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Essays on Economic Integration, Political Separatism, and Democracy

presented by Romain Wacziarg

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Date May 1, 1998

Essays on Economic Integration, Political Separatism and Democracy

A thesis presented

by

Romain Wacziarg

to

The Department of Economics

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the Subject of

Economics

Harvard University

Cambridge, Massachusetts

May 1998

Abstract

Recent decades have been characterized by increasing economic integration, mounting political separatism and the diffusion of democratic institutions. The four essays in this thesis are devoted to analyzing some of the economic causes and consequences of these three waves. Throughout, the emphasis is placed on the relationship that market size, country size and democracy bear with economic growth. Chapter I shows that market size is an important determinant of a country's degree of internal product market competition. Consequently, dynamic gains from trade liberalization can be derived from endogenous changes in the extent of market power. Chapter II decomposes the effect of trade policy on economic growth into several channels, demonstrating empirically that dynamic gains from trade policy openness arise mainly from increased rates of physical capital accumulation. Chapter III shows that increases in market size, through a reduction in trade barriers or lower transportation costs, increases the likelihood of political separatism. Indeed, when the number of countries is determined by a trade-off between the benefits of increasing returns to scale and the costs of heterogeneity, economic integration reduces the need for a large domestic market, thus raising the optimal number of countries. Finally, Chapter IV examines the channels whereby democratic institutions may affect an economy's rate of per capita income growth. While democracy has a positive impact on growth through a faster rate of human capital accumulation and reduced income inequality, these gains are more than entirely offset by its negative impact on the rate of physical capital accumulation.

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The members of my thesis committee have all, in different ways, had a great impact on my years at Harvard: Dale Jorgenson, who is largely responsible for my pursuing a career as an academic economist, has constantly guided me with both advice and encouragement. Not only did he teach me econometrics, he also taught me how to turn a theoretical hypothesis into an empirically testable prediction. From Robert Barro, I have learned most of what I know about economic growth. Through his books or lectures and through our conversations, he showed me the value of provocation and the necessity of humor. Lastly, Alberto Alesina taught me how inseparable economic problems are from their political environment. The door of his office was always open to me, even when he was out of town, and I have benefited from this permanent invitation more than from anything Harvard has had to offer.

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To Catherine Corre

Contents

Chapter I - Introduction

Recent decades have been characterized by increasing economic integration, mounting political separatism and the diffusion of democratic institutions. Figure 1 shows that the ratio of imports plus exports to GDP, averaged over 61 countries, has increased from 43.2% in 1950 to 60.6% in 1992. Similarly, the number of countries has increased from 72 in 1945 to 192 in 1996 (Figure 2). Finally, plotting an index of democracy averaged over 98 countries, Figure 3 displays a steady increase in the level of democracy since the early 1970s. The four essays in this thesis are devoted to analyzing some of the economic causes and consequences of these three waves. Throughout, the emphasis is placed on the relationship that market size, country size and democracy bear with economic growth.

Chapter I studies the effects of trade liberalization on economic growth by focusing on the interaction between market size and market structure. It has long been recognized that trade liberalization could yield static gains from trade through an increase in the degree of product market competition, as domestic producers face the competitive pressure of their foreign counterparts. This chapter takes a different view of the procompetitive effects of trade liberalization, by emphasizing the role of market size: an expansion of the market, for example through trade liberalization, raises the degree of internal product market competition, as more producers find it profitable to operate when market size expands. Contrasting with much of the past literature, the gains from trade are not obtained through increased international specialization or through enhanced technological progress. Rather, the pattern of specialization and the level of technology can be held fixed and the emphasis is on endogenous shifts in the degree of market power.

These ideas are formalized in the context of a dynamic, open economy, general equilibrium model which explicitly endogenizes market structure. The number of firms is determined both by a fixed cost of entry and by the extent of the market. A move toward free trade expands market size, so that more firms find it profitable to incur the entry cost. As more firms enter, the degree of competition rises and the economy converges to a new steady state level of income.

This theory is confronted to cross-country and within-country evidence. An important prediction of the model is that the dynamic gains from trade openness are obtained through

an increase in the domestic rate of investment, since new firms have to pay a fixed cost, in terms of installed physical capital, to enter the markets for their respective products. This hypothesis is consistent with cross-country evidence pointing to the investment rate as the main channel linking trade openness and growth, and receives further empirical support in Chapter II. A second prediction of the model is that the impact of trade openness on the rate of investment should be mediated by country size: larger countries should experience lower dynamic gains from trade than smaller countries, as producers there already have access to a large internal market. Cross-country evidence lends much support to this hypothesis, which is further confirmed in Chapter III.

Turning to within-country empirical evidence, we examine twelve cases of trade liberalization, to determine whether these episodes were accompanied by a process of entry onto domestic markets. Using a new data set on the number of establishments and enterprises, we uncover an important effect of trade liberalization on the entry of new firms. To further evaluate the relevance of the model, we examine whether abstracting from specialization effects, a key assumption of the model, is warranted. Surprisingly perhaps, we find that trade policy has practically no power in explaining shifts in the intersectoral composition of output. Given the importance of specialization in most discussions of gains from trade, this finding opens up very interesting avenues for future research.

Chapter II is concerned with quantifying the effect of trade policy openness on economic growth. Here, the focus is on trying to evaluate empirically the merits of several theories of dynamic gains from trade, through an attempt to precisely quantify the channels whereby trade policy openness affects economic growth. This is done in the context of a panel of 57 countries, between 1970 and 1989. We first develop a new measure of trade policy openness, based on the effective policy component of trade shares, and use it in a simultaneous equations system aimed at identifying the effect of trade policy on several determinants of growth.

The results of Chapter II suggest a strong positive impact of trade policy openness on economic growth, with the accelerated accumulation of physical capital accounting for more than one half of this total effect. Smaller effects operate through technological transmissions and improvements in the quality of macroeconomic policy. This decomposition is robust with respect to alternative specifications and time periods. We also successfully test whether

the empirical specification exhaustively captures the effects of trade policy on growth.

Chapter III, written jointly with Alberto Alesina and Enrico Spolaore, focuses on the interplay of economic integration and political separatism. We argue that trade liberalization and political separatism go hand in hand. In a world of trade restrictions, large countries enjoy economic benefits, because political boundaries determine the size of their market. In a world of free trade and global markets even relatively small cultural, linguistic or ethnic groups can benefit from forming small and homogeneous political jurisdictions that peacefully trade and are economically integrated with others.

The chapter starts with a simple model of the relationship between economic integration and economic growth. When there are costs to trading - whether they are transportation costs, policy induced barriers or other institutional impediments to the free flow of goods and services - larger countries should expect to reap smaller gains from trade than smaller countries - both in a static and in a dynamic sense. Cross-country evidence on growth confirms the theoretical hypothesis: the economic benefits of country size depend on and are mediated by the degree of openness to trade, in the sense that smaller countries stand to gain more from being economically integrated.

The theoretical model is then augmented to allow for the endogenous determination of the number and size of countries. For a fixed level of trade barriers, being a larger country yields economic benefits. How ever, we assume that agents dislike heterogeneity, and that heterogeneity is increasing in country size. This assumption is based on the idea that, in large jurisdictions, it is more difficult for heterogeneous agents to agree on a common set of policies. Therefore, chosen policies are likely to generate more dissatisfaction in larger countries. The trade-off between scale and heterogeneity determines an optimal size of countries, as a function of the world trade regime, among other things. The central result of the paper is that the optimal number of countries is increasing in the degree of trade openness. To provide empirical support to this hypothesis, we turn to a historical appraisal of the relationship between world trade and secessions. We show that the history of Nation-State creations and secessions since the early 19th century has been greatly influenced by the trade regime. Periods of high trade openness were generally accompanied by waves of political separatism, while building empires was often justified on the basis of a need to expand markets in the context of a protectionist trade regime.

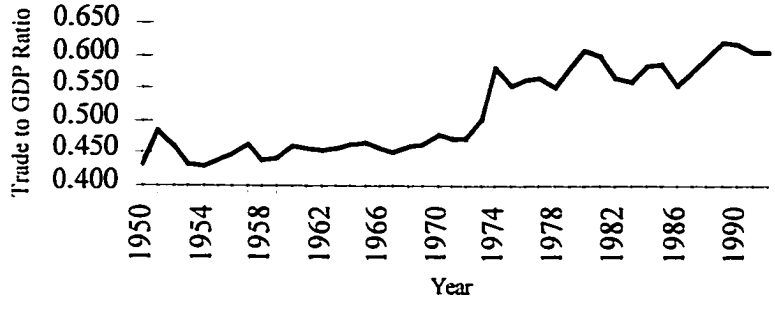
Chapter IV, joint with José Tavares, employs the same methodology as Chapter II to examine the empirical relationship between democracy and economic growth. Democratic institutions are assumed to affect growth only through a series of channels of causation, in accordance with a procedural view of democracy. This stands in sharp contrast with previous studies, which focused on the direct effect of democracy on growth, conditional on other growth-determining factors. We argue that if such a comprehensive institution as democracy matters for growth, it should matter indirectly through its effect on variables that in turn determine economic growth: existing theoretical arguments point to links between democracy and a number of societal characteristics that influence economic growth, but none of them suggest that it should have a direct impact on growth, as would be the case if it entered explicitly in the production function of the economy.

To quantify the channel effects of democracy, we specify and estimate a full system of structural equations determining growth and the channel variables. Results suggest that democracy fosters growth by improving the accumulation of human capital and lowering income inequality. It hinders growth by reducing the rate of physical capital accumulation and, less importantly, by reducing the degree of openness to trade. Once all these indirect effects are accounted for, the overall effect of democracy on economic growth is moderately negative and statistically insignificant.

A possible interpretation of these results is that democratic institutions are responsive to the demands of the less well-off by increasing access to education and lowering income inequality, but do so at the expense of physical capital accumulation. The latter effect dominates, but higher human capital and a more equitable society are valued in themselves beyond their impact on income levels.

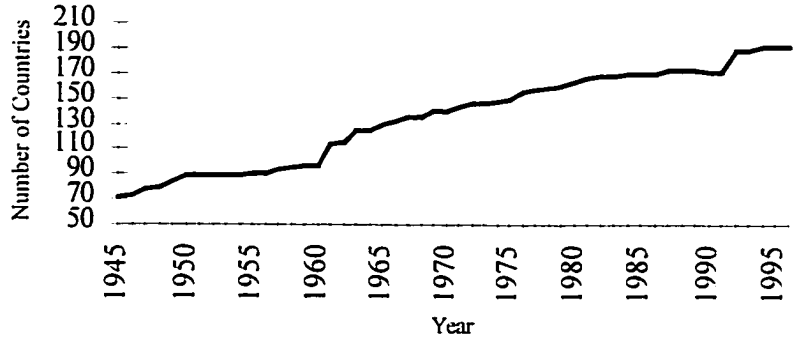
This thesis casts a positive light on the trends described in the opening sentences of this introduction. Economic integration is likely to foster international competition and to generate important gains in terms of per capita GDP. Political separatism in the context of a global economy will allow heterogeneous groups to reap the benefits of sovereignty without incurring the costs of smaller markets. And democratization, while it may be moderately deleterious for economic growth, entails non-economic benefits that are desirable in themselves.

Figure 1 - Trade to GDP Ratio, 1950-1992, averaged over 61 countries



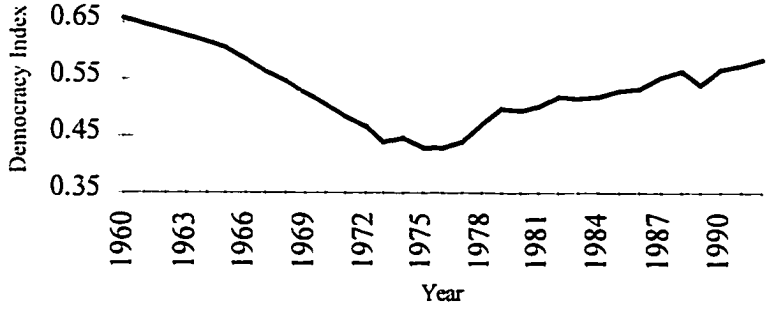
Source: Summers and Heston (1994)

Figure 2 - The Number of Countries since 1945



Source: Alesina, Spolaore and Wacziarg (1997)

Figure 3 - Democracy Index, 1960-1992, averaged over 98 countries



Source: Bollen (1960, 1965), Gastil (1972-92)

Chapter I. Trade, Competition and Market Size

1 Introduction

Recent developments in international trade theory have closely mirrored advances in the theory of economic growth. Both areas of inquiry have come to recognize the importance of increasing returns to scale and more generally of imperfect competition in shaping our view of the economy.[1] This has led to considerable progress in our understanding of issues such as the incidence of market size on economic performance and the role of technological innovation as a source of long-term growth, in a dynamic open economy framework. However, these theories maintain the assumption of a fixed market structure, making the study of the procompetitive effects of trade liberalization difficult.[2] This paper attempts to take the trade and growth literature further by explictly endogenizing market structure.

By far the most widely researched aspects of trade liberalization have to do with its impact on the specialization of production and on technological progress. The dynamic interpretation of competitive trade theory stresses that trade openness raises the overall efficiency of the economy as well as transitional growth rates, by allowing countries to specialize according to the pattern of comparative advantage.[3] In open economy endogenous growth models, trade liberalization may generate sustained growth through the interplay of external effects linked to knowledge accumulation and the specialization of production. Most

[1] A thourough investigation of the implications of imperfect competition in the context of static trade theory can be found in Helpman and Krugman (1985). Theories of growth based on endogenous technological innovation generally rely on imperfectly competitive supply sides. See for instance the discussion in Aghion and Howitt (1997) and the models in Grossman and Helpman (1991).

[2] For closed economy growth models in which market structure is endogenous and changes along the growth path, see Peretto (1995) and Gali (1995). For general equilibrium trade and growth models with imperfect competition (but exogenously fixed market structure), see the seminal work of Grossman and Helpman (1991), among many others. For static trade models with procompetitive changes in pricing behavior by a fixed number of market participants, see, for example, the discussion of monopoly in Bhagwati and Srinivasan (1983) Chapters 19 and 20.

[3] For example, Ventura (1997) presents a model combining Ramsey's neoclassical growth model with the competitive trade theory of Hecksher-Ohlin. In this theory, an open world is characterized by factor price equalization and specialization of production.

of these theories share a common characteristic: they consider the effects of openness through specialization and technological progress, holding market structure fixed. This paper does the exact opposite: it studies the endogenous determination of market power assuming that each country produces a given set of differentiated goods and uses a fixed technology. The assumptions of full specialization and fixed technology allow us to distinguish the traditional effects of trade liberalization from its procompetitive effects.

In this context, trade liberalization generates growth solely through its effect on domestic market power. The number of firms is determined by a fixed cost of entry and by the extent of the market: trade liberalization expands market size, thereby raising profits, so that more firms find it profitable to incur the fixed cost of entry. This leads to a dilution of market power. The model is cast in a dynamic framework: the entry of new firms requires large initial investments in capital, as new entrants need to set up factories and infrastructures before they can operate. This will point to the rate of investment and market size as important channels linking trade openness and economic growth.

We examine the empirical relevance of the model by testing several of its predictions. We find considerable evidence that trade openness affects growth through the rate of investment, and that the rate of investment is positively related to the size of the market. Furthermore, we use a new dataset from UNIDO (1997) to examine the entry of new firms and changes in the sectoral composition of manufactured output before and after episodes of trade liberalization. We uncover a significant positive association between the process of liberalization and the entry of new firms. We also provide justification for keeping specialization fixed, by showing that trade openness does not seem to generate the important shifts in the pattern of production suggested by traditional theories of trade.

This paper is organized as follows: Section 2 presents a model of trade and growth with endogenous market structure. Section 3 contains extensions of the model allowing for open capital markets and technological progress. Section 4 presents empirical evidence consistent with the model, based both on cross-country evidence and on the study of twelve liberalization episodes.

2 The Model

The model has a very standard general equilibrium structure. Consumers in country j ($j = 1...N$) demand a non-tradable homogeneous final good. This final good is assembled in a perfectly competitive context, using a continuum of differentiated goods G_{ij}, with i ranging from 0 to 1.[4] Intermediate goods are either produced domestically or imported. We assume that countries are fully specialized from the outset, so that each country produces a different given segment along the $[0, 1]$ interval. As argued earlier, we make this assumption in order to avoid confusing the specialization effects of liberalization with its procompetitive effects. Consumers optimize intertemporally. They own the stock of capital which they can increase through savings.

Domestic production of the differentiated goods is imperfectly competitive: in each sector, a set of oligopolists faces the demand emanating from producers of the final good, and employ a unique factor of production, capital. They can operate by paying a one time fixed cost in capital, and entry onto each oligopolist's market is free. Demand will determine the size of the market, and the oligopolists' profits. This in turn will pin down the number of firms and market power. Finally, there is an ad valorem tariff τ_j imposed on all goods entering country j. Tariff rates are exogenous and tariff revenues are redistributed lump-sum to domestic consumers.

2.1 Demand

2.1.1 The Demand for Differentiated Goods

We assume that the technology for producing the homogeneous final good has the following Cobb-Douglas form:

$$Y_j = \exp\left[\int_{i=0}^{1} \log G_{ij} di\right] \tag{1}$$

where i denotes the good consumed and j denotes the country under consideration. This specification of the production function implies a preference for diversity in the mix of

[4] As indicated in Grossman and Helpman (1991, chapter 3), this formulation is exactly equivalent to one in which the consumers demand the differentiated goods directly. Under this interpretation, the utility function of the representative consumer must have the same form as the production function for the final homogeneous good.

differentiated goods, and these goods display a unit elasticity of substitution.[5] Without loss of generality, we consider the problem faced by agents in one country, denoted the "domestic" economy. In what follows we denote the domestic economy by the subscript d and the rest of the world by the subscript w. To simplify the algebra, we will assume that all foreign countries impose the same tariff τ_w on the domestic economy, and that they trade freely amongst themselves.[6] Since we have assumed that the final goods sector is perfectly competitive, final goods producers take as given the prices of differentiated goods, P_i, as well as the price of the final good, denoted P_d^f. The competitive set of final goods producers maximize profits $P_d^f Y_d - E_d$, where:

$$E_d = \int_{i=0}^{\delta} P_i G_{id} di + \int_{i=\delta}^{1} (1+\tau_d) P_i G_{id} di \tag{2}$$

and δ denotes the (exogenous) share of differentiated goods produced in this country (i.e. the goods for which domestic oligopolists own blueprints). The country will import goods δ to 1, and export goods 0 to δ. Full specialization implies that no other country produces these goods. Under perfect competition, profits will be zero in the final goods sector, so that $E_d = P_d^f Y_d$. This allows us to relate nominal expenditure to the real value of output.

The first order conditions for maximization by domestic and foreign agents allow us to derive the total demand D_i, facing producers of each of the domestic varieties. This demand is divided into domestic and foreign demand, i.e. exports:

$$D_i = \frac{1}{P_i}\left[E_d + \frac{E_w}{1+\tau_w}\right] \text{ for } 0 \leq i < \delta \tag{3}$$

where $E_w = \sum_{j=2}^{N} E_j$ is total foreign expenditure.

With our simple specification of the production function in equation (1), the demand facing each domestic sector takes a particularly simple form: it is equal to the size of the market divided by the price of the good. We can define the size of the market, S_d, as: $S_d = E_d + \frac{E_w}{1+\tau_w}$.

[5] In fact, the production function is a special case of the often used Dixit-Stiglitz or CES technology, in which the elasticity of substitution has been set equal to 1. Although the results of the model do not change when generalizing to a CES, the algebra becomes significantly more tedious.

[6] This assumption turns our model into a two-country world, composed of the domestic economy and the "rest of the world".

2.1.2 The Price of the Final Good

We can derive the price of the final good, P_d^f, which has to equal the unit cost of production in this competitive, constant returns context. Using the first order conditions for profit maximization by the producers of final goods, taking logs and integrating over $[0,1]$, we obtain the "price equals unit cost" relationship:

$$P_d^f = \exp\left[\int_{i=0}^{\delta} \log P_i di + \int_{i=\delta}^{1} \log\left[(1+\tau_d) P_i\right] di\right] \tag{4}$$

When the prices of domestic differentiated goods are all equal to P_d, as will be the case by symmetry (all sectors are identical), we can write:

$$P_d^f = P_d^{\delta} (1+\tau_d)^{1-\delta} P_w^{1-\delta} \tag{5}$$

where P_w denotes the price of foreign differentiated goods.

2.1.3 Intertemporal Consumption Decisions

We employ a very familiar framework to characterize the intertemporal aspects of consumer behavior. An infinitely-lived representative agent consumes final output and accumulates capital through savings; she receives income from ownership of the stock of capital as well as tariff revenues. The instantaneous budget constraint is therefore:

$$E_d = P_d^f \left[C + \dot{K}\right] = r_d P_d^f K + \tau_d \int_{i=\delta}^{1} P_i G_{id} di \tag{6}$$

In other words, consumption plus savings equal capital income and tariff revenues, both of which accrue to consumers. Capital is accumulated, very conventionally, by diverting resources from consumption: each unit of the final good can be costlessly transformed into a unit of capital. We assume the following logarithmic intertemporal utility function:

$$U_d = \int_{t=0}^{\infty} e^{-\rho t} \log C(t) dt \tag{7}$$

Solving for the growth rate of consumption, we obtain, very conventionally:

$$\frac{\dot{C}}{C} = r_d(t) - \rho \tag{8}$$

2.2 Supply

2.2.1 The Oligopolistic Sector

We assume that each good along the interval $[0, \delta)$ is produced by J_d oligopolists using a single factor, capital, in quantity k_i, to produce a quantity G_i according to the simple constant returns technology:

$$G_i = \alpha k_i \tag{9}$$

α is the productivity of capital, assumed to be identical across sectors and across countries. Each domestic oligopolist faces an interest rate r_d determined at every moment by the equalization of the demand for capital emanating from all domestic sectors, and the total supply of capital K_d. The return to capital is taken as given by each oligopolist even though capital is not mobile internationally. This is because the demand for capital from each oligopolist has measure zero within each country (each domestic sector is infinitesimally small).[7]

Oligopolists rent capital from its owners, the consumers. The value of one unit of capital is P_d^f. Hence when the capital stock is K_d oligopolists must pay $r_d P_d^f K_d$, in aggregate, at each point in time. Marginal cost is $r_d P_d^f / \alpha$.

