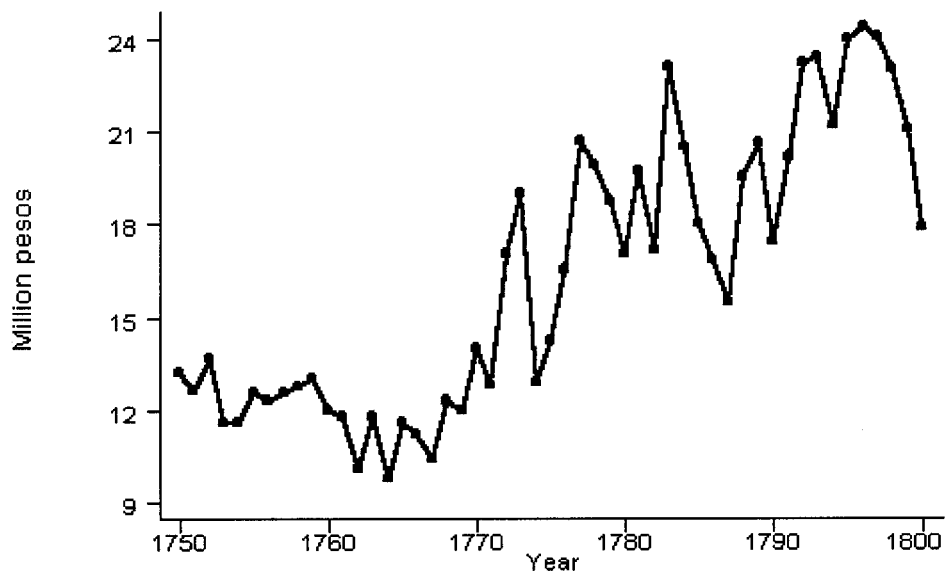
second half of the eighteenth century. Therefore, Figure 1.1 is also presenting an index of the physical amounts of silver contained in coined pesos. Second, I am interested in the physical amount of coined silver as a measure of silver output. In contrast, some authors attempt to estimate total output in colonial Mexico through the deflated value of silver production, an alternative not pursued in this paper.

It is clear from Figure 1.1 that the production of silver remained approximately constant during the 1750-1770 period and then experienced a first boom shortly after 1770, never returning to its previous levels. A second boom in silver production occurred around 1790. In fact, these two events account for the entire increase in silver production during the second half of the eighteenth century. Silver production remained in around 13 million pesos during the 1750-1770 period. At the end of the 1770s, coined silver reached 18 million pesos, and during the 1790s it reached 20 million pesos.

The boom in silver production, and the possible case for Dutch Disease, occurred during the period of Bourbon reforms, and there is some agreement in the economic historiography that it was caused by those reforms. These reforms took place after 1765 period, a set of policies which reanimated silver production. The reforms implemented a reduction in taxes paid by the mining sector. As shown in the next section, this could account for the first boom in silver output in the 1770s. The second boom, during the 1790s, coincides with the 1789 Free Trade agreement between New Spain and Spain. This policy allowed any port in Spain to engage in trade with New Spain, and it also allowed a freer commerce between New Spain and Spain. In the next section, the Free Trade policy is also modeled as a reduction in taxes paid by the export sector and, therefore, would have induced an increase in silver output.

Among the wide array of incentives to the silver industry described by Brading (1971), I mention the following: the price of mercury, which was regulated by the government, was reduced to half its original level; most mines were exempted from the tithe, which represented approximately 10 % of silver produced; and taxes on the sales of all primary inputs used by the mining industry, whose share in total cost was 75 % according to Brading (1971), were eliminated. Using the shares of inputs on total costs as

Figure 1.1 Coined Silver in Mexico, 1750-1800.



Source: Orozco (1857)



reported by Brading (1971), Ponzio (1998) calculates that these reforms reduced the private cost of production by approximately 25 per cent.<sup>3</sup>

The 1789 “Free Trade” policy eliminated commercial restrictions between Spaniards and Mexicans. It was initially implemented for Spanish America in 1778, eliminating commerce restriction for Spaniards trading with Spanish America. However, the 1778 decree initially excluded ports in Mexico and Venezuela; Mexico was not included until 1789. The 1789 reform also implied freer commerce for Mexicans trading with Spain. In this paper, the Free Trade agreement is interpreted as a reduction in taxes paid by the export sector, and therefore it implies an increase in export (silver) production.

After reviewing the evidence on silver production, I now turn our attention to the behavior of prices. The price evidence can be divided into that for Mexico City, an urban center; that for other regions, mostly regional cities; and that for the entire New Spain. Furthermore, whether for Mexico City or for any other region of New Spain, the price of maize has played an important role in the economic historiography since it is believed it can track the general price level of non-tradable goods in colonial Mexico.

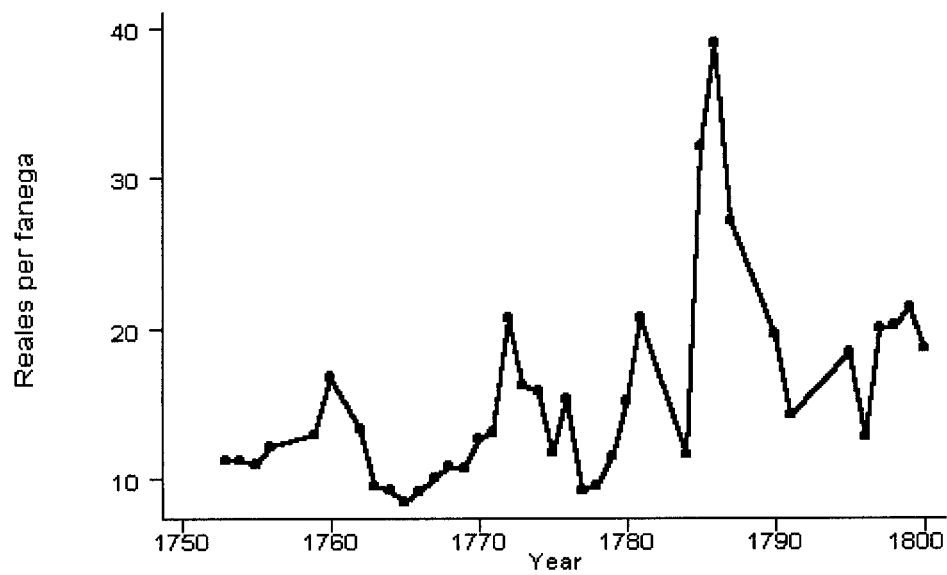
Maize was the most important element in indigenous diet. It was also the “gasoline” of mules when used in transporting goods and the “energy” for animals when used to power industry. This means that the maize price could give us a good idea about the price of non-tradable goods in colonial Mexico. In fact, this paper will use a maize price index to deflate the nominal series on estimated total output. Furthermore, since silver was converted to coins at a fixed rate during our period of interest, the inverse of the price of maize could also represent an index of the real exchange rate for colonial Mexico if the price of imports is constant.

For Mexico City, I rely on the maize price presented by Florescano (1969), which is the only such series available for Mexico City. There is also a maize price series offered by Gibson (1964), but it combines information from different sources around the Valley of

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<sup>3</sup> This result seems to be consistent with revenue-cost ratios calculated by Carmagnani (1986).

Figure 1.2 Maize Price in Mexico City, 1753-1800.



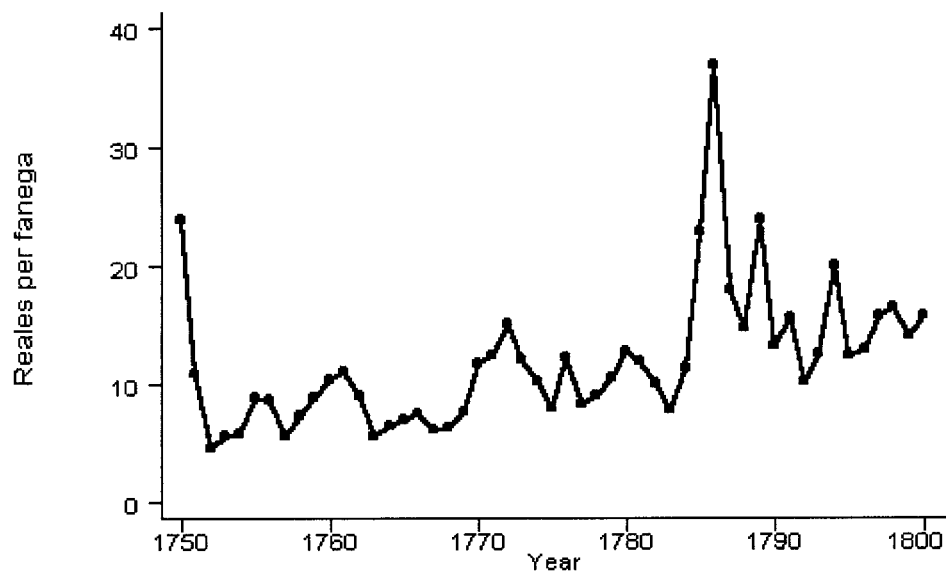
Source: Florescano (1969).

Mexico. I prefer Florecano's series since it has one single and homogeneous source, the sale price at Mexico City's Grain House (Alhóndiga de la Ciudad de México). Figure 1.2 presents Florecano's maize price series for the second half of the eighteenth century. During the decade of the 1760s, the maize price remained around 10 "reales per fanega". It rose to 15 reales per fanega during the 1770s and to 20 reales by the end of the 1790s. The reader should note that during the crop failure of mid 1780s, the maize price almost reached 40 reales per fanega. However, once the effects of the crop failure disappeared in the early 1790s, the price did not return to its 1770s levels, but it remained 5 reales higher than in the 1770s.

The economic historiography has shown that the rise in the maize price during the last 30 years of the eighteenth century was repeated for other products. For Mexico City, Garcia Acosta (1988) studied wheat prices, and concluded that they rose from 1770 to 1814. The increase in wheat prices after 1770 contrasts with its stability before 1770. Once again for Mexico City, Crespo (1990) found that the price of sugar similarly increased between 1770 and 1810. Surprisingly, the rise in the price of sugar came after a century long decline of its own price. Finally, the price of maize also rose in other regions. Brading (1978) documents a decline in the maize price for Leon and Silao from 1690 to 1770 and then an increase until 1800. According to Rabell (1986) and Espinosa (1995), similar results apply to the maize price in San Luis de la Paz and Celaya. Furthermore, other food products like wheat and beans in those other regions showed the same price behavior as maize in Mexico City. In conclusion, current evidence on prices supports the idea there was a general increase in prices during the last 30 years of eighteenth century Mexico.

The connection between the increase in prices and silver production to both the 1769 tax incentives and the 1789 Free Trade policy is a relatively new idea in the literature. Coatsworth (1986) certainly made the connection between tax incentives and silver production, attributing the entire post-1770 silver boom to the post-1765 tax incentives to the mining industry. But he left the price behavior out of his analysis. Ponzio (1998) related the silver boom and increase in prices to tax incentives, attributing the

Figure 1.3 Maize Price in New Spain, 1750-1800.



Source: Garner and Stefanou (1993).

entire post-1770 silver boom and maize price increase to the mining tax incentives. This paper divides the post-1770 silver and price increases in two parts: the 1770s prices and silver increase are connected to the post-1765 tax incentive, while the 1790s events are related to the Free Trade agreement.

The price increase during the last 30 years in eighteenth century Mexico also means that I must deflate the nominal figures for total output constructed in this paper. However, there is no comprehensive price series that is homogeneous, continuous and long enough to cover our period of interest. However, Garner and Stefanou (1993) assembled several sources to construct a maize price series for all of New Spain. Figure 1.3 plots this price series for the 1750-1800 period, in reales per fanega. The maize price remained around 7.5 reales per fanega in the 1750-1770 period, after which it rose to 10.5 reales in the 1770s. The price temporally increased again during the 1785-6 crop failure, when it reached almost 40 reales. The maize price never returned to its 1770s level in the 1790s, but rather remained 4 reales higher, around 14.5 reales per fanega. This price series will serve as our point of departure to deflate the series on nominal output.

### **1.3 Dutch Disease**

In most models, Dutch Disease refers to a decline in output of one sector of the economy, usually manufacturing, in response to a boom in the natural resource based export sector. In other models, under some conditions, Dutch Disease can create a decline in the rate of growth of the economy. Furthermore, these models typically assume that the Dutch Disease has its source in an exogenous price, productivity or discovery shock in the natural resource sector of the economy. This section will review these models to place our own approach into perspective.

Corden and Neary (1982) have provided a theoretical formulation of the Dutch Disease. In their model, Dutch Disease refers to the adverse effect of a boom in natural resources on manufacturing. Therefore, Dutch Disease refers to a process of de-

industrialization. They consider three sectors, which are called energy, manufacturing and services. The first two produce tradable goods, facing given world prices. The third sector is a non-tradable good whose price is determined in the domestic economy. Labor is mobile between all three sectors. In addition, each sector uses a specific input. Factor prices are flexible.

A boom in natural resources (energy) exerts two effects. First, since the boom increases the marginal product of all factors in energy, it draws resources out of both services and manufacturing (resource movement effect). Second, it raises aggregate income and drives up the demand for services. The relative price of the non-tradable good rises, and this draws resources back into services out of energy and manufacturing (the spending effect). The final result is that while the size of the energy sector increases and the manufacturing sector decreases unambiguously, the size of the service sector may shrink or grow depending on the magnitude of the spending and resource movement effects<sup>4</sup>

Van Wijnbergen (1984) has extended the Dutch Disease mechanism to a dynamic setting with learning by doing in the traded sector. He considers a two period economy that produces two commodities; one traded internationally, the other not. There are learning by doing effects in the traded sector. That is, more production in the traded sector during period 1 increases output of that same sector in period 2. The oil sector is modeled as a transfer received from abroad, and it makes no use of capital or labor. An increase in oil prices or a boom in oil production is equivalent to an increase in national revenue. The Dutch Disease refers to the crowding out of the non-oil traded goods sector after an increase in oil revenue.

A temporary increase in oil revenues in period 1 implies a higher demand for non-tradable goods, so a rise in the price of non-tradables is the first result. During period 1, this leads to a shift of resources out of the tradable sector and a decline of production in tradable goods. In period 2, because of learning by doing effects, there is a downward shift in the production function of tradable goods. This will lead to a decline in both the price of

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<sup>4</sup> Corden (1984) makes some extensions to the basic model.

non-tradable goods and in the production of tradable goods. After the increase in oil revenues, the optimal policy is a subsidy to the production of tradable goods. More resources are needed in the tradable sector due to the existence of learning by doing effects, which are external to firms.

Krugman (1987) laid out a model in which comparative advantage evolves over time through learning by doing. In his model, there are dynamic economies of scale in which cumulative past output determines current productivity. He considers a Ricardian economy with an arbitrary number of traded goods and a non-traded good, each using labor as the only factor of production. Labor is mobile among sectors. In each industry, productivity depends on cumulative experience. In this model, comparative advantage is created over time by the learning dynamics. Once a pattern of specialization is established, it remains unchanged with relative productivities further locking the pattern in.

In Krugman's model, the discovery of tradable natural resources leads to a loss in competitiveness in other tradable sectors, and to a reduction of output in them. The natural resource is modeled as a transfer payment from abroad. This transfer has the effect of increase wages in the home economy, and thus of reduce competitiveness in some sectors, which are interpreted as manufacturing. In a Ricardian economy, manufactures are not produced at home anymore, but in the foreign country. If the natural resource boom is long enough, the foreign country may develop a comparative advantage in manufacturing so that in the long run manufacturing permanently moves to the foreign country.

Matsuyama (1992) has studied the connection between agricultural productivity and economic growth. In his model, Dutch Disease refers to the adverse effect of an increase in agricultural productivity on the rate of economic growth. He considers two sectors: agriculture and manufacturing. Both sectors employ labor, and their technologies are subject to diminishing returns on that input. There are learning by doing effects in manufacturing, and productivity in that sector accumulates with manufacturing output. On the demand side, the income elasticity for the agricultural good is less than unitary.

A boom in natural resources is interpreted as an exogenous increase in agricultural productivity. For the closed economy case, the model predicts a positive link between the

boom and economic growth. An increase in natural resources would release labor to manufacturing. Since the rate of growth is proportional to manufacturing output, the growth rate accelerates in the economy. For the open economy case, there is a negative link between the boom and economic growth. An increase in natural resources would lead to higher employment in the booming sector, so comparative advantage is gained in natural resources whereas competitiveness is lost in manufacturing. The rate of growth in the economy declines, since manufacturing reduces.

Sachs and Warner (1995) have studied Dutch Disease features in an endogenous growth model. The Dutch Disease refers to the adverse effects of an employment reduction in manufacturing on economic growth. Their model consists of two sectors of production: tradable and non-tradable goods. The natural resource sector does not employ labor or capital, but it is a flow of exogenous income. The source of growth in their model is labor augmenting technological change, and this stock of knowledge accumulates proportionally to the share of employment in the tradable sector. Furthermore, in steady state also the rate of economic growth is proportional to the share of employment in the tradable sector. On the demand side, they consider an overlapping generations model.

A temporary boom in natural resources leads to a lower rate of economic growth during several periods after the boom. The resource boom is interpreted as an increase in the income flow of the economy, so that in the first period the young generation of the economy becomes wealthier. Some of this income is spent in the non-tradable good, so that the price of non-tradables rises. This draws resources from the traded to the non-traded sector. In the second period, there are two effects. The first one is the higher expenditure of the now old generation of the economy on the non-tradable sector. The second effect is that the first period reduction of employment in the tradable sector reduces accumulation of the stock of knowledge, and thus, the rate of economic growth. This process lasts for several periods.

In addition to these contributions, Torvik (2001) has recently extended the literature by studying a two-sector model where learning by doing can be present in both the tradable and the non-tradable sector. Productivity in each sector accumulates proportionally to the



share of labor it employs, and labor is the only intersectorally mobile factor. He also assumes there are learning spillovers between sectors, so that each sector's productivity also accumulates with the share of labor employed in the other sector. The boom in natural resources is interpreted as a foreign gift. Torvik obtains that the standard result in the Dutch Disease literature, the decline of output in the tradable sector, may be turned around.

While the model used in this paper builds on the literature just surveyed, it differs in some aspects from it. Here, the Dutch Disease "shock" is introduced by changes in tax incentives to the natural resource sector (mining or silver). Also, there are only two sectors of production in our home economy, a non-tradable good and exports, and importables are not produced at home. On the demand side only importables and non-tradables are consumed. Capital and labor are both mobile between sectors. Finally, I drop the small country assumption and consider the effect of Bourbon policies on the terms of trade. These are big differences but they seem essential to accommodate the structure of late colonial New Spain.

## **1.4 The Model**

There are three sectors in the home economy: imports (Z), exports (X), and a non-tradable good (Y). I assume that the imported commodity, say fine textiles, is not produced at home, while the exported good, silver, is not consumed at home. These modifications allow us to better describe the economy of colonial Mexico. I also drop the small country assumption since Mexico was producing more than half the world production of silver at that time. There is also evidence supporting the assumption that the two factors of production, capital (K) and labor (L), were mobile between the two sectors of production, exports and non-tradables. Capital and labor are fully employed. All relative prices will be endogenous to the model. I assume that the imported commodity can be bought only with silver, and that silver is only used to buy imported goods.

Silver in colonial Mexico, though privately produced, was coined by the government and then returned to private silver producers, except for the quantity collected

through taxes. The Church was the only important consumer of non-coined silver and most silver left New Spain in trade for imported commodities. Therefore, in this paper I concentrate on the role of silver as an export good. Of course, the monetary system in New Spain was based on silver, but in this paper I approach silver as an export product that is only used to buy the imported commodities. International trade equilibrium is reached when the value of silver production equals the value of imports.

During the late colonial period, the rate at which silver was converted into coins suffered very small changes that we can easily neglect. In what follows I make no distinction between silver and coins of silver. Furthermore, silver will be our numeraire. As the silver content of coins is constant during our period of interest, nominal and relative prices of non-traded goods are equivalent terms, and sometimes I call the relative price of non-tradable goods as simply the price of non-tradable goods. When I refer to the relative price of silver I mean 1 over the nominal (or relative) price of non-tradable goods.

In the domestic economy, capital and labor are allocated between non-tradables and exports in order to satisfy the domestic demand for non-tradable goods and a “domestic demand” for silver. Though silver does not provide utility for residents of the home economy, they require silver to satisfy their demand for imports. And since the domestic demand for silver is derived from the home demand for imports, international conditions affect domestic equilibrium through the relative price of imports in terms of exports. Therefore, production of silver and non-tradables respond to changes in the terms of trade.

I close the model by studying international equilibrium in the market for Mexican imports. Demand for imports equals the value of silver production in terms of foreign goods. As it is formally shown below, a change in the terms of trade has two effects on import demand. Holding silver production fixed, an increase in the price of imports reduces the amount of foreign goods silver can buy. This reduces the amount of imports demanded. The second effect works through the production of silver. A higher price of imports may imply a higher or lower domestic demand for silver, depending on the aggregate elasticity of substitution between demands for non-tradable and foreign goods. As long as this elasticity is less than one in absolute value, silver production would increase less than

proportionally the increase in the price of imports. The result of both effects is that import demand reduces as the price of imports rises.<sup>5</sup> To determine the equilibrium terms of trade, the model assumes the existence a foreign supply of Mexican imports.

Utility for residents depends on non-tradable and imported commodities, so individuals from the home country are represented by:  $\max U(Z, Y)$ , subject to  $P_Z \cdot Z + P_Y \cdot Y = M$ , where  $M$  denotes national income. If  $Z(P_Z, P_Y, M)$  represents the demand for importable goods, then the amount of silver they need to buy  $Z$  is given by  $D_X = \frac{P_Z}{P_X} \cdot Z(P_Z, P_Y, M)$ , and the demand for non-tradable goods is  $Y = Y(P_Z, P_Y, M)$ . I

assume preferences are homothetic. Total differentiation of the logarithms of the demand functions yields:

$$\hat{D}_X - \hat{Y} = (1 - \sigma_D)(\hat{P}_Z - \hat{P}_X) - \sigma_D(\hat{P}_X - \hat{P}_Y) \quad (1.1)$$

where I define the aggregate elasticity of substitution as  $\sigma_D = -(\varepsilon_{zz} + \varepsilon_{yy}) > 0$ , and  $\varepsilon_{ij}$  denotes the compensated elasticity of the demand for commodity  $i$  with respect to the price of  $j$ . I make use of the property that  $\varepsilon_{ij} = -\varepsilon_{ji}$ .

Equation (1.1) states that the relative demand for silver in terms of non-tradable goods,  $(D_X/Y)$ , falls as the relative price of exports in terms of non-tradables  $(P_X/P_Y)$  rises. Relative demands also vary with the terms of trade. The effect of a change in terms of trade  $(P_Z/P_X)$  depends on the magnitude of the aggregate elasticity of substitution in demands,  $\sigma_D$ . When this elasticity is less than one,<sup>6</sup> relative demand  $(D_X/Y)$  will rise as the terms of trade worsen. Therefore, in a graph showing relative demand  $(D_X/Y)$  against

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<sup>5</sup> This requirement on the elasticity of substitution is sufficient, though not necessary for having a downward sloping import demand. The result can be true even for some elasticities of substitution larger than one.

<sup>6</sup> Since all non-tradable goods are aggregated into one single good,  $Y$ , we can expect the aggregate elasticity of substitution between non-tradable and importable goods to be less than one.

relative price  $(P_X/P_Y)$ , we would have a downward slope curve, which is shifted out with increases in the terms of trade,  $(P_Z/P_X)$ .

On the production side I invoke the Heckscher-Ohlin 2x2 model. I will study the effect on the economy of an ad valorem tax on the good produced by the capital-intensive industry, mining ( $X$ ). I assume that a fraction  $U_X$  of this tax income is not returned to individuals in the Colony, but it is sent to a foreign country. Since I assume income elasticity of demands equals to unity, changes in the tax on silver do not affect relative demands, and the demand side of the model is still given by (1). Let  $S_X = 1 - T_X$  be the fraction of the value of silver that returns to producers, so that  $T_X$  represents the tax on silver. Then, the share of silver that is transferred to the foreign country is  $R_X = U_X \cdot T_X$ . I will assume that the share of silver production that is transferred to the foreign country is held constant when the tax on silver changes. Then the share of silver that remains in the colony without being transferred,  $N_X = 1 - R_X$ , is also constant. I denote by  $w$  and  $r$  the labor wage and the rental price of capital, respectively. Finally,  $A_i$  represents the level of technology in industry  $i$ , and I assume capital and labor grow at the same rate. The equations of change on the supply side would be:

$$\lambda(\hat{X} - \hat{Y}) = -(\beta_X \sigma_X + \beta_Y \sigma_Y) \cdot (\hat{r} - \hat{w}) + \lambda \cdot (\hat{A}_X - \hat{A}_Y) \quad (1.2)$$

$$(\hat{P}_X - \hat{P}_Y) = -\theta(\hat{r} - \hat{w}) - \hat{S}_X - (\hat{A}_X - \hat{A}_Y) \quad (1.3)$$

$$\lambda \cdot \hat{X} = -((\beta_X - \lambda_X) \sigma_X + (\beta_Y - \lambda_Y) \sigma_Y) \cdot (\hat{r} - \hat{w}) + \lambda \cdot (\hat{A}_X) \quad (1.4)$$

where  $\beta_i = \theta_{Ki} \lambda_{Li} + \theta_{Li} \lambda_{Ki}$ ,  $\lambda = \lambda_{LX} - \lambda_{KX}$ , and  $\theta = \theta_{LX} - \theta_{LY}$ .  $\sigma_i$  denotes the elasticity of substitution in sector  $i$ ,  $\lambda_{ij}$  is the share of the input  $i$  in sector  $j$ , and  $\theta_{ij}$  represents the share of the total cost of input  $i$  in industry  $j$ . Because I assume that industry  $X$  is capital intensive, I have  $\lambda < 0$  and  $\theta < 0$ . Furthermore,  $\lambda_i = \lambda_{Ki} \lambda_{Li}$  and  $\lambda_i < \beta_i$ .

Equations (1.2)-(1.4) are standard relationships from the Heckscher-Ohlin theory.<sup>7</sup> From (1.2) and (1.3) we could get an equation relating the changes in the relative supply of silver to the changes in its after-tax relative price,  $(S_X P_X / P_Y)$ . Such an equation would show a positive relationship between the after-tax relative price of silver and its relative quantity. This result is because of the assumption that silver production is capital intensive. Therefore, in a graph showing relative supply  $(X/Y)$  against relative price  $(P_X / P_Y)$ , we have an upward slope curve that is shifted down with increases in the tax on silver,  $T_X$ .

In equilibrium, the home demand for silver must be equal to the domestic supply of silver, so that  $D_X = N_X \cdot X$  holds. Since the share of silver production that is transferred to the foreign country ( $R_X$ ) is assumed to be constant in the analysis, then  $N_X = 1 - R_X$  is also constant, and the proportional change in the internal demand for silver must be equal to the proportional change in silver production:

$$\hat{D}_X = \hat{X} \quad (1.5)$$

Equations (1.1)-(1.5) could be used to express the change in relative factor prices, the change in relative commodity prices, and the change in relative quantities, all of them as functions of the change in the tax on silver and the change in the terms of trade. However, in this paper I am only interested in the effect on relative commodity prices and the amount of silver, so that leaving for later the solution for the change in the terms of trade, we have:

$$\pi \cdot (\hat{P}_X - \hat{P}_Y) = (1 - \sigma_D) (\hat{P}_Z - \hat{P}_X) - \sigma_S \cdot \hat{S}_X - (1 + \sigma_S) \cdot (\hat{A}_X - \hat{A}_Y) \quad (1.6)$$

$$\rho \cdot \hat{X} = \beta \cdot (1 - \sigma_D) \cdot (\hat{P}_Z - \hat{P}_X) + (\beta \sigma_D) \cdot \hat{S}_X + \beta \cdot (1 - \sigma_D) \cdot (\hat{A}_X - \hat{A}_Y) + \rho \cdot (\hat{A}_X) \quad (1.7)$$

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<sup>7</sup> See Jones (1965).

where  $\pi = (\sigma_s + \sigma_D)$ , and  $\rho = \pi \cdot \lambda \cdot \theta$  are both larger than zero.  $\rho$  is "the aggregate elasticity of substitution" defined by Jones (1965), while  $\sigma_s = \left( \frac{\beta_x \sigma_x + \beta_y \sigma_y}{\lambda \theta} \right)$ , and I define  $\beta = (\beta_x - \lambda_x) \sigma_x + (\beta_y - \lambda_y) \sigma_y$ . Since  $\rho > \beta$  and I assume the aggregate elasticity of substitution in demands ( $\sigma_D$ ) is less than unit, then the domestic demand for silver has a negative price elasticity, and this elasticity is less than one in absolute value.

In this model, changes in the terms of trade alter the equilibrium in the home economy through their effect on the domestic relative demand for silver, which is derived from the home demand for imports. According to (1), an increase in terms of trade induces a higher relative demand for silver with respect to non-tradable goods in the home economy, since I assume an elasticity of substitution,  $\sigma_D$ , less than one. The increase in relative demand will move the economy to a higher relative quantity of silver,  $(X/Y)$ . The new equilibrium is also associated with a higher relative price of silver in terms of non-traded goods, and a larger quantity of produced silver. These results are shown in equations (1.6) and (1.7).

To close the model and solve for the change in the terms of trade, let us consider the existence of a function  $\bar{Z} = \bar{Z}\left(\frac{P_z}{P_x}, \dots\right)$  representing the amount of Z exported by a foreign country to the home economy. The home demand for imports equals  $Z = P_x D_x / P_z$  which in equilibrium equals  $P_x N_x X / P_z$ . Let  $\varepsilon_i$  be the price elasticity of good  $i$  with respect to the relative price of home imports in terms of silver, so that  $\varepsilon_z = \varepsilon_x - 1 = \beta(1 - \sigma_D) / \rho - 1$ . I assume that the excess demand for foreign goods is decreasing in  $(P_z / P_x)$ , that is  $\varepsilon_x - 1 - \varepsilon_{\bar{z}} < 0$ . Let  $Z_f$  be a shift in the foreign supply of goods. Differentiating the international equilibrium,  $P_x N_x X / P_z = \bar{Z}$ , we have:

$$(1 - \varepsilon_x + \varepsilon_{\bar{z}}) \cdot (\hat{P}_z - \hat{P}_x) = \frac{\beta \sigma_D}{\rho} \hat{S}_x + \varepsilon_x (\hat{A}_x - \hat{A}_y) + \hat{A}_x - \hat{Z}_f \quad (1.8)$$

Equation (1.8) assumes the share of silver transferred abroad ( $N_X$ ) remains constant, so that the transfer has no effect on the international equilibrium. Since the home economy is a large producer of silver in world markets, we have, as usual, that a decrease in the tax on exports worsens the terms of trade because of its implications on the export supply of silver. Similarly, a decline in the foreign supply of goods also rises the price of imports in terms of exports. Now, let us study the plausible effects of the 1770s tax incentives to silver production and the 1789 trade agreement in this model. Both the tax incentives and the Free Trade agreement are interpreted as a decline in taxes paid by the mining sector.

To consider the effects on the price of non-tradable goods and silver production of a reduction in the tax paid by the mining sector, let us assume  $\hat{S}_X > 0$  in equations (1.3) and (1.6)-(1.8), where  $S_X$  is one minus the tax on silver production. This policy has two effects on the economy. The first would be to increase the rental price of capital, holding without change relative prices. This is because mining is capital intensive. In the domestic market, the relative quantity of silver produced will rise, implying a higher relative price of non-tradables. Silver production in absolute terms also increases. The second effect of a reduction in taxes paid by the mining sector occurs through the international market. Given the increase in exports, the relative price of imports in terms of exports goes up. Since the aggregate elasticity of substitution is assumed to be less than one, this increase in the price of imports leads to a higher domestic demand for silver. In equilibrium silver production increases more, and the initial rise in the price of non-tradables tends to be counteracted by the second effect, which reduces the price of non-tradables.

Interpreted as a decline in taxes paid by the mining sector, the tax incentives of the 1770s and the 1789 Free Trade agreement could potentially explain the boom in silver production and the rise in non-tradable prices during the late colonial period in Mexico. I have shown that an increase in both silver production and the price of non-tradables is consistent with a decline in taxes paid by the mining sector. This link is relatively new to the traditional view on the Mexican performance of the late colonial period. Conventional

wisdom has recognized the role to mining incentives in promoting the silver boom, but not its role in causing the rise in prices. A more traditional view assumes the growth of mining was exogenous, and the rise in prices an unrelated event. Coatsworth (1982, 1986) represents an exception to this view, since he presented the alternative hypothesis in which mining policies played a fundamental role in explaining the boom in silver production, though not in explaining the rise in prices.

For the interested reader, let us also consider the effect on relative prices and silver production of a decline in the foreign supply of goods. This is equivalent to having  $\hat{Z}_f < 0$  in equation (1.8). The immediate effect of such a change would be to increase the price of imports. This will imply a higher domestic demand for silver, given the low level of substitution between imports and non-tradables. In the domestic market, it increases the relative quantity of produced silver and reduces the price of non-tradables.

In the long run, the production of non-tradables and the value of exports in terms of non-tradables grow at rates that depend on technological change in those sectors. Under special circumstances, the long run rate of growth of GDP, measured in terms of non-tradables, is proportional to the rate of technological change in the non-tradable sector. This may occur, for instance, if I assume that there are learning by doing effects only in the non-tradable sector, so that  $\hat{A}_X = 0$ . Furthermore, I could also assume technological change in the non-tradable sector is related to the share of that sector in total GDP. In this case, it would be possible that after a reduction in taxes in the mining sector and a corresponding decline in the share of non-tradables in total output, the economy could suffer from lower rates of economic growth, as pointed out in the Dutch Disease literature. Whether at the end of the eighteenth century colonial Mexico suffered from a Dutch Disease or not is the topic of the rest of this paper.