We will first examine the equilibrium profits, output and prices for the domestically produced goods in the case where J_d oligopolists operate in each domestic sector. For simplicity we drop the sector subscript i: all sectors share the same technology so they will all supply the same quantity at the same price in equilibrium. The first step is to characterize the behavior of oligopolists engaging in Cournot competition. Given the demand function in equation (3), inverse demand facing each sector is:

$$P_d = \frac{S_d}{D_d} \tag{10}$$

Oligopolists in each domestic sector take S_d as given because they are infinitesimally small within their country. We also assume that oligopolists cannot discriminate between domestic and foreign customers. Thus, they each face a conventional downward sloping demand curve. In each given sector, firm k ($k = 1...J_d$) maximizes instantaneous profits by picking

[7] For the same reason, each oligopolist will take as given the aggregate price level, P_d^f, the aggregate expenditure level E_d, and all the foreign variables. The assumption of a continuum of sectors implies that the oligopolists' market power extends no further than their own market.

a quantity d_k. The unique Cournot-Nash equilibrium involves $d_k = D_d/J_d$. Solving the profit maximization problem for D_d and P_d we obtain:[8]

$$D_d = S_d \left(1 - \frac{1}{J_d}\right) \frac{\alpha}{r_d P_d^f} \tag{11}$$

and:

$$P_d = \frac{r_d P_d^f}{\alpha} \frac{J_d}{J_d - 1} \tag{12}$$

With a unit elasticity of substitution between goods, the relative markup over marginal cost (or Lerner index) is simply $1/J_d$. We can take this index as a measure of market power. For a fixed number of firms and a fixed interest rate, the price and the relative markup do not change with market size, even though the intermediate goods are partial substitutes. This stems from the fact that the oligopolists face a constant (and unit) elasticity demand curve. With a constant elasticity, shifts in the demand curve do not modify pricing behavior. As a consequence, in the absence of free-entry the only effect of an expansion of market size is to increase oligopoly profits, with no effect whatsoever on market power.[9]

Per-firm profits are the following:

$$\pi = \frac{S_d}{J_d^2} \tag{13}$$

Note that, as expected, the markup and per-firm profits fall with the number of firms. Price approaches marginal cost as J_d goes to infinity (equation (12)), and profits go to zero. For a fixed number of firms, profits are strictly increasing in market size; any policy that will raise the real value of S_d will also raise the real value of profits.

---

[8] Note that with our specification of preferences, the demand curves display a unit price elasticity. Hence, the case of monopoly is degenerate in this model, in the sense that a monopoly would like to charge an infinite price. The gains in terms of analytical tractability motivated the choice of preferences. Dixit-Stiglitz preferences generate the same intuitions but cannot be solved explicitly.

[9] Previous work on trade and growth, with exogenous market power, has identified market structure with the extent of substituability between goods (see for instance Aghion and Howitt, 1997). A high elasticity of substitution was associated with a more competitive market structure. Results on the impact of enhanced competition for growth and other outcomes were derived by varying this parameter. However, the process through which the extent of substituability may change was not generally modeled (for a recent exception, see Gali and Zilibotti (1995) and Gali (1995), in which demand elasticities are endogenous). Furthermore, the elasticity of substitution between goods is a matter of tastes or technology, and it is far from clear that changes in this parameter reflect what we commonly refer to as changes in market power. In fact, the present paper models endogenous market structure with a fixed (and unit) elasticity of substitution between goods.

2.2.2 The Number of Firms

We now turn to the determination of the number of firms. In modelling endogenous changes in market structure, we opt for simplicity. Obviously, the study of dynamic entry and exit is the object of a very large literature in the field of industrial organization.[10] However, we embed the simplest possible entry game into our model of trade and growth, in order to gain sharp insights into the effects of trade liberalization.

In the absence of a fixed cost of entry, in the long-run the number of firms will approach infinity and the "competitive limit" result will obtain. In the presence of a fixed cost F, however, the number of firms will be determined by a free-entry condition. We can think of the cost of entry as one of three possible prerequisites for productive activity: Firstly, a firm needs to install a set of machines, buildings, infrastructure, before it can start operating. Secondly, it needs to pay for permits, licenses, bribes and other institutional barriers to entry. Lastly, it may have to purchase blueprints or patents in order to obtain the technology it requires for production. We assume that the fixed cost takes the form of F units of capital, and we further assume that the fixed cost is not sunk: at any point in time the firm can cease to function and repay the principal of its debt by returning the fixed cost to the consumers.[11]

Since capital is the only asset in this economy, each entering oligopolist can only pay the fixed cost by renting F additional units of capital from consumers, and paying the corresponding interest. In this context, the natural way to solve for the number of firms would be to write that the present discounted value of per-firm profits has to equal the current value of the fixed cost. In our context, however, this interpretation in terms of a once-time cost is *equivalent* to one in which firms pay a fixed cost at every point in time, because we have assumed that this cost is never sunk: at every point in time, instantaneous profits must equal the payments made to cover the rental of the capital used towards the fixed cost. If profits are smaller than payments made for the fixed cost, the firm makes a

[10] For a thorough discussion of the dynamics of entry and exit, see Tirole (1988), Chapter 8.

[11] We model the fixed cost as exogenous. Obviously, an important dimension of an economy's degree of market competition is the extent of the fixed cost. Antitrust policies, the protection of property rights and governmental regulations directly affect F. However, since we are concerned with the effects of trade liberalization, we focus on the role of market size in determining the number of market actors. We will return to the issue of endogenizing F in sections 3 and 4.

net loss (and will cease to operate) and if they are greater more firms will find it profitable to enter. With this formulation of the problem, incumbent firms cannot deter potential entrants: the fixed cost is never sunk, and oligopolists must keep on paying interest on it as long as they operate, so that there is no advantage to incumbency. Indeed, assuming that the fixed cost is not sunk allows us to disregard important issues having to do with the process of entry, such as the possibility of threats, the endogeneity of barriers to entry or the contestability of markets, and to focus on the effects of liberalization.[12] The free-entry condition imposes that J_d be set so that:

$$\pi = \frac{S_d}{J_d^2} = r_d F P_d^f \tag{14}$$

This can be rewritten as:

$$J_d = \sqrt{\frac{S_d}{r_d P_d^f F}} \tag{15}$$

2.2.3 Trade Balance

The various budget constraints imply that trade will be balanced at every point in time. Indeed, we have not allowed domestic agents to own foreign assets. First, expenditure on the differentiated goods exhaust consumer's nominal income E_d (equation(2)). Second, oligopolists' interest payments to owners of capital must equal their total revenue (by the free-entry condition, equation (14)). Lastly, the consumer instantaneous budget constraint imposes that nominal expenditures equal receipts for the use of capital by oligopolists, plus tariff revenues (equation (6)). Combining these relationships we easily obtain the trade balance equation, i,e, the value of imports equals the value of exports when evaluated at international prices.

2.3 Equilibrium

We now seek to characterize the steady-state of the economy. In order to do so we need to solve for the capital stock, the level of nominal expenditure and the price of the final good. Having done so we will be able to relate the level of income, the capital stock and the

[12] In what follows, we also abstract from integer problems in the determination of the number of firms. The effective number of firms will be the closest smaller integer to the unrestricted solution for J; presumably, in this configuration some non-zero profits remain over and above the fixed cost. We assume these are small and neglect them.

number of firms to the tariff rate, in order to examine the effects of trade liberalization. To characterize the steady-state we assume that our economy is small; that is, it does not affect the level of foreign expenditures and prices. We can think of this assumption as implying that the model is being solve for a small δ. If δ is small enough, we can safely disregard the effect of the economy on the rest of the world.[13] Furthermore, we assume that the rest of the world is in a steady-state situation, so that foreign prices are constant. Given this assumption we normalize the price of foreign intermediate goods, P_w, to 1.

2.3.1 The Market for Capital

Oligopolists are infinitesimal on the market for capital and therefore take r_d as given. The capital market clears, and we assume for simplicity that capital does not depreciate. The interest rate adjusts so that aggregate demand for capital equals the stock of capital. In each sector:

$$k = \frac{D_d}{\alpha} + JF \tag{16}$$

where k is the per-sector capital stock. The aggregate capital stock, K_d, is simply: $K_d = \delta k$. Substituting for D_d and F, we obtain the following relationship, which must hold at every point in time:

$$K_d = \frac{\delta S_d}{r_d P_d^f} \tag{17}$$

2.3.2 Expenditure, Prices and Real Income

We can solve for the nominal expenditure level by substituting for K_d in the consumer's instantaneous budget constraint:

$$E_d = \frac{\delta\left(1+\tau_d\right)E_w}{\left(1-\delta\right)\left(1+\tau_w\right)} \tag{18}$$

The corresponding (nominal) size of the market is simply:

$$S_d = E_d + \frac{E_w}{1+\tau_w} = \frac{\left(\delta\tau_d+1\right)E_w}{\left(1-\delta\right)\left(1+\tau_w\right)} \tag{19}$$

[13] Future versions of this paper will incorporate the large country case. This requires solving for the domestic and the foreign economy simultaneously.

Note that these relationships hold even out of steady-state. In order to analyze the results in real rather than in nominal terms, we need to solve for the prices. Using the equation for the aggregate price level and the oligopolists' pricing equation, we can show that:

$$P_d^f = (1+\tau_d)\left[\frac{r_d}{\alpha}\frac{1}{1-\sqrt{\frac{r_d P_d^f F}{S_d}}}\right]^{\frac{\delta}{1-\delta}} \tag{20}$$

This defines an implicit function for the price of the final good, as a function of the parameters of the model. There is no closed form solution for this price, except in the case of $F = 0$ (perfect competition).[14]

2.3.3 Steady-State Analysis for a Small Country

The steady-state is characterized by a situation in which consumption, the capital stock and the number of firms do not grow.[15] Therefore, the steady-state rate of interest is set equal to ρ (equation (8)). Given total expenditure and the price level, we can compute national real income as E_d/P_d^f. In the steady-state this is also the real level of consumption and welfare. To analyze the steady-state we start from the fundamental pricing relationship, equation (20). We define:

$$\Omega\left(P_d^f\right) = (1+\tau_d)\left[\frac{\rho}{\alpha}\frac{1}{1-\sqrt{\frac{\rho P_d^f F}{S_d}}}\right]^{\frac{\delta}{1-\delta}} \tag{21}$$

Any equilibrium for the system will be characterized by the intersection of this function with the 45° line. Starting from this, we can prove the following proposition:

Proposition 1. In the small country case, there can be at most two equilibria for the steady-state values of income, the capital stock and the number of firms. Furthermore,

[14] In this case, it is clear that trade liberalization has no effect on steady-state real income E_d/P_d^f, which no longer depends on τ_d. We take this as a sign that our model has successfully isolated the competitive effects of trade liberalization: Under perfect competition trade liberalization has no effect (we have assumed away any other effect it may have, such as specialization effects or effects on technological progress).

[15] Since there is no population growth, no technological progress and no depreciation in this model, it is natural that the steady-state growth rate of the level variables be zero.

these equilibria are Pareto-rankable (Figure I).[16]

Proof: See Appendix.

The existence two, Pareto-rankable steady-states is an interesting feature of the model. It stems from the same source as the multiple equilibria found in Murphy, Shleifer and Vishny (1989). Namely, if firms need to overcome a fixed cost in order to operate, and there are demand spillovers across sectors, the model may exhibit several equilibria. Here, if firms in the final sector set a high price, the demand addressed to the intermediate sectors will be lower, and fewer of these firms will invest in overcoming the fixed cost. This will make the high final good price sustainable in equilibrium, as the intermediate sectors, which are more monopolistic, will set higher intermediate goods prices. The same reasoning applies to the low-price case. Therefore, one steady-state will be characterized by low prices, a relatively more competitive market structure and a higher level of welfare, and the other by high prices, a highly oligopolistic market structure and lower steady-state welfare.

Proposition 2. The Pareto superior steady-state is always *saddle-path stable*. The "bad" steady-state is always *unstable*.

Proof: See Appendix.

Proposition 2 allows us to restrict our attention to the saddle-path stable, Pareto superior steady-state. Indeed, the economy will never be observed in the unstable, Pareto-dominated equilibrium unless it happens to "start" exactly there and never deviates.[17]

Proposition 3. The Pareto-superior equilibrium is characterized by *procompetitive effects* of trade liberalization. Namely, a reduction in the domestic tariff rate raises the steady-state levels of income, capital and the number of firms.

Proof: See Appendix.

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[16] As shown in the Appendix, it is possible that an equilibrium does not exist, i.e. that the Ω function never crosses the 45° line. It is also possible that the Ω function will turn out to be tangent to the 45° line, a knife-edge case. In what follows, we rule out these uninteresting or unlikely cases and focus on the general case of two equilibria.

[17] In the unlikely event that the economy is "born" in a "bad" steady-state, any deviation from it, such as one triggered by trade liberalization or any other change in the underlying parameters, will lead it on the saddle path towards the new, Pareto-superior steady-state.

Proposition 3 is the central theoretical result of this paper. It describes the fundamental economic mechanism that we wish to document: Holding the pattern of specialization unchanged, a reduction in impediments to trade will result in an expansion of market size. This will tend to raise the *gross* profits of the exporters, i.e. the producers of intermediates, generating entry onto their markets. The entry process guarantees that the zero *net* profits condition is satisfied at every point in time. Entry involves paying a fixed cost in capital, which is not directly productive but enables more competitors to enter, thereby reducing prices and expanding real output. The transition to this new steady-state involves positive growth rates of income, the capital stock and the number of firms. Hence, the direct channel through which trade liberalization affects transitional growth rates in this economy is the rate of investment; and the channel through which trade liberalization affects incentives to invest is the expansion of market size.

2.3.4 Welfare assessments

The welfare statements that we have made up to now only refer to steady-states. Suppose that an economy starts out in a steady-state and that a tariff reduction is implemented. This economy will start moving towards a new steady-state, characterized by a higher level of income and consumption. Along the transition, it will start investing heavily in order to overcome the fixed costs, and the degree of competition will gradually increase. However, our economy does not conform to the assumptions of the first welfare theorem: it is characterized by the presence of imperfect competition, restricted trade and an overall monopoly of the country in the provision of goods 0 to δ. Since we are essentially in a second best case, we cannot rule out that the transition to the new steady-state may involve inefficient oversaving. In other words, we cannot say that reducing the tariff results in higher *intertemporal* welfare. The only welfare statement we can make refers to the steady-state itself. Hence, this model should be construed as an attempt to describe the effects of liberalization, not to evaluate its overall welfare properties.

3 Extensions

In this section we discuss informally two possible extensions to the basic model of Section 2. We do not provide complete solutions for these extensions. Rather, we indicate how the model could be modified to allow for open capital markets and technological progress, and how this is likely to affect the main results presented thus far.

3.1 Open Capital Markets

In Section 2 we have assumed that capital markets were closed, so that trade had to be balanced at every point in time. If we allow capital to flow internationally, then our small country will face a world interest rate $\overline{r} = \rho$. Any policy action that would tend to raise the steady-state capital stock will trigger an immediate entry of capital, and convergence to the new steady-state will be instantaneous.[18] In this case, we should observe a current account deficit after liberalization, as foreign capital flows in to take immediate advantage of the potential interest rate differential. In other words, the required increase in the investment rate, which is the sole channel through which liberalization affects growth in our basic model, will be attributable to foreign inflows rather than to domestic savings.

An increase in the share of the current account deficit to GDP after liberalization appears to be a rather common occurrence empirically. This provides justification for considering open capital markets. However, the result that convergence to the new steady-state is immediate does not seem realistic. Although we do not explicitly model our economy in the open capital markets case, a more plausible model would look as follows: As in the Ramsey growth model, allowing for convex adjustment costs in capital would restore transitional dynamics, and allow us to avoid the immediate convergence result. The intuition of what would happen in this case is clear: Part of the increase in domestic capital formation, resulting from liberalization, would be attributable to a current account deficit. The bottom line is that allowing for open capital markets would modify none of our results on the procompetitive effects of trade policy. The only change has to do with the source of the required increase in the capital stock: Some of this increase is now financed by international borrowing.

[18] This is exactly what happens in the simplest open economy version of the Ramsey growth model (Barro and Sala-i-Martin, chapter 3).

3.2 Competition and Technological Progress

The model presented in Section 2 has neglected the issue of technological progress, in order to focus on endogenous changes in market structure. However, a common argument in endogenous growth theory points to the fact that incentives for the accumulation of knowledge are largely a function of market structure (Aghion and Howitt, 1997). In particular, new theories of growth have rediscovered an old Schumpeterian argument, stressing the importance of monopoly rents as a reward for innovation. The protection of intellectual property rights is justified, in this context, by the fact that inventors have to be provided with incentives to innovate.[19]

In the context of models with endogenous knowledge accumulation, the efficiency gains from enhanced competition (in terms of product market pricing behavior) may be partly or entirely offset by the lowered rewards to innovation. However, this latter force is not present in our model, even if we consider technological progress explicitly. This is due to our focus on market size, rather than on the extent of the fixed cost itself, as a driving force towards enhanced competition. We can employ a very simple example to illustrate this point. We can interpret the fixed cost F as the resources that must be devoted to innovate, for example the cost of developing a new production process for the differentiated goods, involving a productivity of capital equal to α. Suppose that every time a *new* firm enters on a given market, α is increased by some amount, and further assume that existing firms can costlessly adopt the new technology (every existing firm was an innovator when it first entered, and is now an imitator). Under these conditions, the innovation immediately spreads to existing firms, who all adopt the superior technology. In this case the pure procompetitive benefit from entry is actually supplemented by faster technological progress: While the reward to innovating, equal to oligopoly profits and thus to F, have not changed, the number of firms willing to pay the cost of innovation has actually risen as a result of trade liberalization.

To summarize, in the model of Section 2, F was exogenous and fixed. Our procompeti-

[19] For a recent model with this flavor, see Barro and Sala-i-Martin (1995), Chapter 6. In this model, innovators hold an initial monopoly in the markets for the new varieties that they create. Entry onto their markets takes place exogenously: at every point in time there is a fixed probability that their monopoly power will be diluted by the entry of some competitor. This probability partly determines their decision to innovate in the first place, and therefore the rate of growth of the economy. We can think of countries with poor systems for enforcing intellectual property rights as having a high probability of entry.

tive effect relied solely on changes in the size of the market, not on changes in the oligopoly rents (all of which are used to pay the fixed cost). Since we focused on the role of *market size* in shaping market power, the effects of trade liberalization do not involve eroding the reward that innovators perceive in the form of oligopoly rents. On the contrary, by increasing the number of firms, all of which make the same intertemporal profits F, and therefore perceive the same reward to innovate, trade liberalization may actually spur technological progress.

4 Liberalization, Competition and Growth

In this section we discuss the empirical implications of the paper and provide support for the predictions of the model. Section 2 has stressed the importance of changes in market power as a determinant of the growth effects of trade liberalization. However, it is difficult to obtain comparable time series data on the extent of market power for a sufficiently large number of countries. Hence, instead of providing a single "test" of the model, we examine several of its predictions. We start by focusing on the role of investment and market size as channels whereby trade openness affects growth. We then examine changes in the number of firms and in the sectoral composition of output before and after episodes of trade liberalization. This evidence is discussed both for a broad cross-section of countries and for twelve case studies of liberalization.

4.1 Cross-Country Evidence on Market Size and Investment

4.1.1 Cross-Country Evidence on Investment

The model presented in Section 2 implies that the gains from trade, in terms of transitional growth rates, are mediated by the level of capital formation in the economy. In fact, we have argued that a transition to a more competitive steady-state may be characterized by some degree of oversaving, because the model does not conform to the assumptions of the first welfare theorem. A more competitive economy, we argued, will be characterized by a higher steady-state level of income (and consumption), but this may require some sacrifice in terms of foregoing consumption in the transition. Hence, the predictions concerning investment were stark: given our simplifying assumptions, the economy is characterized by a zero investment rate in steady-state, but has to accumulate capital in the transition.

This prediction of the model is consistent with existing empirical evidence: In the cross-country growth literature, the main channel whereby openness affects growth is through increases in the rate of domestic investment. Levine and Renelt (1992) could no reject (at conventional levels of significance) the null hypothesis that the investment rate was the *only* channel whereby the trade to GDP ratio affects growth. Baldwin and Seghezza (1996) also provide evidence on trade-induced, investment-led growth. Decomposing the impact of trade *policy* liberalization on growth into seven different channels, Wacziarg (1997) found that approximately one-half of this effect is attributable to the investment rate.

Table I provides a brief illustration of this point. It examines the sensitivity of the openness coefficient to the inclusion of the investment rate in a generic, cross-country growth regression. The measure of openness which we employ is the trade to GDP ratio, but the essence of the result is unchanged when using indicators of trade *policy* openness.[20] Estimates show that the effect of openness is reduced by 30-40% (depending on the estimator) when the investment rate is entered in the regression. Attempts to correct for the potential endogeneity of the investment rate, using lagged values of this variable as instruments, confirm this claim.

4.1.2 Cross-Country Evidence on Market Size

Our model suggests that market size matters. Trade liberalization raises the steady-state level of income through an expansion of market size: this allows more oligopolists to enter each given sector by overcoming the fixed cost. It follows naturally that larger countries should benefit less from a given switch in trade policy than smaller ones, since the proportional expansion in the size of their markets will be smaller. This stands in sharp contrast with the predictions of models with constant returns to scale, in which market size does not

[20] Results on trade policy are available upon request. The investigation in Wacziarg (1997) does a more thorough job of quantifying the dynamic gains from trade, by excluding the measure of trade policy openness from the growth regression and examining instead its impact on various determinants of growth. However, the results concerning the investment channel are unaffected by this cleaner methodology. In fact, a precise quantification of the investment channel, controlling for reverse causation through appropriate instrumental variables estimation, suggests that it accounts for over 40-50% of the effect of trade policy openness on growth, roughly the same as the effect obtained here.

matter.[21]

Existing evidence shows that the effect of trade openness on growth is mediated by country size. A simple test of this fact consists of interacting measures of trade openness with a measure of country size in a traditional growth regression. Ades and Glaeser (1994) and Alesina, Spolaore and Wacziarg (1997) show that, according to this simple test, larger countries experience lower dynamic gains from trade than smaller ones: indeed, the coefficients on the size variable (the log of population) and on the trade to GDP ratio are both positive and significant, but the sign of the interaction term is negative. This result is unchanged when using measures of trade *policy* openness, such as tariff rates.

In our model, market size raises the investment rate along the new transition, and this is what creates the growth effect. We should therefore expect the effect of openness on the *investment rate* to be mediated by country size. That is, the gains from openness in terms of raising the investment to GDP ratio should be lower for larger countries. Table II presents the results of this test. We employ a very simple specification in which initial income, the log of population, the ratio of trade to GDP and the interaction of the two variables are included in the investment equation.[22] Parameter estimates replicate the pattern found in the case of growth regressions, namely that both country size and openness have a strong positive impact on investment rates, while the interaction term carries a statistically significant negative coefficient. The interpretation of this result is that the benefits of openness in terms of raising investment rates are negatively related with country size. Alternatively, being small represents less of a constraint on the investment rate when the country under consideration is more open to international trade.

[21] Needless to say, many models with increasing returns to scale (but fixed market power) also predict a market size effect. For instance, Rivera-Batiz and Romer (1991) suggest that by expanding market size, economic integration may "encourage the worldwide exploitation of increasing returns to scale in the research and development sector", thereby generating endogenous growth. However, this model implies that technological progress, rather than the accumulation of capital, is driving the growth effect of liberalization.

[22] Results concerning ths signs of the coefficients are robust with respect to the inclusion of other common determinants of investment rates - such as those employed in the investment regressions of Barro and Sala-i-Martin (1995). However, the significance of the log of population is reduced as more controls are entered. As discussed in Alesina, Spoloare and Wacziarg (1997), this may be due to the fact that we are increasingly controlling for factors that are correlated with country size, such as the government consumption rate. Such variables may constitute the channels through which country size matters for investment.

4.2 Evidence on the Number of Firms

While the cross-country evidence presented above supports two main predictions of our model, it does not constitute a direct test of the theory. In order to assess more closely the procompetitive effects of trade policy we turn to case studies evidence. In particular, we examine the dynamics of entry before and after selected episodes of liberalization. We consider twelve countries which undertook major liberalizations of their trade regimes between 1981 and 1990. The choice of these countries was dictated solely by data availability concerns. To examine the evolution of entry and exit we employ data from UNIDO (1997) on the number of manufacturing establishments per sector (at the 3-digit ISIC level) between 1981 and 1995. Conditional on a country having undertaken trade liberalization policies during this period, we selected *all* the countries for which data on the number of firms were available.

The determination of the dates of liberalization was made on the basis of a recent paper by Tornell (1997). In this paper, the author assigns a country's date of liberalization t on the basis of two criteria: A policy criterion, i.e. whether there has been a significant removal of trade barriers in year t, and a criterion based on trade volumes, i.e. whether there has been a substantial increase in trade volumes within $t+5$.[23] In doing this, we avoid taking into account "false" liberalizations, in which policy makers claimed but may not have really achieved the effective removal of impediments to trade.

Based on these criteria, the twelve countries listed in the following table passed the test for trade liberalization. For purely illustrative purposes, we classify these episodes of liberalization according to whether countries suffered an economic crisis and/or a political crisis in the five years preceding the reforms.[24]

[23] The dates of "policy" liberalizations are those in Sachs and Warner (1995). The data on the ratio of imports plus exports to GDP (all measured in constant 1987 prices) were from the World Bank. A "substantial" increase is defined as a yearly increase in the trade to GDP ratio of 7% or more. I am grateful to Aaron Tornell for providing me with these data.

[24] The precise definitions of severe "economic" and "political" crises can be found in Tornell (1997). Countries which underwent severe crises before liberalization may experience a lag before the long-run effects of trade reform start occurring, because they generally need to go through a period of macroeconomic stabilization.

Political Crisis Economic Crisis	Political Crisis No Economic Crisis	No Political Crisis Economic Crisis	No Political Crisis No Economic Crisis
Bolivia (1985)	Hungary (1990)	Costa Rica (1986)	Colombia (1986)
Mexico (1986)		Israel (1985)	Morocco (1984)
Philippines (1988)			New Zealand (1986)
Poland (1990)			Turkey (1989)
			Venezuela (1989)

There has been little empirical research on the influence of the trade regime on market concentration. Most existing approaches have relied on specific countries or specific industries: Harrison (1994), using plant-level data on Côte d'Ivoire, reports that ignoring the changes in market structure may lead to understating gains in productivity growth which resulted from the 1985 trade reform; in particular, this paper shows that liberalization reduced price-cost margins and excess profits. De Melo and Urata (1986) found similar results when looking at industry markups before and after the 1976 Chilean reform. Harris (1986), in the context of a CGE model for Canada, argued that "large welfare gains are explained in terms of scale economies and the procompetitive effects of import competition" resulting from a 50% reduction in trade barriers. Lastly, Levinsohn (1991) examines the size of markups for five Turkish manufacturing industries before and after liberalization, and observed that statistically significant reductions in markups occurred in four of the five industries.

Rather than focus on markups, which need to be estimated on the basis of data that are not necessarily comparable across countries, or simply not available, we opt for a different approach, which stands closer to the predictions of our model. Our theory predicts directly that the procompetitive effects of trade should be mediated by the entry of new firms. Furthermore, under our specification of the demand for intermediate goods, the relative markup over marginal cost, or Lerner index, was exactly equal to the inverse of the number of firms per sector. Our simple test is to examine whether liberalization episodes define a structural break in time path of the number of establishments per manufacturing sector.

The reader should be cautioned that the data from UNIDO refers to the number of *establishments* (in every case except for Poland and Hungary, for which data on the number of enterprises, i.e. firms, is available). In most cases, an establishment refers to a single

firm, i.e. and industrial unit owned by a single entity, behaving autonomously in setting prices and output. However, some establishments may in fact belong to the same firm, in which case arguing that the appearance of a new establishment is akin to "entry" would be mistaken (rather, it should be identified with the creation of a new plant). However, for about 10 countries, the UNIDO data set contains observations for both the number of establishments and the number of enterprises. For these countries the correlation between the two measures is nearly perfect and the difference between the number of establishments and the number of firms is small (on the order of 5% on average). On this basis we consider the number of establishments as an adequate *proxy* for the number of firms.

The data consist of a panel in which each observation corresponds to a sector-country-year, with 29 sectors, 11 countries and 16 years.[25] In order to analyze these data we employ a differences-in-differences approach. We hypothesize that if there is a structural break in the number of firms, then the growth rate (or the time-difference) of the number of firms should be larger if the country has liberalized than if it has not. We compute growth rates (or log-differences) and differences (or level-differences) across time over 3 years, to minimize the incidence of business cycle effects and other short term variations. Denoting the number of establishments by J, and liberalization status by L ($L = 1$ if the country has liberalized) the simplest formulation of the differences-in-differences estimates is therefore:

$$DD = \frac{1}{16\times 29\times 12}\sum_{t=1}^{16}\sum_{s=1}^{29}\sum_{i=1}^{12}[(J_{s,i,t} - J_{s,i,t-3}|L_{i,t}=1) - (J_{s,i,t} - J_{s,i,t-3}|L_{i,t}=0)] \tag{22}$$

where the i subscript refers to countries, the s subscript to sectors and the t subscripts to time. In terms of growth rates we can formulate the same DD equation by redefining J as the *log* of the number of firms. We will favor the latter estimates because they are independent of the "natural" number of firms in a given country-sector. Indeed, there are large variations in the number of firms per sector, depending on the sector under consideration (for instance there are far fewer oil refineries than there are textile firms in any given country); considering the growth rate in the number of firms will lead to estimates that are independent of these cross-sector and cross-country differences (in other words to limit the

[25] The data for the Philippines seemed highly suspicious; the total number of establishments went from 83180 in 1982 to 5733 in 1983, and then suddenly back to 83825 in 1990. Since these shifts are obvioulsy entry mistakes, the Philippines were excluded from the sample.

incidence of heteroskedasticity).

Since we may want to control for all sorts of sector-specific, country-specific and time-specific effects in computing our DD estimates, we turn to a regression interpretation of these. The differences-in-differences estimates can be rewritten in regression form as follows:

$$J_{i,s,t} - J_{i,s,t-3} = \alpha + DD \times L_{i,t} + \delta' D_{i,s,t} + \varepsilon_{i,s,t} \tag{23}$$

where the D vector contains country, sector, year and country-sector specific effects.

The results from this estimation procedure are presented in Tables III through V. Table III contains summary statistics which allow us to compute the simple estimates for equation (22). The simple DD estimate for log-differences can be computed as $DD = 0.323 - 0.167 = 0.156$ (note that this is precisely the value of the slope estimate in the first column of Table IV). This indicates that the 3-year growth rate of the number of firms in a country which has liberalized will be 15.6 percentage points higher than if the country has not liberalized.

While this large effect is indicative that something major is happening to the entry process when a country liberalizes, we are not controlling for the possibility that other factors may be driving the result. First, country specific, sector specific or time specific effects may be driving the correlation. For example, different sectors may display different overall trends in the number of firms, due to time invariant differences in technology, government regulation or general market conditions. This source of bias would be eliminated by the inclusion of a sector specific effect. Second, different sectors in different countries may respond differently to liberalization, a source of variation which would be wiped out by country-sector specific effects.

To allow for these possibilities, we entered a set of dummies reflecting year, country, sector and country-sector fixed effects, and estimated DD regressions of the form specified in equation (23).[26] Estimates presented in Table IV were extremely robust with respect to the inclusion of these dummies. In fact, our base estimate of the DD effect based on log-differences is increased to 0.209 when including the full set of dummies. In particular, we are controlling for country-sector specific effects, that is, effects that are common to

[26] Note that we did not include country-year specific effects; these would entirely eliminate the effect of liberalization status, which is itself country-year specific (we do not observe sectoral difference in the extent of liberalization).

a country-sector but invariant through time. These estimates are estimated with much precision, as the effects are significantly different from zero at high levels of confidence in every specification.[27]

Results based on level differences rather than growth rates (Table V) tell essentially the same story, although their precision diminishes somewhat with the inclusion of additional dummy variables (however the DD estimate remains statistically significant at the 95% level even when including the full set of dummy variables). Overall, we take the evidence concerning the number of firms as very supportive of the theory. The effect is sufficiently large economically and robust statistically to warrant this paper's focus on changes in domestic market power as a channel linking trade liberalization and growth.

4.3 Evidence on the Sectoral Composition of Output

The model of Section 2 started with an extreme assumption of full specialization. The procompetitive effects of trade liberalization were independent of any changes in the degree of specialization of the economy. In particular, contrary to the traditional focus of trade theory, changes is the sectoral composition of output were not a channel through which liberalization affects growth. In contrast, static trade theory stresses a move from autarky to free trade results in potentially important swings in the pattern of specialization within countries, as the sectors in which a country has a comparative advantage draw an increasing portion of the economy's resources. The dynamic extensions of this theory, such as Ventura (1997), rely on changes in the sectoral composition of output as important factors to explain the growth performance of an economy. Models with endogenous growth, such as Young (1991) and Grossman and Helpman (1991), also point to specialization as a driving force behind the dynamic gains from trade, since they focus on knowledge accumulation or learning by doing as determinants of comparative advantage.[28]

[27] While country and sector specific fixed effects control for variations in the fixed cost F across countries and sectors, we have no way of accounting for time-variations in this parameter. In our model the fixed cost of entry was exogenous, but part of our results could be linked to the fact that trade liberalization may go hand in hand with industry deregulation, privatization and other policies directly reducing F. Hence our estimate should be taken as an upper bound on the effect of expanding market size through trade liberalization.

[28] Young (1991) focuses on learning-by-doing and knowledge spillovers effects as determinants of the dynamic gains from liberalization. He states that "assuming that there is no international diffusion of knowl-

4.3.1 Changes in the Sectoral Mix of Output: Case Studies Evidence

We pursue the analysis of our twelve liberalization episodes by turning to the issue of changes in the sectoral mix of output. We base our test on a very simple idea: The absolute value of changes in sectoral output shares (in short, SOS) should rise after trade liberalization if such a policy shift generates important specialization effects. Hence, regressing the absolute value of changes in the SOS on the dummy for liberalization, along with sector, country and time-specific effects, should allow us to examine whether specialization in fact plays an important role or whether our focus on fixed output composition was justifiable.[29]

The results of this simple test are presented in Tables VI through VIII. Simple summary statistics show that the difference in the average magnitude of sectoral shifts are small between liberalized and non-liberalized observations: Under no-liberalization, the average three-year shift in any given sector has a magnitude of 0.607 percentage points, and this increases to 0.650 in years immediately following a liberalization. The average yearly shift actually exhibits the opposite pattern: The magnitude of changes falls from 0.453 under no-liberalization to 0.353 under liberalization.

The regression approach delivers a similar conclusion: There is no clear pattern in the data in terms of signs or statistical significance, and the results are sensitive to the specification: in particular, considering the yearly changes in sectoral output shares (Table VIII) seems to yield a negative effect of liberalization on the magnitude of shifts, while considering 3-year differences leads to an opposite effect. Economically, the effects are small. For

edge, the effect of trade on technical progress and growth will depend upon whether static comparative advantage leads an economy to specialize in goods in which it has mostly exhausted learning by doing, or in goods in which learning by doing still proceeds apace". Grossman and Helpman (Chapters 7 and 9) study the pattern of comparative advantage and specialization in the context of a model of endogenous growth with an expanding variety of goods. They stress that "when countries' research experiences differ in a world of national knowledge capital stocks, or when the composition of their endowment bundles differ, economic integration induces a particular pattern of specialization that has implications for output growth in each of the trading partners". (p. 238) While specialization is in no way the only channel whereby liberalization affects growth in their discussion of this issue, it certainly plays an important role.

[29] The rationale for using absolute values of changes in SOS is simply that we are interested in the magnitude of the SOS shifts, not their direction. Since changes in SOS must add up to one at every point in time, it would be difficult to identify the effect of the liberalization status on the *magnitude* of cross-sector shifts if we did not consider absolute values.

instance, the last column of Table VII indicates that a liberalizing country will experience an increase of 0.18 percentage points in the magnitude of 3-year SOS changes in the years following liberalization, a small effect indeed.[30]

4.3.2 Within-Country Evidence Based on Sectoral Output Concentration

In order to examine the issue of specialization for a wider range of countries, we supplement the evidence presented above by another test. If specialization were driving the gains from trade, the sectoral composition of output would *tend to* become more concentrated as the economy becomes more open to international trade. This statement would be strictly true in a Ricardian world, where countries specialize fully when moving to a regime of free trade. In a Heckscher-Ohlin world, in contrast, it is *possible* for specialization to imply a less concentrated output mix, although this will not generally be the case if the autarky economy displays a fairly equal distribution of output shares (we will return to this issue when we discuss specific cases of liberalization episodes). We conclude that an index of concentration, while imperfect, will be likely to capture vast swings in the sectoral composition of output. However, the reader should be warned that we are now concerned with a rather extreme (Ricardian) form of specialization, and that our empirical results should be interpreted with caution.

We again employ data from UNIDO (1997) on the sectoral composition of manufactured output.[31] These data allow us to compute yearly observations for the output share of each of 29 sectors for a set of 92 countries, between 1970 and 1995. For each country and each year, we constructed a Herfindahl index of sectoral output concentration. This was used as a dependent variable in a panel-fixed effects regression. There are several decisive reasons for employing a fixed-effects estimator here. Firstly, the question at hand is whether variations in openness impacts the sectoral composition of output within countries, through time, rather than across countries. Secondly, fixed effects estimation allows us to

[30] Admittedly, the specialization effects of trade openness must take time to operate, while we are only looking at roughly 16 years of data (of which about half are "liberalized" years). However, these results are indicative that nothing drastic is happening on the specialization front.

[31] Although sectoral data for agriculture and services are not available, we should note that manufacturing data contains mostly tradable goods. Given our focus on specialization, the omission of services, which are mostly non-tradable, does not appear to be a huge problem.

safely disregard time invariant, country-specific determinants of the sectoral concentration of output, reducing the risk of omitted variables bias.[32]

Tables IX to XI present the empirical results based on different specifications, different time horizons and different estimators. If trade openness resulted in large changes in the pattern of specialization, the index of concentration would be positively related to measures of economic integration. However, the basic result is that openness seems to have no impact whatsoever on the extent of output concentration once the level of income per capita and other controls are accounted for (Table IX, columns (1)-(4)): estimates are small in magnitude and always statistically insignificant, even at very low levels of confidence. The main robust stylized fact which springs from these estimates is that, as countries become richer, the concentration of their output declines significantly. Furthermore, one measure of factor endowments, namely capital per worker, seems to have a positive impact on output concentration. Other measures of factor endowments, such as population density (meant to proxy for the labor-land ratio) and the log of population, do not seem to have a robust impact on the variable of interest.

One possibility is that the effects of openness on output diversification may be operating with a lag; this could be a serious problem particularly in the context of within-country regressions, since the persistence of differences in openness only operates through the between country variation. To account for this potential problem, we used the lagged value of the trade to GDP ratio as a right-hand side variable (Table IX, column (5)). This did not change the result in any way.

Tables X and XI further establish the robustness of these findings. Table X employs yearly data, rather than five-year averages, in order to improve the efficiency of the estimates. Even with roughly 1700 observations on 91 countries, and the potential for business cycle effects to drive an artificial correlation between output concentration and trade openness, no relationship could be uncovered between these two variables. Table XI shows that using some of the between-country variation does not modify the results either.

We interpret the failure of within-country variations in trade openness to account for variations in output concentration in the following manner: while openness may be related

[32] However, our empirical results concerning the effects of openness are not sensitive to the use of between-country variation, as demonstrated in Table V.

to relatively small changes in sectoral output shares (which are not captured by a measure based on concentration), it does not seem to be associated with the vast swings predicted by Ricardian theory. This provides further support for a theory which does not rely on changes in the sectoral composition of output to generate dynamic gains from trade, such as the one presented in Section 2.

Although more research is certainly needed on the extent of the specialization effects of trade liberalization, the preliminary evidence presented here suggests that specialization may not deserve the disproportionate attention it receives in the literature.

5 Conclusion

Changes in the extent of domestic market power are an important feature of trade liberalization and of the growth process in general. The theory presented in Section 2 sought to reverse the traditional approach to dynamic gains from trade by examining endogenous shifts in market structure holding the pattern of production and the level of technology fixed. The main concept underlying the procompetitive effects of liberalization is the size of the market: by expanding market size, trade liberalization allows more domestic entrepreneurs to invest and overcome fixed costs of production. In doing so, it raises the economy's steady-state level of income by improving its overall efficiency.

Our model received considerable empirical support. While we did not rely on one single test of the theory, we have provided a wide array of indicative "clues" which, taken together, tell the very same story as our model. Indeed, while each piece of evidence, *taken individually*, may be consistent with other models of trade and growth, it is hard to reconcile any existing model with all of them *taken together*. Firstly, a large fraction of the dynamic gains from trade appear to be generated through the rate of investment, in accordance with the idea that trade liberalization raises the returns to accumulation and the incentives to overcome fixed costs in capital. Secondly, smaller countries seem to benefit more from trade openness than larger countries, in accordance with our emphasis on market size as a determinant of market power. Thirdly, liberalization episodes seem to be followed by an important process of entry into manufacturing industries, in accordance with our reliance on the *domestic* number of firms as a determinant of market behavior. Lastly, we have provided evidence that specialization effects may not be as important as

generally thought, providing justification for reversing the traditional focus of trade theory, away from its reliance on specialization.

Directions for future research are multiple. On the empirical front, systematic tests of changes in market structure, as a response to policy shifts such as trade liberalization, need to be improved upon. A more complete assessment of the effects of liberalization on the composition of output is also called for, especially given the importance attached to the concept of specialization in common discussions of trade policy.

On the theory side, our focus on market size should not cloud other interesting issues arising in models with endogenous market structure. In particular, a closed economy version of our model may generate insights into the nature of the growth process. For instance, we have not explicitly modeled the determination of the entry cost, which we assumed fixed. Certainly, policies designed to protect property rights, antitrust policies and other governmental regulations affect the size of the barriers to entry. Endogenizing F rather than focusing on market size would be another way to approach changes in market structure. Hence, the theoretical usefulness of this paper lies beyond its focus on the effects of trade liberalization, in its attempt to endogenize a crucial parameter in the analysis of growth: the economy's market structure.

Appendix

Proof of Proposition 1: The $\Omega\left(P_d^f\right)$ function is increasing in P_d^f. Furthermore, if we impose the requirement that the number of firms should be strictly greater than 1, so that $\sqrt{\rho P_d^f F/S_d} < 1$, then the function can only take on positive values. This is necessary for the existence of a steady-state. The maximum value of the price level for which this is ensured is $\overline{P}_d^f < \frac{S_d}{\rho F}$. Hence we restrict our attention to finding equilibrium prices $P_d^f \in \left[0, \overline{P}_d^f\right]$.

For a zero price, the value of Ω is $\Omega(0) = (1+\tau_d)(\rho/\alpha)^{\frac{\delta}{1-\delta}}$. Hence this function starts higher than the origin. If any, the first intersection between $\Omega(\cdot)$ and the 45° occurs in conditions such that: $\Omega'(\cdot) < 1$. Computing the second derivative of $\Omega(\cdot)$, after much tedious algebra, we can show that $\Omega''(\cdot)$ has the same sign as:

$$Q = \sqrt{\rho P_d^f F/S_d} + (\delta - 1)\left(1 - \sqrt{\rho P_d^f F/S_d}\right) \tag{24}$$

The function will be locally concave for values of P_d^f for which Q is negative, locally convex when Q is positive. More specifically, $\Omega(\cdot)$ starts locally concave for low values of P_d^f and becomes locally convex for values larger than $\left(\frac{1-\delta}{2-\delta}\right)^2 \frac{S_d}{\rho F}$.

This establishes that if the function intersects the 45° line once, it must cross it again once and only once. There will be no equilibrium for parameter values such that the function is always above the 45° line, one equilibrium when it is tangent to the 45° line (a knife-edge case), and two equilibria otherwise (Figure I).[33]

These equilibria can be Pareto-ranked in a very straightforward manner: The low price equilibrium, which corresponds to the first intersection of $\Omega(\cdot)$ with the 45° line, always Pareto-dominates the other equilibrium, because the nominal expenditure level is fixed for a given value of the parameters, so a lower final price always results in a higher level of steady-state income (which is equal to steady-state consumption).□

Proof of Proposition 2. We wish to characterize the stability properties of our equilibria. This involves linearizing the dynamic system which describes the path of the economy around the steady-state(s), and then considering its dynamics.

[33] Furthermore, it is easy to show that $\Omega \to \infty$ as $P_d^f \to \overline{P}_d^f$, so that tangency is the only case in which we can have a unique equilibrium.

(i). We start with two useful results. First, totally differentiating equation (20) with respect to r_d and evaluating the total derivative at an intersection point, we get:

$$\frac{dP_d^f}{dr_d} = \frac{P_d^f}{r_d}\left[\frac{\frac{\delta}{1-\delta} + \Omega'\left(P_d^f\right)}{1-\Omega'\left(P_d^f\right)}\right] \tag{25}$$

In the Pareto-superior equilibrium, we have $0 < \Omega'(\cdot) < 1$, as argued earlier, because $\Omega'(\cdot) > 0$ and $\Omega(\cdot)$ approaches the 45° line from above. In this case we will have $dP_d^f/dr_d > 0$. In the Pareto-dominated equilibrium, we have the opposite, namely $dP_d^f/dr_d < 0$.

Second, we can use this to compute $\frac{dK}{dr_d}$ where $K = \frac{\delta S_d}{r_d P_d^f}$. Evaluated at $P_d^f = \Omega\left(P_d^f\right)$, we obtain:

$$\frac{dK}{dr_d} = -\frac{\delta S}{(1-\delta)\, r_d^2 P_d^f}\left[\frac{1}{1-\Omega'\left(P_d^f\right)}\right] \tag{26}$$

so that $\frac{dK}{dr_d} < 0$ at any "good" steady-state, and $\frac{dK}{dr_d} < 0$ at a "bad" steady-state.