## 1.5 Economic Growth Estimation



In this section I present the methodology used to make calculations for the behavior of total output in late colonial Mexico. Available data permits the construction of an output index for the 1750-1798 period. This index tries to proxy Gross Domestic Product from a series on government revenue. The estimates are independent of our model in section 1.4, and depend on three variables: fiscal income for Mexico City, the share of this revenue in New Spain's total fiscal revenue, and the price of maize, which I use to deflate the nominal series.

Our colonial Mexico product estimates in nominal terms depart from the income of the Royal Treasury of Mexico City as published by TePaske (1985). This is government income out of loans, transfers among local treasuries, other extraordinary income, and monies carried over from one year to the next one. I also rely on the regional structure of New Spain's royal income as reported by Klein (1998) to estimate the share of revenue from Mexico City in all government income. In order to get total output in real terms, or more appropriately in terms of the non-tradable sector, I will make use of the maize price index constructed by Garner and Stefanou (1993) to deflate the series. As it is argued below, the maize price provides a good basis to construct a general price index to deflate total output. Finally, I assume New Spain's share of fiscal income in total output remained constant through out our period of interest.

TePaske and Klein (1986) assembled and published annual data extracted from the summary reports of fiscal income produced by the 23 royal treasury offices in New Spain (cajas reales).<sup>8</sup> The summary accounts, however, are very difficult to interpret, and in some periods they present problems of double counting since they include monies that were carried over from year to year, transfers between local governments, and other complications. Fortunately, TePaske (1985) attempted to overcome these problems and presented estimates of annual revenue, out of debt, transfers, extraordinary income, and other double accounting components, for the royal treasury of Mexico City. Therefore, his

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<sup>8</sup> Precursors using these data for studying the economic performance of Mexico are TePaske and Klein (1981), TePaske (1985) and Klein (1985, 1998).

estimates should be the basis of our measure of government income in the treasury of Mexico City.

As in most series in pre-industrial societies, the colonial Mexico government income series shows some fluctuations. Our first task, then, is to estimate what a typical value for royal revenue was in each year. Instead of transforming data using moving averages or regression fits, which are not resistant to outliers, I use a median smoother that provides robustness to isolated spikes in the data. Let  $R_t$  be the observed income from the Royal Treasury of Mexico City at year  $t$ , then, our estimate for a typical value of nominal income in the treasury of Mexico City is:

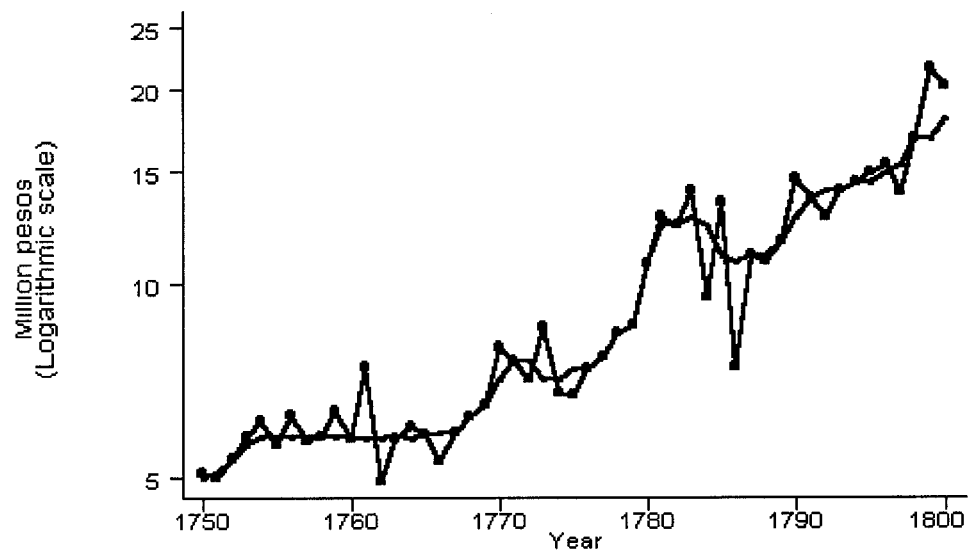
$$R_t^s = \text{median}(R_{t-2}, \dots, R_{t+2})$$

Figure 1.4 presents both actual and smoothed values of royal income in Mexico City for the 1750-1800 period, as measured in million pesos in logarithmic scale.

For now, let us assume that the share of revenue from the treasury of Mexico City in New Spain's total GDP at year  $t$ ,  $\tau_t$ , is known. By definition, real total output in New Spain,  $Y$ , is linked to real Royal income from Mexico City,  $T$ , by the relationship:

$$Y_t = \frac{T_t}{\tau_t} \tag{1.9}$$

Figure 1.4 Fiscal Revenue in the Treasury of Mexico City



Source: TePaske (1985).

The share of income from the treasury of Mexico City in New Spain's total output can be decomposed as follows. It is the share of Mexico City's royal income in New Spain's total royal income ( $\sigma_t$ ), times the share of New Spain's royal income in total output ( $\mu_t$ ):

$$\tau_t = \sigma_t \cdot \mu_t \quad (1.10)$$

To estimate the share of fiscal revenue from Mexico City to New Spain's fiscal revenue,  $\sigma_t$ , I make use of the data presented by Klein (1998). Klein has published decade averages of government income for each treasury of New Spain whose data was available. To the figures on total income I subtract loans, transfers between treasuries ("situados") and miscellaneous income for each treasury.<sup>9</sup>

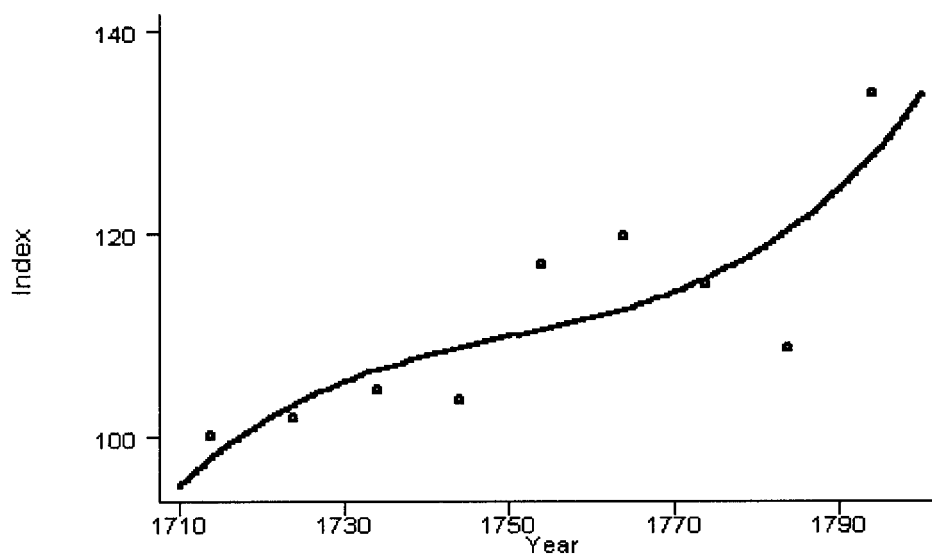
Next, I calculate the growth from decade to decade of the share of Mexico City in the set of treasuries whose information was available for two consecutive decades. This leads to a decade index of royal income in the treasury of Mexico City as a share of New Spain's total. This index is interpreted as an observed value of  $\sigma_t$  in the fourth year of each decade. I fitted a polynomial of third degree to the index and the corresponding fitted values were used as the estimates of  $\sigma_t$ . Actual and fitted values are shown in Figure 1.5.

The share of New Spain's fiscal income in New Spain's total output,  $\mu_t$ , would correspond to the ratio of royal income in all 23 treasuries of colonial Mexico, to the value of total production in the economy. The economic historiography has pointed out that this share could have varied for several reasons. First, there were government efforts to rise revenue during the last two decades of the colonial period. However, I think these efforts were reflected in the government acquisition of loans and other extraordinary income, which are not taken into account in our royal income series.

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<sup>9</sup> In Klein (1998), we subtract from the values given in his Table 5.1, those in Tables 5.6 and 5.7

Figure 1.5 Share of Fiscal Income in Mexico City to New Spain's Total



Source: Index constructed from Klein (1998).

Second, it is possible that during the periods of economic growth, resources from the non-taxable sector were transferred to the taxable sector. Furthermore, the non-taxable sector may have displayed a different behavior than the taxable sector. To capture these possibilities, I assume the share of New Spain's fiscal income in total output held the following relationship with per capita output,  $g_t$ :

$$\hat{\mu}_t = \gamma \cdot \hat{g}_t$$

Third, it is also possible that the colonial government revenue were associated to the production of silver. Therefore, it is possible that the share of New Spain's fiscal income in total output varied with the share of silver production in total output,  $x_t$ . To capture such possibility I could assume the following relationship for the share of New Spain's fiscal income in total output:

$$\hat{\mu}_t = \delta \cdot \hat{x}_t$$

To combine the last two ideas in one expression, each of which is a special case of a more general form, I construct the linear combination:

$$\hat{\mu}_t = \lambda \cdot \delta \cdot \hat{x}_t + (1 - \lambda) \cdot \gamma \cdot \hat{g}_t \quad (1.11)$$

where  $\lambda$  can take the values zero and one.

Our final task is to deflate the series on royal revenue, since it is expressed at current pesos. Ideally, I would like to have price index for imported commodities and for non-tradable goods, neither of which is available. I rely on the maize price index constructed by Garner and Stefanou (1993) using long historical series from Florescano

(1969), Galicia (1975), and Rabell (1986). As it has been argued in the historiography, the maize price can be a good indicator of the general price level of the non-tradable sector since maize constituted a very important element in indigenous diet, transport costs, and the cost of some capital goods.

The maize price series presents much more variation than the one on fiscal receipts. It is important to note that a 5 years smooth will not eliminate price movements caused by epidemics or crop failures. Their effects sometimes spanned for more than a pair of consecutive years, though rarely for more than 5 years. Therefore, in the case of the maize price I use a median smoother of span 9. Let  $p_t$  be the observed price of maize during year  $t$ , then our smoothed value is:

$$p_t^s = \text{median}(p_{t-4}, \dots, p_t, \dots, p_{t+4})$$

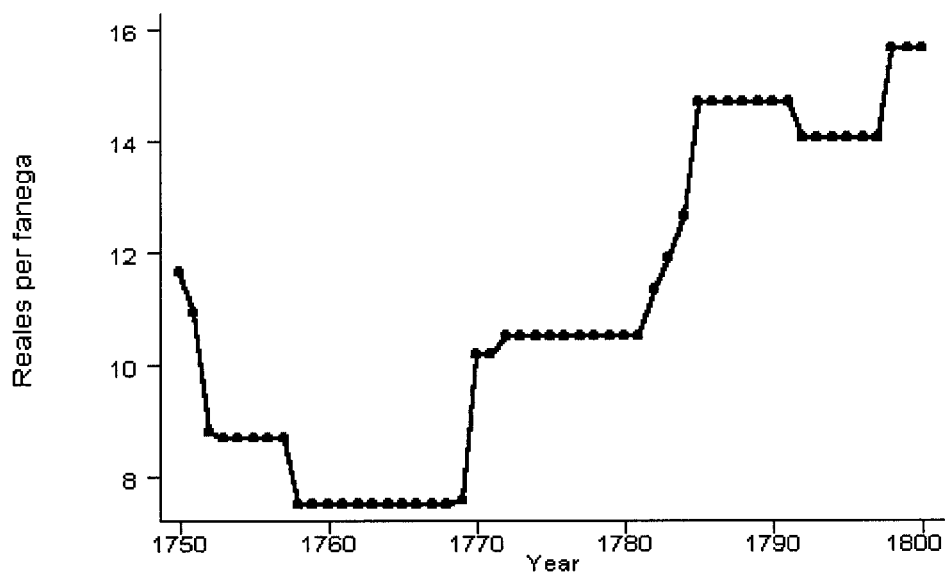
The original series was displayed in Figure 1.3, whereas the resulting smoothed series is presented in Figure 1.6. In this paper, changes in the maize price are assumed to reflect changes in the price level of the non-tradable sector. I assume that the change in other non-tradable goods equals  $\beta$  times the change in the maize price. Let  $q_t$  be the price of non-tradable goods other than maize, then:

$$\hat{q}_t = \beta \cdot \hat{p}_t$$

where again, a hat over a variable indicates the proportional change in that variable. Let  $\alpha$  be the share of maize in the price level of non-tradable commodities. Then, the change in the price level of the non-tradable sector will be:

$$\hat{P}_t = \alpha \cdot \hat{p}_t + (1 - \alpha) \cdot \hat{q}_t$$

Figure 1.6 Smooth Series of Maize Price, 1750-1800.



Source: Constructed from Garner and Stefanou (1993).



And using our last two expressions, I have that the price level of the non-tradable sector will change in  $(\alpha + \beta - \alpha \cdot \beta)$  times the proportional change in the price of maize. That is,

$$\hat{P}_t = (\alpha + \beta - \alpha \cdot \beta) \cdot \hat{p}_t \quad (1.12)$$

Our guess for the share of maize in the price level of non-tradable goods,  $\alpha$ , is neither less than 0.25 nor more than 0.5. For the response of non-maize prices to changes in the maize price,  $\beta$ , a value between 0.4 and 0.5 seems reasonable, given available evidence on the relationship between maize and wheat prices in eighteenth century Mexico. This led us to a value of  $(\alpha + \beta - \alpha \cdot \beta)$  between 0.55 and 0.75. However, the results of this paper are provided for a much wider range of possible values of  $(\alpha + \beta - \alpha \cdot \beta)$ .

## 1.6 Results

Tables 1.1 and 1.2 present the results on the change in economic growth from the pre-1769 to the after-1769 period. Table 1.1 presents the estimated change in the growth rate under different assumptions about  $(\alpha + \beta - \alpha \cdot \beta)$  and  $\delta$ , assuming  $\lambda = 1$  in equation (1.11). Table 1.2 provides the results under different assumptions about  $(\alpha + \beta - \alpha \cdot \beta)$  and  $\gamma$ , assuming  $\lambda = 0$  in equation (1.11). To construct Tables 1.1 and 1.2, I first estimated the annual rates of economic growth for each of the 1753-69 and 1769-98 periods. Then, to the 1769-98 estimated annual rate of economic growth I subtracted the rate of economic growth for the 1753-69 period. These results are displayed in Tables 1.1 and 1.2.

To estimate each period rate of economic growth I first fitted the model:

$$\ln(Y_t^0) = a_i + b_i \cdot t + \varepsilon_t \quad (1.13)$$

where  $Y_t^0$  refers to the smooth estimated series on total output when assuming the share of fiscal income remained constant throughout the second half of the eighteenth century. This is the case  $\delta = \gamma = 0$  in equation (1.10). The subindex  $i$  refers to the 1753-69 ( $i = 1$ ) or the 1769-98 ( $i = 2$ ) period, while  $t$  represents the year.

The first row in Tables 1.1 and 1.2 provide exactly the same information. This is the difference in rates of growth between the two periods,  $b_2 - b_1$ , under the assumption that the share of fiscal income in total output remained constant throughout our period of interest. The rest of Tables 1.1 and 1.2 was calculated from the values given in those first rows. For instance, when I assume that the share of fiscal income varied with the share of mining in total output,  $\lambda = 1$  in equation (1.11), the estimated change in the growth rate is:

$$\frac{(b_2 - b_1) - \delta \cdot (\chi_2 - \chi_1)}{1 - \delta}$$

where  $\chi_i$  is the annual rate of growth in mining output during period  $i$ . Finally, when I assume the share of fiscal income varied with per capita output,  $\lambda = 0$  in equation (1.11), the change in the growth rate can be calculated as:

$$\frac{b_2 - b_1}{1 + \gamma}$$

Table 1.1 presents the change in the growth rate after 1769 when  $(\alpha + \beta - \alpha \cdot \beta)$  takes values between 0.05 and 0.95, and when  $\delta$  takes values between 0.0 and 0.9. In Table 1.1 I assume the share of fiscal income in total output varied with the share of mining in total output, so that  $\lambda = 1$  in equation (1.11). The results in Table 1.1 give an

**Table 1.1**  
**Estimated change in the rate of growth after 1769.  $\lambda = 1$ .**  
**Different assumptions on  $\alpha + \beta - \alpha \cdot \beta$  and  $\gamma$ .**

$\delta$	$\alpha + \beta - \alpha \cdot \beta$									
	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
<b>0.0</b>	2.23	1.96	1.69	1.43	1.19	0.97	0.74	0.53	0.28	0.01
<b>0.1</b>	2.28	1.98	1.68	1.39	1.13	0.88	0.63	0.39	0.11	-0.19
<b>0.2</b>	2.35	2.01	1.67	1.35	1.05	0.77	0.48	0.22	-0.09	-0.43
<b>0.3</b>	2.43	2.04	1.66	1.28	0.94	0.63	0.30	-0.00	-0.36	-0.74
<b>0.4</b>	2.54	2.09	1.64	1.20	0.80	0.44	0.05	-0.30	-0.71	-1.16
<b>0.5</b>	2.69	2.15	1.61	1.09	0.61	0.17	-0.29	-0.71	-1.21	-1.75
<b>0.6</b>	2.92	2.25	1.57	0.92	0.32	-0.23	-0.81	-1.33	-1.96	-2.63
<b>0.7</b>	3.30	2.40	1.50	0.64	-0.16	-0.90	-1.66	-2.36	-3.20	-4.10
<b>0.8</b>	4.07	2.72	1.37	0.07	-1.13	-2.23	-3.38	-4.43	-5.68	-7.03
<b>0.9</b>	6.37	3.67	0.97	-1.63	-4.03	-6.23	-8.53	-10.6	-13.1	-15.8

Source: See text.

ambiguous answer to the question: Was there a slowdown in economic growth after 1769? Some of the results in Table 1.1 suggest that economic growth worsened off after 1769, but some other results in Table 1.1 suggest the rate of economic growth improved after 1769 with the boom in silver production, notwithstanding the accompanying rise in non-tradable prices. In Table 1.1, 37 out of the 100 cases gave negative values for the change in the growth rate. 63 of the cases imply that the growth rate improved after 1769. It is important to note that 13 out of the 37 cases that gave negative values for the change in the growth rate occurred for extremely high values of the parameter  $\delta$ . Those 13 cases occurred when  $\delta$  is as high as 0.8 and 0.9.

When I assume that the share of fiscal income in total output remained constant from 1753 to 1798, I have an improvement in the rate of economic growth after 1769, for any value of the parameter  $(\alpha + \beta - \alpha \cdot \beta)$ . That is, the estimated change in the growth rate is always positive for  $\delta = 0$ . Given a constant share of fiscal income in total output during our period of interest, and if I assume that  $(\alpha + \beta - \alpha \cdot \beta)$  is between 0.55 and 0.75, I obtain an increase in the growth rate after 1769 in between 0.53 and 0.97 percentage points. Furthermore, the estimated increase in the growth rate reduces with  $\delta$  whenever  $(\alpha + \beta - \alpha \cdot \beta) \geq 0.25$ , while it rises with  $\delta$  whenever  $(\alpha + \beta - \alpha \cdot \beta) \leq 0.15$ . Finally, for any value of  $\delta$ , the estimated change in the rate of growth decreases with  $(\alpha + \beta - \alpha \cdot \beta)$ .

Declines in the rate of growth after 1769 begin to appear in Table 1.1 as both  $\delta$  and  $(\alpha + \beta - \alpha \cdot \beta)$  increase. When  $\delta = 0.3$ , a reduction in the growth rate is obtained for values of  $(\alpha + \beta - \alpha \cdot \beta) \geq 0.75$ . When I increase  $\delta$  to 0.5, declines in the growth rate after 1769 appear for values of  $(\alpha + \beta - \alpha \cdot \beta) \geq 0.65$ . When  $(\alpha + \beta - \alpha \cdot \beta)$  takes the value 0.65, and  $\delta = 0.5$ , I have a reduction in the rate of growth after 1769 equal to 0.29 per cent.

**Table 1.2**  
**Estimated change in the rate of growth after 1769.  $\lambda = 0$ .**  
**Different assumptions on  $\alpha + \beta - \alpha \cdot \beta$  and  $\delta$ .**

$\gamma$	$\alpha + \beta - \alpha \cdot \beta$									
	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
<b>0.0</b>	2.23	1.96	1.69	1.43	1.19	0.97	0.74	0.53	0.28	0.01
<b>0.1</b>	2.03	1.78	1.54	1.30	1.08	0.88	0.67	0.48	0.25	0.01
<b>0.2</b>	1.86	1.63	1.41	1.19	0.99	0.81	0.62	0.44	0.23	0.01
<b>0.3</b>	1.72	1.51	1.30	1.10	0.92	0.75	0.57	0.41	0.22	0.01
<b>0.4</b>	1.59	1.40	1.21	1.02	0.85	0.69	0.53	0.38	0.20	0.01
<b>0.5</b>	1.49	1.31	1.13	0.95	0.79	0.65	0.49	0.35	0.19	0.01
<b>0.6</b>	1.39	1.23	1.06	0.89	0.74	0.61	0.46	0.33	0.18	0.01
<b>0.7</b>	1.31	1.15	0.99	0.84	0.70	0.57	0.44	0.31	0.16	0.01
<b>0.8</b>	1.24	1.09	0.94	0.79	0.66	0.54	0.41	0.29	0.16	0.01
<b>0.9</b>	1.17	1.03	0.89	0.75	0.63	0.51	0.39	0.28	0.15	0.01

Source: See text.

Table 1.2 presents the change in the growth rate after 1769 when I assume the share of fiscal income in total output varied with per capita output, so that  $\lambda = 0$  in equation (1.11). Again, the results are presented for cases in which  $(\alpha + \beta - \alpha \cdot \beta)$  takes values between 0.05 and 0.95, and when  $\gamma$  takes values between 0.0 and 0.9. In Table 1.2 there are no cases of negative change in the growth rate. All 100 cases give an increase in the rate of economic growth after 1769. This result comes from the fact that all changes in the rate of growth are positive for the special case of a constant share of fiscal income in total output ( $\gamma = 0$ ). The remaining changes in the rate of economic growth represent a fraction of that growth rate.

The results in Table 1.2 suggest that the rate of economic growth improved after 1769. Therefore, I find no decline in the rate of growth after the boom in silver production and the rise in the price of non-tradables. For the case of a constant share of fiscal income in total output, the estimated change in the rate of growth goes from 0.01 to 2.23 percentage points, as  $(\alpha + \beta - \alpha \cdot \beta)$  goes from a high 0.95 to a low 0.05. Finally, I point out that in Table 1.2, the estimated increase in the growth rate declines as  $\gamma$  rises. For a high value of  $\gamma$  equal to 0.9, the estimated increase in the rate of economic growth is between 0.01 and 1.17 percentage points.

The estimated equation (1.13) also allows for a one-time change in output after 1769. This corresponds to a one-time change in the level of GDP. Any one-time rise or decline in GDP, however, would be completely offset by a lower or higher rate of economic growth. Table 1.3 presents the estimated one-time change in the level of GDP after 1769, expressed in percentage. Table 1.3 provides estimates for both cases: the one in which the share of fiscal income varied with the share of mining in total output, and for the case in which the share of fiscal income varied with per capita output.

The first five rows of Table 1.3 present the one-time change in the level of GDP when I assume the share of fiscal income in total output varied with the share of mining in total output. The last five rows of Table 1.3 show the change in GDP when I assume the

**Table 1.3**  
**Estimated one-time change in the level of GDP after 1769.**  
**Different assumptions on  $\alpha + \beta - \alpha \cdot \beta$ ,  $\gamma$  and  $\delta$ .**

$\delta$	$\alpha + \beta - \alpha \cdot \beta$									
	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
0.0	9.72	6.55	3.45	1.28	-0.32	-2.67	-4.95	-7.19	-9.68	-11.4
0.1	10.78	7.26	3.81	1.40	-0.38	-2.99	-5.52	-8.01	-10.8	-13.8
0.2	12.11	8.14	4.27	1.56	-0.45	-3.38	-6.23	-9.03	-12.2	-15.6
0.3	13.81	9.28	4.95	1.75	-0.53	-3.89	-7.15	-10.4	-13.9	-17.9
0.4	16.08	10.8	5.63	2.01	-0.65	-4.57	-8.37	-12.1	-16.3	-20.9
$\gamma$	$\alpha + \beta - \alpha \cdot \beta$									
	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
0.0	9.72	6.55	3.45	1.28	-0.32	-2.67	-4.95	-7.19	-9.68	-12.4
0.1	8.84	5.95	3.14	1.16	-0.29	-2.43	-4.50	-6.54	-8.80	-11.3
0.2	8.10	5.46	2.88	1.07	-0.27	-2.23	-4.13	-5.99	-8.07	-10.4
0.3	7.48	5.04	2.65	0.98	-0.25	-2.05	-3.81	-5.53	-7.45	-9.57
0.4	6.94	4.68	2.46	0.91	-0.23	-1.91	-3.54	-5.14	-6.91	-8.89

Source: See text.

share of fiscal income varied with per capita output. The case of a constant share of fiscal income in total output is displayed by rows 1 and 5. The results in Table 1.3 are ambiguous, since they present the possibility of both, a one-time decline and a one-time increase in the level of GDP, depending on the values of the parameters. When I assume the share of fiscal income in GDP is constant during our period of interest, and that  $(\alpha + \beta - \alpha \cdot \beta)$  varies between 0.45 and 0.65, the estimated one-time change in GDP after 1769 is a decline between 0.3 and 4.9 per cent of GDP. When  $(\alpha + \beta - \alpha \cdot \beta)$  equals 0.35, I obtain a one-time increase in GDP of 1.3 per cent.

When I assume the share of fiscal income in total output varies with the share of mining in GDP, any estimated one-time decline in GDP becomes steeper as  $\delta$  increases. Similarly, any one-time estimated increase in GDP rises more with  $\delta$ . This relationship is valid for all values of  $(\alpha + \beta - \alpha \cdot \beta)$ . When assuming the share of fiscal income varies with per capita output, the absolute value of any estimated one-time increase or decrease in GDP is reduced as  $\gamma$  rises. That is, the estimated one-time change in GDP (slowly) tends towards zero as  $\gamma$  increases.

This section has presented the results on the change in the rate of economic growth in colonial Mexico after 1769. The post-1769 period is characterized by a boom in silver production, the dominant export of the epoch, and by an increase in the price of non-tradable goods. These two facts suggest the possibility of a case of Dutch Disease in late colonial Mexico. In fact, Coatsworth (1986) conceived the idea and brought up the plausibility of an economic decline during the last 30 years of eighteenth century Mexico. The results of this section, however, are more ambiguous. For some values of the parameters, the evidence supports the idea of a decline in the rate of economic growth during the last 30 years of the eighteenth century. For other values of the parameters, the results suggest there was no decline, but an improvement in economic growth.



## 1.7 Conclusions

This paper poses the question of whether the Bourbon reforms, a set of tax incentives and trade liberalization, increased the returns to mining and spurred a slowdown in economic growth in New Spain during the second half of the eighteenth century, just before the start of the independence war.<sup>10</sup>

The paper began by reviewing the evidence on silver production and prices during the late colonial period in Mexico. After 20 years of stagnation, silver production, the main export product of the epoch, experienced a boom in the 1770s, and then again in the 1790s. These events occurred during the period of Bourbon reforms, and they coincided with the 1769 implementation of tax incentives to the mining industry, and with the 1789 Free Trade agreement between Mexico and Spain. Accompanying the boom in silver production, there was a rise in the price of non-tradable goods. In Mexico City, the price of maize shows a rise in the 1770s when compared to its behavior of 20 years earlier. There is a new increase in this price during the period of intense crop failures in the mid 1780s, but the maize price never returns to its 1770s level during the 1790s. The increase in the maize price in Mexico City was present for the entire New Spain.

In the center of Mexico, the price of wheat and the price of sugar displayed the same behavior as the maize price. They rose during the last 30 years of the eighteenth century, in contrast to their lack of growth or even decline of 20 years earlier. And the same applies to a much larger number of products, including wheat and beans, in regions outside Mexico City, like Leon, Silao, San Luis de la Paz and Celaya.

After reviewing the economic literature on the Dutch Disease, I studied a simple trade model with two sectors of production: exports, which are not consumed at home, and non-tradables, which are consumed at home along with imports, not produced at home. This is a departure from the more traditional three-sector model of the Dutch Disease by

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<sup>10</sup> Whether or not the other export product of the time, “cochinilla”, also encompassed a Dutch disease, was not studied in this paper. However, it is likely that “cochinilla” accounted for less than 10 per cent of exports by the end of the century.

Corden and Neary (1982) that allows for a more realistic structure of New Spain's economy. Manufacturing in this paper was identified with the non-tradable sector. Capital and labor are fully employed and mobile between sectors. A share of exports is transferred to a foreign country, with no payment for the home economy. This share was held constant in the analysis. The share of silver remaining in the home economy is used to buy imports. The home economy was considered to be a large producer in world markets, so that the terms of trade were endogenous to the model. Future work will require extending the static model to generate predictions about economic growth.

I studied the effects on the economy of a reduction in taxes paid by the export (mining) sector. In particular, I found that a boom in exports and a rise in the price of non-tradables are consistent with such a reduction in taxes. The mechanism is as follows. A reduction in taxes paid by the export sector rises the price of capital, relative to wages, since exports are capital intensive. This draws resources from non-tradables into exports, increasing the relative supply of silver (exports). In the domestic market, silver production and the price of non-tradables increase. Second round effects occur through the international market. The higher supply of exports worsens off the terms of trade, driving out an increase in the domestic demand for silver and therefore a second increase in silver production. However, the effect now is to reduce the price of non-tradables in terms of silver. Therefore, the 1769 mining tax incentives and the 1789 Free Trade agreement, interpreted as a reduction in taxes paid by the export sector, could be consistent with, and possibly account for the evidence on silver production and the rise in prices during the last 30 years of eighteenth century Mexico.

Though it was not explicitly shown, it could be possible that in the model of this paper economic growth could worsen off after a reduction in taxes paid by the mining sector. The argument is that if there are learning by doing effects only in the non-tradable sector, so that the rate of growth of the economy equals technological change in non-tradables, then a shrinking of that sector may lead to a decline in the rates of technological change and economic growth. This should be part of any research agenda in this area. In fact, Coatsworth (1986) conceived the idea that there was an economic decline during the

last 30 years of eighteenth century Mexico. This paper also asked the question: Was there a slowdown in economic growth after the implementation of Bourbon reforms?

To answer that question, I estimated an index of total output for the 1753-1798 period, and I compared the rates of growth in the 1753-69 and 1769-98 sub-periods. To construct our output index, I departed from government income for the treasury of Mexico City as reported by TePaske (1986). I estimated the share of this revenue in New Spain's total government income from decade averages for New Spain's treasuries as published by Klein (1998).<sup>11</sup> The resulting series was deflated using a function of New Spain's maize price series published by Garner and Stefanou (1993). From their series I constructed a price index by assuming changes in the price index were proportional to changes in the maize price. Finally, I used several assumptions for the behavior of the share of government income in total output, including the case of a constant share of government income in total output. Specifically, I assumed the share of government income in total output varied with either, the share of mining in total output, or with per capita output.

The estimated rates of growth depend on one or two parameters, depending on whether I assume the share of fiscal income in total output remains constant or varies through our period of interest. First, the rate of growth depends on the sensibility of our price index to changes in the maize price. Second, when I assume the share of fiscal income in total output varied with the share of mining in total output, the estimated rate of growth also depends on the elasticity of government revenue to mining output. On the other hand, when I assume the share of fiscal income in total output varied with per capita output, the estimated rate of growth depends on the elasticity of government revenue to total output.

The idea of a Mexican decline during the last 30 years of the eighteenth century was first suggested by Coatsworth (1986), and then confirmed by other authors (Jacobsen and Pule, 1986; Liehr, 1989; Coatsworth, 1990; Van Young, 1992; and Garner and Stefanou, 1993). This paper has explored the potential role of Ducth Disease in accounting for the

decline, but it found mixed evidence supporting the hypothesis. For some parameter values, I found that economic growth improved during the period of Bourbon reforms. For other parameter values, I found a decline in the rate of growth. When allowing for a one-time change in the level of GDP after 1769, the results are again inconclusive. For some parameter values I found a one-time increase in our estimated GDP, and a one-time decline for other values of the parameters. However, any one-time increase or decline in GDP would be offset by a corresponding reduction or increase in the rate of economic growth of the economy. The jury is still out on the late eighteenth century slowdown in New Spain.

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<sup>11</sup> The structure of government income in New Spain by the end of the century (1795-1799) has been studied by Marichal and Carmagnani (2001). It was as follows: State monopolies (43%), Mining taxes (22%), Trade taxes (20%), Indian tribute (6%), Church transfers (3%), Forced loans (3%), Other (3%).

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## CHAPTER 2

### GLOBALIZATION AND ECONOMIC GROWTH IN THE THRID WORLD: SOME EVIDENCE FROM EIGHTEENTH CENTURY MEXICO

#### 2.1 Introduction

The New Spain of 1800 was radically different from the modest colony of 1700. Population saw a very impressive growth compared to the seventeenth century when it did not grow at all: In 1800 it was 2.7 times larger than a century before. More strikingly, the eighteenth century witnessed how the new race, mix of Spaniards and Indians, became the predominant class. The economy also grew, and New Spain was progressively integrated into the world economic system. Silver production, the colony's predominant export, was multiplied by a formidable factor of 4.5 between 1700 and 1800. But by the end of the eighteenth century, inequality was on the edge of revolution. This was a century of remarkable change and reform, of efficiency and globalization.