(ii) We now consider the system describing transitional dynamics. It consists of equations (6) and (8):

$$\dot{K} = \frac{\delta S_d}{P_d^f} + \frac{\tau_d}{1+\tau_d}\frac{E_d}{P_d^f} - C \tag{27}$$

$$\dot{C} = C\left(r_d - \rho\right) \tag{28}$$

Linearizing this system around the steady-state using a first-order Taylor series expansion, we obtain:

$$\begin{bmatrix} \dot{K} \\ \dot{C} \end{bmatrix} = \begin{bmatrix} \frac{d\dot{K}}{dK}|_{K^{SS}} & -1 \\ C^{SS}.\left(\frac{dr_d}{dK}|_{K^{SS}}\right) & 0 \end{bmatrix} \begin{bmatrix} K - K^{SS} \\ C - C^{SS} \end{bmatrix} \equiv A \begin{bmatrix} K - K^{SS} \\ C - C^{SS} \end{bmatrix} \tag{29}$$

where the last equality is simply a definition. To characterize the stability of each steady-state we need to find the eigenvalues λ_1 and λ_2 of the matrix A. These are the solutions to the following quadratic equation:

$$\lambda^2 - \lambda \frac{d\dot{K}}{dK}|_{K^{ss}} + C^{SS}.\left(\frac{dr_d}{dK}|_{K^{ss}}\right) = 0 \tag{30}$$

The solutions are:

$$\lambda = \frac{1}{2}\left[\frac{d\dot{K}}{dK}|_{K^{ss}} \pm \sqrt{\left(\frac{d\dot{K}}{dK}|_{K^{ss}}\right)^2 - 4C^{SS}.\left(\frac{dr_d}{dK}|_{K^{ss}}\right)}\right] \tag{31}$$

(iii). Consider the Pareto-superior steady-state. In this case we have $\frac{dr_d}{dK}|_{K^{ss}} < 0$. It is then apparent that the two eigenvalues will have opposite signs, whatever the sign of $\frac{d\dot{K}}{dK}|_{K^{ss}}$. Hence, we can conclude that the Pareto-superior steady-state is always *saddle-path stable*. This completes the first part of the proof.

(iv). Consider now the Pareto-dominated or "bad" steady-state. The stability properties of such a steady-state can be characterized by computing the sign of $\frac{d\dot{K}}{dK}|_{K^{ss}}$. We have $\dot{K} = f\left(P_d^f\left(r_d\left(P_d^f, K\right)\right)\right)$. Totally differentiating with respect to K yields:

$$\frac{d\dot{K}}{dK} = \frac{\frac{\partial \dot{K}}{\partial P_d^f}\frac{\partial P_d^f}{\partial r_d}\frac{\partial r_d}{\partial K}}{1 - \frac{\partial P_d^f}{\partial r_d}\frac{\partial r_d}{\partial P_d^f}} \tag{32}$$

We know that $\frac{\partial \dot{K}}{\partial P_d^f} < 0$ (equation (28)), that $\frac{\partial P_d^f}{\partial r_d} = \frac{dP_d^f}{dr_d} > 0$ (when evaluated at the "bad" steady-state), that $\frac{\partial r_d}{\partial K} < 0$ (equation (17)), and that $\frac{\partial r_d}{\partial P_d^f} < 0$ (equation (17)). We can conclude that $\frac{d\dot{K}}{dK} > 0$ when evaluated at the "bad" steady-state. There are then two cases:

(a). $\left(\frac{d\dot{K}}{dK}|_{K^{ss}}\right)^2 < 4C^{SS}.\left(\frac{dr_d}{dK}|_{K^{ss}}\right)$. Equation (30) has complex roots with positive real parts, implying that the system is unstable and oscillating around the Pareto-dominated steady-state.

(b). $\left(\frac{d\dot{K}}{dK}|_{K^{ss}}\right)^2 < 4C^{SS}.\left(\frac{dr_d}{dK}|_{K^{ss}}\right)$. Equation (30) has positive real roots, implying that the system is unstable.

We conclude that the Pareto-dominated steady-state is always unstable.□

Proof of Proposition 3. We wish to establish that, at a Pareto-superior steady-state:

$\frac{dE_d/P_d^f}{d\tau_d} < 0$ and $\frac{dS_d/P_d^f}{d\tau_d} < 0$. The first inequality indicates that steady-state real income is diminishing in the tariff rate, the second allows us to establish that the steady-state capital stock and number of firms are both decreasing in the tariff (see equations (15) and (17)). Note that the first inequality implies the second, since $S_d = E_d + \frac{E_w}{1+\tau_w}$. Furthermore, it also implies that: $\frac{P_d^f}{1+\tau_d} < \frac{dP_d^f}{d\tau_d}$. This is what we will set out to prove.

We start by computing the total derivative of P_d^f with respect to τ_d,and evaluate it at an equilibrium situation (where $\Omega\left(P_d^f\right) = P_d^f$). After much tedious algebra, we obtain:

$$\frac{dP_d^f}{d\tau_d} = \frac{P_d^f}{1+\tau_d}\left[\frac{1-\Omega'\left(P_d^f\right)\frac{\delta\tau_d+\delta}{\delta\tau_d+1}}{1-\Omega'\left(P_d^f\right)}\right] \tag{33}$$

where $\Omega'(\cdot)$ is evaluated at the Pareto-superior equilibrium. In such an equilibrium, we have $0 < \Omega'(\cdot) < 1$, as argued earlier, because $\Omega'(\cdot) > 0$ and $\Omega(\cdot)$ approaches the 45° line from above. Note also that $\frac{\delta\tau_d+\delta}{\delta\tau_d+1} < 1 \ \forall\delta \in]0,1[$. Therefore:

$$\frac{1-\Omega'\left(P_d^f\right)\frac{\delta\tau_d+\delta}{\delta\tau_d+1}}{1-\Omega'\left(P_d^f\right)} > 1$$

This completes the proof that $\frac{P_d^f}{1+\tau_d} < \frac{dP_d^f}{d\tau_d}$. □

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Table I. Growth Regressions: The Investment Channel

Dependent Variable: Growth of GDP per cap.	GMM*			SUR		
Constant	22.063	24.308	24.859	14.267	14.330	14.817
	(4.22)	(6.12)	(5.70)	(5.41)	(5.73)	(5.92)
Log Initial Income	-2.463	-2.589	-2.759	-1.094	-1.510	-1.601
	(-4.68)	(-7.08)	(-6.14)	(-3.61)	(-5.17)	(-5.42)
Investment Rate	-	**0.144**	**0.088**	-	**0.153**	**0.144**
		(6.39)	**(3.21)**		**(7.77)**	**(7.24)**
Trade to GDP	**0.044**	-	**0.029**	**0.012**	-	**0.007**
Ratio (%)	**(3.43)**		**(2.34)**	**(3.22)**		**(1.96)**
Government	-0.213	-0.171	-0.213	-0.074	-0.062	-0.065
Consumption (% GDP)	(-5.29)	(-5.09)	(-6.01)	(-3.71)	(-3.16)	(-3.38)
Fertility Rate	0.595	0.035	0.283	-0.321	-0.202	-0.186
	(2.09)	(0.18)	(1.15)	(-2.67)	(-1.74)	(-1.61)
Male Human Capital	0.718	0.215	0.548	0.119	0.182	0.157
	(0.65)	(0.23)	(0.55)	(0.28)	(0.44)	(0.39)
Female Human Capital	-0.521	0.032	-0.232	-0.565	-0.451	-0.406
	(-0.50)	(0.04)	(-0.25)	(-1.23)	(-1.01)	(-0.92)
Black Market Premium	-0.041	-0.051	-0.043	-0.069	-0.070	-0.069
	(-4.67)	(-6.03)	(-5.22)	(-3.39)	(-3.50)	(-3.46)
Latin America dummy	-4.531	-2.762	-3.619	-1.661	-1.133	-1.139
	(-3.06)	(-2.39)	(-2.70)	(-3.65)	(-2.55)	(-2.60)
East Asia dummy	-3.657	-0.897	-3.453	0.222	0.671	0.308
	(-1.69)	(-0.57)	(-1.85)	(0.35)	(1.15)	(0.51)
Subsaharan Africa	-6.298	-3.653	-4.906	-2.351	-1.361	-1.587
dummy	(-4.05)	(-3.19)	(-3.57)	(-5.16)	(-3.15)	(-3.59)
OECD dummy	2.314	0.256	1.022	0.681	0.243	0.412
	(1.36)	(0.23)	(0.64)	(1.24)	(0.46)	(0.78)
Number of observations	79 83 83	79 83 83	79 83 83	82 82 93	82 82 93	82 82 93
	83 83	83 83	83 83	94 94 94	94 94	94 94

(t-statistics in parentheses)

* Instruments are: Initial income, government consumption, fertility rate, male human capital, female human capital, black market premium, ethnolinguistic fractionalization and all past values of the investment rate. (5 periods because of the choice of instruments). GMM estimates allow for White-robust (heteroskedastic consistent) standard errors.

Table II: Investment, Openness and Country Size

Dependent variable: Investment rate (% GDP)	SUR			GMM*		
Constant	-32.322	5.003	-11.118	-40.855	-0.681	-10.181
	(-7.97)	(1.41)	(-2.06)	(-6.89)	(-0.08)	(-0.81)
Log Initial Income	4.339	-	2.239	5.361	-	1.028
	(11.92)		(4.61)	(16.27)		(0.98)
Openness	**0.140**	**0.124**	**0.122**	**0.203**	**0.244**	**0.280**
	(4.32)	**(3.77)**	**(3.76)**	**(2.39)**	**(2.88)**	**(3.14)**
Log Population	**1.339**	**0.794**	**0.809**	**1.582**	**1.205**	**1.488**
	(3.68)	**(2.16)**	**(2.24)**	**(2.64)**	**(1.77)**	**(2.08)**
Log Population*Openness	**-0.012**	**-0.007**	**-0.009**	**-0.021**	**-0.021**	**-0.027**
	(-2.81)	**(-1.76)**	**(-2.14)**	**(-1.91)**	**(-2.00)**	**(-2.32)**
Latin America dummy	-	-0.965	-1.702	-	-4.616	-5.657
		(-0.81)	(-1.45)		(-0.84)	(-1.00)
South-East Asia dummy	-	0.492	0.758	-	-2.017	-1.725
		(0.34)	(0.53)		(-0.31)	(-0.26)
Subsaharan Africa dummy	-	-6.303	-4.705	-	-1.601	-0.524
		(-5.65)	(-3.77)		(-0.46)	(-0.14)
OECD dummy	-	9.102	5.724	-	18.780	16.771
		(7.19)	(4.36)		(5.95)	(5.06)
Number of Observations	119 120	120 122	119 120	118 118	118 118	118 118
	125 126	125 126	125 126	118 118	118 118	118 118
	131 137	131 137	131 137	118	118	118

(t-statistics in parentheses)

Openness is measured by the ratio of imports plus exports to GDP (%)

* Instruments are contemporaneous values of the log of population, log of initial income, the log of area and all lagged values of the openness ratio. (5 periods because of the choice of instruments). GMM estimates allow for heteroskedastic consistent standard errors.

Table III - Summary Statistics for the number of Establishments Data

Variable	#Obs	Mean	Std.Dev.	Min	Max
Liberalization status	5104	0.506	0.500	0	1
Number of establishments	3563	449.866	1433.665	0	19952
Number of estab| liberalization=0	1904	430.217	1384.889	0	19656
Number of estab| liberalization=1	1659	472.416	1487.776	0	19952
Growth in number of establishments	2621	0.259	1.055	-1	13.077
Growth in number of estab| liberalization=0	1071	0.167	0.880	-0.861	12.923
Growth in number of estab| liberalization=1	1550	0.323	1.156	-1	13.077
Difference in number of establishments	2624	55.061	478.530	-4618	12084
Difference in number of estab| liberalization=0	1071	24.482	387.643	-4618	8681
Difference in number of estab| liberalization=1	1553	76.149	531.342	-399	12084

Note: For Poland and Hungary the data are for the number of enterprises.

Table IV - Differences in Differences Estimates for the Number of Establishments (3-year growth in the number of establishments)

Dependent Variable: 3-year growth in the number of establishments	No controls	Sector dummies	Sector/ country dummies	Sector/ country/year dummies	Sector/ country/year/ country-sector dummies
Liberalization status	**0.156 (3.61)**	**0.147 (3.43)**	**0.273 (5.88)**	**0.192 (2.88)**	**0.209 (3.31)**
R-Squared	0.005	0.027	0.202	0.217	0.370
# of Obs.	2527	2527	2527	2527	2527
# of regressors	2	29	39	49	297

(t-statistics in parentheses).

Table V - Differences in Differences Estimates for the Number of Establishments (3-year difference in the number of establishments)

Dependent Variable: 3-year difference in the number of establishments	No controls	Sector dummies	Sector/ country dummies	Sector/ country/year dummies	Sector/ country/ year/ country-sector dummies
Liberalization status	**25.966 (4.38)**	**24.309 (4.17)**	**42.921 (6.46)**	**16.173 (1.74)**	**16.388 (1.96)**
R-Squared	0.0076	0.0525	0.187	0.199	0.417
# of Obs.	2530	2530	2530	2530	2530
# of regressors	2	29	39	49	296

(t-statistics in parentheses).

Table VI - Summary Statistics for the Changes in Sectoral Output Shares

Variable	# Obs	Mean	Std.Dev.	Min	Max
Liberalization status	5376	0.505	0.500	0	1
Sectoral Output Share (SOS) %	4451	3.752	5.165	0	43.872
Absolute value of the 3-year change in SOS	3437	0.634	1.461	0	31.314
Absolute value of the 1-year change in SOS	4143	0.399	1.070	0	30.445
AV of 3 year change in SOS|liberalization=0	1287	0.607	1.489	0	22.727
AV of 1 year change in SOS|liberalization=0	1910	0.453	1.413	0	30.445
AV of 3 year change in SOS|liberalization=1	2150	0.650	1.443	0	31.314
AV of 1 year change in SOS|liberalization=1	2233	0.353	0.641	0	8.991

Table VII. Regressions for 3-year changes in the sectoral composition of output

Dependent Variable: AV of the 3-year change in SOS	No controls	Sector dummies	Sector/ country dummies	Sector/ country/year/ dummies	Sector/ country/year/ sector-country dummies
Liberalization status	**0.0432 (0.84)**	**0.0634 (1.38)**	**0.0243 (0.49)**	**0.1796 (2.23)**	**0.1799 (2.69)**
R-Squared	0.0002	0.213	0.243	0.246	0.522
# of Obs	3437	3437	3437	3437	3437
# of regressors	2	29	40	52	331

(t-statistics in parentheses)

Table VIII. Regressions for yearly changes in the sectoral composition of output

Dependent Variable: AV of the yearly change in SOS	No controls	Sector dummies	Sector/ country dummies	Sector/ country/year/ dummies	Sector/ country/year/ sector-country dummies
Liberalization Status	**-0.1003 (-3.01)**	**-0.0943 (-3.03)**	**-0.1535 (-4.64)**	**-0.0011 (-0.02)**	**0.0000 (0.00)**
R-Squared	0.002	0.1332	0.1632	0.208	0.381
# of Obs	4143	4143	4143	4143	4143
# of regressors	1	29	40	55	335

(t-statistics in parentheses)

Table IX. Panel Regressions for the Herfindahl Index of Sectoral Output Shares (5-year averages, 1970-1995)

Depend. Variable: Herfindahl Index (Sector Output Shares)	(1)	(2)	(3)	(4)	(5)
Intercept	0.425	0.446	0.853	0.294	0.274
	(4.31)	(4.306)	(3.99)	(1.65)	(0.22)
Log Initial Income	-0.037	-0.039	-0.030	-0.055	-0.046
	(-2.87)	(-2.93)	(-2.17)	(-4.02)	(-3.42)
Trade to GDP Ratio (%)	**0.000125**	**0.000132**	**0.000186**	**-0.000015**	-
	(0.57)	**(0.59)**	**(0.83)**	**(-0.07)**	
Trade to GDP Ratio (%) (Five year lag)	-	-	-	-	**-0.000136**
					(-0.85)
Population Density	-	-0.143	-0.479	0.003	0.094
		(-0.65)	(-1.79)	(0.02)	(0.40)
Log Population	-	-	-0.050	0.027	0.022
			(-2.17)	(1.54)	(1.06)
Capital per Worker	-	-	-	1.61E-06	1.49E-06
				(2.40)	(2.00)
Obs. (countries)	412(92)	408(91)	408(91)	246(52)	164(52)
F-Test (slopes=0)[a]	4.49	3.11	3.54	4.28	2.91
(p-value)	(0.01)	(0.03)	(0.008)	(0.001)	(0.017)
F-Test (fixed effects=0)[b]	12.259	11.922	9.24	11.829	11.891
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ρ (fixed effects, Xb)[c]	-0.1292	-0.2510	-0.5685	-0.7715	-0.8024
Hausman χ^2 test[d]	3.91	5.21	3.73	23.52	17.34
(p-value)	(0.14)	(0.16)	(0.44)	(0.000)	(0.004)

(t-statistics in parentheses)

a. F-test for the null hypothesis that the slope parameters are jointly equal to zero.

b. F-test for the null hypothesis that the estimated fixed effects are jointly equal to zero.

c. Correlation between the estimated fixed effects and the fitted model.

d. Hausman test for fixed vs. random effects; the null hypothesis is that the country-specific effects are uncorrelated with the right-hand side variables.

Table X. Panel Regressions for the Herfindahl Index of Sectoral Output Shares (yearly data, 1970-1995)

Dep. Variable: Herfindahl Index (Sector Output Sh.)	(1)	(2)	(3)	(4)	(5)
Intercept	0.549	0.577	1.071	0.637	0.564
	(10.53)	(10.55)	(10.48)	(6.64)	(5.03)
Log Income	-0.051	-0.0537	-0.0420	-0.0609	-0.0598
	(-7.68)	(-7.85)	(-5.93)	(-8.279)	(-7.35)
Trade to GDP Ratio (%)	**0.0000336**	**0.0000402**	**0.0000695**	**0.0000812**	-
	(0.38)	**(0.45)**	**(0.78)**	**(0.905)**	
Trade to GDP Ratio (%) (Five year lag)	-	-	-	-	**0.0000947**
					(1.10)
Population Density	-	-0.152	-0.538	-0.137	-0.124
		(-1.51)	(-4.46)	(-1.55)	(-1.08)
Log Population	-	-	-0.061	-0.00305	0.00357
			(-5.70)	(-0.34)	(0.34)
Capital per Worker	-	-	-	1.50E-06	1.46E-06
				(4.72)	(3.63)
Obs. (countries)	1757(92)	1738(91)	1738(91)	1048(53)	832(53)
F-Test(slopes=0)[a]	35.78	24.64	26.96	16.65	12.38
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
F-Test(fixed effects=0)[b]	62.171	60.460	47.497	52.017	39.257
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ρ (fixed effects, Xb)[c]	-0.31	-0.40	-0.67	-0.47	-0.53
Hausman χ^2 test[d]	15.41	19.60	16.11	34.50	32.72
(p-value)	(0.0005)	(0.0002)	(0.003)	(0.000)	(0.000)

(t-statistics in parentheses)

a. F-test for the null hypothesis that the slope parameters are jointly equal to zero.

b. F-test for the null hypothesis that the estimated fixed effects are jointly equal to zero.

c. Correlation between the estimated fixed effects and the fitted model.

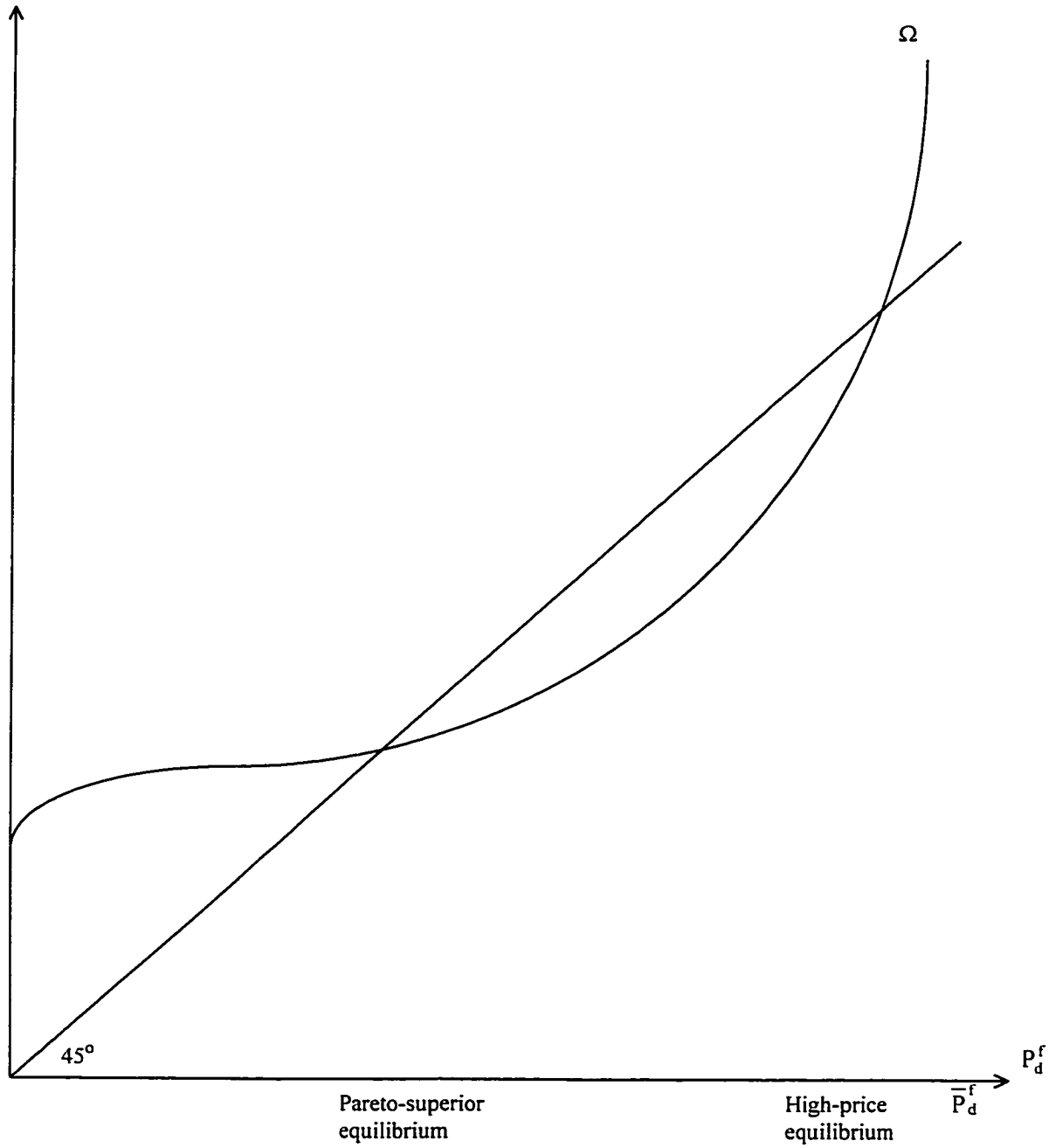
d. Hausman test for fixed vs. random effects; the null hypothesis is that the country-specific effects are uncorrelated with the right-hand side variables.