Economic growth in the eighteenth century has been a major topic in the colonial history of Mexico. Traditionally, the historiography has seen the existence of the colony just for the benefit of the mother country. Spain followed an economic policy of mercantilism where accumulation of specie in the New World was encouraged and other areas of production were limited. And in more than this sense, New Spain was very much restricted by the imperial system. As a consequence, the growth of industry and commerce was probably impeded. However, this view of the colonial economy is going to be challenged in this essay. I will show that the



eighteenth century was a period of rapid growth for colonial Mexico, and that globalization and mercantilism were behind this phenomenon.<sup>1</sup>

The past decade has seen important advances in our understanding of the causes and consequences of globalization in nineteenth and twentieth century industrialized OECD countries (See Williamson, 1996; and O'Rourke and Williamson, 1999). Historical convergence or divergence in the standards of living among the members of the Atlantic economy is now impossible to understand without reference to its corresponding period of globalization or disintegration. However, much less is currently known about the impact globalization has had on the Third World.<sup>2</sup> This paper represents one effort to understand the connection between globalization and economic growth in the periphery, eighteenth century Mexico. The paper offers economic growth estimates for colonial Mexico (New Spain) during one of its periods of globalization, and finds that there was rapid economic growth in that period.<sup>3</sup> The paper also argues that all of that per capita growth was pushed by the dominant export of the epoch, silver.<sup>4</sup>

Globalization is characterized by market integration and the growth of international trade, phenomena not new to Latin America. Globalization has taken place four times in the post-Columbian era of Latin America, and Mexico took part in all of them. The first one began just after the Spanish conquest of Native Americans in the Valley of Mexico (1521), and it probably culminated in the early seventeenth century with a substantial decline in population due to several factors, including the

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<sup>1</sup> There are two other important topics in the economic historiography of eighteenth century Mexico that will not be studied in this paper. First is the evolution of inequality during the century, and second, the spatial and class differences of any possible growth in the aggregate.

<sup>2</sup> See O'Rourke and Williamson (2002) and Williamson (2002). On Latin America see Bulmer-Thomas (1994), Coatsworth and Williamson (2002), and Bértola and Williamson (2003).

<sup>3</sup> A more ambitious goal would be to directly compare the economic growth of this century of globalization to the growth of the period of disintegration in the early nineteenth century. But this requires a much larger and different effort in estimating economic growth in the later period.

<sup>4</sup> This does not mean there was no investment in the economy, but rather, that it was related to exports.

exposure of the native population to Old World epidemics.<sup>5</sup> The second period of globalization, which is the one of interest in this paper, began around 1690, and it spread throughout the eighteenth century. In this period, Mexico saw an unprecedented boom in silver production. Private firms extracted the silver, and most of it was then conducted to government houses where it was coined. After coinage, the government returned the coined silver to private producers, except for taxed amounts. Colonial Mexico silver, after circulating in domestic markets, used to finance foreign imports.<sup>6</sup>

The connection between globalization and economic growth as studied in this paper is the following: The integration of colonial Mexico into European markets through the ports of Spain was a channel that allowed the economic growth of Mexico by means of export-led growth. In measuring this economic growth, real wages and living standards ought to be a key concept as it has been in the economic historiography (O'Rourke and Williamson, 1999). However, evidence on wages for eighteenth century Mexico is very scarce. What is available is a series on government income, which can be used to estimate economic growth as a proxy of aggregate GDP.

Export-led growth encapsulates the idea that the rate of productivity growth, the rate of accumulation, and the rate of employment are positively related to the rate of growth in aggregate demand. Therefore, a boom in exports pushes total economic activity. In another version of export-led growth, a country's expansion may be restricted by a balance of payments constraint, so that a boost in exports will promote investment and growth. Forward and backward linkages have also been key elements in any explanation of export-led growth. In the Mexican case, the economic historiography has documented the rise of cities around mining centers and their connection across space.

Currently, the economic historiography has two competing views on the economic growth of eighteenth century Mexico. The traditional perspective sees

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<sup>5</sup> See Coatsworth (2001)

<sup>6</sup> Surely, some small fraction of silver remained in colonial Mexico serving as money.

significant economic growth in this period of globalization, as signaled by the growth of government income and silver production, and characterized by the expansion of trade, industry, population and the cities (Klein, 1998; Florescano and Menegus, 2000; Miño, 2001). The new view questions the magnitude of this growth. Coatsworth (1998) guesses that per capita output in New Spain was the same at the beginning and at the end of the eighteenth century. Furthermore, when comparing the eighteenth century development of colonial Mexico with the colonial British America, the new view holds that Mexican productivity did not compare favorably, and that institutional obstacles impeded productivity growth in Mexico.<sup>7</sup>

In order to estimate the economic growth of eighteenth century Mexico, I construct an index for total output by using fiscal income in the treasury of Mexico City as published by TePaske (1985). First, I estimate the share of this income in total fiscal income for New Spain from the decade averages of New Spain's fiscal income presented by Klein (1998)<sup>8</sup>. Next, I construct a price index for non-tradable goods from the maize price in New Spain published by Garner and Stefanou (1993). The non-tradable price index is obtained by assuming that changes in the price of non-tradable goods are proportional to changes in the maize price.<sup>9</sup> Finally, in order to connect the behavior of total output to government income, I explore a specific relationship between total fiscal income as a share of total output and two possible variables: the share of silver in total output, and per capita output. As a special case, I also explore the implications of assuming that the share of fiscal income in total output did not vary throughout the eighteenth century.

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<sup>7</sup> Engerman and Sokoloff (1997) link the differences in institutions between Latin America and British America to differences in factor endowments and inequality. Acemoglu et al (2001) attempt to estimate the effect of institutions on economic performance for a large number of countries.

<sup>8</sup> For in depth analysis of the structure of government income in colonial Mexico, see Klein (1998) and Marchal and Carmagnani (2001).

<sup>9</sup> An assumption is required to relate changes in the maize price to changes in the price level, and the one I follow here has appeal for its simplicity. Currently, there is not enough evidence in the economic historiography to attempt an empirical justification of it.

By offering economic growth estimates for eighteenth century New Spain, I am able to establish if there was some positive per capita growth in eighteenth century New Spain. Furthermore, I also want to analyze if this economic growth was pushed by the principal export of the epoch: silver. I also explore the possibility that New Spain established its own dynamics of sustained economic growth, with this growth not being related to silver production. And finally, the paper studies the effect that Bourbon reforms may have had on economic growth on the post-1769 period. Bourbon reforms encompassed political and economic changes in New Spain, but in this paper, by Bourbon reforms I refer to the incentives implemented after 1765 to reanimate silver production

In stark contrast to the economic stagnation economic historians have found in seventeenth and the first half of nineteenth century Mexico, this paper finds rapid economic growth in the eighteenth century period of globalization for Mexico.<sup>10</sup> The two epochs surrounding the eighteenth century, say the seventeenth century and the first half of the nineteenth century, are periods of disintegration for Mexican exports from world markets. If I assume a one per cent annual population growth rate for eighteenth century Mexico, as it has been concluded by the modern demography of New Spain, then I conclude there was positive per capita growth. This means that all of that Mexican per capita growth in the two and a half centuries between 1600 and 1860 can be found in the eighteenth century, and this growth is related to globalization.

I find that the periods of high economic growth in eighteenth century New Spain coincide with periods of mining expansion. If I assume a one per cent population growth rate for the eighteenth century, then the estimated per capita growth rate in the periods of mining stagnation was near zero, whereas all per capita growth in eighteenth century Mexico occurred during the periods of mining expansion. It is likely there would have been no per capita growth in New Spain without growth in

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<sup>10</sup> See TePaske and Klein (1981) and Coatsworth (1988).

mining. Therefore, the economic growth estimates also suggest that colonial Mexico failed to establish its own dynamics of sustained economic growth.

With regard to the period of Bourbon reforms, I find there could have been only a slight increase in the rate of economic growth during the last 30 years of the eighteenth century. Although diminished economic growth during this period is equally likely. This means that even though economic growth may have improved during the period of Bourbon reforms, it seems that Bourbon reforms did not have the success we may have expected. Economic growth may have improved only slightly, in comparison to the growth observed during the periods of mining expansion during the first half of the century. By the end of the eighteenth century, mining ceased to be the force promoting economic growth.

This paper is organized in five sections. Section 2.2 reviews the two methods that have been used by the economic historiography to track total output in New Spain. One of them is based on available series on mining output, the other one on government income. The section also serves to introduce some of the problems and academic discussions that the use of these methods has awakened. Section 2.3 proposes a modification to one of those methodologies to tackle the problems involved in the estimation of economic growth in eighteenth century Mexico. It presents the methodology used in this paper to estimate an index for total output from a series on government income. Section 2.4 provides the estimated output index and the results of this paper. The article concludes with final comments in section 2.5.

## **2.2 Review of the Historiography**

This section reviews two approaches that have been used by the economic historiography in order to track the level of economic activity in New Spain. The first studies the behavior of silver production, and it has a theoretical underpinning. It tries to deduce the behavior of output from the observed behavior of silver. The second studies government income in New Spain and assumes this income did not vary as a share of total output in New Spain. The section concludes with a brief summary of the

academic discussions that were born from the use of these methods to estimate total output.

Output estimates for pre-modern economies usually depend on some assumptions about the economic structure of those economies. With regard to New Spain, we know the Spanish Crown was interested in establishing an American colony in order to sustain its own economy. New Spain's economic structure, by the beginning of the eighteenth century, has been described by Stein and Stein (1970), who wrote that Spaniards spent around two hundred years to establish an economy linked to Spain. By 1700, there was in Spanish America a series of mining centers in Mexico and Peru, agricultural regions around them that provided goods for the mining centers, and a commercial system that helped export the silver to Europe.

This picture of the colonial economy in which the level of mining output determines aggregate economic activity has been supported by the work of several historians. Some of them showed that non-mining economic activity developed around the sixteenth and seventeenth century mining centers in Latin America. Theoretically, it is possible that the reduced form equation:

$$Y_t = \rho \cdot X_t \quad (2.1)$$

could describe well New Spain's economy, where  $Y_t$  is total output in colonial Mexico, and  $X_t$  represents the output of silver. Equation (2.1) simply states that total production in New Spain is proportional to silver production.<sup>11</sup> If correct, equation (2.1) could allow us to track the behavior of total output in New Spain by studying available data on silver production. That is, the rate of economic growth in colonial Mexico would be equal to the rate of growth of silver production. Equation (2.1) can be derived from several models, and depending on the theoretical background we

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<sup>11</sup> Equation (2.1) is far from stating that the colonial economy consisted only of mining. In fact, the presumption here is that  $\rho$  is a number much larger than one, perhaps between six and twelve. On this, see Appendix.

assume, we must take a decision on whether or not to deflate silver production in order to estimate total output in real terms. The appendix of this paper offers two simple models: one of them suggests we should deflate silver production, the other suggests the opposite.

Equation (2.1) has played an important role in the economic historiography of colonial Mexico in order to track the behavior of total output. Up to what point it would be correct to apply this description of New Spain's economy to the entire eighteenth century? Miño (2001) has recently summarized the results of the past 25 years of economic historiography, and he suggests that the theoretical framework embodied in equation (2.1) could be incorrect sometime in the eighteenth century.

The different regions in New Spain are neither peripheral, nor they do only provide with goods the mining centers. He argues that during eighteenth century Mexico, new centers of economic activity aroused in New Spain, and they were not providing merchandise to the mining centers, but to Mexico City and other important cities. Furthermore, at the end of the eighteenth century, textile output continues to depend on mining activities, but now because labor unemployed in mining centers contributed to the production of textiles. Therefore, resources moved from one sector to another, and not just between regions. Mexican population was distributed across New Spain's regions following an economic specialization.

A second approach has been used in the colonial historiography of Mexico in order to track the aggregate level of economic activity. This alternative method received a renewed interest due to the data on government income that John TePaske and Herbert S. Klein assembled in their work "Ingresos y egresos de la Real Hacienda de Nueva España". In studying New Spain's total output, the point of departure is total government income in New Spain,  $I$ . Let us define  $\pi$  as the share of government income in total output in New Spain, then we know that total output in colonial Mexico is given by:

$$Y_t = \frac{I_t}{\pi_t} \quad (2.2)$$

Equation (2.2) states that total output is proportional to government income. This method is useful as long as the share of total government income in total output,  $\pi_t$ , remained relatively constant throughout the century, or as long as its rate of growth could be simple to determine. Therefore, it becomes very important that the measure of government income used in equation (2.2),  $I$ , would correspond to government income that did not vary as a share of output. But it is particularly difficult that total government income could satisfy this requirement.<sup>12</sup>

The accounts on total government income presents problems of double accounting due to transfers among local treasuries and to temporal transfers of income from year to year due to forced savings during the wars of Spain, which prevented boats from sailing, etc. In addition, from total government income we should also remove acquisition of debts. However, removing all these components is not a simple matter. The different components of total government income in the data presented by TePaske and Klein (1986) are very difficult to interpret.

TePaske (1985) published a series on government income for the treasury of Mexico City, which represents an important effort to free that series of the problems mentioned above. Therefore, if we could get an estimate of the share of this income, which I will call fiscal income, in New Spain's total fiscal income, it would be possible to rewrite equation (2.2) to offer new estimates of economic growth for eighteenth century Mexico. Recently, Klein (1998) presented decade averages on government income for all 23 treasuries of New Spain. He also tried to identify the problematic components of the series on government income. Data from Klein (1998) makes it possible to construct an index representing the share of fiscal income in Mexico City in total fiscal income in colonial Mexico. Then I use both series, the fiscal income series for Mexico City from TePaske (1986) and the share of Mexico City in Colonial Mexico constructed from Klein (1998), in order to construct an index of total output for Colonial Mexico.

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<sup>12</sup> The present essay allows government income to vary as a share of total output.



In summary, both equations (2.1) and (2.2) have been used in the colonial economic historiography of Mexico to track the behavior of New Spain's output during the eighteenth century. These equations have stimulated both intense debate and important advances in both methods. The two most important relate to the need of a price series to deflate the nominal income estimates in equations (2.1) and (2.2), and to the recognition that the use of equation (2.2) may lead to some bias since most available series on total government income may have varied as a share of total output.

The traditional picture of eighteenth century Mexico, which the colonial historiography had been offering until two and a half decades ago, was one of economic growth. Furthermore, in their synthesis of the late colonial period, Florescano and Gil (1976) and David Brading on the one hand, and Herbert S. Klein (1985) on the other, characterized the second half of the eighteenth century as a period of rapid economic growth for New Spain. Implicitly assuming equations (2.1) and (2.2), a large part of their arguments relied in the growth of total government income and silver production as measured by coined silver. They used series at current prices.

Until the early 1970s, the use of nominal figures came from a general belief that New Spain's prices did not show any trend during the entire eighteenth century. Florescano (1969) confirmed this belief in his study of the maize price for Mexico City during the 1709-1810 period. Even though he found an increase in maize prices between 1780 and 1810, scholars did not concede importance to it, until new studies confirmed Florescano's findings in other cities and products for the same time period.

The new studies discovered that from the 1770s until the end of the century, the increase to maize prices in Mexico City was repeated in regions outside Mexico City.<sup>13</sup> More recently, for Mexico City, García Acosta (1988) showed that the price of wheat rose for Mexico City from 1770 at least until 1814. Crespo (1990) found that the price of sugar increased between 1770 and 1810, after showing a downward trend for more than a century.

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<sup>13</sup> Garner, (1972), Hurtado (1974), Rabell (1975, 1986) and Galicia (1975).

These price discoveries also had an important impact on the colonial economic historiography thanks to work by John Coatsworth (1982, 1986, 1988). Coatsworth used available price series to deflate the level of silver production in equation (2.1), and he suggested that government income in equation (2.2) should also be deflated. The result was to characterize an economy that began to stagnate around 1780. And therefore, the traditional picture of rapid economic growth in colonial Mexico that Enrique Florescano and Isabel Gil had envisioned was actually only 30 years of growth, from 1750 to 1780. The independence war (1810-1821) and its disastrous political and economic consequences may have suppressed economic development in Mexico, as the traditional historiography suggested, but the roots of slow growth and stagnation had its origin in the last quarter of the eighteenth century, before the wars.

This result led the economic history of colonial Mexico towards a complete revision of previous results established by the traditional historiography. The results had to be reinterpreted. Many of these efforts appeared in the works by Jacobsen and Puhle (1986), Salvucci (1987), Liehr (1989), Coatsworth (1990), Pérez Herrero (1991), Van Young (1992) and Garner and Stefanou (1993). As a result, it was thought that the signals of growth in New Spain during the eighteenth century masked structural problems, which did obstacle the growth of productivity in Mexico. Those structural and institutional problems made themselves self-evident at the end of the colonial period. And all this resulted in a revalorization of the institutional factors that may have had impeded economic development in Mexico.<sup>14</sup>

The revisionism of the 1980s generated two important questions. First, what caused the increase in prices at the end of the eighteenth century? And second, what caused the apparent economic stagnation of the late colonial period? Even though many competing hypotheses were proposed, a few efforts were made to test them against the evidence. The most lasting one attributed the possible stagnation of the Mexican economy to the possible lack of productivity growth. This, along with the

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<sup>14</sup> Recent examples can be found in some of the articles in Coatsworth and Taylor (1998) and Haber (1997, 2000).

evidence on population growth, could possibly explain the growth in prices in New Spain and economic stagnation after 1780.<sup>15</sup>

However, these new views were revised in the 1990s. Available series on prices to deflate government income and the production of silver contain a lot of noise. This presents an important difficulty. Moving averages and regression equations are methods not resistant to peaks in the series. Therefore, the conclusions may vary with the method used to smooth the series. Finally, signs of crisis after 1770 in the data could be interpreted as signals of turning points of growth.<sup>16</sup> In this paper I will confront the problem of smoothing a price series, and I will try to deal with its associated difficulties by using a moving median to smooth the series.<sup>17</sup>

### **2.3 Economic Growth Estimates: Methodology**

This section presents the methodology I use to estimate total output in eighteenth-century Mexico. It will explain the different set of assumptions. It may seem too technical and tedious for some readers, but it is an important part of my research and allows the results to be replicated by anyone who is interested in following the steps.

Possible structural changes somewhere in the eighteenth century suggest that, in order to calculate an output index for New Spain, the best procedure would be to use some measure of government income. John TePaske and Herbert Klein assembled two volumes on income and expenditure for the Royal Government of New Spain, but the raw data is very difficult to interpret, and the totals for government revenue contain debts and the double accounting problem mentioned before. Fortunately,

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<sup>15</sup> For more on this idea, see Salvucci (1999).

<sup>16</sup> See Ponzio (1998).

<sup>17</sup> For an in depth view of the changes occurred in the economic historiography of the 1990s, see Maurer (1999), Ibarra (2003), and Van Young (2003). See also Skidmore (1998).

TePaske (1985) has published a series on fiscal income for the treasury of Mexico City, free of these problems.

My point of departure in constructing an output index for eighteenth century Mexico is fiscal income for Mexico City, which I call  $R_t$ . Let us define  $\sigma_t$  as the share of fiscal income from the treasury of Mexico City in the total fiscal income of New Spain. Finally, let  $\tau_t$  be the share of total output in total fiscal income in New Spain. By definition, we know that nominal total output in New Spain,  $P_t \cdot Y_t$ , is given by:

$$P_t \cdot Y_t = \frac{R_t^s}{\sigma_t \cdot \tau_t} \quad (2.3)$$

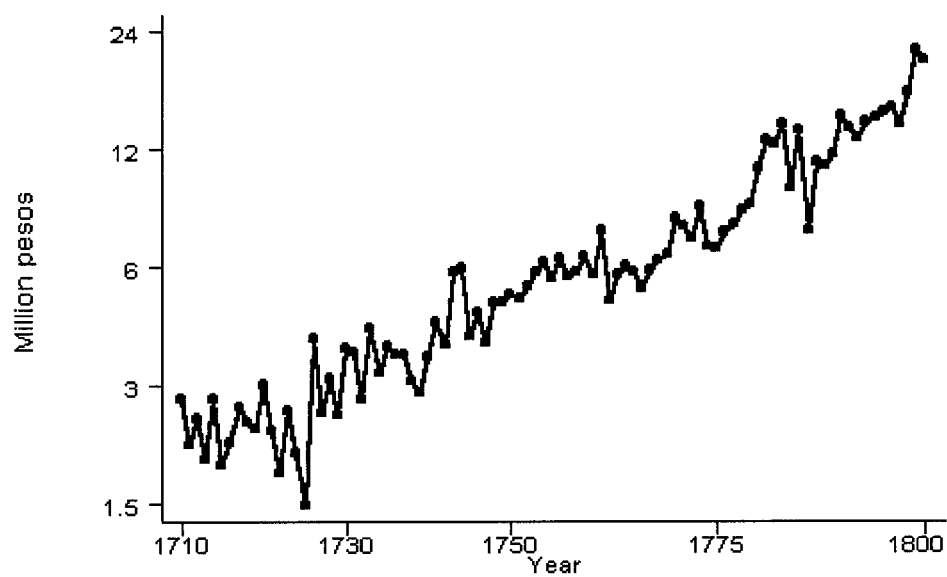
where we have eliminated the fluctuations of fiscal income by smoothing the series on fiscal income with a five years moving median:

$$R_t^s = \text{median}(R_{t-2}, \dots, R_{t+2})$$

Figure 2.1 presents fiscal income for Mexico City, in logarithmic scale, according to TePaske (1985). At the beginning of the 1710s, fiscal income was around 2.1 million pesos. During the 1730s, it rose to 3.5 million and to 5 million pesos in 1750. By the beginning of the 1760s it was 5.8 million pesos, whereas at the beginning of 1780 it reached 10 million pesos. By the end of the century, fiscal income was around 18 million pesos.

In order to form an idea on the share of this fiscal income from Mexico City in total fiscal income for New Spain,  $\sigma_t$ , I use data published by Klein (1998). He presents decade averages on fiscal income for each of the 23 treasuries of New Spain. There is no complete information for each of the 23 treasuries throughout the entire eighteenth century, sometimes because not all of them were created at the same time.

Figure 2.1 Fiscal Income from the Treasury of Mexico City, 1710-1800.



Source: TePaske (1985).

From total income for each treasury, I subtract income borrowed from other treasuries, other transfers between treasuries, and miscellaneous income.<sup>18</sup> Then I calculate the growth, from decade to decade, of the resulting income for Mexico City as a share of total fiscal income in those treasuries that appear in two contiguous decades. More precisely, the decade growth rates are calculated as follows. Let us define the transposed vector:  $a_d' = (a_{1d}, \dots, a_{23d})$ , where  $a_{id}$  is the average fiscal income for treasury  $i$  during the decade  $d$ , if available. If not available,  $a_{id}$  is zero. I also require the transposed vector  $n_d' = (n_{1d}, \dots, n_{23d})$ , where  $n_{id} = 1$  if both,  $a_{id}$  and  $a_{id-1}$  are different than zero. Or zero otherwise.

The growth of the share of fiscal income from Mexico City =  $j$ , in total New Spain' fiscal income, is calculated:

$$\hat{\sigma}_{jd} = \frac{\left( \frac{a_{jd}}{a_d' \cdot n_d} \right) - \left( \frac{a_{jd-1}}{a_{d-1}' \cdot n_d} \right)}{\left( \frac{a_{jd-1}}{a_{d-1}' \cdot n_d} \right)}$$

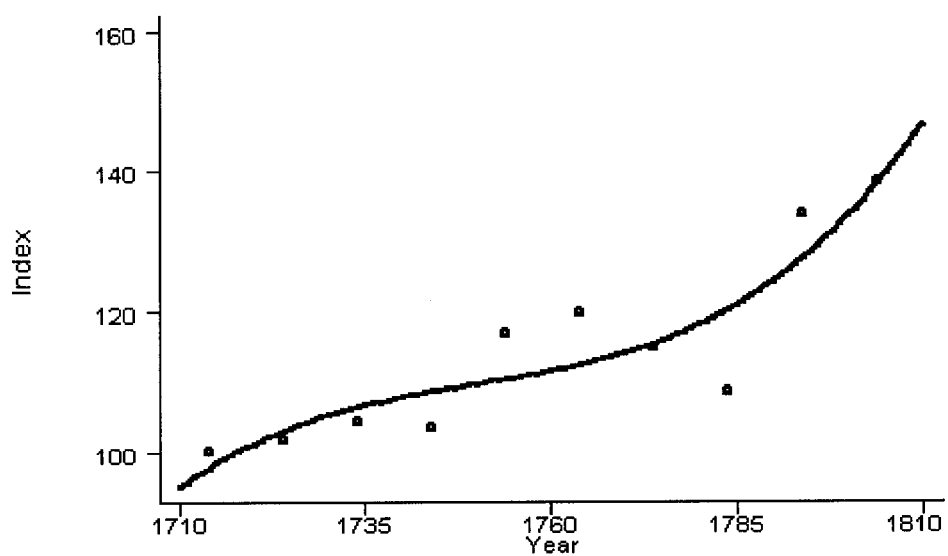
and the last values allow to construct an index which I interpret as an estimate for the true value that  $\sigma_j$  takes in the fourth year of the corresponding decade. The resulting points are displayed in Figure 2.2. Finally, a polynomial regression of third degree is used to estimate  $\sigma_j$ . The fitted curve is also presented in Figure 2.2.

At this moment, we would be able to estimate the economic growth of eighteenth century New Spain at current prices, once we assume fiscal income in New Spain remained constant as a share of total output. In the 1710-1800 period we have

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<sup>18</sup> That is, from the values presented by Klein (1998) in his Table 5.1, I subtract the values given in his Tables 5.6 and 5.7.

Figure 2.2 Share of Fiscal Income in Mexico City to New Spain's Total.



Source: Constructed from Klein (1998).

that total output grew at an annual compound rate of 2 per cent. When using a figure of 1 per cent for the annual rate of population growth, we find that nominal output in New Spain grew at an annual rate of 1 per cent. This result, however, exaggerates the economic growth of eighteenth century Mexico since the available data suggest prices were higher at the end than at the beginning of the eighteenth century.

The literature offers a few series on prices for different regions of eighteenth century Mexico. However, a price series that is homogeneous, continuous and long enough to cover the 1710-1800 period does not exist. In spite of these limitations, Richard Garner<sup>19</sup> has assembled several sources to construct an index for the maize price in New Spain, and this is my point of departure to deflate the index of nominal output. Before we go direct to this price and with the purpose of comparison between different sources, let us review the two longest available series for the maize price in the center of New Spain.

The first one corresponds to the maize price presented by Florescano (1969) for Mexico City. Figure 2.3 presents Florescano's annual averages for this price. Maximum prices reached in the 1720-1750 period grow. However, the minimum prices do not show any significant change during the same period. When using a moving median with span of 9 years the result suggests that the maize price was around 12 "reales" per "fanega" during the 1720s. In the 1730s, the maize price begins to grow to reach 15 reales by 1740, and it remains there until 1750. This price decreases to 10 reales per fanega across the 1760s. However, during the 1770s it grows to 12 or 13 reales, to 14 reales in 1790, and it reaches 20 reales around 1800.

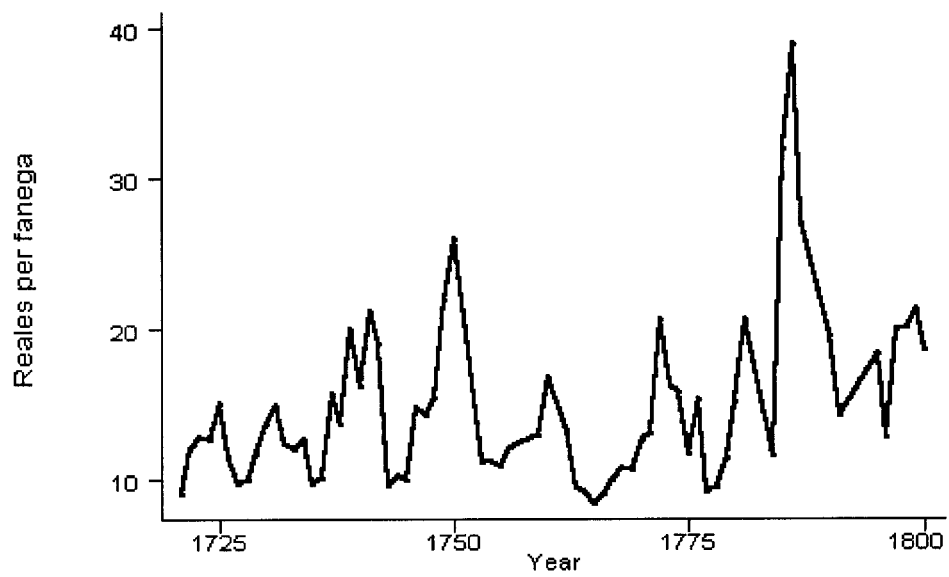
The second series covers the maize price in the Valley of Mexico, according to Gibson (1964). This series is presented in Figure 2.4. The trend of this maize price is downward during the 1700-1750/1760 period. From 16 reales in 1700, the price goes down to 14 reales per fanega in 1710, to 13 reales in 1720, to 12 reales in 1730, and it finally reaches 11 reales in 1750. From 1750 on, the downward trend stops, and the

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<sup>19</sup> See Garner and Stefanou (1993).

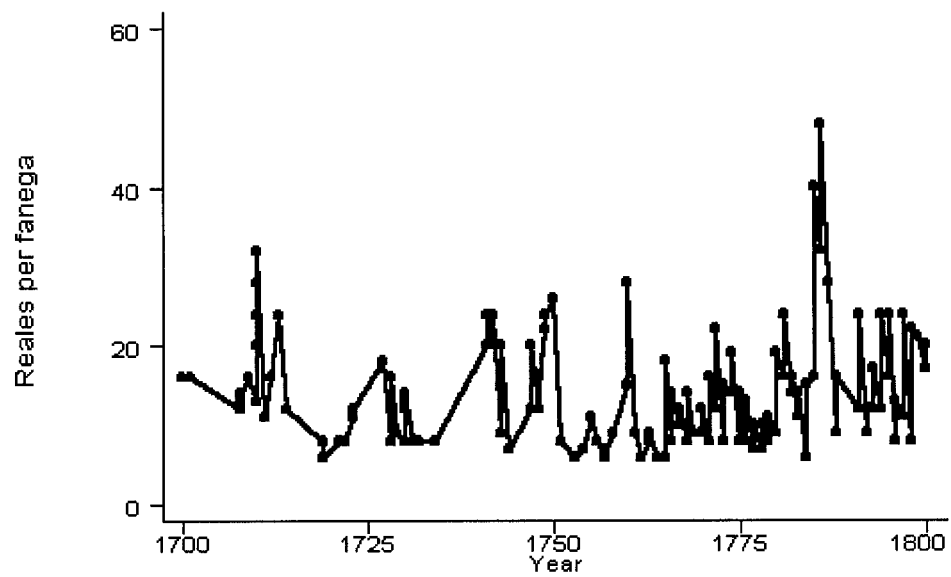


Figure 2.3 Maize Price in Mexico City, 1720-1800.



Source: Florescano (1969).

Figure 2.4 Maize Price in the Valley of Mexico, 1700-1800.



Source: Gibson (1964).

price remains approximately constant until the decade of 1760. By mid of this decade, the price jumps to 11.5 reales, and remains there until 1780, when the price of maize jumps again to reach 12.5 reales. It is around this number that the series fluctuates until 1800.

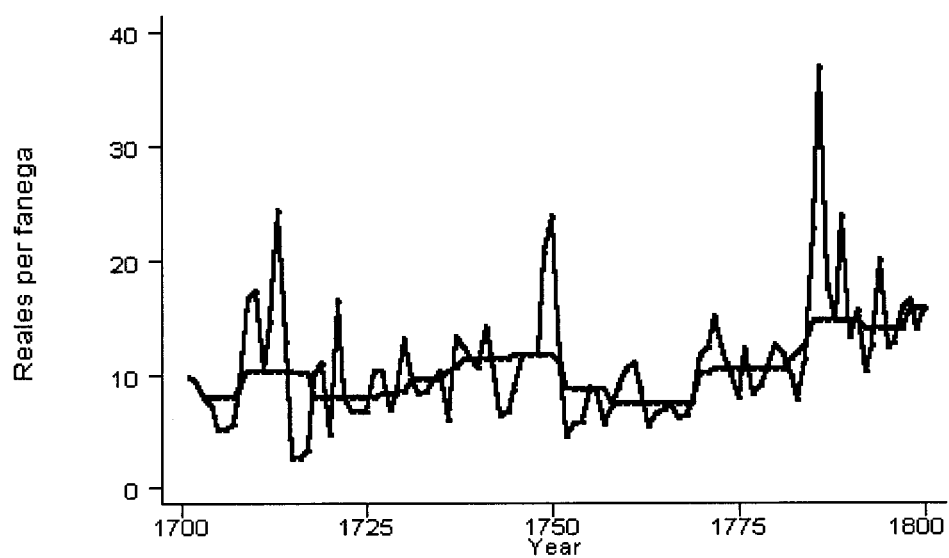
Figure 2.5 presents the maize price in New Spain as presented by Garner and Stefanou (1993). This figure also provides the smoothed series corresponding to the moving median of span 9:

$$p_t^s = \text{median}(p_{t-4}, \dots, p_{t+4})$$

where  $p_t$  refers to the observed price of maize as reported by Garner and Stefanou (1993). During the decade of 1720, the price of maize is around 8 reales per fanega. The price rises during the decade of 1730, and it reaches 11.5 reales in the decade of 1740, remaining there until 1750. Beginning in 1750, the price reduces to 7.5 reales during the decade of 1760. During the decade of 1770 the prices goes up to 10.5 reales, and by 1790 it reaches 14 reales, to end the century in 15.5 reales per fanega. The reader should note that the price of maize presented by Garner and Stefanou (1993) in New Spain follows a very similar behavior to the maize price in Mexico City as presented by Florescano (1969). It departs from the behavior of the maize price in the valley of Mexico as presented by Gibson (1964) during the 1700-1750 period. Therefore, the results of this paper should be taken with caution.