Table XI. Sensitivity to the Estimation Procedure
(yearly data, 1970-1995)

Depend. Variable: Herfindahl Index (Sector Output Shares)	Between	Fixed Effects	Random Effects	GEE
Intercept	0.467 (4.58)	0.637 (6.64)	0.685 (11.75)	0.690 (11.22)
Log Income	-0.0056 (-0.47)	-0.061 (-8.279)	-0.046 (-7.59)	-0.048 (-7.65)
Trade to GDP Ratio (%)	**-0.0001079** **(-0.41)**	**0.0000812** **(0.905)**	**0.0000331** **(0.40)**	**0.0000397** **(0.48)**
Population Density	0.015 (0.22)	-0.137 (-1.55)	-0.047 (-0.96)	-0.057 (-1.07)
Log Population	-0.029 (-4.96)	-0.003 (-0.34)	-0.022 (-5.12)	-0.021 (-4.49)
Capital per Worker	-1.23e-06 (-1.58)	1.50e-06 (4.72)	1.32e-06 (4.54)	1.38e-06 (4.66)
Obs. (countries)	1048 (53)	1048(53)	1048(53)	1048(53)
F-Test (slopes=0) (p-value)	10.17 (0.000)	16.65 (0.000)	-	-
χ^2-test (slopes=0) (p-value)	-	-	100.3 (0.000)	94.27 (0.000)

(t-statistics in parentheses)

Figure I. Multiple Equilibria in the Small Country Case



Chapter II. Measuring the Dynamic Gains from Trade

1 Introduction

The positive empirical association between trade openness and economic growth is a topic of little disagreement among economists.[1] Although theories promoting inward-oriented development strategies flourished in the fifties and sixties, the unsustainable and often destructive effects of import-substitution policies have, by and large, discredited the idea that the costs of an open trade regime may outweigh its potential benefits. Even relatively recent theories of imperfect competition applied to international trade, although they often overturn the results of more conventional approaches, have led to notoriously cautious policy prescriptions as far as protection is concerned.

However, it is unclear whether economists have a clear empirical understanding of the sources of these gains from trade, especially in a dynamic framework. Theory points to a number of possible costs and benefits of trade openness, not mutually exclusive in general. Some of these theories stress the role of technological spillovers and the international transmission of knowledge as a source of growth for open economies[2]. More traditional, static theories involve the role of allocative efficiency, which can be achieved more easily with an open trade regime even when factors of production are assumed to be immobile. Higher levels of output are attained when countries specialize according to their comparative advantage, so growth rates can be expected to increase in the transition that follows a liberalization episode. The increased degree of market competition resulting from a wider scale of market interactions yields further gains in efficiency.[3] More generally, by increasing the size of the market, trade openness allows economies to better capture the potential benefits of increasing returns to scale. Yet another set of theories points to the complementary aspects of virtuous policies: Trade policy openness may create incentives for governments to adopt less distortionary domestic policies and more disciplined types of macroeconomic management.

[1] See, for instance, Sachs and Warner (1995a), Vamvakidis (1996), Edwards (1992), Frankel (1996) among many other studies.

[2] See, for instance, Grossman and Helpman (1991).

[3] For instance, in Wacziarg (1997).

There has been very little empirical work trying to determine the relative roles of these different factors in explaining the observed positive impact of trade openness on growth. One tends to interpret the finding that trade openness spurs growth according to one's preferred theory, and to disregard two important possibilities: several of these forces may be operating simultaneously; and trade openness may also involve some dynamic costs, even if these are outweighed by the benefits. This becomes especially important in the context of increasing integration: by determining the source of the costs and benefits of trade liberalization, policy makers can hope to maximize the latter and to minimize the former.

This paper employs a fully specified empirical model to evaluate the channels whereby trade policy may affect growth. It starts with the specification of equations describing the incidence of trade policy on several growth determining variables. These equations are meant to capture different theoretical arguments used to characterize the potential costs and benefits of trade policy openness. The next step involves including the various channel variables in a growth regression. By multiplying the effects of trade policy on the channel and the effect of the channel on growth, one is able to identify the effect of trade policy on growth through that specific mechanism. The results of this paper suggest a strong positive effect of trade policy openness on economic growth, with accelerated accumulation of physical capital accounting for more than one half of this total effect.

The paper is organized as follows: Section 2 analyzes the theoretical basis for the six channels, discusses measurement issues and provides preliminary evidence concerning trade policy and growth. Section 3 describes the empirical methodology, based on a random effects, instrumental variables, efficient estimator. Section 4 provides parameter estimates for the various equations in the model. Section 5 contains a summary of the channel effects and addresses issues of robustness and exhaustiveness. Section 6 concludes.

2 Theory, Measurement and Preliminary Evidence

2.1 The Six Channels in Economic Theory

Six linkages between trade policy and economic growth are considered in our empirical model.[1] These are meant to capture the dominant theories concerning dynamic gains (or possibly losses) from trade. The underlying assumption is that these six channels, taken together, adequately capture most or all of the total effect of trade policy on growth. We can classify them according to three broad categories: government policy, domestic allocation and distribution, and technological transmissions.

2.1.1 Government Policy

The first possibility is that trade openness creates incentives for policy makers to pursue virtuous *macroeconomic policies*, either because they face the threat of capital flight or because they have bound themselves in international agreements, implicit or explicit, that provide a check on policy. The requirement to maintain a competitive environment for domestic firms engaged in foreign transactions may also require the maintenance of a stable macroeconomic context. In turn, the quality of macroeconomic policy is likely to have favorable effects on growth (Fischer (1993)). Indeed, macroeconomic stability may reduce the level of price uncertainty; furthermore, moderate levels of public deficit and public debt reduce the extent of crowding out as well as the likelihood of future tax increases, furthering the ability of domestic firms to compete on global markets.

Another way to capture the effects of trade openness on governmental activity is to consider its effect on the *size of government*. If more open economies are subject to larger exogenous supply and demand shocks, a larger government may be better able to provide insurance or consumption smoothing through redistribution or other forms of social programs (Rodrik (1996)). On the other hand, open economies may tend to subscribe more widely to laissez-faire arguments, and to limit the extent of taxation in order to preserve the economy's price competitiveness and attractiveness to foreign investors. The effect of trade policy openness on government size, measured by the public consumption of goods and services, is therefore theoretically ambiguous. On the other hand, although theory

[1] Other, possibly omitted channels are discussed in Section 5.

points to the existence of a positive growth-maximizing size of government resulting from a trade-off between the productive function of public activities and the distortionary nature of taxation (Barro and Sala-i-Martin (1992)), the negative impact of a larger government on growth in a cross-section of countries seems to be an established empirical fact (Barro (1991)).

2.1.2 Allocation and Distribution

Open economies are less likely to have tradable goods prices that differ substantially from those prevailing on world markets, because free trade should lead to an equalization of the prices of traded goods across countries. Once the effect of non-tradable goods on deviations from purchasing power parity has been eliminated, one should expect countries with open trade policies to have lower overall price levels (relative to some benchmark country like the United States) than closed economies (Dollar (1992)). Such a result stems from the fact that open countries tend to specialize according to their comparative advantage. Hence, theory points to a lower degree of *price distortions* in open economies. In turn, price distortions have been shown to adversely affect accumulation and growth (Easterly (1989) and (1993)). This is just one aspect of the allocation effects of free trade, having to do with a more efficient price system in open economies.

Factor accumulation may also be of crucial importance. Much of the effect of trade policy on growth may well work through the domestic rate of physical investment, which is a determinant of economic growth in a nearly tautological sense (Levine and Renelt (1992), Baldwin and Seghezza (1996)). The investment channel may capture several types of theories. Firstly, countries that are relatively labor abundant, when they adopt open trade policies, are likely to experience an increase in the wage-rental ratio, because tendencies towards factor price equalization lead to upward pressures on the wage rate and downward pressures on the price of investment goods. Translated into a dynamic context, this should lead to a greater level of investment relative to GDP. The growth benefits from this effects should fade out as more and more countries become open. Although this type of theoretical argument can only apply to relatively labor abundant economies, most protectionist countries tend to be more labor abundant, so that the benefits of openness in terms of growth

may be greatest precisely for those countries that are still closed.[5]

Secondly, and perhaps more importantly, investment may respond to openness through a size of the market effect.[6] As first stressed by Adam Smith, market size imposes a constraint on the division of labor, so that more open countries are better able to exploit increasing returns to scale. Trade liberalization may thus provide the type of 'big push' effect on capital accumulation which Murphy, Shleifer and Vishny (1989) argued was required in order for less developed countries to move from a low growth equilibrium to a path of sustained industrialization. Preliminary empirical evidence showing that the extent of the market raises growth largely through an increase in the rate of capital accumulation was provided by Ades and Glaeser (1994), thus lending support to 'Big Push' theories. Using a related argument, Wacziarg (1997) argues that the extent of the market is an important determinant of the degree of product market competition. The entry of new firms on export markets, after an episode of liberalization, may well entail large fixed investments. This points to the rate of investment as a potentially important channel linking trade policy openness and growth.

Thirdly, trade liberalization may simply allow domestic agents to import capital goods that were unavailable previously (or produced locally but at higher costs), thus removing structural constraints on investment. These imports of capital goods, which make up sizable proportions of the imports of many recently liberalized developing countries, also embody more recent technologies, a further source of growth.

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[5] However, the scope of this argument is somewhat limited. Since currently 'open' economies tend to be relatively capital abundant, we would be left with the task of explaining why their investment rates tend to be higher than in 'closed' countries, once other determinants of investment are kept constant. Indeed, openness for capital abundant countries is associated with a lower wage-rental ratio under free trade compared to autarky, hence presumably with lower investment rates under free trade. Hence, this type of theory helps make a normative case in favor of liberalization, but does not really explain the currently observed positive impact of trade on investment.

[6] We need to explain why lower restrictions on imports should lead to a larger market for exports: since economies face an intertemporal budget constraint, balanced trade must hold at least in the long-run. In this case, removing restrictions to imports is equivalent to allowing a greater volume of exports.

2.1.3 Technological Transmission

The last channels that we consider stem from the recent literature on endogenous growth: if knowledge spillovers are a driving force for sustained, long-run growth, and open economies are more exposed to a worldwide stock of productivity enhancing knowledge, then *technological transmissions* can be a channel through which trade openness affects growth and convergence (Barro and Sala-i-Martin (1997), Grossman and Helpman (1991)). There are two potential ways by which openness may increase the exposure of the domestic economy to technological transmissions.

Firstly, more frequent and sustained international trade interactions may make it easier for domestic producers to imitate foreign technologies and to incorporate this knowledge in their own productive processes (Edwards (1992)). This increased exposure can stem from direct imports of high technology goods or from greater interaction with the sources of innovation (through enhanced international communication and mobility brought forth by economic integration). This should translate into a higher capacity to compete with more advanced economies on world markets. Such a pattern was certainly part of the East Asian growth miracle, characterized by broad transformations in the product composition of output and exports from agriculture to heavy industry and finally to high technology goods, via the imitation of technology originating in Europe and the United States.

Secondly, *foreign direct investment*, whether or not it is associated with joint ventures, often leads to the direct international transmission of advanced types of technology, either through capital goods imports which are later imitated, or through the diffusion of knowhow and expertise. However, it is unclear, a priori, that trade openness is associated with greater levels of foreign direct investment. On the one hand, FDI may act as a substitute for trade, as foreign investment is used to set up plants producing goods that cannot be imported due to trade restrictions ("tariff-hopping"). On the other hand, investors may view trade openness as a signal that a country is committed to stable and market oriented economic policies; in addition, trade openness allows them to import the intermediate goods that are required to initiate the projects, to expect repatriation of some profits and to export the goods that they produce. Falling transport costs may allow a 'slicing up the value added chain', whereby firms can "produce a good in a number of stages in a number of locations, adding a little bit of value at each stage" (Krugman (1995)). Hence, one can plausibly

argue that FDI acts as a complement, not a substitute, to trade openness. Indeed, existing evidence suggests that open economies tend to attract more foreign direct investment than closed economies (Harrison and Revenga (1995)).

In turn, FDI is likely to spur growth. In fact, since the share of FDI in GDP is typically small (on the order of 1% of GDP on average), it is hard to argue that FDI spurs growth via traditional physical capital formation. It is likely that, if there is any significant dynamic effect of FDI, it captures the incidence of a certain type of technological transmissions. This, indeed, is the interpretation that we shall favor for the FDI channel.

2.2 Characteristics of the Data

2.2.1 Construction of the Trade Policy Openness Index

Measuring the nature of trade regimes constitutes a major challenge for any study involving the analysis of trade policy. Indeed, measures of protection are not readily available for a vast number of countries and time periods. It is worth spending some time assessing the existing measures of trade openness, of which there are three broad categories:

Outcome measures describe the volume of existing trade, or its components. This type of indicator is most subject to endogeneity problems with respect to growth (Frankel and Romer (1995)), but measures actual exposure to trade interactions and hence may account quite well for the effective level of integration. On the other hand, it may correlate only imperfectly with attitudes or institutions relating to openness. The tendency to confuse outcome measures with policy attitudes (which are presumed to partly determine the outcome) has been a feature of past research, largely because precise measures of actual trade policies are not widely available.

Policy indicators, such as tariff rates, non tariff barriers, tariff revenues, etc., describe the institutional features of a country's attitude towards the rest of the world, as far as trade and factor flows are concerned. As such, they are likely to be an important determinant of the outcome measures. However, endogeneity problems in their relationship with growth are not absent, and their availability tends to be limited. Furthermore, they may not directly reflect the degree of effective protection faced by domestic agents, but only the legal framework to which they are confronted.

Lastly, we can consider measures of *effective protection* based on deviations from the predicted free trade volume of trade. Factor endowment and gravity models of trade generate predictions about a country's propensity to trade internationally. For instance, country size, distance from major trading partners, negative terms of trade shocks can be thought to affect trade volumes negatively. Similarly, relative endowments of skilled labor, unskilled labor, capital and land (or natural resources) may have an impact on overall trade volumes, as well as, perhaps more obviously, their composition. Using this type of variables only, one can attempt to predict a country's potential free trade volume of international commercial transactions. Deviations of the observed trade volume from this potential volume provide a measure of how restrictive the trade regime really is.

Given these three alternatives, which one should we choose ? Because most theories about dynamic gains from trade have to do with policy measures, in the sense that the relevant comparisons generally involve contrasting free trade to restricted trade or autarky, our objective must be to construct an index of trade policy that adequately captures the nature of the policy regime vis-à-vis international trade.[7] The use of outcome measures seems undesirable on these grounds. We are left with a choice between direct policy indicators and effective protection measures. In fact, this paper employs a (presumably optimal) combination of both.

There are three drawbacks to using effective protection measures. First, there is no guarantee that the predicted level of trade adequately measures the volume of commercial transactions that would prevail under complete free trade, because determinants of potential trade may have been omitted. Second, some gravity or endowment determinants of potential trade may be highly correlated with policy attitudes. For instance, large countries tend to have more restrictive trade policies, and so do relatively labor abundant countries. If this is the case, the deviation of observed from potential trade may exclude some valid information about policy (all the variation in policy due to size effects and labor abundance has been removed). Lastly, as long as the observed volume of trade contains a white noise disturbance term, deviations from predicted volumes will also contain a white noise disturbance (whose share of the variance in the total variance of the measure has increased

[7] Appendix IV presents empirical evidence in favor of this choice: the growth effects of trade openness are due mostly to the trade policy regime, rather than to the gravity component of trade shares.

due to the differencing), and any use of such a variable as a regressor will induce downward bias associated with measurement error. The most serious problem is probably the second one, because gravity-type variables can be shown empirically to be important determinants of policy itself (we shall return to this issue in Section 4).

The major drawback of direct policy attitude measures is that they may not capture effective levels of protection. The approach in this paper constitutes an attempt to avoid this problem as well as those associated with effective protection measures. Outcome measures can be viewed as resulting from a series of factors: gravity determinants, factor endowments and policy variables. Appendix IV examines a regression of trade volumes on several openness-determining variables. The objective is to largely explain the extent of observed trade interactions. This can then be broken down into several components: the policy component of observed trade shares is obtained as the weighted sum of the policy measures included in the regression, where the weights are the estimated coefficients from the trade volume regression. This measure can then be used as an index of trade policy openness, which can be interpreted as the portion of observed trade shares that is due to the effective impact of trade policy. This procedure avoids both the problem of measurement error due to the construction of the difference between observed and potential trade volumes, and the problem of collinearity between gravity/endowment factors and policy factors. It also limits the potential effect of omitted variables in the equation that determines trade volumes, insofar as these omitted factors can be assumed to bear a weak correlation with the policy determinants that are included in the regression.

Our main concern is to obtain a measure that applies to a broad range of countries over the period 1970-1989, and that adequately accounts for several aspects of trade policy: tariff barriers, non-tariff barriers and other forms of attitudes towards international trade which capture whether the trade policy regime is outward-oriented or not. These considerations inspired the choice of the policy indicators chosen to construct the index.[8] First, tariff rates were available for the period 1980-1993 only, and for approximately 50 countries. To capture the effects of tariff barriers, we used the share of *import duty revenues* in total imports (from the IMF's government finance statistics), available for more countries and a wider time span. This has two advantages. First, it better captures the effective degree of tariff restrictions.

[8] Appendix III describes in more detail the procedure used to construct this index of trade policy.

Direct overall measures of tariff protection obtained from UNCTAD are unweighted averages of goods-specific tariff rates. However, duty revenues are by construction weighted by the composition of imports. Furthermore, there may be a weak relationship between officially declared tariff rates and those that are effectively implemented. Duty revenues once again avoid this problem by measuring the amount of tariff revenue actually collected. One potential limitation of the use of tariff revenues is that prohibitive tariff rates will tend to reduce revenues through a "Laffer curve" effect applied to imports. Hence, the use of revenues may lead to underestimate the true level of tariff barriers. However, we are considering duty revenues as a share of total imports, which may greatly limit the incidence of this problem (high tariff rates work to reduce revenues by deterring imports, so the ratio of the two should roughly reflect effective tariff rates). Table I contains correlations between tariff revenues and tariff rates, for the dates and countries available for both measures. The correlations are very high, suggesting that the choice between the two measures may not be a crucial issue.

Non-tariff barriers constitute the second component of our trade policy index. Insofar as policy-makers employ a diverse set of tools to attain certain policy objectives, and the mix varies across countries, NTBs may actually capture much of the effective degree of protection. However, measures of NTBs are highly imperfect. Available data concern the coverage rate of NTBs, i.e. the percentage of goods affected by quotas, voluntary export restraints, etc., but not the extent to which these constraints are binding. Furthermore, time series data for NTBs have yet to be assembled. We use an unweighted coverage ratio for the pre-Uruguay Round time period, published by UNCTAD. Presumably, the extent of NTBs has varied somewhat across time although, as with tariffs, it is likely to be highly autocorrelated within countries. We are unable to account for this time-series variation, since we only have one observation for the 23 years under consideration. Presumably, this type of measurement error should weaken the relationship of NTBs with trade volumes, and correspondingly reduce the weight of this indicator in the overall index.

We try to capture the overall attitude of policy makers using a third component for the index of trade policy. Sachs and Warner (1995a) have compiled a list of dates of trade liberalization, including episodes of temporary liberalization, for a large sample of countries. These dates were constructed by examining trade policy data and by conducting

a systematic analysis of the literature concerning the trade regimes of specific countries (the results of this search are reported, for each country, in the appendix to their paper). We constructed dummy variables for a country's liberalization status, for each year. These were then averaged over the time periods under study (1970-74, 1975-79, 1980-84, 1985-89). Liberalization status is highly correlated with other components of trade policy, and is meant to capture the prevailing policy attitude towards foreign trade. Insofar as this indicator receives some weight in the index, it captures factors other than just tariffs barriers and NTBs; in particular, it may help account for the effect of time variations in NTBs which we cannot explicitly account for, due to data unavailability.[9]

Correlating the trade policy index with its three components (Appendix III, Table A-III-II) can give an idea of the relative weights attached to each of these. All the components bear correlations with the overall index that are larger than 0.4 in absolute value but the duty revenue component dominates with a correlation ranging from 0.72 to 0.77, depending on the time period under consideration. The non-tariff barriers component received the smallest weight.

We can obtain preliminary insights into the relationship between growth and trade policy by examining summary statistics for the two variables. Tables II and III display first and second moments for per capita GDP growth and the policy index for five-year averages, over the 1970-89 period.

Table III indicates that trade policy tends to be much more persistent over time than growth rates. The simple contemporaneous correlations between growth and openness are positive but their magnitudes are somewhat small, especially for the 1975-79 period during which the oil shock may have affected the relationship between openness and growth in a negative way. Overall these simple correlation suggest that the relationship between trade policy openness and growth may be conditional on other growth determinants rather than absolute.

[9]The exclusion of this indicator from the trade policy index reduced the precision of the estimates presented below, but did not change the qualitative nature of the results.

2.2.2 Measurement of the Channel Variables

Some of the channel variables considered in Section 2.1 can be readily measured. Such is the case for foreign direct investment inflows as a share of GDP, government consumption of goods and services as a share of GDP and the domestic investment rate. So three of our six channels can be captured in fairly uncontroversial ways as far as measurement is concerned.

The other three channels are captured by composite indices or approximated using available data.[10] The *quality of macroeconomic policy* is captured by an index that gives equal weight to each of three decile rankings of policy characteristics for each country. Specifically, for each time period, each country is ranked on a scale of 1 to 10 according to its decile position for the level of the public debt as a percentage of GDP, the level of the government deficit as a share of GDP, and the growth of M2 net of total real output growth (higher numbers signal better policies). The rankings are then averaged to obtain an index of overall macroeconomic policy quality, which reflects a country's position relative to others. This avoids the problem of having to characterize a 'good' macroeconomic policy in absolute terms.

The extent of *technological transmissions* is approximated by the share of manufactured exports in total merchandise exports, admittedly an imperfect proxy for technological transmissions.[11] The main rationale for this measure is that countries able to compete effectively on world markets for manufactured goods and to produce at world standards are likely to incorporate more of the existing modern technologies in their productive processes. Other suggestions for the measurement of technological transmissions include the share of manufactured *imports* in merchandise imports, but this measure suffers a major drawback: imports of manufactures may act as a substitute rather than a proxy for technological transmissions.[12] On the other hand, if a country is able to produce at world standards, the

[10] Appendix III describes the construction of these indices and proxies in more detail.

[11] The share of manufactures in merchandise exports was used as a proxy for technological transmissions in the World Bank's Global Economic Prospects, 1996.

[12] We tried to employ the share of manufactured imports to total merchandise imports as a proxy for technological transmissions, instead of the share of manufactured exports. We could determine no statistically significant relationship between this variable and growth on the one hand, and with trade policy openness on the other, even when controlling for a diverse set of variables.

likelihood of it absorbing relatively modern technologies is higher. The crucial point is that technological advances and knowledge embodied in existing goods must make their way into production processes in order to truly qualify as technological transmissions. More direct measures of technological absorption, such as patent licensing agreements, are extremely difficult to assemble for a wide array of countries.

Lastly, we need a measure of *price distortions* prevailing within the economy, in order to capture the effect of trade policy on the efficiency of the price system. Appendix III-3 describes a direct way to measure price distortions originating from trade policy or domestic sources such as taxation, subsidies and imperfectly competitive pricing.[13] However, our analysis employs a less direct approach. The black market premium on the official exchange rate is widely used in cross-country analyses, to approximate the implementation of distortionary policies. As argued in Barro (1995), "the black market premium on foreign exchange is a widely available and apparently accurate measure of a particular price distortion. The premium likely serves as a proxy for governmental distortions of markets more generally".

It is useful to examine simple statistics for the channels variables, openness and growth averaged over the period under consideration (Tables IV and V). This might provide some preliminary evidence about the relevance of our choice of channels. Table IV provides information about the means and standard deviations of the main variables, which may prove useful when interpreting the regression results.

Table V displays correlations between the main variables. The most interesting columns to examine for our purposes are the first and second. The first column shows the unconditional relationship between channel variables and growth, while the second one contains the correlations of trade policy with the channels. Multiplying the numbers in each column gives a rough idea of what to expect in terms of channels. In particular, simple correlations suggest that all of the channels involve a positive effect of trade on economic growth. The largest correlations appear to be in the investment and manufactured exports channels. Overall, these correlations show that the trade policy index is positively related to FDI as a share of GDP, macroeconomic policy quality, manufactured exports as a share of merchandise exports and the domestic investment ratio. In turn, each of these are positively related to growth. Trade policy openness is negatively related to the black market premium and

[13] Appendix III-3 also explains why this index was not used in the analysis.

government size. In turn, each of these is negatively associated with growth.

3 Estimation Framework

This section briefly reviews the technical aspects of the estimation method employed in this paper. The method was first developed and employed in a cross-country growth context by Tavares and Wacziarg (1998), to analyze the effects of democracy on growth. The underlying econometric theory is an extension of Zellner and Theil (1962) to the case of panel data.

3.1 The Structural Model

The basic framework for the cross-sectional analysis consists of a simultaneous equations model aimed at identifying the various effects of trade policy on growth. The model consists of a growth equation, an equation determining the nature of trade policy, and a series of channel equations describing the effects of trade policy on several growth determining variables. This series of equations constitutes the structural model, derived from economic theory: the channel variables are included in the growth regression, but the measure of trade policy openness only appears in the channel relationships. The hope is that the specification of the channels fully exhausts the potential ways in which openness affects growth (some formal evidence concerning this issue will be provided in Section 5). The equation describing the determinants of trade policy openness only appears in order to make explicit endogeneity issues, having to do with the simultaneous determination of trade policy, growth and the channel variables. In particular, several channel variables may appear on the right-hand side of the trade policy equation. But this relationship could be removed altogether with no implication on the estimation of the channel effects.

3.2 Estimation

The parameters of the structural model are estimated jointly using three-stage least squares. This method achieves consistency by appropriate instrumenting, and efficiency through optimal weighting. It combines features of instrumental variables, random effects and generalized least squares models.

Each equation in the structural model is formulated for the four time periods under

scrutiny (1970-74, 1975-79, 1980-84, 1985-89).[14] Joint estimation allows the derivation of a large covariance matrix for the error terms of all 32 equations. Hence, both cross-period and cross-equation error correlations are brought into the picture. This ensures the efficiency of the estimates. The fact that cross-period error correlations are taken into account is akin to assuming that the error terms contain country-specific effects that are uncorrelated with the right-hand side variables. The flexibility of the error covariance matrix means that we are able to obtain substantial efficiency gains compared to estimating each equation separately.

Since several endogenous variables appear on the right-hand side of the structural equations, endogeneity bias must be a major concern. To achieve consistency, we need to instrument for every endogenous variable appearing as a regressor. This is done by first writing the model's reduced form, in which every endogenous variable is rewritten as a function of all the exogenous variables in the system. The fitted values of each endogenous variables from OLS estimation of the reduced form will provide suitable instruments for each corresponding endogenous variables in the structural form.[15] Constructing these fitted values constitutes the first stage of the 3SLS procedure. The second stage consists of estimating each equation in the structural model separately via instrumental variables (or two-stage least squares), using the instruments constructed in the first stage. This allows the derivation of a consistent covariance matrix for the error terms of the model. Lastly, the third stage involves employing this covariance matrix as a weighting matrix as well as the instruments derived in the first stage, to jointly estimate the equations in the structural model using instrumental variables-generalized least squares. Instrumenting ensures consistency, while joint estimation ensures asymptotic efficiency.

[14] In addition, we present results including the 1990-92 period, although this leads to a loss in degrees of freedom. For this resaon, the baseline model only extends until 1989.

[15] Given the above specification of the baseline model, the instruments are: male and female human capital, the island dummy, the log of population, the democracy index, the log of area, terms of trade shocks, population density, the secondary school completion rate, the share of population over 65, the share of population under 15, ethnolinguistic fractionalization, postwar independence status, each taken at every time period when applicable. Reflecting concerns for the endogeneity of per capita income levels, this variable was excluded from the instrument list (see Caselli et al., (1996)).

3.3 Identification and Restrictions

As far as specification is concerned, some assumptions are required for this methodology to carry through. Enough instruments must be validly excludable from each equation for the order condition to be met. For each equation, the order condition for identification states that at least as many exogenous variables must be excluded as regressors as there are endogenous variables included on the right-hand side: enough exogenous variables must be validly left out of each equation for the system as a whole to be identified.[16]

The chosen specification is based on existing empirical work on the determinants of the various endogenous variables under study. For instance, the growth and investment equations are based on common specifications used in the cross-country growth literature (Barro and Sala-i-Martin (1995)). Similarly, the specification of the government size equation is based on Rodrik (1996) and Alesina and Wacziarg (1997). For other channels, such as the macroeconomic policy quality channel, we relied on theoretical priors to determine the set of exclusions.[17] The specification of each equation is given in Section 4, which contains the results for the parameter estimates of each equation in the system.

In order to assess the long-run effects of trade policy on growth in a unified manner, we impose cross-period parameter equality restrictions: none of the estimates of the parameters in the structural model are allowed to vary across time. This allows efficiency gains via higher degrees of freedom, as the number of estimated parameters in the system is divided by four. To examine whether these restrictions are justified, there are two alternatives. The first one is to run the system without the restrictions and to test the hypothesis that the parameters are jointly equal between the two models. However, the loss in degrees of freedom is such, that it is unclear whether the difference in parameters is due to the imprecision of the estimates in the unrestricted model, or to the time varying nature of the processes being modeled. The second, preferred alternative is to examine whether the results are sensitive to the inclusion of any given period. This is done is Section 5.

[16] We do not check the rank condition for identification, which can be safely assumed to hold for a system of this size.

[17] Tavares and Wacziarg (1998) discuss in more detail the issue of specification search for the type of system that we are considering.

4 Parameter Estimates

This section presents, for each equation in the system, the results of the estimation procedure applied to five variants of the same model. Model I is the baseline model for this paper, for the period 1970-89. Model II includes the 1990-92 period into the analysis, with a corresponding loss of 8 observations. Model III restricts the sample to developing countries. Model IV examines the robustness of the model to the estimation method, by employing the Seemingly Unrelated Regression estimator. This estimator, while inconsistent (no instruments are used), is characterized by greater efficiency and may provide some indication of the model's robustness. Lastly, in model V, regional dummy variables were added to every equation in the system, to account for time invariant region specific effects. We should expect this inclusion to reduce the overall effect of trade policy on growth, as much of the between-country variation in the endogenous variables is now accounted for by the regional dummies.

4.1 Growth equation

The results for the *growth equation* closely match existing findings in the cross-country empirical growth literature (see, for example, Barro (1991)). The rate of conditional convergence in our sample (equal to the estimated coefficient of the log of initial income), 1.67%, is in line with common analyses of convergence in a cross-sectional framework.

Most of the other estimates reflect the current "Washington consensus" on the determinants of growth: Table VI contains evidence pointing to the positive effects of the domestic investment rate, male human capital, macroeconomic policy quality and FDI on growth. Negative factors include the black market premium, female human capital and government consumption of goods and services, while manufactured exports seem largely unrelated to economic growth in most specifications. The pattern of human capital coefficients is in line with results by Barro (1991), and can be interpreted as resulting from conditional convergence.[18]

[18] A larger gap between male and female human capital signals a lower level of per capita income. Conditional on steady-state determining variables, this gap should be negatively associated with growth. If, in addition to this, the average level of human capital (male and female) has a positive effect on the steady-state income level, we obtain the observed pattern of male and female human capital coefficients.

These results do not seem sensitive to changes in the specification. Both the signs and orders of magnitude of the coefficients are preserved in most cases. In particular, the signs and magnitudes of all of the channel variables are maintained.

4.2 Openness equation

The equation accounting for the degree of *trade policy openness* (Table VII) is considered solely to capture various endogeneity issues. Its inclusion in the model should not affect the estimates in the other equations, except insofar as efficiency gains are concerned. The growth rate of per capita GDP is included to control for endogeneity in the growth-openness relationship. A one percentage point increase in growth is shown to trigger a .32 percentage point increase in the policy component of the trade ratio. While highly significant statistically, this effect is very small economically.

Measuring country size using the log of area, we find that larger countries have more restrictive trade policies, reflecting several possible theoretical explanations. Firstly, under any model with increasing returns, larger countries should experience smaller losses from protection than smaller ones, prompting them to a greater vulnerability to protectionist arguments. Secondly, in the neoclassical trade theory, the optimal trade policy for a large country is not complete free trade. Because they can affect their terms of trade, large countries should implement an optimal tariff in order to reach allocative efficiency, and this incentive may be partly reflected in the estimated effect of land area (note however that the coefficient country size measured by the log of population is not significantly different from zero).[19] At any rate, the significance of the area variable and of the island dummy indicate that 'gravity' variables do bear some relationship with trade policy, and provide further justification for the method used to construct the trade policy openness index.

4.3 Government Policy

4.3.1 Macroeconomic Policy Quality

The policy quality equation brings out the positive effects of democracy and trade openness on the *quality of macroeconomic management* (Table VIII). In the baseline model, a 10

[19] See also the discussion in Alesina and Wacziarg (1997) and Alesina, Spolaore and Wacziarg (1997) for more on the relationship between country size and trade openness.

percentage point difference in trade policy openness, which corresponds to one standard deviation of the index, is associated with a 0.27 increase in the index of macroeconomic policy quality, which ranges from 1 to 10. This estimate remains statistically significant in four of the five models, and increases in magnitude when the sample is restricted to developing countries.

The effect of initial per capita income on the quality of macroeconomic policy is generally positive, but not significant at the 5% level in the baseline model. Countries with a larger share of government consumption and a high black market premium also have worse macroeconomic policies, indicating that bad policies tend to go together. The negative coefficient on the terms of trade shocks may reflect the fiscal response to economic shocks.

4.3.2 Government Size Equation

Trade policy has a positive impact on *government size* (Table IX) in the baseline regression. This provides some support to results by Rodrik (1996), who also reported a significantly positive impact of trade shares on government size, although the result disappears when the sample is restricted to developing countries.[20] Taken together with the results of the growth regression, this suggests that government size may be a channel whereby openness works *negatively* for growth.

Other determinants of government size are included in the regression, following Rodrik's specification. The log of initial per capita income is negatively related to government consumption. Its inclusion into the regression drives much of the positive effect of trade policy (the sign of this variable is reversed when initial income is excluded from the regression). The role of a large population in limiting the size of government can be viewed as the result of increasing returns in the provision of public goods (Alesina and Wacziarg, (1997)). These may result from the partly nonrival character of many such goods, such as defense, diplomacy and the maintenance of law and order. The signs of most of the other determinants of government size are as expected: population density is associated with a smaller government, perhaps capturing another type of scale effect. Dependency rates are associated with

[20] However, Alesina and Wacziarg (1997), using a wider sample of countries, have cast some doubt on Rodrik's results, by showing that they are sensitive to the chosen specification and to the inclusion of country size in the regression.

larger governments, in line with the idea that government consumption is likely to respond positively to increased schooling and retirement needs.

4.4 Allocation effects: Distortions and Capital Accumulation

4.4.1 Distortions channel

The baseline model displays a negative but insignificant effect of trade policy on *price distortions*, proxied by the level of the black market premium, once other determinants of distortions are held constant (Table X). A 10 point increase in the trade policy index is associated with a 3.4 percentage point reduction in the black market premium, although the slope parameter is estimated very imprecisely. However, this effect becomes significant at the 90% level in all other specifications. In particular, the estimated coefficient become large economically when OECD countries are excluded from the sample, as we find that a 10 point increase in trade policy openness reduces the black market premium by 18 percentage points.

The inclusion of government size, which enters with a positive sign, provides further evidence of the complementarity between maintaining a small level of public spending and policies aimed at ensuring the efficiency of the price system. Democracy, measured by an objective index compiled by Gastil and his followers for the yearly Freedom in the World reports, is associated with lower distortions, even when controlling for initial income. This may reflect the ability of democracy to provide a check on the abuses of policy-makers, as argued in Tavares and Wacziarg (1998). Finally, and as expected, a higher level of per capita income is associated with reduced distortions.

4.4.2 Investment channel

Trade policy bears a strong and robust positive relationship with the *share of investment in GDP* (Table XI). This constitutes one of the main findings of this paper. Estimates from the baseline model suggest that a one standard deviation difference in the trade policy index is directly associated with a 3.2 percentage point increase in the ratio of domestic investment to GDP. This effect is robust with respect to alternative models, although its magnitude is reduced when the 1990-92 period is brought into the picture.

Other determinants of domestic investment include life cycle variables (dependency ra-

tios), ethnolinguistic fractionalization and initial income. Contrary to what conditional convergence would imply, the share of investment in GDP is larger for richer countries when other determinants of investment are held constant. This suggests that the forces behind conditional convergence may have little to do with the traditional assumption of diminishing marginal product of capital, but perhaps with some form of convergence-inducing technological transfers (Barro and Sala-i-Martin, 1995). Furthermore, as expected, a low level of distortions and a high quality of macroeconomic management appear conducive to physical capital investment.

4.5 Technological Transmissions

4.5.1 Manufactured exports channel

The transmission of technology, proxied by the ratio of manufactured exports in total merchandise exports, is strongly influenced by trade policy (Table XII). In the baseline model, a 10 percentage point increase in the policy component of trade shares is associated with a 6.35 percentage point rise in the manufactures to merchandise exports ratio. Both the magnitude and the precision of the estimates are robust in four out of five specifications of the model.

Other regressors included in this equation bear the expected signs: population density, which proxies for the labor/land ratio, is positively associated with the export share of manufactures (presumed to be relatively labor intensive rather than land intensive); human capital, measured by the proportion of the adult population having completed secondary school, captures the ratio of skilled to unskilled labor, which is also expected to bear a positive relationship with the share of manufactures in merchandise exports. Initial income displays a positive and significant estimated coefficient. All of these conditioning variables can be interpreted as relative endowments, which are obvious determinants of the composition of exports.

4.5.2 Foreign Direct Investment Channel

Foreign direct investment appears to be a complement, rather than as substitute to trade policy openness (Table XIII). A 10 points change in the trade policy index is associated with a 0.46% direct increase in the FDI to GDP ratio, which represents about 50% of

this variable's mean, a large effect indeed. Countries with lower distortions, which in turn attracts more FDI. A similar effect holds for countries with relatively smaller governments. Non-distortionary policies, a commitment to non-interventionist policies and free trade all appear conducive to attracting foreign capital. In turn, the effect of FDI on growth can be interpreted as a technological transmission mechanism, since FDI represents too small an effect on the growth of the domestic capital stock to represent a direct accumulation effect.[21] The estimates from the FDI channel equation are robust across the five variants of the baseline model. Furthermore, isolating developing countries leads to a doubling of the trade policy coefficient.

Among the other determinants of FDI, former colonies having gained independence after the Second World War tend to attract more FDI, other things equal. This may reflect privileged economic ties between certain countries and their former colonizers.

5 Summary of the Channel Effects and Robustness Analysis

5.1 Analyzing the channel effects in the baseline model

The summary of the channel effect of trade policy on growth, based on the baseline model, is given in Table XIV, which reports the effects of each channel on growth and the effect of trade policy on each channel. The last column displays the product of the two coefficients. The t-statistics for the channel effects are obtained by computing linear approximations of the products of the parameters around the estimated parameter values, and applying the usual formula for the variance of linear functions of random variables to this linear approximation. Computing these standard errors is possible thanks to the joint estimation of all the equations in the system, which allows the derivation of the covariance matrix for all of the estimated parameters. In the baseline model, three of the six channels involve statistically significant effects of trade policy openness on growth at the 90% level. The overall effect, once all the channels have been added, is significant at the 99% level.

According to Table XIV, trade policy openness works positively for growth through

[21] We tried to use the investment rate net of the foreign direct investment rate in the investment channel. to better separate the two effects. The results for both equations were similar. However, the precision of the parameter estimate for the trade policy coefficient in the investment equation decreased somewhat. At any rate, FDI represents a very small fraction of total domestic capital formation in our sample.

five out of six of the channels. Some channels are weak in magnitude: reduced distortions account for roughly 3% of the net effect of open trade policy openness on growth, and is statistically insignificant. This is a surprising result in light of the importance that allocative efficiency has received in the arguments about static and dynamic gains from trade. The same holds for the manufactured exports channel, meant to capture technological transmissions. The government size channel works negatively for growth, although the effect is weak both in terms of magnitude and in terms of statistical significance. Differences in the quality of macroeconomic policy and in the ratio of FDI to GDP appear to be relatively important channels, each accounting for roughly 20% of the total effects of trade policy on growth.

The most important channel by far seems to be the investment rate. It accounts for close to 63% of the total effect of trade policy on growth, a somewhat unexpected result. Several theoretical arguments point to the potential direct impact of trade policy openness on investment, such as those outlined in section 2.1.2. However, dominant theories about dynamic gains from trade generally do not put physical capital accumulation directly at the center of their logic, although the returns to capital are predicted to increase as a result of openness in most of these theories.

Furthermore, theories that stress the favorable effects of trade openness on capital accumulation are often of a static nature. Either through its pro-competitive effects of through enhanced efficiency in the sectoral composition of output, openness raises the steady state capital-labor ratio, which requires more investment in the transition to the steady state. Common estimates of the speed of convergence to the steady state (2%) suggest that this convergence might be rather slow, implying that a country that liberalizes might experience a rather lasting surge in its investment ratio, before the marginal product of capital falls back to its steady state level. Since many of the countries in our sample liberalized their trade regimes either during the period under consideration, or just before, our estimate of the investment effects of trade policy openness might well be capturing this transitional effect.

Long-run effects of trade openness on growth are also theoretically possible. In the endogenous growth literature, any mechanism that prevents the marginal product of capital from falling to zero spurs growth by preventing a fall in the rate of investment. Technological

transmissions, improved policy quality and allocative efficiency are thought to work mainly by raising the productivity of factors, and generate long-run growth through endogenous mechanisms. However, given our methodology, such an effect should show up through the technological transmissions, distortions or policy quality channels.

Another possible explanations for the results is that measurement error in some of the channel variables leads us to overstate the effect of trade policy via investment. Indeed, if investment is positively correlated with technological transmissions, and the share of manufactured exports in total merchandise exports is a weak proxy for the extent of technological transmissions, then part of this effect will be accounted for by the investment channel. This again, seems to point to the logical complementarity between physical capital accumulation and the overall improvement in the productivity of existing factors. A similar argument could be made concerning price distortions. However, the scope of this argument is somewhat limited by the fact that we are using instruments for all of the channel variables: if the measurement errors in the instruments are uncorrelated with measurement errors in the channel variables, the incidence of attenuation bias will be greatly reduced.

To summarize, this model provides strong evidence in favor of the beneficial total effect of trade policy on growth. A 10 percentage point increase in the trade policy measure, which corresponds roughly to one standard deviation, is associated with a 0.71 percentage point increase in the annual growth rate once all of the channels of influence are brought into the picture. This effect is estimated with great precision. The most important channels by far seem to be through investment (63% of the total effect). Technological transmissions, according to our accounting framework, explain 22.5% of the overall positive effect of trade on growth, and macroeconomic policy quality accounts for 18% of this effect.

5.2 Robustness analysis

5.2.1 Robustness to the Specification

We now turn to the analysis of sensitivity for our model. Table XV contains the channel decomposition of the impact of trade on growth in the five different specifications of the model. In addition to the t-statistics, this channel also contains Wald tests for the significance of the products of coefficients. These Wald statistics are asymptotically distributed as χ^2 variables with 1 degree of freedom. As the table shows, the p-values implied by the

t-tests and those obtained from the Wald tests are very similar. Figure 1 displays the six channels graphically.

Column III shows that, when adding the 1990-92 time period, most of the previously insignificant effects become significant. Although the addition of this time period reduces the number of observations, it raises by 20% the amount of data used to estimate each parameter compared to the case where only four time periods are used. The signs and relative magnitudes of most of the effects are maintained. The reduction in the overall effect, from 0.71 to 0.46, is almost entirely due to a reduction in the investment channel. Distortions and government size become statistically significant channels, although relatively small in magnitude.

Column IV shows that the effect of trade policy on economic growth is actually increased when the sample is restricted to developing countries. This is due to the fact that the distortions channel is now significant, and represents roughly 10% of the overall effect. The other channels are preserved. Column V shows that changing the estimator used for the analysis does not greatly affect the sign and magnitude of the estimated effects. In fact, the overall effect of trade policy is roughly preserved compared to the baseline model.