There are two reasons that make Garner's price index preferable for use in this paper. First, it is the only one that summarizes information on the maize price for the entire New Spain, and not only for Mexico City or its Valley. Secondly, it is the only one without missing values in any year of our period of interest, and so it is feasible to smooth the series with a moving median. In order to construct a price index to deflate the series on fiscal income, I assume that the price of all other non-tradable goods different than maize,  $q$ , respond to the proportional changes in the maize price by a fraction  $\beta$ . Then, I calculate:

Figure 2.5 Maize Price in New Spain, 1700-1800.



Source: Garner and Stefanou (1993).

$$\hat{q}_t^s = \beta \cdot \hat{p}_t^s$$

as the proportional change in the price of other non-tradable goods different than maize. Finally, I construct the price index,  $P_t^s$ , from the equation:

$$\hat{P}_t^s = \alpha \cdot \hat{p}_t^s + (1 - \alpha) \cdot \hat{q}_t^s$$

and using the last two expressions we get:

$$\hat{P}_t^s = (\alpha + \beta - \alpha \cdot \beta) \cdot \hat{p}_t^s \quad (2.4)$$

The last equation states that a 100 per cent increase, or decrease, in the maize price leads the general price level to a  $(\alpha + \beta - \alpha \cdot \beta)$  per cent increase, or decrease. This paper presents results for a broad range of possible values for  $(\alpha + \beta - \alpha \cdot \beta)$ . However, note that the parameter  $\alpha$  represents the share of maize in non-tradable output, so that my own guess is that reasonable values for  $\alpha$  are between 0.25 and 0.50. On the other hand, reasonable values for  $\beta$  could be between 0.40 and 0.50. This can be defended by the observation that prices (Garner and Stefanou, 1993) responded by something between 40 and 50 per cent to the change in maize prices during the period between the late 1760s and the late 1780s. All this implies that  $(\alpha + \beta - \alpha \cdot \beta)$  could be between 0.55 and 0.75. However, the reader should note that this paper explores an even larger range for  $(\alpha + \beta - \alpha \cdot \beta)$ .

Finally, to estimate total output from fiscal income, we could assume that fiscal income in New Spain did not vary as a share of total output in New Spain through out the entire eighteenth century. So  $\tau_t$  could be assumed constant. However, we know

that the colonial government associated its income to the production of silver. Therefore, there is the possibility that the share of fiscal income in total output could be related to the share of silver in total output. This paper tries to capture such a possibility by assuming the following relationship between the share of fiscal income and the share of silver in total output ( $x$ ):

$$\hat{\tau}_t = \gamma \cdot \hat{x}_t$$

On the other hand, there is the possibility that during the periods of economic growth, there was a transfer of resources from non-taxable to taxable sectors, i.e. from rural to urban regions. Even more, the non-taxable sector may have had displayed a different behavior than the taxable sector. In this paper, we could also try to capture such possibilities by assuming the following relationship between the share of fiscal income and economic growth:

$$\hat{\tau}_t = \delta \cdot \hat{y}_t$$

where  $y_t$  is per capita output. For  $\gamma$  positive, the last equation establishes that the share of fiscal income in total output grows if and only if there is per capita growth. To combine the last two ideas in one expression, each of them being a particular case of the more general form, we construct the linear combination:

$$\hat{\tau}_t = \lambda \cdot \gamma \cdot \hat{x}_t + (1 - \lambda) \cdot \delta \cdot \hat{y}_t \quad (2.5)$$

where  $\lambda$  can take the values zero and one.

Intermediate cases in which  $0 < \lambda < 1$  are relatively difficult to study. These cases would correspond to assuming the share of fiscal income in total output varies

with both, the share of silver in total output, and with per capita output. This paper limits itself to show that the estimated rate of per capita growth in the more general case is determined by a linear combination of the estimated rates of growth when  $\lambda$  equals zero and one. Let  $\hat{y}(\lambda_i)$  be the estimated rate of per capita growth when  $\lambda$  equals  $\lambda_i$ . Then, the general formula for estimating per capita growth under arbitrary values of  $\lambda$  in equation (2.5) would be:

$$\hat{y}(\lambda_i) = \frac{\lambda(1-\gamma)}{(1-\bar{\gamma}+\bar{\delta})} \cdot \hat{y}(1) + \frac{(1-\lambda)(1+\delta)}{(1-\bar{\gamma}+\bar{\delta})} \cdot \hat{y}(0)$$

where  $\bar{\delta} = \lambda \cdot \delta$  and  $\bar{\gamma} = (1-\lambda) \cdot \gamma$ .

Finally, let us consider the relationship between the rate of growth when the share of fiscal income is assumed constant and the rate of growth when we assume the share of fiscal income varies with either, the share of silver in total output, or with per capita income. Denote by  $\hat{y}_{jk}$  the rate of per capita growth in the period from year  $j$  to year  $k$ , when assuming the share of fiscal income in total output remained constant.<sup>20</sup>

Let us begin by calculating economic growth when we assume that the share of fiscal income in total output varies with the share of mining output in total output. Therefore,  $\lambda = 1$  in equation (2.5). The estimated rate of per capita growth,  $\hat{y}_{jk}(1)$ , is given by the following equation:

$$\hat{y}_{jk}(1) = \frac{\hat{y}_{jk}}{1-\gamma} - \frac{\gamma \cdot \hat{x}_{jk}}{1-\gamma} \quad (2.6)$$

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<sup>20</sup> The corresponding values for this variable are presented in Tables 2.4 and 2.5 below.

where  $\hat{x}_{jk}$  represents the growth rate in per capita output of silver.

Now we calculate the rate of growth when the share of fiscal income in total output varies with per capita output. This is the case of  $\lambda = 0$  in equation (2.5). Let us denote again by  $\hat{y}_{jk}$  the rate of growth when the share of fiscal income in total output is assumed to be constant during the century. And let  $\hat{y}_{jk}(0)$  be the estimated rate of per capita growth when the share of fiscal income in total output varies with per capita output. Then,

$$\hat{y}_{jk}(0) = \frac{\hat{y}_{jk}}{1 + \delta} \quad (2.7)$$

## 2.4 Economic Growth Estimates: Results

Firstly, I am interested in establishing that there was positive per capita growth in eighteenth century Mexico. Finding support of per capita growth in this period of globalization is staggering since the seventeenth and the first part of the nineteenth century are periods of economic stagnation, and of disintegration from world markets for Mexican exports. The next question in this paper is whether this per capita growth was pushed by the dominant export product of the epoch: silver. The answer is “yes”. The third and final question is whether economic growth improved during the period of Bourbon reforms. And the answer here is more ambiguous. Economic growth may have improved, but not as expected. Mining ceased to be the source of economic growth at the end of the century.

The per capita growth estimates for the 1710-1798 period are presented in Tables 2.1 and 2.2. Table 2.1 presents the average annual rates of growth for per capita output under different assumptions about  $(\alpha + \beta - \alpha \cdot \beta)$  and  $\delta$ , assuming the share



**Table 2.1**  
**Annual Rates of Estimated Per Capita Growth for Colonial Mexico, 1710-1798.**  
 $\lambda = 1.$   
**Different Assumptions on  $\alpha$ ,  $\beta$  and  $\gamma$ .**

$\gamma$	$\alpha + \beta - \alpha \cdot \beta$									
	0.05	0.15	0.25	0.35	0.45	0.55	0.65	0.75	0.85	0.95
<b>0.0</b>	0.98	0.91	0.85	0.80	0.75	0.70	0.66	0.61	0.57	0.53
<b>0.1</b>	1.02	0.94	0.88	0.82	0.77	0.71	0.66	0.61	0.57	0.52
<b>0.2</b>	1.08	0.99	0.91	0.85	0.79	0.73	0.66	0.61	0.56	0.51
<b>0.3</b>	1.14	1.04	0.96	0.89	0.81	0.74	0.67	0.61	0.56	0.50
<b>0.4</b>	1.23	1.12	1.02	0.93	0.85	0.77	0.68	0.62	0.55	0.48
<b>0.5</b>	1.36	1.22	1.10	1.00	0.90	0.80	0.70	0.62	0.54	0.46
<b>0.6</b>	1.55	1.38	1.23	1.10	0.98	0.85	0.73	0.63	0.53	0.43
<b>0.7</b>	1.87	1.63	1.43	1.27	1.10	0.93	0.77	0.63	0.50	0.37
<b>0.8</b>	2.50	2.15	1.85	1.60	1.35	1.10	0.85	0.65	0.45	0.25
<b>0.9</b>	4.40	3.70	3.10	2.60	2.10	1.60	1.10	0.70	0.30	-0.10

Source: See text.

of government income varied with silver production ( $\lambda=1$  in equation 2.5). Table 2.2 provides the average annual rate of growth for per capita output under different assumptions about  $(\alpha + \beta - \alpha \cdot \beta)$  and  $\gamma$ , assuming government income varies with per capita output ( $\lambda=0$  in equation 2.5). In presenting the results in Tables 2.1 and 2.2, I followed the literature in assuming that population grew at an annual rate equal to 1 per cent.

The first row in Tables 2.1 and 2.2 provides exactly the same information. This is the annual compound rate of per capita growth under the assumption that the share of fiscal income in total output was constant through out the century. Assuming that  $(\alpha + \beta - \alpha \cdot \beta)$  equals 0.65, these rows show that the annual rate of growth for per capita output equals 0.66 per cent in the 1710-1798 period. My own guess is that the parameter  $\alpha$  is between 0.25 and 0.50, whereas plausible values for  $\beta$  are between 0.40 and 0.50. This implies that the elasticity of the price level with respect to the price of non-tradable goods,  $(\alpha + \beta - \alpha \cdot \beta)$ , would be between 0.55 and 0.75. Under the assumption of a constant share of government income, values for  $(\alpha + \beta - \alpha \cdot \beta)$  between 0.75 and 0.55 lead to estimates of annual per capita growth between 0.61 and 0.70 per cent. Furthermore, a value for  $(\alpha + \beta - \alpha \cdot \beta)$  as high as 0.95 implies an annual average rate of per capita growth equal to 0.53 per cent.

Now, Table 2.1 presents the estimates on economic growth assuming that any change in the share of fiscal income in total output was due to changes in the share of silver production in total output. That is, when  $\lambda=1$  in equation (2.5). The first result I must point out is that, except for one, all numbers in Table 2.1 are positive. Therefore, there was positive per capita growth in eighteenth century Mexico.

When  $(\alpha + \beta - \alpha \cdot \beta)$  takes values smaller than 0.75, the estimates on economic growth are higher the larger the value for  $\gamma$ . That is, the higher the response of the share of fiscal income as a share of total output to changes in the share of silver production in total output, then the higher it is the estimated growth for eighteenth

**Table 2.2**  
**Annual Rates of Economic Growth Estimated for Colonial Mexico, 1710-1798.**  
 $\lambda = 0$ .  
**Different Assumptions on  $\alpha$ ,  $\beta$  and  $\delta$ .**

$\delta$	$\alpha + \beta - \alpha \cdot \beta$									
	<b>0.05</b>	<b>0.15</b>	<b>0.25</b>	<b>0.35</b>	<b>0.45</b>	<b>0.55</b>	<b>0.65</b>	<b>0.75</b>	<b>0.85</b>	<b>0.95</b>
<b>0.0</b>	0.98	0.91	0.85	0.80	0.75	0.70	0.66	0.61	0.57	0.53
<b>0.1</b>	0.89	0.83	0.77	0.73	0.68	0.64	0.59	0.55	0.52	0.48
<b>0.2</b>	0.82	0.76	0.71	0.67	0.63	0.58	0.54	0.51	0.48	0.44
<b>0.3</b>	0.75	0.70	0.65	0.62	0.58	0.54	0.50	0.47	0.44	0.41
<b>0.4</b>	0.70	0.65	0.61	0.57	0.54	0.50	0.46	0.44	0.41	0.38
<b>0.5</b>	0.65	0.61	0.57	0.53	0.50	0.47	0.43	0.41	0.36	0.35
<b>0.6</b>	0.61	0.57	0.53	0.50	0.47	0.44	0.41	0.38	0.36	0.33
<b>0.7</b>	0.58	0.54	0.50	0.47	0.44	0.41	0.38	0.36	0.34	0.31
<b>0.8</b>	0.54	0.51	0.47	0.44	0.42	0.39	0.36	0.34	0.32	0.29
<b>0.9</b>	0.52	0.48	0.45	0.42	0.39	0.37	0.34	0.32	0.30	0.28
<b>1.0</b>	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.31	0.29	0.27

Source: See text. Annual population rate of growth assumed to be one per cent.

century Mexico, as long as  $(\alpha + \beta - \alpha \cdot \beta) \leq 0.75$ . If we consider values higher than 0.85 for  $(\alpha + \beta - \alpha \cdot \beta)$ , then the estimated rate of economic growth declines when  $\gamma$  rises. The higher the response of the share of fiscal income to changes in the share of silver, the lesser the estimated growth for eighteenth century Mexico.

In Table 2.1, the estimated economic growth rises when the value for  $(\alpha + \beta - \alpha \cdot \beta)$  reduces. That is, the lower the change in prices we assume for eighteenth century Mexico, the higher the estimated rate of growth. This relationship is valid for any value of  $\gamma$  in Table 2.1. The effect of  $\gamma$  on the estimates is that as we increase its value, the range of possible estimates for economic growth for different values of  $(\alpha + \beta - \alpha \cdot \beta)$  also rises. For instance, possible rates of per capita growth when  $\gamma=0$  are between 0.53 and 0.98 per cent. On the other hand, possible values of economic growth when  $\gamma=0.8$  are between 0.25 and 2.50 per cent.

Table 2.2 provides the results on economic growth when the share of fiscal income in total output only varies with per capita output ( $\lambda=0$  in equation 2.5). That is, we assume the share of silver production in total output does not affect the share of fiscal income in total output. Again I assume an annual population growth rate equal to one per cent. The first result I must point out is that all numbers in Table 2.2 are positive. And therefore, per capita growth was positive in the 1710-1798 period.

Table 2.2 also shows that the estimated rate of per capita growth reduces when  $\delta$ , the response of fiscal income to per capita output, rises. For instance, the range of possible rates of per capita growth, when  $\delta=0$ , is between 0.53 and 0.98 as  $(\alpha + \beta - \alpha \cdot \beta)$  varies between 0.95 and 0.05. On the other hand, the range of possible rates of per capita growth, when  $\delta=1$ , is between 0.27 and 0.49 as  $(\alpha + \beta - \alpha \cdot \beta)$  varies between 0.95 and 0.05. And as in Table 2.1, the estimated rate of per capita growth also falls when the response of our price index to changes in the maize price,  $(\alpha + \beta - \alpha \cdot \beta)$ , rises.

Intermediate cases in which  $0 < \lambda < 1$  are relatively difficult to study. They correspond to assuming the share of fiscal income in total output varies with both, the share of silver in total output, and with per capita output. As shown in last section, the estimated rate of per capita growth in the more general case is determined by a linear combination of the estimated rates of growth in Tables 2.1 and 2.2.

The results in Tables 2.1 and 2.2 are surprising when compared to the idea in the economic historiography that both, the seventeenth century and the first part of the nineteenth century were periods of economic stagnation for Mexico. Both were periods in which exports stagnated. And the economic historiography agrees that the Mexican economy also stagnated. The results are also surprising when compared to the rates of growth observed in European countries between the sixteenth and eighteenth centuries. Among the European countries shown in Table 2.3, only the Netherlands had rates of growth as high as 0.60 per cent during the sixteenth century, and 0.43 per cent during the seventeenth century. The United Kingdom achieved annual average rates of growth in per capita output between 0.25 and 0.31 per cent in the sixteenth to eighteenth century period. Spain recorded one of highest sixteenth century growth rates, an annual rate of per capita growth of 0.25 per cent. For sixteenth century Portugal, the rate of growth in per capita output was 0.20 per cent. In Table 2.3, the remaining 35 observations, out of 42, show annual rates of per capita growth less than 0.20 per cent.

Eighteenth century Mexico seems to have achieved very high growth rates, even when compared to the 0.5 per cent rate of growth currently calculated for the eighteenth century in colonial British America.<sup>21</sup> That high rate of growth is usually explained as the result of the use and transformation of available European technologies among its free and egalitarian citizens (see Engerman and Sokoloff, 1997). Clearly, these elements were not present in New Spain.

The economic historiography suggests that part of the Mexican growth in eighteenth century Mexico may have been pushed by the growth in the dominant export

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<sup>21</sup> See Atack and Passell (1994).

**Table 2.3**  
**Annual Rates of Per Capita Growth in European Countries.**  
**Sixteenth to Eighteenth Centuries.**

<b>Country</b>	<b>1500-1600</b>	<b>1600-1700</b>	<b>1700-1820</b>
Austria	0.17	0.17	0.17
Belgium	0.11	0.16	0.12
Denmark	0.17	0.17	0.17
Finland	0.17	0.17	0.18
France	0.14	0.16	0.18
Germany	0.14	0.14	0.12
Italy	0.00	0.00	0.01
Holland	0.60	0.43	-0.12
Norway	0.17	0.17	0.17
Sweden	0.17	0.17	0.17
Switzerland	0.17	0.17	0.17
United Kingdom	0.31	0.25	0.26
Portugal	0.20	0.10	0.10
Spain	0.25	0.00	0.14

Source: Maddison (2001).

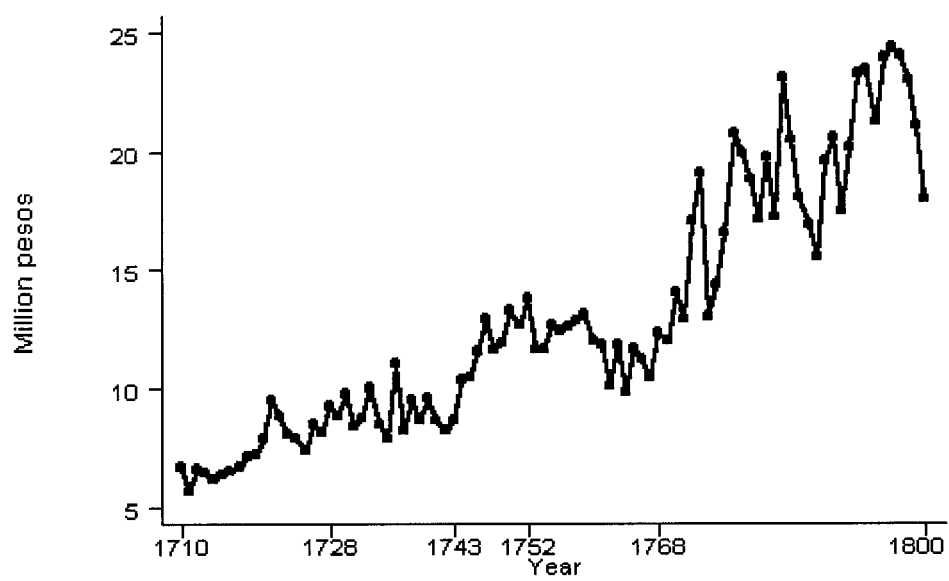
product: silver. We know that the growth of silver production could have allowed the economic organization and employment of resources. And therefore, it is important to distinguish the periods of mining expansion from those of mining stagnation.

Figure 2.6 presents annual silver production in New Spain, as measured by coined silver in the coining houses of New Spain (Casas de Moneda de la Nueva España). The source of this data is Orozco (1857), and for our purposes, the results are the same when using the alternative series on coined silver by Humboldt (1966). In Figure 2.6, I have selected different years to separate the periods of mining booms from those periods of mining stagnation. The 1710-1728 period is one of growth in coined silver. From 6.7 million pesos coined in 1710, this number went to more than 9 million pesos in 1728. From this year to 1743, silver production stagnated, and in 1743, approximately 8.6 million pesos were coined. From 1744 to 1752, silver production recovered, and in 1752 the amount of silver coined reached 13.7 million pesos.

Therefore, during the first half of eighteenth century, say between 1710 and 1752, we have three separated periods. The first one is of mining expansion (1710-1728), the second one is of mining stagnation (1743-1752), and the third one sees a second boom in silver production (1743-1752). During the second half of the century, we have two different periods. The first one, from 1752 to 1769, is a period of mining stagnation. From 13.7 million pesos coined in 1752, this number fell to 11.9 million pesos in 1769. During the decade of 1770, however, there was a boom in silver production. By the end of this decade, coined silver reached 18 million pesos. A second jump in silver production occurred during the decade of 1790, reaching 20 million pesos by the end of the century. Then, we divide the second half of eighteenth century Mexico in a first period of mining stagnation (1752-1769), and a second period of mining growth (1769-1800).

In order to study the economic growth of colonial Mexico during the different periods mentioned, I first present the results on economic growth when assuming the share of fiscal income in total output remained constant through out the century. Table

Figure 2.6 Annual Coined Silver, 1710-1800.



Source: Orozco (1857).



2.4 presents the results on per capita economic growth for different values of  $(\alpha + \beta - \alpha \cdot \beta)$ . The estimated values were calculated after smoothing the output index with a five years moving median. Table 2.5 presents the results for a narrower range of  $(\alpha + \beta - \alpha \cdot \beta)$ , between 0.56 and 0.74. Table 2.5 also uses smoothed values with a five years moving median.

Table 2.4 shows that values of  $(\alpha + \beta - \alpha \cdot \beta)$  less than 0.55 imply a very negative per capita growth rate in the 1753-1769 period. Similarly, for values of  $(\alpha + \beta - \alpha \cdot \beta)$  larger than 0.75, the estimated rate of per capita growth in the 1729-1744 period is very low. Values for  $(\alpha + \beta - \alpha \cdot \beta)$  between 0.55 and 0.66 result in estimates that seem very reasonable. If we restrict ourselves to values of  $(\alpha + \beta - \alpha \cdot \beta)$  between 0.55 and 0.66, we may also conclude that the economic growth of eighteenth century Mexico coincides with the periods of growth in silver production.

Table 2.5 presents the results on economic growth when the possible values for  $(\alpha + \beta - \alpha \cdot \beta)$  are between 0.56 and 0.74. As in Table 2.4, in Table 2.5 I assume the share of fiscal income in total output remained constant through out the century. Table 2.5 shows that during the first half of the century, the periods of mining expansion coincide with the periods of high growth in total output. This result strongly supports the idea that there was a connection between the economic growth of New Spain and the growth of silver production.

During the periods of mining expansion in the first half of the century, 1710-1728 and 1743-1752, the calculated growth rates for per capita output are between 1.08 and 3.55 per cent. But during the period of mining stagnation, say between the years of 1728 and 1743, the annual rate of growth for per capita output was calculated around 0.0 per cent. These results extend to the second half. That is, the period of positive per capita growth coincides with the period of boom in silver production,

**Table 2.4**  
**Annual Rates of Per Capita Growth in New Spain, different periods.**  
 Assuming  $\delta = \gamma = 0$ .

$\alpha + \beta - \alpha \cdot \beta$	<b>1710-29</b>	<b>1729-44</b>	<b>1744-53</b>	<b>1753-69</b>	<b>1769-98</b>
<b>0.05</b>	0.61	1.24	1.30	-0.29	1.66
<b>0.15</b>	0.70	1.02	1.61	-0.21	1.39
<b>0.25</b>	0.79	0.80	1.92	-0.13	1.12
<b>0.35</b>	0.88	0.58	2.24	-0.15	0.91
<b>0.45</b>	0.98	0.37	2.56	-0.16	0.70
<b>0.55</b>	1.08	0.16	2.90	-0.06	0.45
<b>0.65</b>	1.18	-0.05	3.23	-0.06	0.24
<b>0.75</b>	1.29	-0.26	3.58	-0.14	0.12
<b>0.85</b>	1.40	-0.46	3.93	-0.12	-0.08
<b>0.95</b>	1.51	-0.67	4.30	-0.02	-0.32

Source: See text. The annual rate of population growth is assumed to be one per cent.

**Table 2.5**  
**Annual Rates of Per Capita Growth in New Spain, different periods.**  
 Assuming  $\delta = \gamma = 0$ .

$\alpha + \beta - \alpha \cdot \beta$	1710-29	1729-44	1744-53	1753-69	1769-98
<b>0.56</b>	1.08	0.14	2.93	-0.05	0.42
<b>0.58</b>	1.11	0.09	3.00	-0.03	0.37
<b>0.60</b>	1.13	0.06	3.06	-0.01	0.32
<b>0.62</b>	1.15	0.01	3.13	-0.03	0.29
<b>0.64</b>	1.17	-0.03	3.20	-0.05	0.26
<b>0.66</b>	1.19	-0.07	3.27	-0.07	0.23
<b>0.68</b>	1.21	-0.11	3.34	-0.08	0.20
<b>0.70</b>	1.23	-0.16	3.41	-0.10	0.18
<b>0.72</b>	1.25	-0.20	3.48	-0.12	0.15
<b>0.74</b>	1.28	-0.24	3.55	-0.13	0.13

Source: See text. Smoothed values. Population growth assumed equal to one per cent per year.

which occurred during the period of Bourbon reforms in the last 30 years of the eighteenth century.

The effect of Bourbon reforms, which occurred in the after-1769 period, was to reanimate economic growth in New Spain. Though to a lesser extent in comparison to the growth observed during the first half of the century. According to Table 2.5, for the 1769-1798 period, I calculate an annual rate of per capita growth between 0.13 and 0.42 per cent. This rate is low when compared with the calculated per capita growth rates of the first half of the century. During the periods of mining expansion in the first half of the eighteenth century, the rates of growth are between 1.08 and 3.55 per cent. Therefore, even though the Bourbon reforms reanimated economic growth in colonial Mexico, they did not have the expected success when compared to the behavior of the economy during the first half of the century.

Even more, this suggests that growth based in the export of silver exhausted by the end of the colonial period. To make more precise the calculations, let us take a value of 0.65 for  $(\alpha + \beta - \alpha \cdot \beta)$ . In this case, the periods of mining expansion in the first half of the century, 1710-1729 and 1744-1753, saw annual rates of per capita growth equal to 1.18 and 3.23 per cent. On the other hand, in the period of Bourbon reforms and mining recovery, 1769-1798, per capita growth is calculated in 0.24 per cent per year.

I find that during the entire eighteenth century, the periods of mining growth coincide with the periods of high growth in total output. As before, let me present more precise figures by using a value for  $(\alpha + \beta - \alpha \cdot \beta)$  equal to 0.64. In the periods of mining expansion during the first half of the century, 1710-1729 and 1744-1753, the rates of per capita growth are equal to 1.17 and 3.20 per cent per year, respectively. But during the period of mining stagnation, from 1729 to 1744, the annual rate of per capita growth is 0.0 per cent. Again I am assuming population growth was one per cent, and that the share of fiscal income in per capita output was

constant through out the century. I conclude all per capita growth in the first half of the century occurred during the periods of growth in mining.

The same result applies to the second half of the eighteenth century. In fact, there is no change in the relationship between silver production and total output. Again, I present precise figures by using a value for  $(\alpha + \beta - \alpha \cdot \beta)$  equal to 0.64. Between 1752 and 1768, mining output stagnates, and so per capita output does. In the period of Bourbon reforms, say between 1769 and 1798, silver production recovers, and the rate of growth of per capita output does increase. In fact, the growth rate in per capita output went from 0.0 per cent in the 1753-1769 period, to 0.24 per cent in the 1769-1798 period. These results are summarized in Table 2.5.

This change in the rate of growth that occurs at the end of the eighteenth century, after 1769, in principle, seems to have no important consequences for the period under study. Between mid of the century and the arrival of Bourbon reforms, say between 1753 and 1769, the rate of per capita growth was around zero per cent per year. Then, per capita output, behaving like this for the rest of the century, would have remained constant to 1800. However, with the per capita growth rate calculated in this paper for the 1769-1798 period, say around 0.26 per cent, I calculate per capita output grew 8.4 per cent during the last 31 years of the eighteenth century. This is the effect Bourbon reforms could have had on the economic growth of the late colonial period in Mexico.

This result, that during the period of Bourbon reforms there was some improvement in economic growth, is in contrast to what the critics of the 80s had established. However, it also confirms the belief of the same critiques that economic growth in the late colonial period was not as dazzling as the traditional historiography had suggested. This comes from comparing the annual rate of per capita growth in one of the periods of mining expansion, say the 1710-1729 period, which equals 1.17 per cent, with the annual rate of per capita growth of 0.26 per cent for the 1769-1798 period. Therefore, the Bourbon reforms did not achieve the splendor of the economy of first half of the century.

The estimates do not support the idea that the roots of sustained economic growth in Mexico could be situated in the eighteenth century. First, because it is not noteworthy the per capita growth during the periods of mining stagnation, which I calculated in around 0.0 per cent per year, and is much lower than the estimated rate of growth in periods of mining expansion. The reader should also note that during the periods characterized by the lack of growth in mining output, the estimated rate of per capita growth in Mexico did not result very similar to the growth observed in European countries during the sixteenth to eighteenth centuries (see Table 2.3). Finally, each period of mining stagnation is yet to be followed by another period of growth led by the mining sector

Now I summarize the conclusions we have reached on the economic growth of eighteenth century New Spain, when assuming the share of fiscal income in total output remained constant throughout the century. First of all, the eighteenth century is a period of rapid economic growth for Mexico. Second, we observe sub-periods of high economic growth, which coincide with the sub-periods of mining expansion. The periods of economic stagnation in terms of per capita output also coincide with the stagnation of mining output. These results confirm that the eighteenth century New Spain's economy grew pushed by the production of silver, as was suggested by the economic historiography. But during the periods of mining stagnation, we do not observe rates of growth similar to those observed in growing European countries of the epoch. Therefore, we concluded that the origins of sustained economic growth for Mexico could not be situated in the eighteenth century. Finally, I found economic growth slightly improved during the period of Bourbon reforms, in comparison to its previous period of mining stagnation. However, even though economic growth improved during the last 30 years of the eighteenth century, this growth did not achieve the splendor of the first half of the century. Mining output ceased to be the source of economic growth at the end of the eighteenth century.

Can we extend these results to more general cases in which we do not assume the share of fiscal income in total output remained constant through out the eighteenth century? For extreme values of the parameters, the answer is no.

Equation (2.6) allows calculating economic growth when we assume that the share of fiscal income in total output varies with the share of mining in total output. This is the case of  $\lambda = 1$  in equation (2.5). Table 2.6 presents the per capita growth rates in this case. The values for per capita growth in silver production, during our periods of interest, are shown in the first column of Table 2.6. The remaining columns display the results on economic growth using equation (2.6). Table 2.6 presents results while assuming  $(\alpha + \beta - \alpha \cdot \beta)$  equals 0.65. The second column in Table 2.6 provides the estimates when  $\delta = 0$ . Therefore, that column presents the same information than the seventh row in Table 2.4. The first two columns are used in equation (2.6) to obtain the results of the remaining columns.

When the sensibility of fiscal income to changes in silver production,  $\delta$ , increases, our results on economic growth also change. The periods of mining expansion see a decline in the estimated rate of economic growth, while the periods of mining stagnation see a rise in the estimated rate of growth. For large values of  $\delta$ , say larger than 0.4, the conclusions we got before begin to disappear. For values of  $\delta$  lesser than 0.3, the conclusions remain. That is, the periods of mining expansion are the ones that see higher rates of growth in per capita output.

In Table 2.6, most of all when assuming the share of fiscal income in total output remained constant, per capita silver production and per capita output grew at roughly the same rate during the first half of the century, but only in the periods of mining expansion. On the other hand, during the period of mining stagnation in the first half of the century, 1744-1753, total output grew more rapidly than silver. Therefore, equation (2.1) seems to be a good approximation during the periods of mining growth in the first half of the eighteenth century when  $Y$  refers to real, not nominal, output.

Following the same Table 2.6, I must point out that in the second half of the century, equation (2.1) fails to be a good approximation to describe the behavior of real output. For the second half of the century, equation (2.1) provides a better approximation for the behavior of nominal output, especially during the period of

**Table 2.6**  
**Annual Rates of Per Capita Growth in Mining and Output, New Spain,**  
**different periods. Assuming  $(\alpha + \beta - \alpha \cdot \beta) = 0.65$  and  $\lambda = 1$**

	Mining	Per capita output				
Period		$\gamma = 0$	$\gamma = 0.1$	$\gamma = 0.2$	$\gamma = 0.3$	$\gamma = 0.4$
1710-1729	1.41	1.18	1.15	1.12	1.08	1.03
1729-1744	-2.21	-0.05	0.19	0.49	0.88	1.39
1744-1753	3.31	3.23	3.22	3.21	3.20	3.18
1753-1769	-1.34	-0.06	0.08	0.26	0.49	0.79
1769-1798	1.42	0.24	0.11	-0.05	-0.27	-0.55
1710-1798	0.60	0.66	0.66	0.66	0.67	0.68

Source: See text.



mining growth. For the 1769-1798 period, the annual rate of growth for mining output was 2.42 per cent per year, while nominal output grew at a rate of 2.83 per cent per year. Definitely, a good fit for the behavior of nominal output during the last 30 years of the eighteenth century.

Finally, I must note that in Table 2.6, two of our previous conclusions disappear. First, for values of  $\gamma$  larger or equal than 0.1, it seems that by mid of the century, New Spain reaches to grow in a period of mining stagnation. This is important because it seems to establish its own growth dynamics, confirming Florescano and Gil (1976) view of growth after 1750. And secondly, I can also find a decline in the growth rate of the last 30 years of the eighteenth century, during the period of Bourbon reforms, when  $\gamma$  is larger or equal than 0.2. This would confirm the critiques of the 1980s and early 1990s.

Now I consider how the results are modified when we let the share of fiscal income in total output to vary with per capita output. This is the case of  $\lambda = 0$  in equation (2.5). In this case, the orders of magnitude in rates of growth among different periods do not change. The conclusions are the same as in the case where we assumed the share of fiscal income in total output remained constant through out the century. That is, positive per capita growth occurs only during the periods of mining expansion, and the period of Bourbon reforms saw some improvement in the rate of growth. Table 2.7 presents the results for different values of  $\gamma$ , when we assume  $(\alpha + \beta - \alpha \cdot \beta)$  equals 0.65.

The calculations presented in this paper would allow us to construct and index of the share of silver production in total nominal output for New Spain. This is in order to understand the implication of our estimates on that ratio. In this paper we only consider one example, which comes from assuming the share of fiscal income in total output remained constant in the eighteenth century. That is, assuming  $\delta = \gamma = 0$ . Let us consider the case of  $(\alpha + \beta - \alpha \cdot \beta)$  equal to 0.65. Following some works in the

**Table 2.7**  
**Annual Rates of Per Capita Output Growth, New Spain, different periods.**  
 Assuming  $(\alpha + \beta - \alpha \cdot \beta) = 0.65$  and  $\lambda = 0$

Period	$\delta = 0$	$\delta = 0.1$	$\delta = 0.2$	$\delta = 0.3$	$\delta = 0.4$	$\delta = 0.5$
<b>1710-1729</b>	1.18	1.07	0.98	0.91	0.84	0.79
<b>1729-1744</b>	-0.05	-0.05	-0.04	-0.04	-0.04	-0.03
<b>1744-1753</b>	3.23	2.94	2.69	2.48	2.31	2.15
<b>1753-1769</b>	-0.06	-0.05	-0.05	-0.05	-0.04	-0.04
<b>1769-1798</b>	0.24	0.22	0.20	0.18	0.17	0.16
<b>1710-1798</b>	0.66	0.59	0.54	0.50	0.46	0.43

Source: See Text.

colonial historiography, let us assume that 8 per cent is the share of silver in total nominal output at the end of the eighteenth century, in particular in 1798.

At the beginning of our period of study, mining represented 11.4 per cent of total output. During the period of mining expansion that initiates in 1710, the share of mining grows to 13.0 per cent in 1729. The next period, of mining stagnation, saw a decline in this share to 10.8 per cent in 1744. Towards 1753, once there was some economic growth, the share of mining remains in 10.9 per cent. From 1753, the share of silver declines to 9.5 per cent in 1769, and finally to 8 per cent in 1798.

Once we determined the share of mining in nominal output,  $\theta$ , we can use the corresponding index for real per capita output to construct an index of non-mining output,  $A$ , from the equation:

$$A = (1 - \theta) \cdot y$$

In the example we are considering in this paper, the behavior shown by the index of non-mining output is very similar to the behavior of total output. The rates of per capita growth during the periods of mining expansion are 1.1 (1710-29), 3.2 (1744-53) and 0.3 (1769-98) per cent per year. The rates of per capita growth during the periods of mining stagnation are 0.12 (1729-44) and 0.03 (1753) per cent per year. The reader should note that even though some of the magnitudes are altered as in comparison to our index of per capita output, the relationship between economic growth and mining growth also seems to apply to non-mining output.

## 2.5 Final Comments

As it has been long recognized in the social sciences, the Mexican experience with development cannot be treated separately from the pattern of transactions the country has established with the world system. What is astonishing is that the last one hundred years of colonial history represented for Mexico advantageous dealings with

the rest of the world. This is the most surprising result in the present essay, since it turns on its head traditional interpretations of the colonial past.<sup>22</sup>

The conclusions obtained in this paper on the economic growth of eighteenth century Mexico are as follows. First, there was positive per capita growth in this period of globalization for Mexico. The estimated rate of Mexican per capita growth is very similar to the currently estimated rate for the colonial United States in the same century. This result is in stark contrast to the economic stagnation found by other authors in the seventeenth and the first part of the nineteenth century. Both are periods of disintegration from international markets for Mexican exports.

During the eighteenth century, I observe periods of rapid economic growth, and they coincide with the periods of mining expansion. The estimated rates of growth of these two variables could be quite similar. This finding confirms that economic growth in eighteenth century Mexico was pushed by the principal export product of the epoch, silver. However, it seems that the roots of sustained economic growth in Mexico cannot be situated in the eighteenth century. The periods of stagnation in the mining sector implied total output stagnation. Or put it another way, the economy did not grow without export expansion. And furthermore, these periods of stagnation did not see rates of growth similar to those calculated in the economic literature for sixteenth to eighteenth century European countries.

Finally, it seems that economic growth slightly improved during the period of Bourbon reforms. These reorganizations had consequences in terms of total output for the last 30 years of eighteenth century Mexico.<sup>23</sup> They increased per capita output in around 8.4 per cent during the last third of the century. However, the Bourbon reforms did not achieve the expected magnificence when compared to the first half of the century. In fact, it is possible that mining ceased to be the source of growth in colonial Mexico by the end of the eighteenth century, just before the start of the independence war.

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<sup>22</sup> See, for instance, Adelman (1999).

<sup>23</sup> The reader should note that our conclusions disappear under certain assumptions, for instance in Table 2.6.

The estimates on economic growth relied on three previously published variables in the colonial historiography, and on two important assumptions. The variables are, with their respective sources, 1) Fiscal income for the treasury of Mexico City (TePaske, 1985), 2) The share of this income in total fiscal income for New Spain (Klein, 1998), and 3) The price of maize for New Spain (Garner and Stefanou, 1993). The assumptions were, 1) Fiscal income in New Spain did vary as a share of total output in a particular way with the share of silver in total output, or with per capita income, and 2) The price index of non-tradable goods responded in a specific magnitude to the changes in the maize price. To provide estimates for per capita growth, I also assumed population growth was 1 per cent per year during the 1710-1798 period.

Possible sources of error due to my assumptions and the nature of the data used were mentioned throughout the paper. I must insist that the results of this paper should be taken with caution, and they could change as the economic historiography improves on the knowledge of the variables of interest. In particular, an exhaustive study on government income, prices, and population growth, could yield improved results on the economic growth estimates for eighteenth century Mexico. Future research could apply a methodology similar to the one developed in this essay in order to study economic growth during the seventeenth century of population depression.

My qualitative results on the relationship between mining expansion and economic growth during the first half of the eighteenth century are very robust. Less robust are the conclusions for the second half of the century. With no doubt, the magnitudes involved in this relationship may be sensible to the definition of periods and my assumptions, but the qualitative relationship between mining expansion and total output growth is definitely present during the first half of eighteenth century New Spain. For the second half, my own particular view sees the same relationship, but synthesizes both the old and the new paradigms: Bourbon reforms improved economic growth, but not sumptuously.

The comparisons of per capita growth between Mexico and European countries are sensitive to the assumption of 1 per cent per year for population growth. If

population growth was higher than 1 per cent during the second half of the eighteenth century, it could be possible to conclude colonial Mexico experienced a decline in per capita output by the end of the colonial period. In this case, it would be the result of a disequilibrium between output and population growth, rather than as the result of Bourbon reforms. And finally, I must mention that each of the old and the new views of the Bourbon period can be vindicated for a stretch range of parameter values. Economic growth from 1750 to 1770 and economic decline afterwards are consistent with very particular values of the parameters.

The eighteenth century was important for New Spain. Colonial Mexico grew. In 1800, its per capita output was between 1.6 and 1.9 times higher than in 1700. And behind this growth was the mercantilist policies of Spain. With no doubt, during this century the colonial economy benefited from the imperial system. Exploitation of silver allowed the growth of commerce and industry that otherwise would have been impossible.

## **Appendix**

This appendix considers the determination of total output in equation (2.1) from two simple disequilibrium models. The first one corresponds to the textbook model in the determination of total output from aggregate demand. The second one is an application of the Harrod-Domar model, in which exports serve to import foreign inputs.

### **A1. Aggregate Demand**

To simplify, let us omit investment and changes in relative prices. The aggregate demand approach assumes that demand for domestic goods is a share  $\varepsilon$  of New Spain's income. Therefore, the marginal propensity to spend in domestic goods must satisfy  $\varepsilon = (\rho - 1)/\rho$ , and the marginal propensity to spend on foreign goods

satisfies:  $(1 - \varepsilon) = 1/\rho$ . The utility function behind these assumptions is the Cobb-Douglas:

$$U = D^\varepsilon \cdot Z^{1-\varepsilon}$$

where  $D$  indicates the consumption of domestic goods, and  $Z$  indicates the consumption of foreign goods. Assuming silver is only used foreign goods, then the equilibrium in the international market would be  $Z = X$ , and the level of output in New Spain would be determined by aggregate demand  $Y = D + Z$

In this case,  $\rho$  in equation (2.1) is the multiplier of silver exports. And then,  $1/\rho$  is the share of silver in total output, which if we assume equal to 8 per cent, then an additional “peso” would lead to an increase of 12.5 pesos in total output. With this approach in mind, equation (2.1) should be deflated to form a correct idea about real output.

## A2. Production Function and Balance of Payments Constraint

Now we consider the aggregate production function:

$$Y = \min\{a_C \cdot C, a_L \cdot L\}$$

where  $C$  represents an intermediate good used for domestic production, whereas  $L$  is the amount of labor available in the economy. The requirements of the intermediate good and of labor are  $a_C$  and  $a_L$ , respectively. Let us assume an excess in labor in the domestic economy, and that the intermediate good is imported. That is,

$$C = s \cdot Z$$

Let us omit the changes in the prices of imported goods. According to the last equation, a share  $s$  of imports corresponds to the imported input used in domestic production. Again, international equilibrium is achieved with  $Z = X$ . In this case we have  $\rho = s \cdot a_c$  in equation (2.1). Our assumption on excess labor would be satisfied as long as silver production is such that

$$X < \left( \frac{a_L}{s \cdot a_C} \right) \cdot L$$

In this model, silver production in (1) does not require to be deflated as long as there are no changes in the prices of Mexican imports.



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## CHAPTER 3

# POLITICAL INSTABILITY AND ECONOMIC GROWTH IN POST-INDEPENDENCE MEXICO

### 3.1 Introduction

With independence, Mexico turned from a wealthy, flourishing colony, into a nation disturbed by political strife and economic decline. Modern estimates suggest Mexican GDP per capita to be at least as high as in the United States in the eighteenth century.<sup>1</sup> While the Atlantic economy started industrialization during the nineteenth century, Mexico collapsed into its own internal struggles, foreign invasions, and penurious times. Coatsworth (1998) estimates that the difference in GDP per capita between Mexico and the United States has not changed since the start of the twentieth century. Thus, all of the gap between Mexico and the economies of the North Atlantic can be explained by Mexican economic failure in the nineteenth century and the 50 years between 1820 and 1870 in particular. The purpose of this paper is to explore the connection between economic and political instability during those “lost decades”.

Increasingly, economists are focusing their attention on the historical experience of the past two centuries in the underdeveloped world to gain some insight into the process of growth. A central question in this recent literature is how is it that the underdeveloped world actually became, and then remained, poor relative to currently rich countries?<sup>2</sup> Past institutions, past inequality, and past international trade, all seem to have played an important role (Acemoglu, Johnson, and Robinson 2001; Engerman and Sokoloff 2002; Sokoloff and Engerman 2000; Williamson 2002).

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<sup>1</sup> See Maddison (2001) and Coatsworth (1998).

<sup>2</sup> On the timing of divergence among regions, see Pritchett (1997, 2000), O'Rourke and Williamson (1999), Allen (2001), and Bourguignon and Morrisson (2002).

This paper will concentrate on political instability, something that political economists have explored with modern evidence (Alesina et al. 1996). I will study the most politically turbulent era in Mexican history, its post-independence period (1821-1867). I will argue that economic conditions stagnated due to political causes. We also know that by world standards, tariffs in Latin America were very high during the second half of the nineteenth century. And more, the roots of this protectionism were the financial problems created by the military requirements associated with conflict and instability (Coatsworth and Williamson 2002).

From independence, Mexico acquired a legacy of political violence that accompanied the economic devastation. The army did not step aside to allow civilians to control the nation, but for a long time, it would be involved in the political process to increase its share of government, ready to be an instrument of corrupt politicians. The country was not united, but divided between liberals and conservatives, federalists and centralists, republicans and monarchists, and between anticlerical and proponents of clerical privilege.<sup>3</sup> These divisions transformed the 50 years between 1820 and 1870 into an epoch of violence, lack of property rights, and other forms of disorder. For many writers, the political groups in the new nation proved without the ability to govern the country.

Table 3.1 presents the governments in independent Mexico from 1821 to 1911. The first column provides the period of each government, while the second column presents the corresponding administration. Some of them governed during different periods, and a number in parenthesis indicates this. The governments displayed in Table 3.1 include emperors, dictators, and presidents. First, I must point out that in the 46 years that go from 1821 to 1867, Mexico had 56 administrations. This includes the first presidency of Manuel Gómez Pedraza nullified by congress, and the two days government of José Ignacio Pavón. Seven more governments lasted less than a month, those of José María Bocanegra, Francisco Javier Echeverría, José Joaquín Herrera (1<sup>st</sup>), Valentín Canalizo (2<sup>nd</sup>), Nicolás

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<sup>3</sup> See Meyer and Sherman (1995).



**Table 3.1**  
**Governments in Mexico, 1821 - 1911**

<b>Period</b>	<b>Administration</b>
1821 – 1823	Agustín de Iturbide
03/30/1823 – 10/10/1824	Supremo Poder Ejecutivo
10/10/1824 – 04/01/1829	Guadalupe Victoria
Congress nullified election	Manuel Gómez Pedraza (1 <sup>st</sup> )
04/01/1829 – 12/19/1829	Vicente Guerrero
12/18/1829 – 12/23/1829	José María Bocanegra
12/23/1829 – 12/31/1829	Gobierno Provisional
01/01/1830 – 08/14/1832	Anastasio Bustamante (1 <sup>st</sup> )
08/14/1832 – 12/24/1832	Melchor Múzquiz
12/24/1832 – 04/01/1833	Manuel Gómez Pedraza (2 <sup>nd</sup> )
04/01/1833 – 05/16/1833	Antonio López de Santa Anna (1 <sup>st</sup> )
04/02/1833 – 04/24/1834	Valentín Gómez Farías (1 <sup>st</sup> )
04/24/1834 – 01/28/1835	Antonio López de Santa Anna (2 <sup>nd</sup> )
01/28/1835 – 02/27/1836	Miguel Barragán
02/27/1836 – 04/19/1837	José Justo Corro
04/19/1837 – 03/20/1839	Anastasio Bustamante (2 <sup>nd</sup> )
03/20/1839 – 08/10/1839	Antonio López de Santa Anna (3 <sup>rd</sup> )
07/10/1839 – 07/19/1839	Nicolás Bravo (1 <sup>st</sup> )
07/19/1839 – 10/22/1841	Anastasio Bustamante (3 <sup>rd</sup> )
09/22/1841 – 10/10/1841	Francisco Javier Echeverría
10/10/1841 – 10/26/1842	Antonio López de Santa Anna (4 <sup>th</sup> )
10/26/1842 – 03/05/1843	Nicolás Bravo (2 <sup>nd</sup> )
03/04/1843 – 10/04/1843	Antonio López de Santa Anna (5 <sup>th</sup> )
10/04/1843 – 04/04/1844	Valentín Canalizo (1 <sup>st</sup> )
04/04/1844 – 12/12/1844	Antonio López de Santa Anna (6 <sup>th</sup> )
12/12/1844 – 12/24/1844	José Joaquín Herrera (1 <sup>st</sup> )
12/24/1844 – 12/06/1844	Valentín Canalizo (2 <sup>nd</sup> )
12/06/1844 – 12/30/1845	José Joaquín Herrera (2 <sup>nd</sup> )
01/04/1846 – 07/27/1846	Mariano Paredes y Arrillaga
07/28/1846 – 08/04/1846	Nicolás Bravo (3 <sup>rd</sup> )
08/06/1846 – 12/24/1846	José Mariano Salas (1 <sup>st</sup> )
12/24/1846 – 03/21/1847	Valentín Gómez Farías (2 <sup>nd</sup> )
03/21/1847 – 04/02/1847	Antonio López de Santa Anna (7 <sup>th</sup> )
04/02/1847 – 05/20/1847	Pedro María Anaya (1 <sup>st</sup> )
05/20/1847 – 11/16/1847	Antonio López de Santa Anna (8 <sup>th</sup> )

**Table 3.1 (cont.)**

11/26/1847 – 11/13/1847	Manuel de la Peña y Peña (1 <sup>st</sup> )
11/13/1847 – 01/08/1848	Pedro María Anaya (2 <sup>nd</sup> )
01/08/1848 – 05/30/1848	Manuel de la Peña y Peña (2 <sup>nd</sup> )
06/03/1848 – 01/15/1851	José Joaquín Herrera (3 <sup>rd</sup> )
01/15/1851 – 01/06/1853	Mariano Arista
01/06/1853 – 02/08/1853	Juan Bautista Ceballos
02/08/1853 – 03/20/1853	Manuel María Lombardini
04/20/1853 – 08/12/1855	Antonio López de Santa Anna (9 <sup>th</sup> )
08/15/1855 – 09/12/1855	Martín Carrera
09/12/1855 – 10/04/1855	Rómulo Díaz de la Vega
10/04/1855 – 09/15/1856	Juan N. Alvarez
09/15/1856 – 01/21/1858	Ignacio Comonfort
01/23/1858 – 12/23/1858	Félix Zuloaga *
12/23/1858 – 01/21/1859	Manuel Robles Pezuela
02/02/1859 – 08/13/1860	Miguel Miramón (1 <sup>st</sup> )
08/14/1860 – 08/15/1860	José Ignacio Pavón
08/15/1860 – 12/24/1861	Miguel Miramón (2 <sup>nd</sup> )
1862 – 1864	French Occupation
06/1863 – 04/1864	Junta de Regencia
04/10/1864 – 05/15/1867	Ferdinand Maximilian of Hapsburg
01/19/1858 – 12/01/1867	Benito Juárez *
1867 – 1872	Benito Juárez
07/19/1872 – 11/20/1876	Sebastián Lerdo de Tejada
10/31/1876 – 10/23/1877	José María Iglesias
11/23/1877 – 12/11/1877	Porfirio Díaz (1 <sup>st</sup> )
12/11/1877 – 02/17/1877	Juan N. Mendez
02/17/1877 – 11/30/1880	Porfirio Díaz (cont.)
12/01/1880 – 11/30/1884	Manuel González
12/01/1884 – 1911	Porfirio Díaz (2 <sup>nd</sup> to 7 <sup>th</sup> )

Source: Vázquez-Gómez (1998).

- From 1858 to 1867, after the presidency of Comonfort, Mexico had two parallel governments. During all this period, the president of the liberal government was Benito Juárez. The conservative government started with Felix Zuloaga and ended with Maximilian of Hapsburg.

Bravo (3<sup>rd</sup>), Rómulo Díaz de la Vega, and Manuel Robles Pazuela. In contrast, the United States had 13 administrations in the 52 years between 1817 and 1869.

The economic literature has shown that political instability has an economic impact on growth first because it increases policy uncertainty, discouraging investment and savings of risk-averse economic agents (Alesina et al. (1996). Foreign investors also prefer a stable economic environment. And more, government changes can have large effects when there are stark differences between the new and the old group in power. Second, when political change is associated with violence, individuals engage in revolutionary instead of productive activities. This diverts resources from market activities, and, most important, it discourages investment because violence leads to risks of expropriation and other violent forms of economic loss for citizens. And third, political instability makes continuity of public programs for development an impossible task. Public investment in roads, education, law enforcement, etc., becomes unattainable.<sup>4</sup>

Political instability in Mexico lasted for the entire 1821-1867 period. The number of administrations reached a peak in the 1840s, when the nation had 21 different governments. Most of the changes in administration were associated with armed movements ousting a particular government. This was a common practice in early independent Mexico. The major civil conflict, known as the War of the Reform (1858-1861), was the culmination of prior political disputes and other minor civil wars settled since independence in 1821. In 1862, the French started a war of occupation in Mexico that culminated with the arrival of new monarchs, the Austrian archduke Maximilian of Hapsburg and his wife Charlotte, sent by the French emperor. From the start of the War of the Reform in 1858 to the execution of Maximilian in 1867, two parallel governments ruled in Mexico. One of them was liberal, led by Benito Juárez; the other was conservative,

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<sup>4</sup> Section 3.3 offers several examples from post-independence Mexico showing these effects of political instability.

**Table 3.2**  
**Chronology of Events in 19<sup>th</sup> century Mexico**

<b>Period</b>	<b>Event</b>
<b>1521-1810</b>	Colonial Period
<b>1810-1821</b>	Independence War
<b>1824-1834</b>	First Federalism
<b>1834-1846</b>	Centralism
<b>1836</b>	Loss of Texas
<b>1838</b>	Pastry War with France
<b>1846-1848</b>	War with the United States
<b>1846-1853</b>	Second Federalism
<b>1854-1855</b>	Revolution of Ayutla
<b>1858-1861</b>	War of the Reform
<b>1862-1867</b>	French Occupation
<b>1867-1876</b>	Restored Republic
<b>1876-1880</b>	First Presidency of Porfirio Díaz
<b>1884-1911</b>	Porfiriato Dictatorship

and its last representative was Maximilian.<sup>5</sup>

Coatsworth (1978) and Stevens (1991) have already pointed out the plausible relationship between political instability and lack of growth in post-independence Mexico. According to Coatsworth (1978), the political turmoil deprived the economy of the resources necessary to invest in transportation. According to him, geography was not favorable to Mexican economic development. On the other hand, Stevens (1991) has presented another non-competing view. He related the lack of strong governments in independent Mexico to the financial difficulties confronted by the Federal administration, which might be related to the economic stagnation of the country.

In the economic historiography, the period after the Independence War (1810-1821) has been portrayed as one of economic decline. In the traditional story, the deterioration of the mining industry during the decade of war led to the economic crisis. And since recovery of mining took several decades, per capita output declined for half a century. In one interpretation, mining and its silver was a growth-leading sector, so its stagnation hindered economic growth. In another interpretation, shortages of money (silver) spread the depression. And at first sight, either of these two versions seems consistent with the observed behavior of coinage in Mexico.<sup>6</sup>

Figure 3.1 displays the behavior of silver production from the start of the eighteenth century to the end of the nineteenth century, measured by coined silver.<sup>7</sup> This

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<sup>5</sup> With the start of the war, conservative general Zuloaga dissolved the liberal government, led by President Comonfort. According to the constitution, the new president was the Chief Justice of the Supreme Court, Benito Juárez. He managed to escape to the north, where his liberal cohorts proclaimed him President. In the capital, the army declared Zuloaga as president. During this period of war between liberals and conservatives, the liberals were able to establish their capital in Veracruz, the most important port of the country, where they controlled custom receipts.

<sup>6</sup> Recent applications of these ideas can be found in Dobado and Marrero (2001), Cárdenas (1997), and Salvucci (1997). Irigoin (2003) studies the role of fiscal and monetary fragmentation after independence in explaining Latin American backwardness.

<sup>7</sup> From 1700 to 1856, it is measured by coined silver as reported by Orozco (1857). From 1857 to 1900, it is measured by silver coinage as reported by Peñafiel (1900). Coined silver does not represent total production of silver inasmuch as it does not include metal in the form of bullion or used for jewelry. However, coined silver may record very fairly the rise and decline of total production of silver.

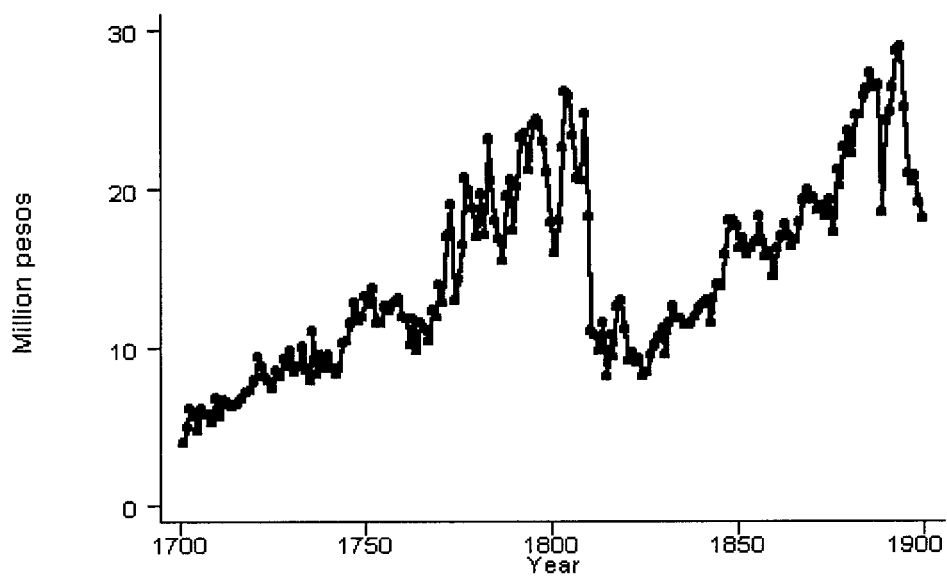
figure puts in perspective the decline in silver production that occurred during the decade of war. During the period of 1810 to 1821, coined silver went back to levels observed during the middle of the eighteenth century; and for the Coinage House of Mexico City, the return was to values similar to those at the start of the eighteenth century. In comparison to levels reached during the middle of the decade of 1800, coined silver in Mexico City dropped 76 per cent during the early years of the 1810s, whereas in the entire colony it dropped by 57 per cent. An additional decline of 25 per cent came after the end of the independence war, in the early 1820s.

From Figure 3.1, it is natural to conclude that stagnation of silver production lasted for several decades. In comparison to pre-war levels, it seems that the recoveries in the 1830s and 1840s were very small. In those decades, silver production was 45 and 55 per cent of the values reached in the first decade of the century. Even in the 1850s, silver production was only 65 per cent of what it had been a half a century before. Recuperation in the 1860s and 1870s put silver production around 75 and 82 per cent of pre-war levels. It was at the start of the Porfiriato, in the early 1880s, when silver output finally achieved colonial levels, and it continued growing to the end of the century.

Conventional wisdom states that since silver production did not reach its pre-war levels, the economy lagged in terms of gross domestic product, and per capita income during the early independent period was lower than in the pre-war period. However, it is also possible that independence had brought a one time permanent reduction in silver production for several reasons, including the end of economic incentives the colonial government had for the mining industry. In this case, same levels of total output in the early independent period as in the late colonial period could be consistent with lower levels of silver production during the early independence period, when compared to the late colonial period.

However, what is most striking in Figure 3.1 is that almost the entire decline in silver production occurred the year after the start of the independence war, in 1811. In general, the growth rate seems roughly the same before and after that year, so that independence did not affect it: Any reduction between 1811 and 1826 is trivial compared

Figure 3.1 Coined Silver in Mexico, 1700-1900.



Source: Orozco (1857) and Peñafiel (1900).

to the decrease in 1811. The use of a moving median<sup>8</sup> suggests that after 1811 and until the end of the war in 1821, there was not any additional decline in silver output: it remained stagnant. Between 1821 and 1825 silver production deteriorated by 25 per cent, but this decrease was only temporary, since silver output recovered its 1820 level at the start of the 1830s. In short, the war had one permanent disruption on silver output, and it all came in one year, 1811.

The observation about 1811 may turn on its head the entire economic historiography of the post-independence period, and demands an explanation. There is the following agreement among economic historians of the period: There was an economic depression during the war and its aftermath in the fifty years after independence. If we track the performance of the economy through Figure 3.1, it is evident that there was a one time permanent change in 1811, and stagnation during the rest of the 1810s that extended to the 1820s. But economic growth resumed its normal course from 1830 on. But also likely is that the year of 1811 saw a mix between a one-time decline in total output and a tremendous structural change in the relationship between silver production and total output.<sup>9</sup> The complete explanation must be part of the research agenda on early nineteenth century in Mexico.

The discussion of the past 25 years on economic trends during the early independence period has been as follows. Coatsworth (1978) offered estimates for total and per capita income in selected years of nineteenth century Mexico, and his estimates of total and per capita output show an economic crisis during the post-independence period. Coatsworth calculates that after a quarter century of independence, in 1845, total income was 96 per cent of its 1800 level, while per capita income was 77 per cent of it. The decline continued at least until 1860, when total income was estimated at 89 per cent of the 1800 level, while per capita income was estimated at 67 per cent of it. The next estimate,

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<sup>8</sup> An example of a moving median is the series:  $y_t^m = \text{median}(y_{t+2}, \dots, y_{t-2})$ .

<sup>9</sup> It may be also true that to establish the existence of an economic depression during the independence period, more data are now required.



for 1877, shows some recovery. The decline of the Mexican economy during its post-independence period is in contrast to the rapid economic growth currently calculated for the eighteenth century.

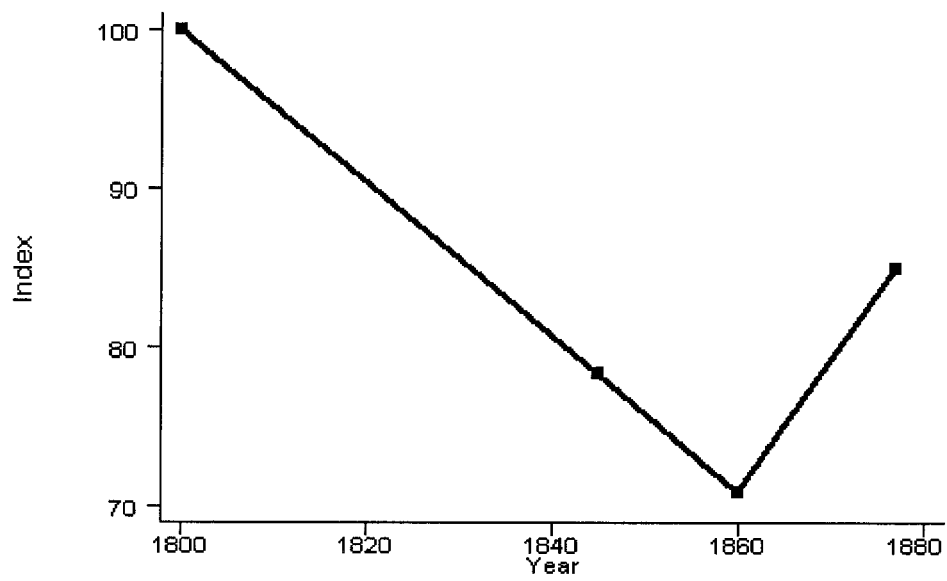
Richard and Linda Salvucci (1993) disputed these estimates of national income. They combined data on per capita subsistence income, per capita consumption in Mexico City, and monthly wages in both rural and urban areas, to construct estimates of national income around 1800 and 1840. They calculated that total national income went from 200 to 260 million pesos from one year to the other. And assuming that population grew from 5.2 to 7 million inhabitants in that period, they estimated an annual compound rate of growth equal to 0.5 per cent in per capita terms. Therefore, the Salvucci's did not find any decline after independence, but they obtained a fairly high rate of economic growth.

John Coatsworth (1989) has presented new estimates, but the revisions left the same picture as before, with just a slightly less deep economic fall after independence. Total income in 1845 declined by 2 and not 4 per cent with respect to 1800; while per capita income declined by 31, not 33 per cent during that period. In 1860, total income was 5, not 10 per cent less than it had been in 1800; while per capita income was 29, not 33 per cent less than at the start of the century. The economic decline remained (See Figure 3.2). Richard Salvucci (1997) also revised his own conjectures. But here the economic progress of early independent Mexico disappeared. His 1800 national income figure was adjusted upwards, at something between 217 and 225 million pesos, instead of the 200 millions put before. The result was that Mexico stagnated, with no growth in per capita terms between 1800 and 1840.

This essay explores the hypothesis that economic stagnation in nineteenth century Mexico was caused by political instability. Section 3.2 presents the theory. It also reviews the empirical results in the economic literature connecting political instability and economic performance. Section 3.3 describes political instability in Mexico, from 1821 to 1867. Its purpose is to establish the following: Political instability might have transformed itself into lack of property rights, constant risks of economic loss, and forms of disorder that disincentive investment and economic growth. It also shows that the political conflicts

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Figure 3.2 Index of Mexican Per Capita Income.



Source: Coatsworth (1989).

of early independent Mexico were exogenous from an economic point of view. They were based on ideological differences among opposing parties.

Section 3.4 presents the data, where economic growth is proxied by the growth of government revenue. Five different series of government income are presented, each for different periods of nineteenth century Mexico. A simple summary of government income shows support for the idea that Mexico stagnated after independence, from 1821 to 1867, and then shows unambiguous evidence of growth in the epoch of political stability known as the Restored Republic and the Porfiriato, starting around 1867. As population grew during the century, per capita GDP may have declined from 1821 to 1867, though not from 1867 on. Section 3.5 presents the main empirical results. It reports estimates of the connection between the rate of economic growth, proxied by the growth of government income, and an index of political instability, using different data sets between 1821 and 1910. The results show that political instability reduced economic growth in Mexico. The estimates are robust to different control variables, to different combinations of the dependent variable, and to different estimation methods.

Section 3.6 shows that political instability severely harmed Mexican economic growth, and is the most important factor in explaining why Mexico lagged behind. Between 50 and 88 per cent of the increase in the growth rate after 1867, during the Belle Époque, can be attributed to the political stability of the period. And most important, when I control for political instability, there is no systematic difference in the rate of growth after 1867. Furthermore, political instability is responsible for about 50 to 100 per cent of the reduction in the rate of growth during the four or five “lost decades” after independence. Section 3.7 concludes.

The results of this paper differ from those of Haber et al. (2003), who studied the period from 1876 to 1929, and found no evidence of economic stagnation during the Mexican Revolution and its aftermath. This may be due to several factors. First, the period under study of this and their work is different. The political instability during the Revolution could be distinct to the political instability of the post-independence period, where it was dominated by foreign invasions. Second, they do not compare their period of

instability, 1910-1929, to the period of stability after 1940. And third, the nature of the statistical analysis in this essay is very different than in their work.

### 3.2 Political Instability and Economic Growth: Theory and Empirical Literature

Theoretical models describing the effects of political instability could be just around the corner. This is because the economic effects of taxation may be suggestive of the impact of lack of protection of property rights, and policy instability can be equivalent to rapid changes and uncertainty in taxes. To illustrate this point I will rely on the work by Mendoza (1997). I adapt his analysis of terms of trade volatility to study uncertainty in taxes. The model builds on previous developments by Phelps (1962) and Levhari and Srinivasan (1969).