Our estimator does not allow for country specific fixed effects that can covary with the right-hand side variables in the various equations. Accounting for country specific fixed effects would involve rewriting the econometric theory underlying the estimation procedure. a task that is left for future research. However, in order to account for the possibility that regional specificities might be the driving force of the results, regional dummies for Latin America, Sub-Saharan Africa, South East Asia and the OECD countries were added to each of the channel equations, as well as to the list of instruments (Column VI). Since accounting for fixed effects tends to wipe out much of the cross-sectional variation (the fixed effects estimator uses only the variation within regions across time, discarding the between-country variation), we should expect the inclusion of these variables to lower the estimated effects of trade policy. This is indeed the case, as shown in Figure 1. The total effect of trade policy is reduced by the inclusion of region specific dummies, but the respective shares of each channel are roughly preserved. In particular, the dominant role of physical capital formation is maintained.

To summarize, the main message of this paper, namely that trade policy openness

works mostly through the rate of physical capital investment, appears robust to a variety of modifications of the baseline model.

5.2.2 Robustness to the Time Coverage

In order to examine the robustness of the model with respect to its time coverage, and therefore with respect to the cross-equation parameter equality restrictions, we excluded each time period from the baseline model one at a time. Furthermore, the exogenous variables corresponding to the excluded period were removed from the list of instruments. The resulting channel effects are presented in Table XVI. We should expect the precision of the parameter estimates to be greatly reduced, as we are now throwing out 25% of the data in each case. This is indeed the case, as the t-statistics on most of the channel effects are considerably lower when only three time periods are used for estimation. For example, the macroeconomic policy and government size channels no longer appear significant statistically. However, both the signs and magnitudes of the estimates are remarkably close to those of the baseline model. In particular, the investment effect is preserved in all specifications, and in all but one case the overall effect of trade policy remains of the same magnitude. This provides evidence that the estimates are robust with respect to the time period coverage.

5.3 Exhaustiveness of the model

The last concern that we address is that the six channels considered above may not fully capture the total effect of trade policy on growth. In particular, we may have omitted one channel or more, leading both to an incomplete characterization of the effects of trade policy and to potential biases in the estimates of the included channels (insofar as the omitted channels covary with the included ones in the growth regression).

5.3.1 Other possible channels

We start with a brief discussion of other possible linkages which may have been omitted from the system. Firstly, the accumulation of human capital might be one of the channels linking trade policy and economic growth. Indeed, if trade openness modifies the relative returns to factors, then it may create greater incentives to accumulate human capital. For

instance, if an open trade policy spurs technological transmissions, and if technology and skills are complements, then trade openness will increase the returns to accumulating human capital. However, specifying a human capital channel led to no significant linkage effect: the coefficient on the trade policy variable was essentially zero once other determinants of human capital formation, such as per capita income, were held constant. This was robust with respect to the inclusion of a diverse set of controls. Furthermore, the effects of human capital on growth are not robust in our growth specification, a problem which is compounded by the opposite signs of male and female human capital. Hence, human capital does not appear to be an important channel linking trade policy and growth.

We carried out a similar exercise for income inequality. Neoclassical trade theory provides several tools for the analysis of income distribution in relation to trade openness. For example, the simple factor endowments theory of Hecksher-Ohlin-Samuelson predicts that when a relatively unskilled labor abundant country moves from autarky to free trade, returns to unskilled labor should increase in relative terms, with presumed positive effects on income distribution. In turn, there are reasons to believe that inequality has an effect on growth, although the direction of this effect appears a priori ambiguous. Alesina and Perotti (1993), among others, have studied the issue of distribution and growth. They argue that when the poor have a larger weight in the political decision making process, they tend to vote for transfer schemes that involve distortive (i.e. growth reducing) taxation. Empirically, they report that more unequal societies tend to display lower growth rates, once other determinants of growth are held constant. However, including a measure of income inequality (the Gini coefficient) in the basic growth regression gave rise to an insignificant effect. Furthermore, the effect of trade policy on income inequality, once controlling for the level of per capita income, was found to be essentially zero. Hence, the income inequality channel does not appear to operate either, although the poor quality of cross-country inequality data may be the source of this result.[22]

5.3.2 Unconditional effect of trade policy openness

The unconditional effect of trade policy on growth can be calculated by removing all of the channel variables from the growth regression, and including the trade policy index in their

[22] Results for the income inequality and human capital channels are available from the author upon request.

place (Table XVII). The resulting estimate suggests a strong association between the trade regime and growth: A 10 percentage point increase in the trade policy index is associated with a 0.66 percentage point increase in the annual growth rate in the baseline model.

With the exclusion of many variables from the growth equation, the trade policy index now captures much of the portion of their effect on growth that is not necessarily linked to trade policy. However, this coefficient is useful in that it provides us with a rough order of magnitude against which to compare the total effect of trade policy computed above. Indeed, in all five models, the unconditional effect of trade policy (where we take 'unconditional' to mean that we are not conditioning on the channel variables) is roughly of the same magnitude as the total effect of trade policy computed in Table XV. This increases our confidence that no major channel has been omitted.[23]

5.3.3 Tests based on the residuals from the growth equation

A perhaps more formal test of exhaustiveness can be carried out by regressing the residual vector from the growth regression on the index of trade policy. If any significant channel has been left out of the growth regression, this should generate some correlation between the estimated residual and the measure of trade openness. The results presented in Table XVIII, based on a seemingly unrelated regression estimator, show that this is not the case.[24] In most of the models, the residual effect of trade policy is generally positive, but not significantly different from zero at any reasonable level of significance. This, again, reinforces our confidence in the exhaustiveness of the model. The fact that the estimates are generally positive shows that, if anything, our channel methodology has uncovered a lower bound on the total effect of trade openness. In the only case where the estimate is negative, the effect is very small in magnitude.

[23] A remaining possibility is that we have omitted an important negative channel and an offsetting positive channel, although this would be an unlikely coincidence.

[24] Again, this should not be taken as an absolute proof of exhaustiveness. To the extent that potentially omitted channels covary with the included ones, then the latter will pick up the effects of trade policy that should be accounted for by the missing channels; this would be reflected by a lower correlation between the growth residual and trade policy openness. However, this test provides yet another indication that no major channel has been omitted.

6 Conclusion

This paper constitutes the first attempt to empirically evaluate, in a cross-country context, the respective roles of various theories of dynamic gains from trade in explaining the observed positive impact of trade openness on economic growth. Trade openness affects growth mainly by raising the ratio of domestic investment to GDP. Depending on the specification, the rate of physical capital accumulation explains between 46% and 63% of the impact of trade policy on economic growth. Foreign Direct Investment, used as a proxy for technological transmissions, and the quality of macroeconomic policies each account for roughly 20% of the overall effect. Lastly, we found weak evidence that the size of government, measured by the ratio of public consumption to GDP, constitutes a channel whereby trade policy affects economic growth negatively.

The lack of statistically significant results concerning manufactured exports and distortions may be due to measurement problems. These are the two channels for which measurement, although improving on past attempts, is still subject to considerable shortcomings. The black market premium may be a weak proxy for the overall efficiency of the price system. International technological transmissions are extremely hard to measure as well, resulting perhaps in a downward bias in the estimates corresponding to this channel, and a concurrent overstatement of the other channels. Future research should seek to improve upon the measures used in this study.

The important role of investment in physical capital poses a serious theoretical challenge. While some theories about gains from trade do predict positive effects of openness on the rate of return to capital, these effects should be captured either by the distortions or the technological transmissions channels. Furthermore, theories based on dynamic gains from technological transmissions and efficiency improvements center on the improvement of the overall productivity of factors, rather than on the acceleration of their accumulation. If specialization is limited by the extent of the market, under increasing returns to scale theories, trade openness should allow entrepreneurs to undertake previously unprofitable investments. Theories based on such a 'Big Push' may provide useful insights into the nature of dynamic gains from trade.[25] Further theoretical investigations into the interplay between investment rates, trade openness and growth seem called for.

[25] Results presented in appendix V, however, suggests that such theories may not provide the full picture.

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Appendix I. List of countries

OECD	Asia	Latin America	Africa
Australia	Cyprus	Argentina	Ghana
Austria	India	Barbados	Kenya
Belgium	Israel	Brazil	Malawi
Canada	Jordan	Colombia	Mauritius
Finland	Korea	Costa Rica	Sierra Leone
France	Malaysia	Dominican Republic	South Africa
Germany, West	Myanmar (Burma)	El Salvador	Tanzania
Greece	Pakistan	Guyana	The Gambia
Ireland	Philippines	Mexico	Tunisia
Italy	Singapore	Paraguay	Zaire
Japan	Sri Lanka	Peru	Zambia
Netherlands	Syria	Venezuela	
New Zealand	Thailand		
Norway			
Portugal			
Spain			
Sweden			
Switzerland			
Turkey			
U.S.A.			
United Kingdom			

Appendix II: Data Sources and Description

Variable Name: **Growth**

Source: Summers-Heston v. 5.6

Unit: % points

Description: Growth rate of PPP adjusted Gross Domestic Product

Variable Name: **Import duties as a % of total imports**

Source: IMF-IFS and IMF-GFS

Unit: % points

Description: Import duties in local currency as a percentage of total imports in local currency.

Variable Name: **Pre-Uruguay Round NTB coverage**

Source: UNCTAD/World Bank

Unit: % points

Description: Coverage rate of non-tariff barriers pre-Uruguay Round

Variable Name: **Sachs and Warner Liberalization Status**

Source: Sachs-Warner (1995)

Unit: Values ranging from 0 to 1.

Description: For each year, a dummy variable was constructed based on the years of liberalization in Sachs and Warner (1995). Liberalized countries took a value of 1, closed countries took a value of zero. The data were averaged over the relevant 5 year sub-periods.

Variable Name: **Manufactured Exports Share**

Source: World Bank

Unit: % points

Description: Share of manufactured goods in merchandise exports

Variable Name: **FDI ratio**

Source: IMF

Unit: % points

Description: Ratio of gross Foreign Direct Investment inflows to GDP.

Variable Name: **Democracy**

Source: Gastil (Freedom In the World Reports, various issues)

Unit: Takes values from 0 (non-democracy) to 1 (country with fully developed democratic institutions)

Description: Index of how democratic institutions are (regular elections, broad franchise, wide access to office and relevance of elected officials).

Variable Name: **Initial Income**

Source: Summers-Heston v. 5.6

Unit: Log of per capita GDP in Dollars

Description: Real Gross Domestic Product per capita in a given year (PPP adjusted)

Variable Name: **Human Capital**

Source: Barro-Lee

Unit: Years

Description: Average years of secondary and higher education in the total population over age 25.

Variable Name: **Secondary School Completion Rate**

Source: Barro-Lee

Unit: %

Description: Percentage of "secondary school complete" in the total population.

Variable Name: **Macroeconomic Policy Quality**

Source: Wacziarg / World Bank / IMF

Unit: index

Description: Index of macroeconomic policy quality. Constructed by ranking countries according to the public debt to GDP ratio, deficit to GDP ratio and growth of M1 net of total output growth and assigning values from 1 to 10 to each decile, then averaging the three resulting indicators. Index also ranges from 1 to 10. Higher numbers signal better policies.

Variable Name: **Black Market Premium**

Source: Tavares-Wacziarg data set, initially World Currency Yearbook and IMF.

Unit: (Black market rate-official rate)/official rate. %

Description: Black market premium on the official exchange rate.

Variable Name: **Public Consumption**

Source: Summers-Heston v. 5.

Unit: %

Description: Share of government consumption of goods and services in GDP, excluding transfers and public investment.

Variable Name: **Population over 65**

Source: Barro-Lee

Unit: %

Description: Share of population aged over 65 in the total population

Variable Name: **Population over 15**

Source: Barro-Lee

Unit: %

Description: Share of population aged over 15 in the total population

Variable Name: **Terms of Trade Shocks**

Source: Tavares-Wacziarg, initially from the World Bank.

Unit: %. A positive value means terms of trade move favorably, a negative value the opposite.

Description: Growth rate of manufactured export prices minus growth rate of manufactured import price

Variable Name: **Population**

Source: Barro-Lee

Unit: Logarithm of population.

Description: Country population

Variable Name: **Population Density**

Source: Barro-Lee

Unit: 1000 population per million square km

Description: Population density

Variable Name: **Ethnolinguistic fractionalization**

Source: Mauro (1994)

Unit: Probability.

Description: Probability that two randomly selected persons from a given country will not belong to the same ethnolinguistic group.

Variable Name: **Postwar Independence**

Source: Barro-Lee

Unit: Dummy variable

Description: Takes on a value of 1 if the country gained independence after the Second World War.

Appendix III. Issues in Measurement

A-III-1. The Trade Policy Index.

Section 2.2.1 discusses the conceptual basis of the trade policy index used throughout the paper. This part of the appendix describes the actual computation of the index in more detail. Table A-III-I displays the results of the regression used to construct the weights on the three components of trade policy, namely import duties as a share of total imports, the per-Uruguay round NTB coverage ratio and the Sachs-Warner liberalization status indicator (averaged over the relevant five-year time periods). The regression also features gravity components such as land area and the log of population, as well as the growth rate (Appendix IV provides evidence of reverse causation from growth to trade shares).

As expected, the share of import duties in total imports and the NTB coverage ratio receive a negative weight in the index, while the liberalization status receives a positive weight. The lack of precision of the estimates, largely due to collinearity between the policy measures, is not really a source of concern since the objective is only to generate weights that provide a rough notion of how the three components effectively impact trade volumes. Minor variations in these weights are not likely to affect the final results.[26]

For each period, the trade policy openness index was computed as:

Trade Policy = -34.73*(Import Duty Share) - 0.217*(NTB) + 11.262*(Liber. Status)

Table A-III-II contains correlations between the resulting trade policy index and its various components for the time periods under consideration. This shows that the liberalization status and the duty ratio receive the greatest weight in the index, although the correlation of NTBs with the overall index is substantial.

The correlations between the underlying components of the trade policy indicator are displayed in Table A-III-III. The signs of the correlations are as expected. The NTB measure is weakly correlated with the other indicators, suggesting that its inclusion may provide useful information about trade policy. However, the NTB coverage ratio receives the smallest weight in the overall index.

[26] In fact, the results for the channels model are not very sensitive to the inclusion of NTBs in the index.

A-III-2. The Macroeconomic Policy Quality Index.

The index of macroeconomic policy quality used in this paper is based on three underlying components: The ratio of government deficit to GDP, the ratio of government debt to GDP and a measure of excessive monetary creation, equal to the difference between the growth rate of M2 and the growth rate of real GDP (this is based on the fact that a growing economy needs to be supplied with liquidity; any excessive money growth sustained for a long time is likely to result in nothing more than inflation). Each country is first ranked according to each component. Each decile is then given a number from 1 to 10, with higher numbers signaling better policies (low excess money growth, low deficit ratio, low debt ratio), and these rankings are simply summed up. The use of quantiles avoids having to decide what a good policy is in absolute terms, and defines the quality of macroeconomic policy relative to the policies adopted in the rest of the world. It also avoids having an index that increases systematically through time due to the accumulation of the public debt. Lastly, it increases the spread of the index compared to an index based on scaled values of the underlying data, which provides more within- and cross-country variation.

Summary statistics for the macroeconomic policy index are contained in Tables A-III-IV and A-III-V. The correlations suggest that the excessive growth of money plays the least part in the variation of the index of macroeconomic policy.

A-III-3. An Alternative Measure of Price Distortions.

Dollar (1992) proposed a measure of outward orientation (or more generally, of distortions) based on an internationally comparable consumer price index compiled by Summers and Heston (1994). This index is constructed by pricing the same basket of goods across countries, taking the US price basket as a numeraire. In the absence of nontradable goods, trade-induced price distortions and domestic price distortions brought forth by taxes, subsidies, and imperfectly competitive pricing (the extent of which can be expected to vary systematically from country to country), full purchasing power parity ought to hold, and the value of the index should be equal across countries. Hence, if one could somehow eliminate price level differences due to the existence of non-tradable goods, one could obtain an index of price distortions.

Systematic price level differences due to the existence of non-tradable are related to differences in factor endowments. Hence, the residual from a regression of the price level on

country factor endowments should yield a measure of distortions. However, it is not clear that distortions themselves are unrelated to endowments, so that the residual may be leaving out important variation in price distortions. Furthermore, measures of factor endowments are missing for many countries, especially as far as the capital stock is concerned.

Estimates of price distortions obtained using this methodology did not give very convincing results.[27] OECD countries displayed abnormally high distortions levels, similar to those of Africa. Both Latin America and South East Asia displayed relatively low distortions. This does not accord with our priors concerning the efficiency of price systems across countries. Further research into a measure of distortions based on overall price levels seems warranted.

[27] Results are available from the author upon request.

Appendix IV. Trade Policy Matters for Growth

This appendix investigates which component of the trade shares, policy or gravity, affects growth mostly. The objective is also to examine the issue of reverse causality between trade shares and growth. Unlike in the text, the channel relationships are absent from this Appendix. The system, made up of two sets of equations (the four growth equations for periods 1970-74, 1975-79, 1980-84 and 1985-1989, and the four openness equations for the same periods), is estimated jointly using three-stage least squares.[28] The estimator used is the same as the one discussed in the text. Note that the measure of openness now consists of the ratio of imports plus exports over GDP, which appears directly in the growth equation.

A-IV-1. Reverse Causation

We first consider the effects of a higher trade to GDP ratio on the growth rate, as well as the possibility of reverse causation whereby growth might affect the degree of openness rather than the opposite. The regressors that appear in the growth equation are: the log of initial GDP, the level of human capital (measured by the average number of years of schooling in the total population over age 25), the black market premium on the exchange rate, the investment share in GDP, the measure of trade openness (imports plus exports over GDP) and the share of government consumption in GDP. The regressors included in the openness equation are: the growth rate of GDP (to assess the magnitude of endogeneity), the log of the country's area, a measure of terms of trade shocks, the log of population, and the Sachs and Warner dummy for liberalization status (averaged over 5-year time periods), and a measure of the country's distance from the capitals of the world's 20 major exporters. The results for this procedure are reported in Table A-IV-I.

The coefficient on the trade to GDP ratio is positive and significant at the 90% confidence level. The magnitude of the coefficient suggests that a 10 percentage point increase in the

[28] The instruments used are: the log of initial income for all periods, population density for all periods, a dummy for major religions (Muslim, Confucian/Buddhist, Catholic, Other Christians), a dummy for oil exporting countries, the number of years the country was involved in an external war during the period 1960-1985, a dummy for whether the country obtained independence after the Second World War, the log of population for all periods, the share of population over 65 for all periods, the log of the country's land area, the log of the distance measure, and the measure of terms of trade shocks for all periods. The panel data used throughout this Appendix contain 61 countries for 4 time periods (averages over 1970-74, 1975-79, 1980-84, 1985-89).

trade to GDP ratio leads to a 0.17 percentage point increase in the annual growth rate of the economy. Although this is admittedly a small effect, it might be important intertemporally (if the US had grown just 1 percentage point slower per annum since 1870, its per capita income would be that of today's Hungary or Mexico, see Barro and Sala-i-Martin (1995), p.1).

We reestimated this growth relationship without controlling for the endogeneity of the openness variable. Specifically, the growth regression above was reestimated in isolation of the openness equation, and the openness variable was added to the list of instruments (this is equivalent to not instrumenting for openness). The coefficient on the trade ratio decreased to 0.004 and became insignificant at any reasonable confidence level (t=.52). This broadly confirms previous results by Frankel (1996), showing that the effect of trade openness on growth increases when controlling for endogeneity.

The trade openness equation also displays common patterns: country size, as measured by land area or population, has a significantly negative effect on trade openness. The distance from the world's main trading nations also has a negative impact on the trade ratio. Positive terms of trade shocks potentially lead to both more exports and more imports, hence a positive impact on the trade ratio. The Sachs and Warner measure of an open trade policy also has the expected sign, and is large in magnitude (economies with open trade policies have trade to GDP ratios 7.54 percentage points higher than those with policies that discourage trade, all other things equal). Lastly, the contemporaneous growth rate has a positive and significant effect on the trade to GDP ratio. The magnitude of this coefficient is rather small: a 1 percentage point increase in the growth rate leads to a 1.1 percentage point increase in the trade to GDP ratio. But we do find statistically significant evidence of reverse causation: growth positively affects the trade to GDP ratio, even if the effect may be considered small (especially compared to the effects of, for instance, country size or the trade policy regime).

A-IV-2. Separating the impact of gravity effects from policy effects.

We now attempt to separate the effects of gravity-type variables on growth (country land area and population, terms of trade shocks) from policy effects. In order to do this, we first run a regression of trade openness, measured by the ratio of imports and exports to GDP, on land area, distance, growth, terms of trade shocks and the log of population. The fitted

value from this regression is a country's "potential degree of openness". The deviation of this fitted value from the observed measure of openness is interpreted as the effect of policy on openness.[29] The smaller the deviation, the more distortionary the policy (negative deviations signal a policy that reduces the effective trade to GDP ratio through protection, while positive deviations signal policies that favor international trade integration). Results from this regression are shown in Table A-IV-II. Table A-IV-III contains summary statistics for the "potential openness component" and for the "policy attitude component".

These two measures are then included in the growth regression instead of the observed trade to GDP ratio. The results from this growth regression appear in table A-IV-IV.[30] The estimates suggest that it is the "trade policy" component of openness that matters most for growth. The gravity component alone is not statistically different from zero. Once geographical and environmental factors have been "purged" out of the openness measure. the effect of openness on growth increases by 60% and becomes significant at the 5% level.

A-IV-3. Conclusion

1. There is some evidence of reverse causation, although the magnitude of the effect of growth on openness is rather small. A 1 percentage point increase in a country's growth rate leads to a 1.1 percentage point increase in its trade to GDP ratio, other things equal. Once endogeneity is controlled for, the estimated effect of trade openness on growth increases and becomes statistically significant.

2. Once trade ratios have been "purged" of their gravity component, their effect on growth becomes larger and even more significant. This can be considered evidence that what matters most for growth is not the trade to GDP ratio per se, but the prevailing trade policy. This provides justification the focus on trade policy openness throughout this paper.

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[29]This is a much less reliable measure of trade policy openness than the one used in the text. Indeed, the residual from the gravity equation may contain more than policy effects. Other potential defects of this deviation approach are discussed in section 2.2.1 of the text. However, by purging out the gravity component, we can gain some insight into the relative role of gravity and other components.

[30]The growth model was, once again, estimated jointly with a trade openness equation in which the observed trade ratio was the dependent variable. The results for that equation are essentially the same as those presented in the first part of this note.

Appendix V. Increasing Returns, the Size of the Market and Growth: A Replication Exercise

This appendix replicates and checks the robustness of the findings in a paper by Ades and Glaeser (1994, henceforth AG), in which the authors document the fact that, in two sets of economies (US States in the 19th century and developing countries since 1960), increasing returns operate by expanding the extent of the market. Their evidence shows that, in samples that display absolute divergence (which is possible only under increasing returns technologies), countries with larger internal markets benefit less from openness in terms of growth. Put differently, more open countries tend to display a smaller correlation of growth with initial income than closed countries, with openness measured as the ratio of exports plus imports to GDP. This is the case because openness eliminates the constraint imposed on growth by the size of the internal market. Under increasing returns-size of the market theories, what matters for growth is how much effective demand can be directed towards the productive sector. Greater effective demand originates either from a larger internal market of from foreign markets, but only open countries can benefit from the latter.