The point of departure is the basic neoclassical model of savings and consumption, which also forms part of the economic growth literature. Households inhabit the economy, and they form consumption plans to maximize expected lifetime utility:

$$U(C) = E \left[ \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma} \right] \quad (3.1)$$

with  $\gamma > 0$  and  $0 < \beta < 1$ .  $C_t$  is consumption and  $\beta$  is the subjective discount factor. With this utility function,  $\gamma$  is the coefficient of relative risk aversion and the intertemporal elasticity of substitution is equal to  $1/\gamma$

On the production side, I also follow Mendoza (1997) in assuming a linear technology that, put simply, consists of a perfectly durable asset,  $A_t$ , that yields an exogenous stochastic gross return  $\bar{R}_t$ . As it will be shown in the next section, this assumption helps to capture the risks associated to investment in nineteenth-century Mexico. Furthermore, I also assume that consumption is taxed at the random rate  $\tau_t$ . However, in this study political instability will be only partially captured through

instability in consumption taxes and the return of savings. Political instability in post-independence Mexico also meant expropriation of assets, and therefore, it will be natural to consider the case in which wealth is randomly taxed, say at the rate  $\theta_t$ . This captures the more general situation in which property rights are not well protected, and there is the risk of expropriation of wealth as well as other forms of property loss like violent seizures of property by armed groups.<sup>10</sup> The period by period resource constraint is:

$$A_{t+1}(1 + \theta_{t+1}) \leq \bar{R}_t \cdot (A_t - (1 + \tau_t) \cdot C_t) \quad (3.2)$$

Households maximize utility (3.1) subject to the resource constraint (3.2). In what follows, I will assume that the random variable  $(1 + \theta_{t+1})$ , which involves the tax on wealth, distributes independently of  $C_{t+1}^{-\gamma} / (1 + \tau_{t+1})$ , which involves the marginal utility of consumption in period t+1. Furthermore,  $\theta_t$ ,  $\tau_t$ , and  $\bar{R}_t$  are such that the effective rate of return of savings defined by:

$$r_t = \frac{(1 + \tau_t) \cdot \bar{R}_t}{(1 + \tau_{t+1}) \cdot (1 + \theta_{t+1})}$$

follows an i.i.d. log-normal distribution. These assumptions help to simplify the analysis.

The optimal intertemporal decision involves two sets of equations. These are the budget constraint (3.2), and Euler's equation (3.3):

$$C_t^{-\gamma} = \beta \cdot E \left[ C_{t+1}^{-\gamma} \frac{(1 + \tau_t) \cdot \bar{R}_t}{(1 + \tau_{t+1}) \cdot (1 + \theta_{t+1})} \right] \quad (3.3)$$

The solutions in this model have the same structure than those in Mendoza (1997):

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<sup>10</sup> Examples of violent seizures of property and other forms of disorder are presented in section 3.3.

$$C_t^* = \lambda \cdot \left( \frac{A_t}{1 + \tau_t} \right) \quad (3.4)$$

$$A_{t+1}^* = \left( \frac{(1 - \lambda) \bar{R}_t}{1 + \theta_{t+1}} \right) \cdot A_t^* \quad (3.5)$$

In these equations,  $\lambda$  represents the marginal propensity to consume with respect to wealth, and is given by:

$$\lambda = \left[ 1 - \beta^{1/\gamma} [E(r_t^{1-\gamma})]^{1/\gamma} \right]$$

I assume that the effective rate of return is such that  $\beta \cdot E(r_t^{1-\gamma}) < 1$ . Furthermore,  $\lambda$  can be expressed as a function of the mean and the mean-preserving variance of  $r_t$ , according to the following equation:

$$\lambda = 1 - \left( \beta \cdot E(r_t)^{1-\gamma} \cdot e^{-\frac{(1-\gamma) \text{Var}(r_t)}{2}} \right) \quad (3.6)$$

Finally, I must note that equations (3.4) and (3.5) imply that:

$$\frac{C_{t+1}}{C_t} = (1 - \lambda) \cdot r_t \quad (3.7)$$

Equation (3.7) shows that the rate of growth of consumption (and thus of the economy) are affected by the actual realization of  $r_t$ , and by its statistical properties: its mean and variance. In particular, when the coefficient of relative risk aversion is lower than one, increased political instability will reduce the rate of economic growth. That is, when  $\gamma < 1$ , a higher variance of the effective rate of return, say stimulated by increased volatility in the expropriation rates of consumption and wealth, will decrease the growth rate in this economy.<sup>11</sup>

The last decade has seen an increase in the empirical literature that explores the effects of political instability on economic growth. The empirical literature can be divided in two groups: Those that exploit country cross sections, (Campos and Nugent 2002; Ali 2001; Fosu 2001; and Alesina et al 1996), and those that study country time series experience (Asteriou and Price 2001; Asteriou and Siriopoulos 2000; and Gounder 1999).<sup>12</sup> The seminal paper is Alesina et al (1996) who investigate the relationship between political instability and per capita GDP growth, using a sample of 113 countries for the period 1950 through 1982. They define political instability as the propensity of a change in the executive power, either by constitutional or unconstitutional means, and construct three measures of government change. First, they code a variable as 1 for any regular or irregular transfer of executive power, and they code it as 0 otherwise. The second variable eliminates from the first one those changes that do not involve substantial turnover of leadership. And the third variable includes only irregular transfers of power, such as military coups.

Alesina et al estimate a two-equations system where annual observations of government change and economic growth are simultaneously determined. Economic

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<sup>11</sup> Evidence from twentieth century data poses an anomaly for the consistency of equation (3.7) and the empirical results of this paper that show a negative relationship between growth and instability. This is because consumption studies by Mankiw (1981), Hansen and Singleton (1983), Hall (1988), and Campbell and Mankiw (1989,1991) estimate  $\gamma$  to be larger than one.

<sup>12</sup> There is a related field of literature that explores the effects of terms of trade instability on economic growth (Mendoza, 1997), the role of adverse trade shocks in prolonged recessions (Kose and Riezman, 2001), and the negative effects of volatility on economic performance (Ramey and Ramey, 1995).

growth affects government change, and government changes affect growth. When these authors study the broad definition of government changes, they find that political instability is harmful to economic growth, but that growth does not affect the propensity of a change in government. The results also apply to major government changes: Those that involve regular or irregular but significant turnovers of leadership. For the case of coups, political instability reduces growth again, but now low growth increases the propensity of a government change, especially among Latin American countries.

Fosu (2001) studies the relationship between political instability and economic growth using data on different events of coups d'état in 31 post-independent sub-Saharan African countries during the 1960-1986 period. Political instability is measured not only by successful coups, but as well by abortive coups and officially reported coup plots. However, the best measure of political instability comes from the first component in the method of principal components that collects information from all three variables. Fosu estimates an augmented production function in which political instability has a direct effect on productivity and on the marginal productivity of capital and labor. The results show that political instability has a detrimental effect on economic growth through its effect on the marginal productivity of capital.

Ali (2001) empirically investigates the effect of political stability and the stability of economic policies on economic growth, using a panel of developing countries between 1970 and 1995. He considers a wide array of political instability measures: antigovernment demonstrations, political assassinations, cabinet changes, genocidal incidents, constitutional changes, coups, revolutions, riots, civil wars, government crises, border wars, and purges. He also aggregates these variables into a single index using the method of principal components. To measure the instability of economic policies, eleven fiscal, monetary and trade variables are employed. The unexplained components of autoregressive processes for these variables are identified with policy uncertainty.

The author finds that none of the measures of political instability has an effect on cross-country differences of economic growth or capital formation. This result comes when the political instability variables are incorporated into a typical growth equation that accounts for initial GDP per capita, the rate of population growth, and the rate of human



and physical capital accumulation. However, when he turns to the instability of economic policy, Ali finds that almost all of the policy instability variables are negatively related to GDP growth. The author interprets these findings as evidence of political instability affecting economic growth through economic policy instability.

Different results are obtained by Campos and Nugent (2002), who empirically test for a causal and negative relationship between political instability and economic growth using a panel of 98 developing countries during the 1960-1995 period. They use Granger causality tests and report Anderson-Hsiao-Arellano instrumental variable estimates. Two measures of political instability are used, and each of these is constructed through the principal components method as a linear combination of other variables. The “severe” political instability index uses information on the number of political assassinations, revolutions and *coups d’Etat*. For the “moderate” political instability index they use data on political participation, executive recruitment and independence of the chief executive.

When conducting Granger causality tests, these authors find no evidence of a causal relationship from political instability to economic growth. Neither severe nor moderate political instability seems to Granger cause economic growth. And when they break down the results by region, they find a negative relationship between the moderate political instability index and economic growth that is significant at the 0.10 level, not at the 0.05 level, for Sub-Saharan Africa. With respect to the relationship flowing from economic growth to political instability, the results fail to reveal any indication of causality.

Using time series experience, Gounder (1999) examines the impact of military coups on Fiji’s recent economic growth. He uses time series data for the period 1968 to 1996, and applies a neoclassical production function to estimate the effect of political instability on growth. In particular, Gounder compares the 1968 to 1986 period of political stability with the 1987 to 1996 period of political instability. The year of 1987 marks the end of 17 years of political stability after independence in 1970. On May 14, 1987, members of the Royal Fiji Military Force ousted the democratically elected government. It started a period where political freedom was restricted. The results of the paper show that military coups had a detrimental effect on Fiji’s economic growth.

Asteriou and Siriopoulos (2000) examined empirically the relationship between stock market development, economic growth, and political instability in Greece between 1960 and 1995. Political instability is measured by the following five variables: the number of politically motivated assassinations, the number of terrorist activities that caused mass violence, the number of politically motivated strikes, the number of elections, and a variable indicating whether a democracy, a “semi-democracy”, or a dictatorship was present. The last variable divides the 1960 to 1995 period in Greece into the 1960-66 period of Royal Democracy, the 1967-73 period of dictatorship, and the 1974-95 period of democratic elections. In addition, these authors construct an index of sociopolitical instability through a linear combination of the five original instability variables, the first component in the method of principal components.

From the start, the index of political instability and the five original variables are negatively related to the rate of Greek economic growth. It is interesting to note that dictatorship, and not democracy, is associated with political stability.<sup>13</sup> Political assassinations, terrorism, strikes, and elections are all negatively correlated with the rate of economic growth. In the multivariate regression analysis, only the index of political instability is considered, and it turns out that a high index of sociopolitical instability is associated to lower levels of economic growth and stock market development.

Asteriou and Price (2001) have tested for the influence of political instability on UK economic growth between 1961 and 1997. They estimate GARCH and GARCH-M models that reveal negative effects of instability on growth. Political instability is measured by the following six variables: the number of terrorist incidents, the number of strikes, a dummy for elections, changes from one party to another, and two dummy variables, one for the Falkland’s War in 1982, and another for the Gulf War in 1994. In addition to the use of these proxies, they also employ the principal components method to express these variables as a linear combination of a possibly smaller set of variables that are linearly independent.

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<sup>13</sup> The index constructed for Mexico also shows more stability during the dictatorship of Porfirio Diaz than in any other part of the century.

Using Granger causality tests these authors find that political instability mainly affects economic growth, and not vice versa. Strikes, terror and changes in regime affected growth, while growth only caused changes in regime. Their estimated GARCH model resulted in negative and significant effects of those same three variables on UK economic growth between 1961 and 1997. That is, strikes, terror and changes in regime reduced the rate of economic growth. Finally, using GARCH-M models, they find that political instability increases the variance of per capita GDP growth; however, this variance did not affect the rate of economic growth.

In summary, the economic literature has found strong evidence of a negative relationship between political instability and economic growth. And the causation tends to be from instability to growth.

### **3.3 Stability and Instability in Nineteenth-Century Mexico**

#### **3.3.1 Political Instability in Post-Independent Mexico<sup>14</sup>**

This subsection describes political instability in early independent Mexico. It shows that political instability implied economic policy uncertainty, no public programs for development, and most important, violence, lack of property rights, and other forms of disorder that led to risk of loss for economic actors in Mexico, and that might have discouraged investment. I also argue that the origin of these disputes was exogenous from an economic standpoint. Political differences were based on ideological disagreement among political and economic agents.

In post-independence Mexico politicians gained and lost power with perplexing dispatch. Administrations were brief and many economic policies involving taxes changed drastically from one year to another, or were quickly reversed.<sup>15</sup> And many economic

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<sup>14</sup> My discussion of political instability in Mexico draws heavily from Stevens (1991), and that of rural rebellions from Coatsworth (1988).

<sup>15</sup> This evidence is difficult to survey in a Table, but it is evident through the several thousands of pages of laws and decrees compiled by Dublan and Lozano (1876-1912).

policies involving public programs were not enforced. The significant decisions were to replace cabinet ministers or overthrow a government. But most important, urban riots, demonstrations, assaults, and rural rebellions usually accompanied cabinet resignations and changes of presidents. According to Stevens (1991), historians are still reluctant to characterize post-independence Mexico as a period of revolution, but they consider it as one of rapid violent political rotations.

After independence, violent struggles to control the government lasted for half a century. Political instability coincided with financial difficulties for the Treasury, and with masses armed by radical leaders to attack armories and government offices. Weakened by the internal political turmoil, Mexico saw the loss of Texas in 1836, the Pastry War with France in 1838, and very dramatically, the loss of half its territory to the United States in the War of 1846-1848. In the end, political instability transformed into civil war by end of the 1850s, known as the War of the Reform. By that time, two clearly defined armies opposed each other. The middle stratum of the population supported the liberals, living in the periphery of Mexico. The conservatives were supported by privileged classes living in the capital. And it was until the triumph of the liberal army over conservatives and the French occupation (1862-1867) that Mexico saw the start of political stability.

The disputes in the post-independence period involved economic policies. In modern terms, there were no political parties in early independent Mexico, but politics was fragmented into conservative, moderate, and radical factions. Conservatives thought the state should regulate the economy and social life, supporting a strong military, a large central bureaucracy, and the monopoly of the Catholic Church. They would respect traditions and social hierarchy, and opposed social mobility. The Church should control education and marriage. Conservatives feared that liberal notions including democracy and federalism could lead to anarchy. They relied on the national army and tried to abolish provincial and civic militias.

On the other hand, moderates, radicals, and liberals supported freedom. They held positions of tolerance for other religions, liberty of press, liberty of association, and most

importantly, juridical equality among citizens.<sup>16</sup> But in other aspects, liberals were divided. Moderates would favor a constitutional monarchy, radicals a republic. Moderates wanted less taxes, radicals more. Moderates were more tolerant of foreign capital than radicals. Both would agree on reducing the economic and political power of the Church, but only radicals attempted to mortgage and sell Church property, while moderates, in the name of property rights, supported rebellions opposing it.<sup>17</sup> Radicals, more than moderates, depended on civic and provincial militias.

The three political factions differed on the issue of eligibility to participate in elections. Conservatives and moderates restricted suffrage, while radicals favored a franchise regardless of literacy and owned property. However, conservatives preferred a more restricted electorate than moderates.<sup>18</sup> Also, Mexican political factions disagreed on agrarian and social reform in rural areas. Under Spanish rule, the Crown had distributed rural land between basically two competing uses: Haciendas or private property for the Hispanic population, and communal land kept for Indian villages. Indigenous people were under a special juridical status of tutelage and protection by the Crown, so their lands could not be taken for payments nor alienated.

During colonial times, this policy had helped to restrict the power of Spanish or Hispanic landowners. After independence, the liberals opposed the restrictions imposed on indigenous lands, and the juridical status of Indians. Both factions of liberals, moderates and radicals, were in favor of legal equality and individual liberty, abolishing community ownership. Only radicals proposed an expropriation and free distribution of land to replace the large haciendas, and these measures were implemented, it was not only Church property that was under attack. Conservatives naturally opposed all of these reforms, recalling the peaceful environment during the colonial period.

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<sup>16</sup> On the role of inequity on economic growth in Latin America, see Engerman and Sokoloff (2002) and Sokoloff and Engerman (2000).

<sup>17</sup> The Church was the wealthiest organization in colonial and post-independent Mexico, and a very important source of credit in the economy.

<sup>18</sup> On the role of suffrage on the economic development of the New World, see Engerman and Sokoloff (2001).

Traditionally, conservatives have been identified with the upper classes that prospered under colonialism: the highest ranks in the Church and the military, along with wealthy landowners and merchants. Liberals, on the other hand, represented lower ranks of those groups, along with professionals and small merchants. Stevens (1991) has gathered information on Mexican politicians that occupied the presidency or were cabinet ministers between 1824 and 1867. 50 men out of 229 took up arms during the independence war. Among those who were radicals, 70 per cent had been insurgents, and 30 per cent royalists. Among the moderates, 44 per cent were insurgents and 56 per cent royalists. In contrast, among conservatives, only 16 per cent fought for independence, while 84 per cent defended the Crown.

These data reveal something of the political conflict in post-independence Mexico. And according to Stevens (1991), there were also differences in terms of the first major political post occupied by the 229 men. 75 per cent of the radicals and 74 per cent of the moderates started their political careers in a state governor's office or in the national legislature, while 50 per cent of conservatives did so. The other 50 per cent of conservatives started in a national executive office, while only 25 per cent of the radicals and 26 per cent of moderates did it. Finally, with regard to initial military experience, radicals tended to start in irregular state or civic militias, moderates in these and the national army, while conservatives almost exclusively in the latter.<sup>19</sup> All this information is summarized in Table 3.3.

Between 1824 and 1867, the average period of presidents was 15 months, 7 months for both ministers of war and justice, and less than 5 months for ministers of finance and of foreign relations. Continuity of economic policy for development was impossible. Public investment in roads, education, and social order, was missing.<sup>20</sup> The direct economic impact of political instability in independent Mexico through lack of long-term projects for

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<sup>19</sup> Stevens (1991).

<sup>20</sup> See Dublan and Lozano (1876-1912).

**Table 3.3**  
**Political Factions by Independence Era Group, First Major Political Post, and Initial Military Experience (1821-1867)**

	Radicals (%)	Moderates (%)	Conservatives (%)
<b>Independence Era Factions:</b>			
<b>Insurgents</b>	70	44	16
<b>Royalists</b>	30	56	84
<b>First Major Political Post:</b>			
<b>State Governor / National Legislator</b>	75	74	51
<b>National Executive Office</b>	25	26	49
<b>Initial Military Experience</b>			
<b>State / Civic Militia</b>	100	40	10
<b>National Army</b>	0	60	90

Source: Stevens (1991).

development is evident in the case of the Bank of Provision,<sup>21</sup> a public firm created to finance private entrepreneurial projects. It lasted just a few years in the late 1820s and early 1830s; and furthermore, most of its resources were spent as government consumption.

The period of political instability coincided with strong financial difficulties for the Mexican government. The collection of laws and decrees gathered by Dublan and Lozano (1876-1912) shows that this problem in public finances was reflected in the constant change of taxes on international trade, taxes on domestic commerce, and very importantly, unexpected taxes on property.<sup>22</sup> Sometimes this involved expropriation and sale of private property that might have constituted a violation of property rights.<sup>23</sup> Some economic policies, however, were never enforced, or were reversed, after coups and revolts that ousted that particular government.<sup>24</sup> In addition to difficulties for the Treasury, political instability also saw masses armed by radical leaders to attack armories and government offices.

Rural revolts accompanied political instability. According to Coatsworth (1988), rural revolts like land invasions involved the burning of estate buildings, theft of livestock and other property, and sometimes the assassination of estate employees, foreman, and owners. Invasions of hacienda lands were associated with village rebellions, especially after independence. Village riots, on the other hand, were often provoked by arbitrary acts of public officials. Sometimes, these were economic provocations like new taxes, monopolies and forced sales, though more documented acts are imposition of new village

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<sup>21</sup> "Banco de Avío".

<sup>22</sup> Many of these measure also coincided with coups d'etat and rebellions.

<sup>23</sup> Examples are the continuous expropriation of Church wealth through out the century, unexpected reductions of salaries to government officials, unexpected taxes on buildings including residential houses, etc.

<sup>24</sup> For instance, on May 22, 1829, Finance Minister Lorenzo Zavala levied new taxes of 5% on yearly incomes exceeding 1,000 pesos and 10% on incomes exceeding 10,000 pesos. The wealthy took action supporting a successful coup on December 4, led by General Anastasio Bustamante (Tenenbaum, 1986, pp. 34-35).



officials, quarantines, boundary changes, etc. Caste wars predominated in the northern and southern peripheries of Mexico, where indigenous uprisings were directed at the expulsion of non-indigenous authority. Political authority in the post-independence period was closely associated with the regional elite of hacendados.

Coatsworth (1988) emphasizes that the most prolonged rural revolts in independent Mexico involved alliances between different ethnic and social groups. They did not include hacienda peons, but comprised tenants, sharecroppers, migrant laborers, small farmers, and Indian villagers. Indian districts sometimes allied with “popular” caudillos. Social banditry, though impossible to measure, was naturally connected to rural rebellions. Coatsworth (1988) gathered information on the frequency of small-scale village riots and uprisings in Latin America during the 1820-1900 period. Excluded are most uprisings that included participants from more than five villages or lasted more than one month. He finds that Mexico led all other regions in the number of incidents, with 102. In Peru and Bolivia together the total was 61.

In contrast to other regions, the decline of revolts following the independence war lasted for less than three decades. From the 1840s to the 1870s, Mexico experienced resurgence not only in small village revolts, but also in large-scale caste wars and regional rebellions. This suggests that Mexico’s experience in the mid 19<sup>th</sup> century resulted from circumstances it did not share with other regions. Large-scale non-slave wars in Latin America include village-based revolts, as well as multi-class, regional insurrections and peasant uprisings. Some were with the purpose of expelling European or white rulers, and others sought to protest an abuse of authority. In the 1820-1900 period, Mexico had 18 large-scale wars. In contrast, Peru had 4 and Bolivia 3.<sup>25</sup> And when compared to the previous colonial period, from 1700 to 1820, Mexico had only 5 large-scale revolts. The contrast between Mexico and Latin America and between Colonial and Independent Mexico stands out clearly. Mexico saw a lot of violence between 1820 and 1870.<sup>26</sup>

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<sup>25</sup> Brazil stands with 8 wars in that period.

<sup>26</sup> This data comes from Coatsworth (1988).

Ten of the eighteen wars occurred in the decades of the 1840s and 1850s. In contrast, the last two decades of the nineteenth century were relatively peaceful. No new large-scale rebellions occurred after 1883. This is consistent with the accepted view that the regime of Porfirio Díaz (1876-1880 and 1884-1911) was successful in maintaining rural peace until the turn of the century.<sup>27</sup> No evidence of plantation uprisings is recorded for nineteenth century Mexico, though four of these conflicts are known for the eighteenth century. Of the 102 small-scale village uprisings, there is information on the precipitating causes of 54. In 8 of them, there were complaints about taxes. But in 40 out of 52 cases, private property rights violations were involved. There were protests against usurpation, violent land seizures, etc. This was another consequence of political instability in Mexico that might have discouraged investment.

Rural revolts in Mexico included attacks on the haciendas as well as on the civil authority. While weakness of political authority combined with diverted military resources for civil war and international conflicts facilitated rural rebellions. The government was unable to exert fiscal pressure on rural communities and to repress insurrections. Village rebellions in nineteenth century Mexico merged with regional movements, as they involved alliances with mestizo townspeople, the Church, local caudillos, etc. From village uprisings against abuses of authority in the colonial period, they shifted to assaults on property rights of the economic elite in the post-independent period. And these revolts diminished only during the Porfiriato, at the end of the century. Large-scale rebellions exploited the fragmentation of political power in the new nation.

Rural revolts in Mexico also prevented the consolidation of conservative regimes after independence. Conservatives attempted to impose centralist regimes, restoring colonial elements in the fiscal and regulatory spheres. This paternalistic rule faced revolts. However, liberal regimes in Mexico also failed to impose stability, though rural rebellions favored the liberal cause against the French invasion (1862-67). In summary, political

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<sup>27</sup> There was an increase in small-scale rebellions during the 1890s, but they did not reach the magnitude of the 1850s.

instability in Mexico caused all kinds of violence and instability in the economic sphere, including a lot of uncertainty in taxes, property rights, and risks of loss.

### **3.3.2 Political Stability in the Late Nineteenth Century<sup>28</sup>**

The history of modern Mexico starts with the Restored Republic (1867-76), with the triumph of the liberal army over the French occupation and its conservative support, in 1867. Democracy and modernization were two milestones in the victorious President Juarez administration. According to Meyer and Sherman (1995), the Restored Republic shows signs of an era of political stability and economic progress. Though differences existed among political actors, war became less the means to solve disputes. This is the transition to a period of complete political calm: the Porfiriato in the last quarter of the nineteenth century.

Juarez's administration reduced the size of the Mexican army from 60 to 20 thousand men. His economic plan included improvement of transportation facilities, exploitation of natural resources through foreign investment, and tax and tariff incentives to increase mineral production. Minor rebellions and private armies were reduced in this period, and completely disappeared with the arrival of the Porfiriato.

The Restored Republic also brought some peace to the countryside through an increased rural police force of "rurales". They patrolled roads, assisted the army, and guarded special shipments. The Mexico City-Veracruz railroad was completed in 1872, modernly linking the Mexican capital to its most important port. The educational system was reformed in 1867, placing emphasis on arithmetic, physics, chemistry, and practical mechanics in primary schools, and on mathematics and natural sciences in secondary schools. This left the arts and humanities subordinated to those areas. But most important, primary school was made free and obligatory, and all towns with a population of more than five hundred were going to have a school.

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<sup>28</sup> My discussion of the Restored Republic and the Porfiriato in this section relies heavily on Meyer and Sherman (1995).

The death of Juarez in 1872 led to new elections won by Sebastian Lerdo. He let railroad contracts for the construction of a new line from Mexico City to the United States. And there were also contracts for the construction of telegraph lines. He added more than 1,600 miles of telegraph. School construction sharply increased. In 1870 there were less than 5 thousand schools in Mexico, but by 1874, there were almost 9 thousand.<sup>29</sup> In 1876, Lerdo sought reelection, but General Porfirio Diaz, who had already opposed Juarez's reelection in 1871, also did in 1876, but this time he was successful in overthrowing the government. Porfirio Diaz would control the government from 1876 to the Mexican Revolution, in 1910.

According to Meyer and Sherman (1995, p. 414), it was in the Restored Republic (1867-76) that "for the first time in Mexican history the administrations in power seemed more to pull the country together than to drive it apart". The governments of Juarez and Lerdo laid the foundations for modernization in Mexico, and "Porfirio Diaz would construct the edifice". In the 46 years from 1821 to 1867, Mexico had 56 administrations, making continuity of policy very difficult. During the 9 years of Restored Republic (1867-1876), Mexico had 3 presidents; and during the 35 years of Porfiriato, the presidency changed hands only 4 times.

During his first term of presidency (1876-1880), Porfirio Díaz faced some agrarian rebellions and other types of insurrections. However, violence would promptly decline during the Porfiriato, and order became the landmark of this period. In his first term, Porfirio Diaz cut public spending by reducing salaries, increased revenues by strengthening punishment of smuggling in Mexican ports, and opened ports of commerce with the United States. During the presidency of Manuel Gonzalez (1880-1884), railroad construction continued and steamship lines were fostered. Rumors started that Porfirio Díaz would run for the presidency again in 1884. And both liberals and conservatives gathered together around him. He would not step out of the presidential office again until 1911.

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<sup>29</sup> See Cosío (1957).

During the Porfiriato, steam and electric power replaced human and animal force. Hydraulic and hydroelectric stations were built, along with the telephone, wireless telegraph and submarine cables. Flooding problems in the capital that used to damage property were solved. Several public renovations were carried on. And most importantly, the Porfiriato was able to attract foreign investment and technology into the transportation sector. A boom in railroads occurred during this period. In 1876 there were 400 miles of track, but in 1911 there were 15,000. Most of the state capitals were connected to the trunks running from Mexico City to the United States. A boom that might have sparked commerce in Mexico.

Foreign investment also promoted silver mining, oil, steel, drink, cement, textile, cigarette, brick, and many other industries and factories. Facilities in Mexican ports were improved. Mexico's foreign trade went from 50 million pesos in 1876 to 488 million pesos in 1910. Economic progress occurred without civil wars, and without liberal-conservative disputes. Order and progress were synonymous of the Porfiriato.

I can compare the economic situation of the 1870s to that of the 1820s using data on international trade. It could be possible that trade policy was very similar at the start of both decades, so that the share of imports or exports in GDP could have been the same in both decades too. Table 3.4 presents estimates of international trade in Mexico according to Herrera Canales (1980). Average imports in the 1820s were 14,845,608 pesos per year. In the 1870s, average imports were 28,882,504 pesos per year. This is a growth of 94.5 per cent in 50 years.

Population should have grown 64.5 per cent in that 50 years period, given an annual population growth rate of 1 per cent. This gives a per capita growth rate of imports equal to 0.3 per cent per year. And this will be equal to the rate of growth in GDP per capita if the share of imports in GDP was the same in the 1870s than in the 1820s. And if not, then the estimated growth rate must be adjusted down, since international trade could have only grown, not declined, at the start of the Mexican Belle Époque. In any case, the growth rate I estimate through imports is lower than the estimated GDP per capita growth rate of the eighteenth century, at 0.5 per cent per year.

**Table 3.4**  
**International Trade in Nineteenth-Century Mexico**  
**(1820s and 1870s)**

<b>Year</b>	<b>Imports</b>	<b>Exports</b>
<b>1820s:</b>		
1825	19 093 716	5 082 240
1826	15 452 001	7 648 137
1827	14 889 016	12 171 780
1828	9 947 700	14 488 793
<b>1870s:</b>		
1871	24 775 933	13 602 867
1872	29 552 433	31 594 005
1873	34 005 299	27 688 703
1874	27 300 856	27 318 788
1877	28 778 000	28 777 508

Source: Herrera Canales (1980).

Table 3.4 also presents data on exports. Average exports in the 1820s were 9,847,737 pesos per year. In the 1870s, average exports were 25,796,374 pesos per year. This corresponds to an increase of 161.9 per cent, or 59.2 per cent in per capita terms. Again, I assume that population grew at the rate of 1 per cent per annum between the 1820s and the 1870s. This gives an increase of 0.9 per cent per year in per capita exports. This rate is obviously higher, and should be adjusted down in case the share of exports in GDP did not remain constant, but increased, between the 1820s and the 1870s. The evidence on exports is less conclusive with regard to the attempted comparison of economic situations in both decades.

### **3.4 The Data**

This section describes the main data used in this study. I will start with a description of the several measures of Fiscal Revenues that I will use to proxy GDP growth. Then I will turn to the construction of an index of political instability that may reflect threats to the security of property rights and high risks of loss for economic actors. These measures tend to reduce the incentives of investment in the economy. To track the performance of the Mexican economy, I use several measures of government revenue summarized in Table 3.5 that I will now describe.

Figure 3.3 presents Tax Collections of the Federal Government from 1825 to 1856. These data were constructed from Tenenbaum (1986), and are missing for some years in the late 1840s and the early 1850s. Two big declines are evident in Figure 3.3, and both occurred immediately after foreign invasions. The first one coincides with the Pastry War with France in 1838. The second decline comes after the war with the United States in 1846-1848 and the return of federalism in 1846. The difference between centralism and federalism is important because centralism involved a higher appropriation of state income by the Federal Government, while under federalism the states retained higher shares of their revenues. Federalism lasted from 1824 to 1834, when it was replaced by centralism from 1834 to 1846, and it finally returned from 1846 to 1855.

**Table 3.5**  
**Summary Statistics**

Variable	Mean	Std. Dev.	Max	Min	N	Period
$\Delta \ln T_1$	-.007	.219	.406	-.678	24	1826-1856
$\Delta \ln T_2$	.006	.283	.685	-.671	26	1826-1856
$\Delta \ln T_3$	.040	.213	.629	-.673	47	1825-1879
$\Delta \ln T_4$	.056	.064	.159	-.083	34	1877-1910
$\Delta \ln T_5$	.054	.093	.213	-.220	34	1877-1910
$G_1$	.030	.151	.406	-.678	58	1826-1910
$G_2$	.028	.159	.406	-.678	58	1826-1910
$G_3$	.045	.175	.629	-.673	78	1825-1910
$I$	0.000	1.25	3.44	-1.24	79	1821-1899
$I_p$	0.000	1.25	3.34	-.764	91	1821-1910
Changes	.725	1.16	6	0	91	1821-1910
Regional	1.68	.941	4	0	79	1821-1899
Governments	1.10	.314	2	1	91	1821-1910
War	.175	.382	1	0	91	1821-1910
$\Delta \ln P_b$	-.006	.226	.664	-.614	65	1825-1889
$\Delta \ln S$	-.014	.161	.340	-.792	90	1821-1910
$\Delta \ln P_s$	-.009	.047	.105	-.214	90	1821-1910
$\Delta \ln e$	.008	.043	.206	-.178	90	1822-1911

Note:  $T_1$  and  $T_2$  represent Tax Collections of the Federal Government and Total Income of the Federal Government (without Loans) by Tenenbaum (1986).  $T_3$  represents Ordinary Income of the Federal Government by Carmagnani (1982).  $T_4$  and  $T_5$  represent Tax Income and Ordinary Income of the Federal Government, according to Rosenzweig et al. (n.d.).  $I$  is the index of political instability using all 4 measures of instability: Changes of executive (Changes), Regional, caste, and peasant wars (Regional), Number of parallel governments (Governments), and Foreign wars (War).  $I_p$  is the index that uses those measurements except Regional.  $G_1$  is the combination of rates of growth in  $T_1$  and  $T_4$ ,  $G_2$  is the combination in  $T_2$  and  $T_5$ , and  $G_3$  in  $T_3$  and  $T_5$ .  $P_b$  refers to the price of Mexican bonds in the British market,  $S$  is the quantity of silver measured by coinage,  $P_s$  is the price of silver in terms of gold in the U.K, and  $e$  is the dollar exchange rate.



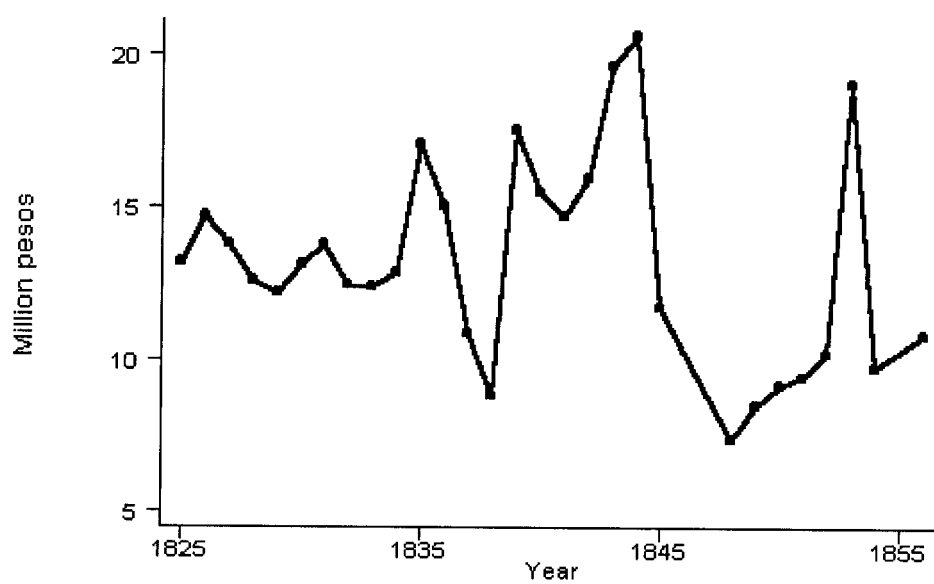
If we abstract from the effects of wars, Figure 3.3 shows two big changes in the level of tax collections. They occurred as the government went to centralism in 1834 and then to federalism after 1846. Centralism increased tax collections. Then the arrival of the second federalism reduced tax revenues so much that they were lower than during the first federalism. However, this is expected since some taxes of the first federalism were abolished during the second. If we were to ignore these two shifts in tax collections, from visual inspection of Figure 3.3 it seems probable that a slight upward trend in tax revenues appeared after the arrival of centralism in 1834, and maybe during the second federalism. However, the unambiguous overall picture depicted in Figure 3.3 is one of a lack of growth during the entire 1825-1856 period.

The picture of the economy suggested by total income of the federal government is a little bit different. Figure 3.4 displays Total Income of the Federal Government, according to Tenenbaum (1986), from 1825 to 1856. There are two lines in that figure. The highest curve is total income including loans, and it is less reliable for tracking the behavior of the economy. The lower curve excludes both domestic and foreign loans, and is more credible for my purpose of establishing economic trends in nineteenth century Mexico.

Figure 3.4 shows an upward trend in total revenues, including loans, since the first federalism (1824-1834) and it continues during most of the centralist period (1834-1846). However, the reader will notice that the one-time increase in tax collections seen in the 1830s in our previous Figure 3.3, occurring with the change from federalism to centralism, is less evident from pure visual inspection in Figure 3.4. Though it is manifest in Total Income excluding loans. In fact, this income is consistent with the idea of a stagnant economy during both the federalist and centralist periods (1824-1846).

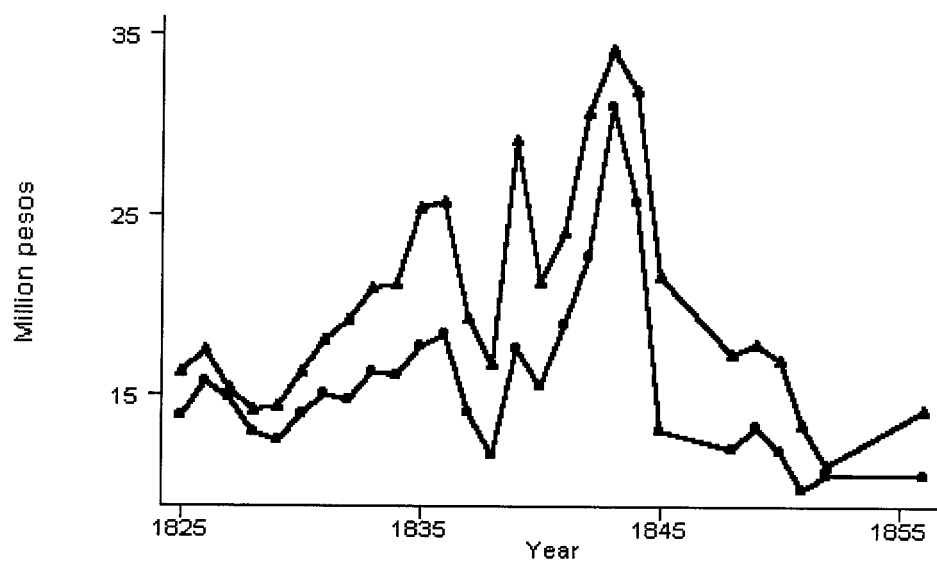
It is important to note that the upward trend in total revenues including loans, in Figure 3.4, comes to an end after the war with the United States (1846-48) and the arrival of the second federalism (1846-1853). And more, during this period there is a dramatic downward trend in total government income. By the end of the term, in the early 1850s, total revenues reach lower levels than those of the first federalism. A one-time decline and

Figure 3.3 Tax Collections of the Federal Government, 1825-1856.



Source: Tenenbaum (1986).

Figure 3.4 Total Income of the Federal Government, 1825-1856.



Source: Tenenbaum (1986).

the appearance of a downward trend in the level of total income could have taken place during the second federalism. For Total Income excluding loans, the decline is also evident, though less pronounced.

In terms of general trends, Tax Revenues in Figure 3.3 and Total Income excluding Loans in Figure 3.4 are not contradictory from the first to the end of the second federalism (1824-1856). Both figures present increases with the arrival of centralism, and decreases in the aftermath of the war with the United States and with the arrival of the second federalism. The “Pastry War with France had only temporary effects on these measures of government revenue. I must conclude that the data on Government Income –Tax Collections and Total Income excluding Loans- presented by Tenenbaum (1986) clearly suggest economic stagnation from 1825 to 1856

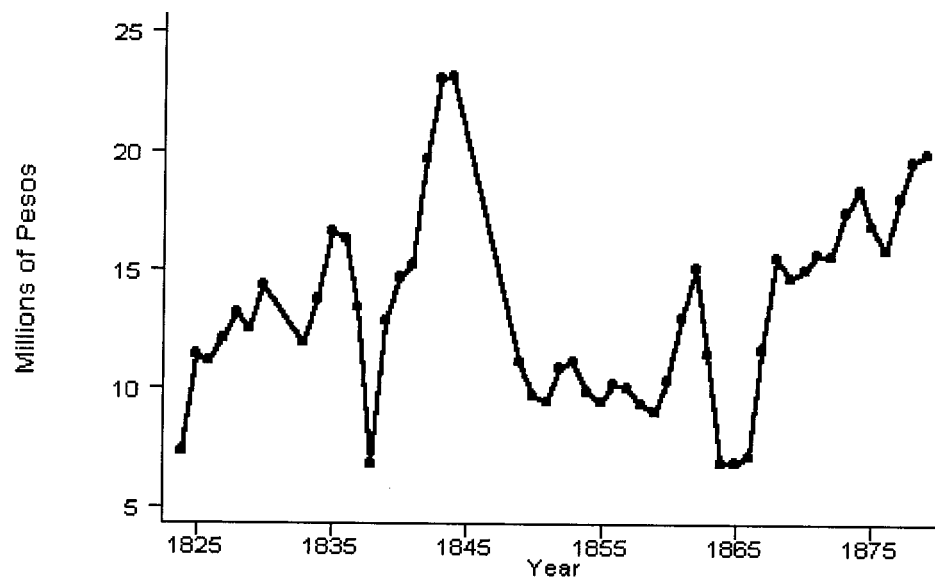
Figure 3.5 presents another measure, Ordinary Income of the Federal Government according to Carmagnani (1982). This series covers a longer period than that of Tenenbaum, going from 1824 to 1879. Like total revenue of Tenenbaum, ordinary income shows an upward trend during the first federalism (1824-1834) and during the centralist period (1834-1846). Again, there is a temporary decline with the Pastry War of 1838, though the sharpest decline in government income occurred only after the war with the United States (1846-1848). Government revenue stagnated from here, in the late 1840s, to the end of the War of the Reform (1857-1861).<sup>30</sup>

After this War, at the start of the 1860s, ordinary income of the Federal Government showed some signs of recovery, but this was soon interrupted with the French occupation of the country in 1863 (1863-1867). It was until the execution of Emperor Maximilian of Hapsburg during the Restored Republic (1867-1876) when government revenues resumed growth. And it was only at the end of the period of the Restored Republic in the late 1870s, with the start of the Porfiriato, that ordinary income neared levels observed before the war with the United States.

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<sup>30</sup> This was the major civil conflict of nineteenth century Mexico.

Figure 3.5 Ordinary Income of the Federal Government, 1824-1879.



Source: Carmagnani (1982).

In summary, the picture offered by Carmagnani's (1982) figures is somewhat different from what those of Tenenbaum (1986) reveal. It shows some growth from 1824 on, only interrupted by the War with the U.S. in the late 1840s and its aftermath, and by the French occupation in the 1860s. However, the evidence is conclusive in one respect. Taking the post-independence period as a whole, say from 1824 to the late 1860s, it is very evident that Mexico missed sustained economic growth.

We now turn to the data for the last quarter of the century, during the Porfiriato, which is more abundant. We have a series that complements the previous one on Tax Income by Barbara Tenenbaum, and another one on Ordinary Income that complements the data of Carmagnani. Both series come from Rosenzweig et al. (n.d.) and cover the period from 1876 to 1910. And both of them show signs of plausible economic progress.

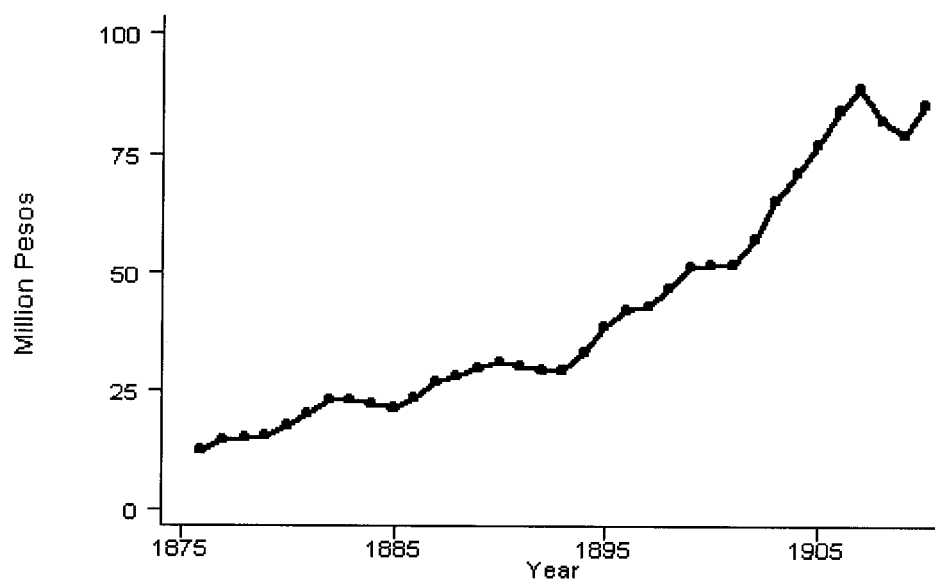
Figure 3.6 presents the 1876-1910 series on Tax Income of the Federal Government, which corresponds to direct and indirect taxes, including taxes on international trade. The upward trend is very evident. The annual average rate of growth of this revenue is 5.6 per cent. See Table 3.5. This is in contrast with the zero average growth rate estimated from the mid 1820s to the mid 1850s using the Tax Collection series by Tenenbaum (1986). A difference in means test for the rate of growth, allowing for different variances in each period, gives a one sided p-value of .04. Therefore, at the 5% significance level, we reject the hypothesis that the rate of growth was equal in both periods, and we accept the alternative hypothesis that it was higher during the Porfiriato.<sup>31</sup> Summary statistics of the variables are presented in Table 3.5.

Figure 3.7 presents the 1876-1910 series on Ordinary Income of the Federal Government. This is Tax Income plus revenue from public firms, government services, etc. The upward trend is also evident for this income. The average rate of growth from 1876 to 1910, according to this revenue, was 5.4 per cent. This is higher than the 0.6 and 4.0 per cent rates estimated with the series of Total Income excluding loans from Tenenbaum

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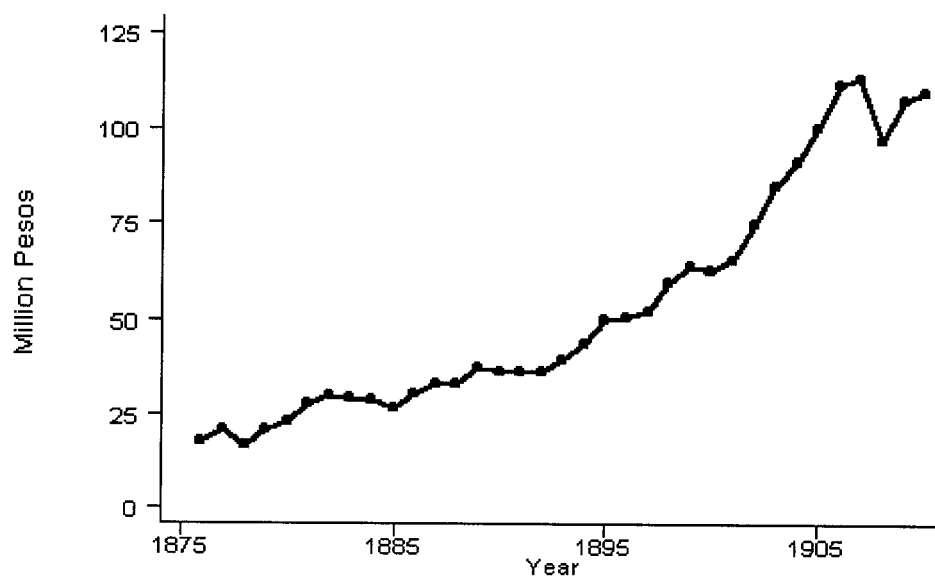
<sup>31</sup> This results comes from using the Satterthwaite approximation formula of degrees of freedom, and from eliminating two plausible outliers from the sample: the maximum and minimum growth rates.

Figure 3.6 Tax Income of the Federal Government, 1876-1910.



Source: Rosenzweig et al. (n.d).

Figure 3.7 Ordinary Income of the Federal Government, 1876-1910.



Source: Rosenzweig et al. (n.d.).



(1986) and Ordinary Income from Carmagnani (1983) in the period from the 1820s to the 1850s and 1870s, respectively (Table 3.5). A mean test for the difference in average growth rates in both periods, using Tenenbaum (1986) and Rozensweig (n.d) data, rejects the null hypothesis that the growth rates are the same in both periods, in favor of the alternative that the growth rate was higher during the Porfiriato.<sup>32</sup> The one sided p-value is .01

Political instability poses a threat to the security of private rights, whenever driven by violence and revolutions. Greater instability reduces the incentive to invest in various economic activities, and, therefore, it lowers the growth rate of the economy. I have several measurements of political instability that are related and will be used to create a new aggregate variable. This will simplify the analysis and interpretation, and it will help to increase the degrees of freedom in the regression analysis.

The measures of political instability are the following: annual number of changes of executive ( $z_1$ ); number of regional, peasant, and caste wars<sup>33</sup> ( $z_2$ ); number of parallel governments ( $z_3$ ); and a dummy variable indicating a foreign war ( $z_4$ ). Forming a linear combination of these variables will produce a single index containing information from all variables. To choose the weights, principal component analysis is used, since this produces a valuable summary of the measurements.

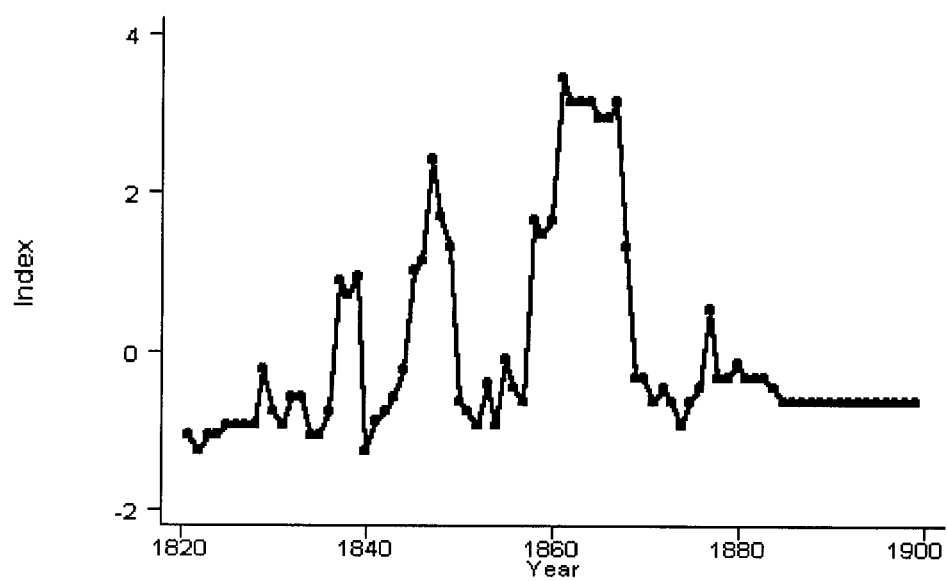
Details of the principal component analysis applied in this paper are presented in the Appendix. I use the first component as the index of political instability in nineteenth century Mexico, and Figure 3.8 displays it. The mean of this index is 0.000, with standard deviation of 1.25. The peaks in Figure 3.8 coincide with international wars. First, the Pastry War with France in the late 1830s, then the War with the United States in the late 1840s, and finally the French Intervention in the 1860s. The index is mainly a constant

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<sup>32</sup> This is invariant to whether we use the Welch or Satterthwaite approximation formula of degrees of freedom. The two maximum and the two minimum growth rates of the combined sample were treated as outliers.

<sup>33</sup> Data from Coatsworth (1988).

Figure 3.8 Index of Political Instability, 1821-1899.



Source: See Text.

with zero variance during most of the Porfiriato, reflecting the low political turbulence of that period. Was political instability negatively related to economic growth in nineteenth century Mexico? I now turn to that question.

### 3.5 Empirical Model and Estimation Results

This section presents estimates of the effect of political instability on economic growth. Its primary purpose is to test the hypothesis that economic growth declined in nineteenth century Mexico when political instability increased. Economic growth is proxied by the growth of the different measures of government revenue presented in the last section. The rationale for this approximation is that economic growth must have been reflected in the growth of government income, or that at least there was a positive relationship between the growth of the economy and the growth of government revenues.

The models estimated in this paper have the general form:

$$g_t = c_0 + \alpha_0 I_t + \alpha_1 I_{t-1} + \gamma g_{t-1} + \beta' x + u_t \quad (3.8)$$

where  $g_t$  is a proxy of economic growth as described in section 3.4. It represents the growth rate of one of the government revenue measures.

$I_t$  is the index of political instability constructed through principal components using four measurements of instability: the number of changes in the executive post, the number of regional, peasant, or caste wars, a dummy variable indicating a foreign war, and number of parallel governments. Since the number of regional wars is measured up to 1899, I also constructed the index  $I_t^P$  as a linear combination of all three variables except regional wars, using the principal component method. This new index increases the sample size up to 1910, and its summary statistics are depicted in Table 3.5. Sometimes I use  $I_t^P$  as explanatory variable instead of  $I_t$ . This increases the sample size, and it will be

indicated each time that I use it. The graph of  $I_t^P$  looks very similar to that of  $I_t$ , but less smooth.

Some forms of regression equation (3.8) correspond to Finite Distributed Lag (FDL) models because I include one lag of political instability as an explanatory variable. In this case, the lag of the dependant variable is excluded from the equation. This is because most of the time the lag of the dependent variable must be instrumented, and for that I use the lag of the political instability variable. The FDL model allows political instability to affect economic growth with a lag of one year. Other forms of regression equation (3.8) correspond to Infinite Distributed Lag (IDL) models because I include one lag of the dependent variable as regressor. Most of the time, in these cases the lag of economic growth must be instrumented, and I use one lag of political instability as the instrument, so that the lag of political instability is excluded from the regression equation as explanatory variable.

Under the FDL and IDL models, a temporary, one-year increase in political instability affects current economic growth as  $\alpha_0$  times the change in political instability, and next year it affects economic growth by  $\alpha_1$  and  $\alpha_0\gamma$  times the change in instability, respectively. After  $t > 1$  years, there is no additional effect in the FDL model, but it is  $\alpha_0\gamma^t$  and  $(\alpha_0 + \alpha_1)\gamma^t$  times the change in political instability under the IDL model with and without lag of political instability, respectively. The long run multiplier (LRP) is the long run effect of a permanent change in political instability, and this is given by  $\alpha_0 + \alpha_1$  in the FDL model, and by  $\alpha_0/(1 - \gamma)$  and  $(\alpha_0 + \alpha_1)/(1 - \gamma)$  in the IDL models. Studies on the empirics of economic growth such as Alesina et al. (1996), Barro (1991), Barro and Lee (1994), Caselli, Esquivel, and Lefort (1996), Levine and Renelt (1992), and Sala-i-Martin (1997) have found a negative relationship between political instability and economic growth.<sup>34</sup>

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<sup>34</sup> Levine and Renelt (1992), however, dispute the robustness of the result.

In equation (3.8),  $\beta$  represents a vector of parameters and  $x$  is a vector of control variables. They include the growth in the price of Mexican bonds in the London market, the growth in the quantity of coined silver, the growth in the relative price of silver in terms of gold, and the rate of depreciation of the Mexican peso with respect to the U.S. dollar. Summary statistics of these variables are displayed in Table 3.5.

The change in the price of the Mexican bonds<sup>35</sup> is included in the regression because it can potentially measure the expectations of foreign investors on the stability and growth of the Mexican economy. It reflects expectations on future growth in the Mexican economy, which can be related to current economic growth as in recent New Keynesian macroeconomic models (See Clarida, Gali, and Gertler, 1999). Furthermore, it may also reflect the expectations of future political instability. Its coefficient in equation (3.8) should be positive. Finally, this variable may also measure the profitability of investment in the Mexican economy. Studies on growth empirics such as Barro (1991, 1996, 1997), Barro and Lee (1994), Caselli et al. (1996), DeLong and Summers (1993), Levine and Renelt, and Mankiw, Romer and Weil (1992) have found a positive relationship between the investment ratio and economic growth.

The rate of growth of the coined silver may be related to two other variables. First, a high rate of growth is associated with higher employment, and therefore, with higher growth during the year. Second, the growth of coined silver may reflect the growth in silver production, which was the most important export product of the epoch. Many economic historians believe that exports were an important sector that pushed growth in the rest of the economy. And therefore, I expect the coefficient of this variable to be positive. Sala-i-Martin (1997) finds a positive relationship between mining as a share of GDP and growth, while Kormendi and Meguire (1985) find a positive link between money and economic growth. On the relationship between trade and growth, Frankel and Romer (1996), Frankel, Romer and Cyrus (1996), and Kormendi and Meguire (1985) found a positive association.

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<sup>35</sup> The source of this variable is Costeloe (2003).

The growth in the relative price of silver in terms of gold<sup>36</sup> is included for reasons similar to those outlined for coined silver. This was the relative price of the principal export product of Mexico, and it is determined in world markets. An improvement in this price raises Mexico's real income, and this may generate more output and growth, so that its coefficient in the regression equation should be positive. Barro(1996, 1997), Barro and Lee (1994), Caselli, Esquivel and Lefort (1996), and Easterly, Kremer, Pritchett and Summers (1993) found that an improvement in the terms of trade betters economic growth. However, Hadass and Williamson (1993) found something different. They conclude that before World War I, improvements in the terms of trade damaged economic growth in the periphery.<sup>37</sup>

Since colonial times, Mexico was an importer of machinery and other important intermediate goods. The most important supplier of these goods during the nineteenth century was the U.S. Therefore, a depreciation of the Mexican peso with respect to the U.S. dollar would increase the price of important capital goods and reduce investment. This is the reason for which I include the change in the price in Mexican pesos of the U.S. dollar. The depreciation of this exchange rate is expected to reduce the rate of economic growth.<sup>38</sup>

Tables 3.6-3.10 present the estimation results for equation (3.8). Table 3.6 excludes the control variables  $x$  from the regression, so that it incorporates the restriction  $\beta = 0$ . It estimates three different models. First, a static model in which only the current level of political instability affects growth ( $\alpha_1 = \gamma = 0$ ). Second, a Finite Distributed Lag model (FDL) where current and one lag of political instability affects growth ( $\gamma = 0$ ). And third, an Infinite Distributed Lag (IDL) model where the current level of political instability and one lag of the rate of growth affect the current growth rate. In two out of three cases, the

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<sup>36</sup> The source of this variable is Jastram (1981).

<sup>37</sup> However, Blattman, Hwang, and Williamson (2003) show that in the Third World, volatility in the terms of trade has been more important than their secular change.

<sup>38</sup> Most studies on growth empirics have found a negative relationship between the real exchange rate and economic growth.

lag of political instability was excluded ( $\alpha_1 = 0$ ). These models are applied to three data sets: Tax collections of the Federal Government from Tenenbaum (1986),  $T_1$ ; Total Income of the Federal Government, excluding loans, again from Tenenbaum (1986),  $T_2$ ; and Ordinary Income of the Federal Government from Carmagnani (1982),  $T_3$ . At this moment, the remaining two series from the Porfiriato,  $T_4$  and  $T_5$ , were not considered since there is almost no variation in political instability in that period. They will be taken into consideration when combined with  $T_1$  to  $T_3$  in Tables 3.7 to 3.10.

Regression equations in Table 3.6 were first estimated using OLS, and then testing for serial correlation of order one with the Breusch and Godfrey LM statistic. Under the null hypothesis of no autocorrelation, this statistic follows a  $\chi^2$  distribution with one degree of freedom. This is reported as BP(1) in Table 3.6. If the test rejected the null hypothesis, then Newey-West robust standard errors were reported (OLSN) in the static and FDL models, while IV estimation was carried on for the IDL model. A lag of political instability instrumented the lag of growth. When BP(1) did not reject the hypothesis of zero autocorrelation, the Breusch-Pagan test of homoskedasticity was carried on. The LM statistic follows a  $\chi^2$  distribution with  $k-1$  degrees of freedom,<sup>39</sup> and it is reported as BP(k-1) in Table 3.6. When homoskedasticity was rejected, White robust standard errors were reported (OLSR). Otherwise, OLS estimates were used.

All equations in Table 3.6 resulted in an estimated negative effect of political instability on economic growth. The first 6 equations, which correspond to  $T_1$  and  $T_2$ , gave estimates of the current effect of instability which are statistically different than zero at the 10% significance level, and half of them are significant at the 5 % level.<sup>40</sup> The highest p-value among them is .072, so that marginally, all 6 regressions gave a significant negative relationship between political instability and the growth of government revenue.

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<sup>39</sup>  $K$  represents the number of regressors, including the constant.

<sup>40</sup> Columns (1), (5) and (6).

**Table 3.6**  
**Results for the Simple Static, FDL, and IDL models for each Data Set**  
**in Post-Independence Mexico**

Independent Variable	Dependent Variable								
	$\Delta \ln T_1$			$\Delta \ln T_2$			$\Delta \ln T_3$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$I_t$	-.133 (.057)	-.116 (.056)	-.120 (.062)	-.119 (.059)	-.142 (.064)	-.235 (.046)	-.028 (.024)	-.033 (.035)	-.013 (.018)
$I_{t-1}$	-	-.068 (.042)	-.063 (.046)	-	.045 (.066)	-	-	.006 (.032)	-
$\Delta \ln T_{t-1}$	-	-	-.070 (.202)	-	-	-.273 (.152)	-	-	.289 (.323)
<i>Constant</i>	-.084 (.046)	-.110 (.047)	-.110 (.050)	-.076 (.048)	-.067 (.047)	-.148 (.035)	.036 (.021)	.036 (.021)	.009 (.031)
<i>LRP</i>	-.133	-.185	-.171	-.119	-.096	-.184	-.028	-.027	-.019
<i>BG(1)</i>	.200 [.654]	.583 [.445]	1.57 [.209]	4.99 [.025]	4.83 [.027]	.837 [.360]	1.02 [.311]	1.41 [.233]	6.54 [.010]
<i>BP(k-1)</i>	.572 [.449]	.392 [.821]	1.26 [.737]	-	-	.393 [.821]	13.1 [.000]	13.9 [.000]	-
$F_{k-1,n-k}$	5.44 [.030]	4.25 [.030]	2.39 [.106]	4.03 [.057]	2.57 [.101]	12.8 [.000]	1.30 [.260]	0.68 [.510]	1.67 [.201]
<i>RSS</i>	.365	.319	.312	-	-	.266	-	-	.705
$R^2$	.222	.320	.309	-	-	.588	.067	.068	.135
$\overline{R}^2$	.181	.245	.180	-	-	.542	-	-	.090
<i>N</i>	21	21	20	23	23	21	44	44	41
<i>Period</i>	1825-1856			1825-1856			1824-1879		
<i>Estimation</i>	OLS	OLS	OLS	OLSN	OLSN	OLS	OLSR	OLSR	IV

Note: Standard errors are in brackets, and p-Values in square brackets. *RSS*,  $\overline{R}^2$ , and  $\overline{R}^2$  were not reported when robust standard errors were used. For variable definitions, see note to Table 3.5. *BG(1)* is the Breusch-Godfrey LM statistic for testing the null hypothesis of no serial autocorrelation of order one. *BP(k-1)* is the Breusch-Pagan LM statistic for testing the null hypothesis of homoskedasticity, and it was not reported when the *BG(1)* test rejected the hypothesis of zero autocorrelation. Newey-West robust standard errors were used when *BG(1)* rejected the assumption of spherical errors (Equations 4 and 5). White robust standard errors were used when *BG(1)* did not reject zero autocorrelation, but *BP(k-1)* rejected homoskedasticity (Equations 7 and 8). *RSS* is the Residual Sum of Squares. OLSN and OLSR refer to robust OLS using Newey-West and White standard errors, respectively. When IV was applied, the lag of the independent variable was excluded from the equation and used to instrument the lagged dependent variable. Under IV, *BG(1)* refers to the zero autocorrelation test using OLS.



The range of the Long Run Multiplier (LRP) goes from -.096 to -.185 in the 6 equations, and from -.013 to -.185 including all 9 regressions. This measures the long run effect of a permanent increase in political instability on the growth of government income.

Tables 3.7 and 3.8 report estimates of the static model using control variables  $x$ , and combining the series for post-independent Mexico (1820-1870) with the series for the Porfiriato (1870-1910). The static models exclude the lag of political instability and the lag of growth in the regression equation (3.8). That is,  $\alpha_1 = \gamma = 0$ . The model is estimated using three combined data sets.  $G_1$  joins together the growth rate of Tax Collections from Tenenbaum (1986) with the growth rate of Rosenzweig's Tax Income in the Porfiriato.  $G_2$  unites Total Income excluding loans from Tenenbaum with Rosenzweig's Ordinary Income of the Porfiriato. And finally,  $G_3$  combines the growth of Ordinary Income from Carmagnani with the growth of Rosenzweig's Ordinary Income. These are three series that go from the 1820s to the 1910s, though two of them with missing values in the middle of the them.

Table 3.7 presents robust (Newey-West) estimates including control variables as explanatory variables for each of the  $G$  series, and using in the regression equation either the index of political instability from 4 variables,  $I$ , or the modified index constructed from three variables,  $I^P$ . The reason is that even though  $I$  summarizes more information than  $I^P$ , it is truncated at 1899. On the other hand,  $I^P$  reaches the year of 1910. Each series of growth in government income is regressed against the index of political instability and the control variables. The results excluding control variables are also reported in Table 3.7.

The 12 equations estimated in Table 3.7 give negative relationships between political instability and growth. The first 8 regressions resulted in significant coefficients at the 10 % significance level, and half of them at the 5 % level. Their highest p-value is 0.088, and therefore, they are marginally significant. The range of the coefficient on political instability goes from -.111 to -.168 in the first 8 equations, and from -.038 to -.168

**Table 3.7**  
**Robust OLS Estimates of Static Model**

Independent Variable	Dependent Variable											
	$G_1$				$G_2$				$G_3$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$I$	-.161 (.082)	-.161 (.085)			-.111 (.063)	-.120 (.063)			-.038 (.028)	-.039 (.029)		
$I_p$			-.161 (.056)	-.168 (.059)			-.120 (.051)	-.122 (.054)			-.037 (.026)	-.039 (.027)
$\Delta \ln P_b$		.161 (.077)				.221 (.101)				.169 (.076)		
$\Delta \ln S$		.117 (.241)		.041 (.046)		-.033 (.315)		.011 (.061)		.043 (.242)		.031 (.059)
$\Delta \ln P_s$		-.070 (1.36)		.413 (.143)		.136 (1.37)		.607 (.250)		1.94 (2.17)		.632 (.234)
$\Delta \ln e$		-.065 (1.57)		.144 (.230)		-.365 (1.84)		.530 (.329)		1.27 (1.97)		.509 (.298)
<i>Constant</i>	-.073 (.058)	-.088 (.065)	-.066 (.041)	-.065 (.043)	-.037 (.044)	-.051 (.048)	-.036 (.036)	-.034 (.036)	.020 (.022)	.025 (.025)	.022 (.020)	.025 (.021)
$F_{k-1,n-k}$	3.80 [.057]	2.21 [.082]	8.10 [.006]	7.95 [.000]	3.04 [.088]	2.14 [.087]	5.41 [.023]	3.50 [.013]	1.77 [.188]	2.63 [.035]	1.94 [.167]	3.42 [.013]
$N$	44	34	55	55	46	36	57	57	64	54	75	75

Note: Standard errors are in brackets like ( ), and p-Values in square brackets like [ ]. Robust standard errors were calculated using the Newey-West procedure. For variable definitions, see note to Table 3.5.

including all 12. The change in the price of Mexican bonds is included as explanatory variable in columns (2), (6) and (10). Its sign is positive as expected, and significant at the 5 % significance level. This variable is truncated at the year of 1899, and so columns (4), (8) and (12) exclude this price from the equation, because they use the modified index of political instability to expand the size of the series. In these equations, the change in the relative price of silver has the expected positive sign, and is significant at the 5 % level. The growth in silver production has most of the time the desired sign, but it is usually not significant. The rate of depreciation sometimes has the wrong sign, but it is never significant.

Section 3.2 argued that political instability was exogenous from an economic standpoint. I argued that it was generated by ideological differences between political actors. Now I relax that hypothesis, and I assume political instability may be endogenous. I instrument it with one lag. Table 3.8 presents the results. It shows 3 panels, each for each  $G$  variable. And each panel presents the IV estimation for all different subsets of control variables. To have reasonable standard errors, the sample size becomes critical, and most of the time the index of political instability used is  $I^P$ , while the growth in the price of Mexican bonds is excluded from the equation.<sup>41</sup>

All 27 regressions showed a negative relationship between political instability and growth. And 24 of them gave significant results at the 5 % significance level. For  $G_1$ , the range of values goes from -.316 to -.350; for  $G_2$ , the estimated coefficient is between -.200 to -.206; and for  $G_3$ , the results are between -.046 and -.048. The growth of silver production and the growth in its relative price always have the desired sign: they are positively related with the growth rate, but their coefficients are never significant. The depreciation of the exchange rate sometimes has the wrong sign, but it is never significant.

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<sup>41</sup> The sample size becomes so critical that correcting for autocorrelation in the IV estimation leaves very similar point estimates with very high standard errors. The number of significant estimates reduces in each case.

**Table 3.8**  
**IV Estimates of Static Models**

Variable	Panel A: Dependent Variable is $G_1$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$I$	-.358 (.209)								
$I_p$		-.316 (.107)	-.334 (.116)	-.336 (.113)	-.324 (.111)	-.350 (.121)	-.347 (.123)	-.336 (.114)	-.350 (.123)
$\Delta \ln S$			.148 (.114)			.137 (.117)	.172 (.122)		.154 (.135)
$\Delta \ln P_s$				.494 (.346)		.441 (.351)		.567 (.518)	.264 (.581)
$\Delta \ln e$					-.363 (.381)		-.474 (.412)	.103 (.060)	-.244 (.686)
Constant	-.176 (.111)	-.146 (.058)	-.152 (.061)	-.149 (.060)	-.146 (.059)	-.154 (.063)	-.153 (.063)	-.150 (.060)	-.154 (.063)
$F_{k-1,n-k}$	2.93 [.094]	8.73 [.004]	4.17 [.021]	4.50 [.015]	4.25 [.019]	2.87 [.045]	2.67 [.057]	3.11 [.034]	2.26 [.075]
$\sigma$	.164	.139	.143	.143	.141	.147	.146	.145	.148
$N$	44	55	55	55	55	55	55	55	55
Panel B: Dependent Variable is $G_2$									
$I$	-.160 (.095)								
$I_p$		-.200 (.078)	-.208 (.082)	-.211 (.081)	-.202 (.081)	-.216 (.084)	-.211 (.085)	-.212 (.081)	-.216 (.085)
$\Delta \ln S$			.100 (.109)			.090 (.110)	.106 (.113)		.067 (.123)
$\Delta \ln P_s$				.345 (.349)		.308 (.352)		.686 (.529)	.554 (.580)
$\Delta \ln e$					-.079 (.387)		-.142 (.402)	.490 (.587)	.341 (.662)
Constant	-.061 (.051)	-.075 (.042)	-.076 (.043)	-.075 (.043)	-.074 (.042)	-.076 (.044)	-.076 (.043)	-.076 (.043)	-.077 (.043)
$F_{k-1,n-k}$	2.83 [.099]	6.49 [.013]	3.21 [.048]	3.38 [.041]	3.22 [.047]	2.22 [.096]	2.11 [.109]	2.69 [.055]	2.00 [.107]
$\sigma$	.157	.146	.147	.147	.147	.149	.147	.148	.150
$N$	46	57	57	57	57	57	57	57	57

Table 3.8 (cont.)

	Panel C: Dependent Variable is $G_3$								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$I$	-.051 (.019)								
$I_p$		-.046 (.017)	-.047 (.018)	-.048 (.017)	-.046 (.018)	-.049 (.018)	-.048 (.018)	-.047 (.018)	-.048 (.018)
$\Delta \ln S$			.086 (.103)			.074 (.104)	.089 (.105)		.039 (.115)
$\Delta \ln P_s$				.307 (.339)		.271 (.344)		.717 (.542)	.631 (.598)
$\Delta \ln e$					-.038 (.373)		-.082 (.378)	.573 (.593)	.480 (.654)
<i>Constant</i>	.019 (.019)	.021 (.017)	.022 (.017)	.024 (.017)	.021 (.017)	.025 (.017)	.023 (.018)	.024 (.017)	.024 (.018)
$F_{k-1,n-k}$	6.69 [.012]	6.72 [.011]	3.64 [.031]	3.72 [.029]	3.31 [.042]	2.60 [.058]	2.40 [.075]	2.82 [.045]	2.10 [.089]
$\sigma$	.158	.148	.149	.148	.149	.149	.150	.148	.149
$N$	64	75	75	75	75	75	75	75	75

Note: Standard errors are in brackets like ( ), and p-Values in square brackets like [ ]. For variable definitions, see note to Table 3.5.  $\sigma$  is the root mean square error.

Table 3.9 extends the static model to include lags of the dependent and independent variables. It estimates an FDL model with one lag of instability, and an IDL model with one lag of the dependent variable. For comparison purposes, it also displays the static model with no lags. The estimation methodology was similar to that used to generate Table 3.6. I relayed on the Breuch-Godfrey and Breusch-Pagan tests to select an estimation method. The results show again a negative relationship between political instability and growth.

The first 6 regressions in Table 3.9 gave negative and significant relationships between instability and growth at the 10 % significance level, and half of them at the 5 % level. The long run multiplier in Table 3.9 is between -.020 and -.280. The growth rates of silver production and its relative price have always the desired sign, and the later is significative several times. The rate of depreciation of the Mexican peso with respect to the dollar is never significative.

Finally, I combined all 5 original measures of economic growth, the growth rates of  $T_1$  to  $T_5$ , into one single series that I call  $G$ . This series may contain more than one estimate of economic growth for a single year, since the original measurements overlap in certain periods. To estimate the relevant parameters of regression equation (3.8), I included a set of 5 dummy variables indicating the original data set to which each observation belongs. Furthermore, the error series of the pooled data will be correlated at least by groups of years. That is, the measurements of economic growth in a single year will be correlated. To estimate equation (3.8), then, I used clustered regression to estimate the standard errors.

The estimation results for the pooled data are displayed in Table 3.10.<sup>42</sup> The first 6 regressions used  $I$  as the index of political instability, while the last 6 equations used  $I^P$ . The effect of political instability is always negative, and it is significative at the 10 % level

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<sup>42</sup> The estimates for the dummy variables are not displayed.

**Table 3.9**  
**Estimation of Finite and Infinite Distributed Lag Models**

Independent Variable	Dependent Variable								
	$G_1$			$G_2$			$G_3$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$I_t^p$	-.168 (.058)	-.145 (.053)	-.271 (.089)	-.122 (.062)	-.098 (.057)	-.280 (.110)	-.039 (.027)	-.020 (.031)	-.032 (.022)
$I_{t-1}^p$		-.059 (.024)			-.044 (.030)			-.023 (.022)	
$G_{t-1}$			-1.08 (.863)			-1.46 (1.14)			.161 (.153)
$\Delta \ln S$	.041 (.046)	.043 (.047)	.066 (.138)	.011 (.062)	.009 (.062)	.049 (.173)	.031 (.059)	.034 (.060)	.046 (.062)
$\Delta \ln P_s$	.413 (.171)	.486 (.137)	.363 (.655)	.607 (.266)	.671 (.260)	.559 (.840)	.632 (.234)	.645 (.235)	.522 (.231)
$\Delta \ln e$	.144 (.251)	.186 (.222)	-.303 (.846)	.530 (.340)	.574 (.332)	-.090 (1.06)	.509 (.298)	.509 (.300)	.515 (.310)
<i>Constant</i>	-.065 (.040)	-.081 (.045)	-.073 (.034)	-.034 (.042)	-.042 (.037)	-.051 (.044)	.025 (.021)	.025 (.021)	.013 (.022)
<i>LRP</i>	-.168	-.205	-.130	-.122	-.143	-.113	-.039	-.043	-.038
<i>BG(1)</i>	1.98 [.159]	4.53 [.033]	3.07 [.079]	1.59 [.206]	2.58 [.108]	2.11 [.145]	2.58 [.108]	2.96 [.085]	1.82 [.177]
<i>BP(k-1)</i>	19.9 [.000]	-	-	26.5 [.000]	-	-	-	-	40.8 [.000]
$F_{k-1, n-k}$	6.01 [.000]	6.64 [.000]	3.23 [.013]	3.29 [.017]	3.25 [.012]	1.91 [.110]	3.42 [.013]	2.98 [.017]	2.76 [.025]
<i>RSS</i>	-	-	1.33	-	-	2.26	-	-	
$R^2$	.359	-	-	.202	-	-	-	-	.136
<i>N</i>	55	55	53	57	57	54	75	75	72
<i>Method</i>	OLSR	OLSN	IV	OLSR	OLSN	IV	OLSN	OLSN	OLSR

Note: Standard errors are in brackets like ( ), and p-Values in square brackets like [ ]. *RSS* were not reported when robust standard errors were used. For variable definitions, see note to Table 3.5. *LRP* is the Long Run Multiplier of Instability. *BG(1)* is the Breusch-Godfrey LM statistic for testing the null hypothesis of no serial correlation of order one. Critical values of *BG(1)* were selected at 15% significance levels. *BP(k-1)* is the Breusch-Pagan LM statistic for testing the null hypothesis of homoskedasticity, and it was not reported when the *BG(1)* test rejected the hypothesis of zero autocorrelation. Newey-West robust standard errors (OLSN) were used in the FDL models when *BG(1)* rejected the assumption of spherical errors. IV estimation was carried on in the IDL models when *BG(1)* rejected the assumption of no autocorrelation. White robust standard errors (OLSR) were used when *BG(1)* did not reject zero autocorrelation, but *BP(k-1)* rejected homoskedasticity. *RSS* is the Residual Sum of Squares. When IV was applied, the lag of political instability was excluded from the equation and used to instrument the lagged dependent variable. *BG(1)* and *BP(k-1)* refer to tests using OLS.

**Table 3.10**  
**Cluster Estimation with Pooled Data**

Independent Variable	Dependent Variable is $G$											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$I$ or $I_p$	-.051 (.027)	-.051 (.027)	-.051 (.027)	-.055 (.027)	-.052 (.043)	-.055	-.052 (.025)	-.053 (.026)	-.053 (.026)	-.055 (.026)	-.047 (-.010)	-.061 (.034)
$I_{t-1}$ or $I_{t-1}^p$	-	-	-	-	-.003 (.035)	-					-.010 (.027)	
$G_{t-1}$						.091 (.428)						-.089 (.326)
$\Delta \ln P_b$	-	-	-	.132 (.060)	.134 (.062)	.122 (.072)				.126 (.057)	.138 (.059)	.142 (.061)
$\Delta \ln S$	-	-.100 (.138)	-.098 (.136)	-.051 (.172)	-.054 (.173)	-.089 (.176)		.029 (.053)	.000 (.053)	-.060 (.173)	-.065 (.174)	-.075 (.179)
$\Delta \ln P_s$	-	.302 (.263)	.933 (.849)	.806 (1.01)	.821 (1.05)	.859 (1.07)		.340 (.185)	.649 (.195)	.633 (1.05)	.741 (1.06)	.447 (1.14)
$\Delta \ln e$	-	-	.677 (.871)	-.190 (1.35)	-.170 (1.43)	.536 (1.45)			.430 (.265)	-.434 (1.43)	-.302 (1.47)	-.121 (1.65)
Constant	-.049 (.046)	-.047 (.046)	-.047 (.046)	-.047 (.046)	-.048 (.046)	-.066 (.049)	-.032 (.041)	-.032 (.041)	-.032 (.041)	-.029 (.042)	-.028 (.042)	-.041 (.048)
LRP	-.051	-.051	-.051	-.055	-.056	-.061	-.052	-.053	-.053	-.055	-.058	-.056
$F_{k-1,n-k}$	1.30 [.276]	1.29 [.270]	1.43 [.200]	2.47 [.018]	2.53 [.013]	2.87 [.006]	1.33 [.259]	1.37 [.230]	2.90 [.006]	2.45 [.019]	2.32 [.022]	2.94 [.005]
$R^2$	.126	.135	.137	.171	.171	.205	.126	.140	.145	.168	.166	.155
$N$	135	135	135	115	115	106	157	157	157	115	115	106

Note: Standard errors are in brackets like ( ), and p-Values in square brackets like [ ]. Robust standard errors were calculated assuming data was clustered by year. For variable definitions, see note to Table 3.5. Equations (1)-(6) use  $I$  as independent variable, while equations (7)-12 use  $I_p$ .



in 8 out of the 12 regressions,<sup>43</sup> and in half of them at the 5 % level.<sup>44</sup> The significative estimates in the 5% one tailed tests range between -.051 and -.053. Among them, the change in the price of Mexican bonds has the expected positive sign and is significative. The growths in silver production and its relative price have the expected positive and significative sign in some equations. The rate of depreciation of the Mexican peso, on the other hand, is never significative.

The results in this section show very strong evidence of a negative effect of political instability on economic growth when this growth is measured by the growth of fiscal variables. The results are robust to different control variables, estimation methods, and growth measurements.

### 3.6 Political Instability: Accounting for the Lost Decades and the Porfiriato

Table 3.6 suggests that in the best scenario, political instability accounts for almost 60 per cent of the variance in the growth rate during the lost decades of nineteenth-century Mexico. This section now asks two more questions. First, how much of rise in growth from c1820-c1860 to c1860-c1910 is due to decline in political instability? And second, How much of the drop in growth after independence was due to political instability? I will use the estimates presented in the last section to offer an answer to these questions.

The first row in Table 3.11 displays the change in the average growth rate after 1867 in each measure of growth,  $G_1$  to  $G_3$  and  $G$ . This varies from .036 to .106. The second row presents the change in the index of political instability. The difference is a decline of 0.58 points. And the third row shows the estimated effect of a one-unit increase in political instability on the growth rate. This parameter varies from -.038 to -.161, and its source are the preferred (by precise) estimates in Table 3.7. The fourth

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<sup>43</sup> These are the static models, columns (1)-(4) and (7)-(10).

<sup>44</sup> Columns (7)-(10).

**Table 3.11**  
**Effect of decline in Political Instability on Economic Growth after 1867**

	Independent Variable			
	$G_1$	$G_2$	$G_3$	$G$
$\Delta G$	.106	.079	.036	.063
$\Delta I$	-.58	-.58	-.58	-.58
$\alpha$	-.161	-.111	-.038	-.055
<i>Est. Effect</i>	.093	.064	.022	.032
<i>Percentage</i>	87.7	81.0	61.1	50.8

Note:  $\Delta G$  is the observed increase in the rate of growth after 1867. It was calculated as the difference between mean growth after 1867 and mean growth before that year.  $\Delta I$  is the observed change in political instability after 1867. It is the mean difference between periods.  $\alpha$  is the estimate used for the effect of political instability on economic growth. *Est. Effect* is the effect estimated on economic growth due to the decline in political instability after 1867. *Percentage* is the proportion of the observed change in the rate of growth after 1867 that can be explained by the decline in political instability.

row presents the estimated effect of the decline in political instability after 1867. It is given by the multiplication of the second and third rows.

The fifth and last row in Table 3.11 presents the estimated effect of political instability, as a proportion of the actual change in growth. The results show that between 50 and 88 per cent of the increase in the growth rate was due to reduced political instability. Two columns attribute more than 80 per cent of the growth change to political instability and one more attributes it 60 per cent.

Table 3.12 presents regression estimates of the static model, including and excluding control variables, and for each of the two indexes of political instability, when I include a dummy variable to account for a possible difference in the growth rate after 1867 that has nothing to do with political instability. This allows me to establish if there is still any difference in the growth rate after 1867 that is not accounted by political instability or the control variables.

I first notice that political instability has always the expected sign, and is significant at the 5 per cent level in more occasions than before: in 7 out of 16 cases. It is significant in one-tailed tests, or at the 10 per cent level, in 12 cases. In the 4 cases in which political instability is not significant, the dummy variable is also insignificant. And only 3 cases resulted with a significant dummy variable (at the 10 per cent level), but it never transformed political instability into a non-significant variable. These results suggest that once we control for political instability, there is no systematic difference in the growth rate after 1867.

I now turn to the following question: how much of the drop in the growth rate after independence was due to political instability? Table 3.13 uses the same estimates for the effect of political instability on the growth rate. To calculate the average growth rate before 1810, I used data on government income in Mexico City from TePaske (1985). The first row shows the decline in growth after independence, while the second row displays the increase in political instability. To construct the values of the index of political instability before independence, I constructed a linear combination of the relevant variables using the

**Table 3.12**  
**Robust OLS Estimates accounting for different Periods**

Variable	Panel A. Dependent Variable:							
	$G_1$				$G_2$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$I$	-.169 (.071)	-.195 (.078)			-.109 (.059)	-.128 (.060)		
$I_p$			-.148 (.063)	-.151 (.065)			-.113 (.061)	-.114 (.062)
$D$	.120 (.040)	.170 (.069)	.026 (.042)	.035 (.044)	.079 (.039)	.095 (.059)	.013 (.045)	.018 (.048)
$\Delta \ln P_b$		.081 (.082)				.185 (.102)		
$\Delta \ln S$		.220 (.181)		.051 (.048)		-.005 (.290)		.016 (.065)
$\Delta \ln P_s$		.228 (1.38)		.419 (.150)		.358 (1.33)		.612 (.254)
$\Delta \ln e$		-1.54 (1.80)		.109 (.234)		-1.14 (2.06)		.515 (.336)
Constant	-.141 (.061)	-.158 (.069)	-.076 (.045)	-.077 (.047)	-.077 (.052)	-.082 (.055)	-.040 (.040)	-.040 (.041)
$F_{k-1,n-k}$	5.41 [.008]	3.02 [.021]	4.39 [.017]	6.52 [.000]	2.93 [.064]	2.22 [.069]	2.96 [.060]	3.12 [.015]
$N$	44	34	55	55	46	36	57	57
	Panel B. Dependent variable:							
	$G_3$				$G$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$I$	-.031 (.028)	-.033 (.029)			-.051 (.027)	-.054 (.027)		
$I_p$			-.034 (.029)	-.035 (.030)			-.055 (.027)	-.055 (.027)
$D$	.022 (.037)	.027 (.048)	.002 (.040)	.008 (.042)	.002 (.051)	.017 (.052)	-.027 (.054)	-.024 (.053)
$\Delta \ln P_b$		.146 (.086)				.132 (.061)		
$\Delta \ln S$		.080 (.238)		.047 (.065)		-.055 (.167)		.001 (.053)
$\Delta \ln P_s$		3.00 (2.40)		.649 (.219)		.806 (1.02)		.644 (.194)
$\Delta \ln e$		2.07 (2.22)		.504 (.304)		-.254 (1.35)		.433 (.266)
Constant	.016 (.034)	.023 (.037)	.026 (.032)	.027 (.033)	-.049 (.046)	-.047 (.046)	-.032 (.041)	-.032 (.041)
$F_{k-1,n-k}$	0.83 [.439]	2.91 [.017]	0.89 [.415]	3.53 [.006]	1.07 [.387]	2.16 [.033]	1.12 [.361]	2.62 [.010]
$N$	64	54	75	75	135	115	157	157

**Table 3.13**  
**Effect of increase in Political Instability on Economic Growth after Independence**

	Independent Variable			
	$G_1$	$G_2$	$G_3$	$G$
$\Delta G$	-.053	-.053	-.007	-.013
$\Delta I$	.24	.24	.24	.24
$\alpha$	-.161	-.111	-.038	-.055
<i>Est. Effect</i>	-.038	-.027	-.009	-.013
<i>Percentage</i>	71.7	51.0	128.6	100.0

Note:  $\Delta G$  is the observed decline in the rate of growth after independence. It was calculated as the difference between mean growth in the period from 1821 to 1857 and the period between 1750 and 1800.  $\Delta I$  is the observed change in political instability after independence. It is the mean difference in political instability between the 1821-1857 and the 1750-1810 period.  $\alpha$  is the estimate used for the effect of political instability on economic growth. *Est. Effect* is the effect estimated on economic growth due to the increase in political instability after independence. *Percentage* is the proportion of the observed change in the rate of growth that can be explained by the increase in political instability.

same weights that I employed for the post-independence period. The estimated effects on growth appear in the fourth row.

The fifth and last row of Table 3.13 displays the estimated decline in the growth rate that is due to political instability, as a proportion of the actual decline. The results show that between 50 and 100 per cent of the decline was due to increased political instability. The first and second column attribute 72 and 51 per cent of the decrease to instability. The third column overestimates the effect of political instability, and the fourth column attributes to political instability the totality of the drop in the growth rate.

In summary, this section has shown two important results. First, an important cause of the increase in the growth rate after 1867, during the Restored Republic and the Porfiriato, was political stability. Between 50 and 88 per cent of the increase can be attributed to the stability of the period. Second, a large fraction of the decline in the growth rate during the “lost decades” after independence was related to the increase in political instability. It is responsible for about 50 to 100 per cent of the reduction.

### **3.7 Conclusions**

This essay studied the connection between economic growth and instability during the most politically turbulent period in Mexican history, the post-independence period in the nineteenth century. Political instability implied economic policy uncertainty, no public programs for development, but most important, violence, lack of property rights, and other forms of disorder that led to risk of loss for economic actors and that might have discouraged investment. I also argued that the origin of these disputes was exogenous from an economic standpoint. Political differences were based on ideological disagreement among political and economic agents.

Political instability was measured by a combination of four variables: Annual changes in the executive post; regional, caste and peasant wars; number of parallel governments; and foreign wars. To increase the sample size, an additional measurement

excluded regional wars. But the general results applied to either of these indexes. There is strong evidence of a negative link between instability and growth.

Economic growth was proxied by the growth of Tax and/or Ordinary Income of the Federal Government. The results are robust to different measures. Also, Static, Finite Distributed Lag, and Infinite Distributed Lag models were estimated, including and excluding a number of control variables. These variables were the change in the price of Mexican bonds in the London market, the growth in silver production and its relative price in terms of gold in international markets, and the depreciation of the Mexican peso with respect to the U.S. dollar.

The growth in the price of Mexican government bonds was related positively to economic growth, as expected. This variable may be measuring the expectation of the international public on the future stability of the Mexican economy, and therefore a positive link was likely. The growth in silver production also resulted positively related to growth. The rationale for this result is that the growth in silver production may be related to the rate of employment. Finally, I did not find any evidence of a significant relationship between growth and the depreciation of the Mexican peso with respect to the dollar. Most of these results did hold when I instrumented political instability and when the different measurements of growth were combined.

This paper showed that political instability harmed Mexican growth during the 40 or 50 years of the post-independence period. And foreign wars contributed a lot to it. Between 50 and 88 per cent of the increase in the growth rate after 1867 can be attributed to the stability of the period. And most important, political instability is responsible for about 50 to 100 per cent of the reduction in the growth rate during the four or five “lost decades” after independence. It was an important factor that made Mexico fall behind.

## **Appendix**

Fiscal variables are originally expressed in fiscal years. In this essay, they were transformed to calendar year by the following formula:

$$y_t^c = \frac{a}{A} y_{t-1,t}^f + \frac{b}{B} y_{t,t+1}^f$$

where  $y_{t,t+1}^f$  is the value of the variable in fiscal year  $t$  to  $t+1$ . The numbers  $a$  and  $b$  are the number of months of year  $t$  in fiscal years  $t-1$  to  $t$ , and  $t$  to  $t+1$ , respectively.  $A$  and  $B$  are the total number of months on those fiscal years.

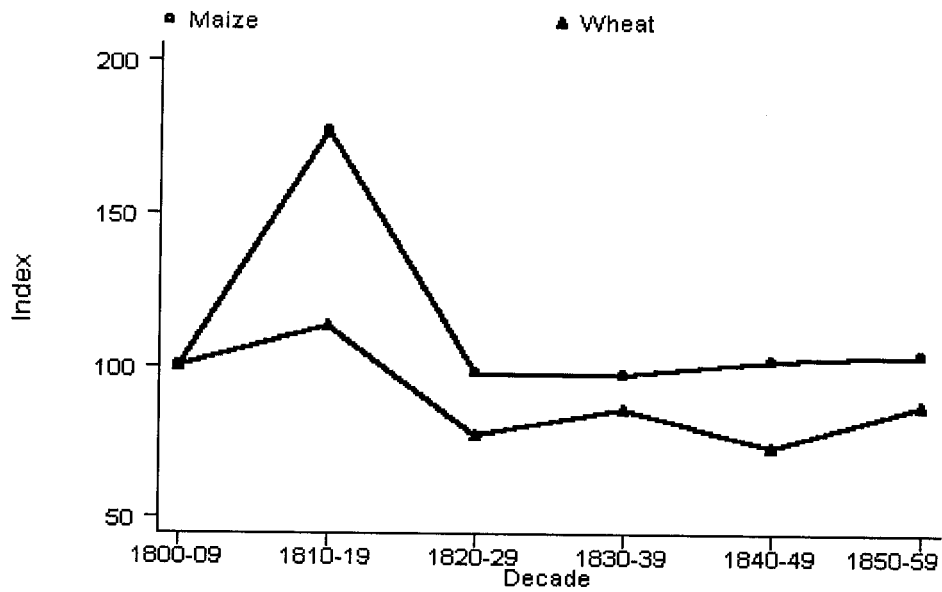
The evidence on prices does not reveal any long-run pattern of inflation in our period of interest. Figure 3.9 presents data from Chowning (1997) on decade average maize and wheat prices in Michoacan from 1800 to the 1850s. They are expressed in the form of index base 1800-09. The independence war brought a 77 per cent increase in maize prices and a 13 percent rise in the price of wheat. However, as early as the first decade of the independent period, in the 1820s, maize prices returned to pre-war levels and wheat prices were even lower than that. From then on, maize prices increased only slightly, remaining almost stagnant to the 1850s, when they were 4 per cent higher than at the start of the century. On the other hand, wheat prices fluctuated from decade to decade, but always staying below pre-war levels. In brief, it seems that independence only had temporary effects on maize and wheat prices, and that these effects disappeared with the end of the war.

The story is somewhat different for sugar and beef prices, which are displayed in Figure 3.10. Again, these are Michoacan decade averages presented by Chowning (1997). During the decade of war in the 1810s, sugar prices increased 115 per cent, while beef prices rose by 36 per cent. In the 1820s, after the war, sugar prices decreased, but remained almost 50 per cent higher than pre-war levels, while beef continued increasing. In the next decade of the 1830s, both prices declined, but again, they stood higher than at the start of the century. Pre-war levels or so were reached until the decade of 1840-49. It is more difficult to say that the Mexican independence war had a short temporary effect on sugar and beef prices.

Additional price series are very scarce for the most part of nineteenth century Mexico. This is in contrast to their availability for the eighteenth and very late nineteenth

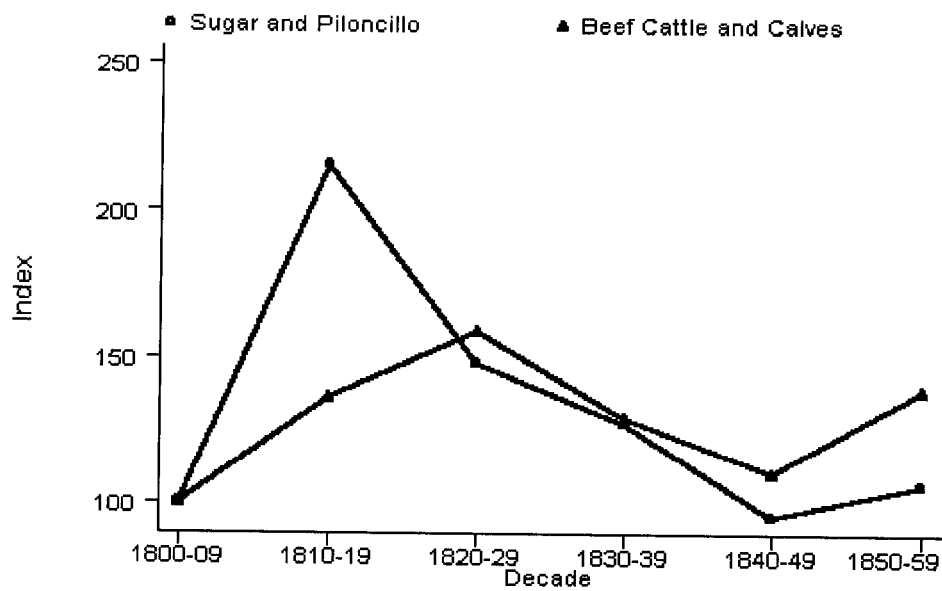


Figure 3.9 Maize and Wheat Price Indices in Michoacan, 1800-1860.



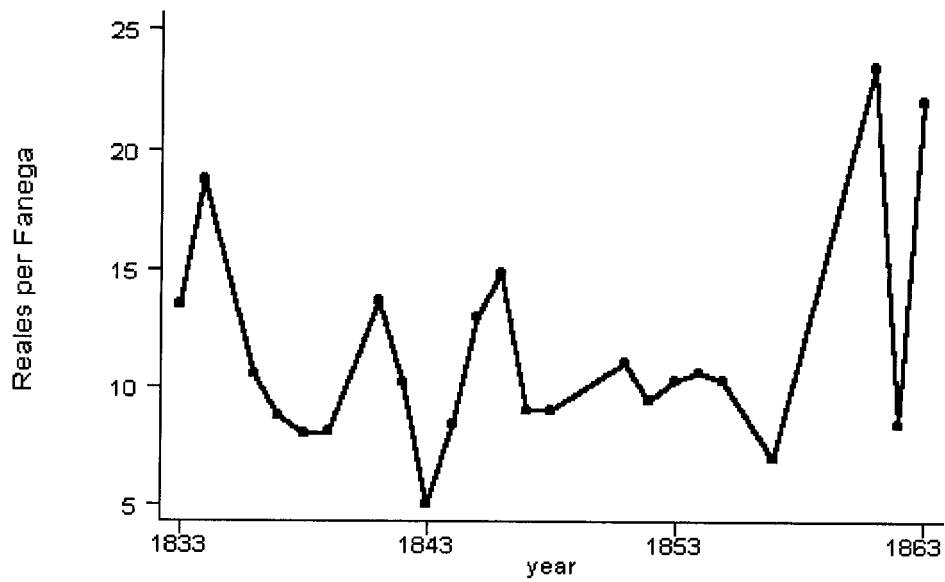
Source: Chowning (1997).

Figure 3.10 Sugar and Beef Price Indices in Michoacan, 1800-1860.



Source: Chowning (1997).

Figure 3.11 Maize Prices in Leon-Silao, 1833-1863.



Source: Brading (1978).

Figure 3.12 Hacienda Sale Prices in Michoacan, 1800-1856.



Source: Chowning (1997).

centuries. Nonetheless, some yearly maize prices in Leon-Silao are available from Brading (1978), and they cover the period from 1833 to 1863. These observations are displayed in Figure 3.11, and they confirm the idea that maize prices were relatively constant from the 1830s to the 1850s, as shown in Figure 3.9 for Michoacan.

Figure 3.12 displays estate or hacienda sale prices in Michoacan from the 1800s to the 1850s. It seems that the independence war reduced estate prices by 43 per cent, or perhaps more since information is available for the 1811-29 period, not for the 1811-19 period. Some recovery occurred in the 1830s and 1840s, and pre-war levels were reached in the 1850s. In the 1830s, estate prices were 25 per cent lower than at the start of the century, while in the 1840s they dropped a little more, situating 30 per cent lower than in the 1800s. But they reached pre-war magnitudes in the early 1850s.

In summary, some prices adjusted immediately after the war, like maize and wheat. Other prices, including real estate, adjusted more slowly towards pre-independence levels. This could be a signal for long term effects of the 1810-1821 war, or it could also be a signal of rebellions and other types of instability in areas where sugar and beef were produced, and where private estates were prevalent.<sup>45</sup>

The index of political instability  $I$  was constructed as a linear combination of the following variables: number of changes of executive ( $z_1$ ), number of regional, peasant, and caste wars ( $z_2$ ), number of parallel governments ( $z_3$ ), and a dummy variable indicating a foreign war ( $z_4$ ). The variables were standardized and the weights in the expression  $I = \sum \delta_i \cdot z_i$  were chosen using the first component in the principal component method. The results were  $\delta = (.22, .29, .65, .67)$ . The first component explains 40 % of the total variance.  $I^p$  excluded  $z_2$ , and the weights were  $\delta^p = (.37, .63, .68)$ . The first component explained 90 % of the total variance.

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<sup>45</sup> We could expect that the money supply also affected prices, but in this case, there is no evidence of continuous growth in prices that could be consistent with the continuous growth of silver (See Figure 1).

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