A-V-I. Divergence and the Extent of the Market.

The basic test of divergence involves regressing the growth rate (averaged between 1960 and 1985) on initial income in 1960 measured in PPP adjusted dollars. To evaluate the role of openness and market size, two other regressors are added: openness (trade to GDP ratio, averaged over 1960-1985) and an interaction term between openness and the initial level of GDP.[31] To examine robustness, other variables such as regional dummies and an education variable are added. Table A-V-II below replicates table 3 in AG (appendix). The only difference compared to their set up is that the openness variable here is taken from the latest version of the Summers-Heston data set, whereas AG used World Bank data. Income and growth are from version 4.0 of Summers-Heston, as in AG. Results based on the latest

[31] Note that there is no control for the endogeneity of the openness measure. When replication the estimations using an instrumental variables estimator, neither the sign nor the magnitude of the coefficients were affected. The precision of the estimates, however, decreased significantly. This is a natural consequence of using IV. See appendix IV for a more thorough investigation of this aspect of the growth-openness relationship.

version of the Penn World tables (version 5.6) display no significant differences compared to the ones presented in table A-V-II.

In addition to the developing countries sample chosen by AG, in which they selected countries with per capita income lower than $1,500 (in 1980 constant dollars), we run the same regressions for an extended sample, which includes the OECD as well as a broader range of developing economies. AG only sought to examine how increasing returns operated, so they selected a sample of countries in which they knew unconditional divergence did hold. However, in order to analyze the effect of market size on growth in a broader framework, and to check the robustness of the AG results, we extended the sample. An increased market size should not be a channel whereby openness spurs growth in a sample where increasing returns does not operate.

The results of the replication exercise are satisfactory. Both in terms of orders of magnitude and in terms of the signs of the coefficients, regressions (1)-(3) closely track those reported in AG. In regression (1), initial income bears a positive and significant coefficient, suggesting absolute divergence in our sample. In regression (2), the inclusion of openness and the interaction term also confirms the results in AG: in more open countries, the size of the internal market, proxied by per capita income, has a lower effect on subsequent growth.[32] Put differently, the effect of openness on growth is lower for countries with a larger internal market. This strongly suggests that one channel through which openness may matter for growth is the market size channel. The results do not seem sensitive to the inclusion of regional dummies and the primary school enrollment rate. In all regressions, openness in isolation of the interaction term has a strong positive impact on growth (a 10 percentage point increase in the trade to GDP ratio rises the growth rate by 0.4 percentage points per year, which is in line with the results in note #3).

Much of this breaks down when we consider a larger sample of countries. The unconditional regression (4) displays evidence of very weak absolute convergence (the coefficient

[32]The relevance of this approximation is debatable. After all, total GDP is arguably a better proxy for the size of the market than per capita GDP. Countries with a relatively high per capita GDP may still display a small internal market if they are sparsely populated. In this case, the size of their internal market, if they are closed to trade, is imposing a constraint on their growth rates, as indivisibilities prevent certain investments from being profitable unless the market for the corresponding products becomes larger. See Alesina, Spolaore and Wacziarg (1997) for a discussion of this issue.

is very small: a 1000 dollar difference in per capita initial income (1980 base) entails a 0.1 percentage point difference in growth rates across countries).[33] Although openness retains its strong positive influence on growth, the interaction term is now insignificant and ten times smaller than for the restricted sample. In a sample that includes countries that do not seem to display increasing returns, there are no substantial gains to having a larger market in terms of growth. This, admittedly, may not be considered very useful: we know that, in theory, size cannot matter unless there are increasing returns. However, this result suggests that, although the extent of the market channel may operate for certain countries (mainly the poorest ones), it is certainly not the only channel whereby openness spurs growth. Indeed, with this extended sample, openness still has a positive impact on growth despite that fact that the increasing returns/size of the market story breaks down.

A-V-II. Growth Decomposition

We continue the replication of the AG results by considering a decomposition of growth rates according to a factorial analysis akin to growth accounting. Specifically, we start with a simple production function in which output per capita is a function of technology, of per capita physical capital stock and of per capita human capital:

$$Y_{it} = F(A, K_{it}, H_{it}) = Ae^{\theta_i t} K_{it}^{\beta} H_{it}^{\alpha} \tag{1}$$

or:

$$\log Y_{it} = \log A + \beta \log K_{it} + \alpha \log H_{it} + \theta_i t \tag{2}$$

where A grows at a constant rate θ_i and the coefficients α and β are assumed to be time and country invariant.

Taking first differences of (2) yields:

$$\log \frac{Y_{it}}{Y_{it-1}} = \beta \log \frac{K_{it}}{K_{it-1}} + \alpha \log \frac{H_{it}}{H_{it-1}} + \theta_i \tag{3}$$

This is just a growth regression in which the right hand side variables represent the change in factor inputs for a given country over time, and the residual qi captures the contribution

[33] The fact that increasing returns seem to hold for poorest countries (as in the AG sample) but no longer when richer economies are brought into the picture may suggest interesting paths for future research: Why is it that initial income has a positive impact on growth for poorer countries but not for richer ones ? The study of the endogenous change in market structure is largely absent from economics.

of technological progress to growth (akin to Total Factor Productivity). For each country, we can use (3) to determine the respective contributions of physical capital accumulation, human capital accumulation, and technological change, to the overall observed growth rate.

To estimate the parameters of (3), we can either estimate (2) using a country-specific fixed effects estimator, and then proceed with the appropriate algebraic manipulation to obtain (3), or we can directly estimate equation (3) for two dates (1960 and 1985), as in table A-V-III.[34] The two solutions should yield algebraically the same estimates.

We then construct a measure of the extent of the market based on a weighted average of initial GDP, openness and the interaction between the two. As in AG, the weights are obtained by running the basic growth regression (Table A-V-II) and using the respective estimates as the weights in the construction of the extent variable. The growth in per capita human capital, the growth in per capita capital stock and the estimated residual from equation (3) are then regressed on a constant and the extent of the market variable to determine the magnitude of each channel (Table A-V-IV). The total effect of the extent of the market on growth, through each of the channels, is given in Table A-V-V.

The results broadly confirm the AG findings (their table 8b):[35] The most important channel appears to be the unexplained increase in productivity, which accounts for two thirds of the effect of the extent of the market on growth. Physical capital accumulation accounts for the remaining third, while the growth in human capital accounts for virtually nothing (mainly because it does not affect the growth performance in this sample). The effect of a larger market on growth is thus twofold: Firstly, the level of investment in physical capital is raised by a larger market. This is in line with theories that stress the importance of demand spillovers and backward linkages (Rosenstein-Rodan, Murphy-Shleifer-Vishny). Secondly, market size works by increasing the speed of technological progress, embodied in the residual from regression (3). Several hypotheses can be formulated to explain this. By

[34] AG prefer a third method. They stack the initial income data for 1960 and 1985, and run a regression of this stacked initial income vector on time specific dummies (one for 1960 and one for 1985), the log of human capital in 1960 and the log of capital stock per capita in 1960. It is not clear what connection there is between this specification and the relationship derived from theory as above. Additionally, I have not been able to reproduce their results using their specification.

[35] The magnitudes of the estimates are not directly comparable due to differences in units between the data in AG and the data used herein. However, the estimated contributions of the factors can be compared.

allowing a greater degree of division of labor, a larger market size may allow a shift towards the production of goods that embody more technology (this goes hand in hand with an expansion of the variety of goods). Secondly, the technology effect may simply be capturing the fact that more open economies tend to be more exposed to foreign technology. An accelerated transmission of technology may well be an important channel whereby openness spurs growth. These results tend to lend support to this type of explanation.

A-V-III. Conclusion.

This appendix has explored the relationship between the extent of the market and growth, using the methodology in Ades and Glaeser (1994). In a sample of the poorest developing countries, which exhibits increasing returns to scale (unconditional divergence), openness and initial income have a positive impact on growth. The interaction between the two has a negative effect on accumulation. The effect of these 'extent of the market' variables works mainly through growth enhancing technological improvements and the accumulation of physical capital. Possible interpretations of these results are the following:

(1). The size of the internal market is an important constraint on growth. By integrating in the world economy, many poor and small countries are likely to be better able to exploit dynamic increasing returns and grow faster. However, this channel is by far not the only channel whereby openness improves growth.

(2). Access to larger markets works in two ways: it makes previously unprofitable investments worth undertaking, thus solving a coordination problem within the economy. Furthermore, it allows technological improvements to take place, either through direct technological transmissions, or through a shift in the product mix towards goods that embody more sophisticated technology.

Table I. Correlations Between Duty Revenues and Unweighted Tariff Rates

	Import Duties 1980-84	Import Duties 1985-89	Import Duties 1990-94
Tariff rate 1980-84	0.67	0.74	0.73
Tariff rate 1985-89	0.64	0.75	0.72
Tariff rate 1990-94	0.80	0.84	0.83

Number of countries: 50.

Table II. Summary statistics for Growth and the Trade Policy Index

	Mean	Std. Dev.	Minimum	Maximum
Growth 70-74	3.990	2.520	-0.499	12.351
Growth 75-79	2.333	2.845	-6.688	10.433
Growth 80-84	0.380	2.740	-8.277	6.018
Growth 85-89	1.974	2.455	-3.063	8.770
Trade Policy 70-74	-1.305	8.496	-17.840	10.438
Trade Policy 75-79	-0.937	8.460	-18.716	10.781
Trade Policy 80-84	-0.712	8.663	-19.358	10.784
Trade Policy 85-89	-0.326	9.425	-26.000	10.781

Number of Observations: 57

Table III. Correlation Matrix for Growth and the Trade Policy Index

	Growth 70-74	Growth 75-79	Growth 80-84	Growth 85-89	Trade 70-74	Trade 75-79	Trade 80-84
Growth 75-79	0.283	1.000					
Growth 80-84	0.249	0.397	1.000				
Growth 85-89	0.264	0.361	0.391	1.000			
Trade Pol. 70-74	0.242	0.168	0.259	0.286	1.000		
Trade Pol. 75-79	0.241	0.168	0.270	0.284	0.991	1.000	
Trade Pol. 80-84	0.267	0.177	0.285	0.294	0.967	0.982	1.000
Trade Pol. 85-89	0.325	0.101	0.118	0.223	0.908	0.919	0.930

Number of Observations: 57

Table IV. Summary Statistics for the main variables.

	Mean	Std. Dev.	Minimum	Maximum
Growth	2.169	1.858	-1.798	7.513
Trade Policy Openness	-0.820	8.588	-19.511	10.696
Macro Policy Quality	5.203	1.711	1.750	8.833
Black Market Premium	42.417	83.247	-0.471	437.182
Government Consumption	15.591	6.681	7.731	33.962
Manufactured Exports	36.933	25.138	0.421	83.664
Investment Share	19.381	7.745	1.320	36.135
Foreign Direct Investment	0.871	1.217	-0.761	7.876
Human Capital	1.515	1.163	0.084	5.343
Log Income Per Capita	8.159	0.993	6.154	9.586

Number of Observations: 57

Table V. Correlation matrix for the main variables

	Growth	Trade Policy	Macro Policy	BMP	Govt. Cons.	Manuf Exp.	Inves. Share	FDI	Hum. Cap.
Trade Pol.	0.331	1.000							
Macro Pol.	0.384	0.420	1.000						
BMP	-0.408	-0.404	-0.304	1.000					
Govt. Cons.	-0.421	-0.265	-0.594	0.390	1.000				
Manuf. Exp.	0.387	0.602	0.393	-0.484	-0.268	1.000			
Invest. Sh.	0.483	0.674	0.441	-0.498	-0.428	0.556	1.000		
FDI	0.503	0.263	0.155	-0.255	-0.296	-0.012	0.342	1.000	
Human Cap.	0.185	0.554	0.361	-0.357	-0.334	0.487	0.522	0.116	1.000
Log Income	0.266	0.743	0.469	-0.530	-0.504	0.648	0.754	0.188	0.750

Number of Observations: 57

Table VI: Growth Equation

Dep. Var: Growth	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	10.598	7.815	5.543	9.006	7.113
	(4.70)	(6.74)	(3.55)	(4.59)	(2.99)
Log Initial Income	-1.672	-1.132	-1.106	-1.390	-0.740
	(-5.81)	(-7.66)	(-5.45)	(-5.17)	(-2.24)
BMP	-0.007	-0.005	-0.005	-0.005	-0.007
	(-9.08)	(-21.81)	(-13.09)	(-8.85)	(-9.14)
Government Consumption	-0.042	-0.055	-0.025	-0.043	-0.043
	(-1.57)	(-5.76)	(-1.84)	(-2.20)	(-2.13)
Manufactured Exports	0.004	0.002	0.006	0.007	-0.004
	(0.45)	(0.53)	(1.01)	(1.14)	(-0.72)
Investment Rate	0.143	0.132	0.146	0.143	0.109
	(6.86)	(12.10)	(7.27)	(7.99)	(5.06)
FDI	0.320	0.249	0.271	0.355	0.178
	(4.68)	(8.44)	(4.79)	(4.83)	(2.75)
Macro Policy Quality	0.489	0.290	0.505	0.333	0.280
	(4.22)	(8.62)	(8.70)	(5.03)	(3.27)
Male Human Capital	0.481	0.732	1.351	0.448	-0.136
	(1.59)	(4.24)	(5.47)	(1.57)	(-0.42)
Female Human Capital	-0.387	-0.862	-1.284	-0.429	0.005
	(-1.39)	(-5.65)	(-5.30)	(-1.58)	(0.02)
Latin America Dummy	-	-	-	-	-2.291
					(-6.32)
South East Asia Dummy	-	-	-	-	0.047
					(0.06)
Sub-Saharan Africa Dummy	-	-	-	-	-2.126
					(-4.39)
OECD Dummy	-	-	-	-	-1.466
					(-3.15)
R-squared	.25 .29	.24 .26 .46	.34 .41	.27 .28	.23 .41
	.41 .31	.39 .18	.54 .37	.45 .32	.52 .30
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table VII. Openness Equation

Dep. Var: Trade Policy	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	-53.851 (-16.55)	-49.902 (-21.34)	-23.667 (-6.56)	-53.115 (-17.66)	-46.642 (-9.77)
Log Initial Income	6.548 (17.55)	6.559 (30.36)	3.468 (10.07)	6.422 (18.57)	5.528 (12.96)
Island Dummy	-3.049 (-2.37)	-3.483 (-5.08)	-2.124 (-1.83)	-3.177 (-2.58)	-3.848 (-2.96)
Log Area	-0.888 (-2.20)	-0.653 (-3.73)	-0.005 (-0.02)	-0.866 (-2.35)	-0.718 (-2.35)
Terms of Trade Shocks	-7.148 (-4.97)	-13.690 (-23.73)	-1.480 (-1.56)	-6.877 (-4.63)	-5.014 (-4.01)
Growth	0.321 (10.44)	0.228 (20.31)	0.385 (30.24)	0.377 (12.03)	0.230 (8.13)
Log Population	0.420 (0.79)	-0.044 (-0.19)	-0.973 (-2.19)	0.432 (0.90)	-0.177 (-0.40)
Latin America Dummy	-	-	-	-	3.570 (2.41)
South East Asia Dummy	-	-	-	-	12.173 (6.99)
Sub-Saharan Africa Dummy	-	-	-	-	6.597 (4.16)
OECD Dummy	-	-	-	-	8.950 (5.65)
R-squared	.55 .53 .60 .54	.54 .52.58 .53.45	.26 .28 .37 .32	.55 .53 .60 .54	.67 .66 .74 .72
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table VIII: Macroeconomic policy quality channel

Dep. Var: Macro Policy	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	5.980	5.695	11.534	6.647	4.371
	(5.14)	(6.49)	(8.49)	(5.14)	(2.81)
Log Initial Income	0.187	0.203	-0.501	0.093	0.393
	(1.42)	(2.13)	(2.99)	(0.65)	(2.00)
Trade Policy Openness	**0.027**	**0.038**	**0.033**	**0.048**	**0.014**
	(2.19)	**(5.57)**	**(3.81)**	**(4.07)**	**(1.28)**
BMP	-0.002	-0.004	-0.001	-0.001	0.0002
	(-1.90)	(-7.92)	(-3.42)	(-1.16)	(-0.20)
Government Consumption	-0.126	-0.126	-0.124	-0.122	-0.130
	(-8.25)	(-11.67)	(-12.09)	(-10.44)	(-8.57)
Ethnolinguistic Fractionalization	-0.006	0.001	-0.014	-0.005	-0.005
	(-1.45)	(-0.16)	(-5.37)	(-1.21)	(-0.96)
Terms of Trade Shocks	-1.318	0.213	-1.091	-1.475	-1.252
	(-1.86)	(-0.54)	(-2.03)	(-2.35)	(-1.95)
Latin America Dummy	-	-	-	-	-0.310
					(-0.87)
South East Asia Dummy	-	-	-	-	0.631
					(-1.51)
Sub-Saharan Africa Dummy	-	-	-	-	-0.176
					(-0.45)
OECD Dummy	-	-	-	-	-0.147
					(-0.32)
R-squared	.36 .28	.35 .36 .45	.34 .37	.37 .28	.34 .29
	.34 .36	.42 .35	.42 .34	.35 .36	.38 .37
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table IX: Size of Government Channel

Dep. Var.: Govt. Cons.	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	57.718	37.621	31.387	33.873	40.759
	(10.58)	(22.73)	(8.14)	(8.50)	(7.88)
Log Initial	-4.439	-2.848	-0.875	-2.332	-2.463
Income	(-9.58)	(-32.57)	(-2.84)	(-5.93)	(-5.34)
Trade Policy	**0.154**	**0.121**	**0.034**	**0.102**	**0.249**
Openness	**(3.73)**	**(43.28)**	**(1.34)**	**(2.50)**	**(5.73)**
BMP	0.008	0.004	0.006	0.006	0.007
	(20.19)	(30.77)	(24.17)	(15.55)	(20.57)
Log Population	-0.911	-0.900	-1.856	-0.977	-0.726
	(-4.52)	(-8.08)	(-7.45)	(-4.82)	(-3.25)
Population	-0.003	-0.003	-0.005	-0.004	-0.004
Density	(-5.87)	(-16.65)	(-8.59)	(-6.60)	(-6.47)
Population	16.262	32.549	-10.267	26.215	14.491
over 65	(1.54)	(4.94)	(0.79)	(2.85)	(1.39)
Population	1.653	18.525	14.574	18.595	12.093
under 15	(0.29)	(7.76)	(4.07)	(3.80)	(2.48)
Ethnolinguistic	0.038	0.039	0.107	0.056	0.032
Fractionalization	(3.23)	(5.26)	(12.21)	(4.66)	(1.97)
Latin America	-	-	-	-	-6.095
Dummy					(-4.51)
South East Asia	-	-	-	-	-4.565
Dummy					(-3.18)
Sub-Saharan	-	-	-	-	-2.003
Africa Dummy					(-1.30)
OECD Dummy	-	-	-	-	-5.846
					(-3.91)
R-squared	.28 .28	.21 .29 .47	.25 .33	.29 .33	.35 .36
	.42 .53	.55 .55	.47 .48	.46 .52	.48 .59
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table X: Distortions Channel

Dep. Var: BMP	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	39.720	80.849	168.293	124.906	104.804
	(0.83)	(8.48)	(3.66)	(2.91)	(1.81)
Log Initial	-2.535	-5.314	-17.208	-11.666	-13.617
Income	(-0.43)	(-4.49)	(-2.78)	(-2.18)	(-1.90)
Trade Policy	**-0.344**	**-0.855**	**-1.826**	**-0.900**	**-1.092**
Openness	**(-0.63)**	**(-7.56)**	**(-2.45)**	**(-1.77)**	**(-1.69)**
Government	3.821	1.493	2.407	2.452	3.688
Consumption	(8.13)	(14.62)	(8.44)	(6.49)	(8.28)
Democracy	-51.987	-42.665	-46.554	-35.274	-56.272
	(-4.69)	(-15.57)	(-3.65)	(-3.62)	(-4.74)
Population	-0.025	-0.012	-0.016	-0.027	-0.0004
Density	(-3.37)	(-10.16)	(-1.50)	(-3.77)	(-0.03)
Terms of Trade	71.589	-36.730	47.780	57.464	76.925
Shocks	(2.87)	(2.77)	(1.73)	(2.29)	(2.87)
Latin America	-	-	-	-	44.517
Dummy					(3.55)
South East	-	-	-	-	-11.335
Asia Dummy					(-0.64)
Sub-Saharan	-	-	-	-	11.584
Africa Dummy					(0.89)
OECD	-	-	-	-	42.212
Dummy					(3.24)
R-squared	.19 .23	.17 .18 .06	.15 .28	.24 .29	.20 .27
	.10 .27	.18 .23	.09 .17	.12 .27	.13 .33
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table XI: Investment Channel

Dep. Var: Inves. Rate	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	27.493	12.459	8.243	15.498	25.778
	(3.72)	(2.82)	(1.27)	(2.41)	(3.46)
Log Initial	1.003	2.609	2.746	2.414	1.277
Income	(1.56)	(6.59)	(5.38)	(4.25)	(1.98)
Trade Policy	**0.317**	**0.161**	**0.270**	**0.228**	**0.204**
Openness	**(6.72)**	**(9.77)**	**(7.04)**	**(5.40)**	**(4.40)**
BMP	-0.010	-0.010	-0.006	-0.007	-0.007
	(-7.15)	(-20.13)	(-18.60)	(-8.97)	(-5.70)
Macro Policy	1.027	0.609	0.381	0.390	0.250
Index	(6.97)	(9.79)	(5.31)	(3.16)	(1.88)
Population	-38.321	-33.230	-24.285	-30.457	-30.237
under 15	(-5.16)	(-7.54)	(-4.27)	(-4.12)	(-4.06)
Population	-88.353	-65.596	-67.586	-73.547	-88.871
over 65	(-5.45)	(-7.58)	(-2.66)	(-4.33)	(-5.90)
Ethnolinguistic	-0.047	-0.036	-0.014	-0.051	-0.058
Fractionaliz.	(-3.02)	(-4.37)	(-0.85)	(-3.43)	(-3.38)
Latin America	-	-	-	-	-1.809
Dummy					(-1.35)
South East	-	-	-	-	3.778
Asia Dummy					(2.16)
Sub-Saharan	-	-	-	-	-2.227
Africa Dummy					(-1.57)
OECD	-	-	-	-	3.520
Dummy					(2.30)
R-squared	.44 .56	.49 .60 .61	.21 .52	.49 .62	.53 .67
	.61 .62	.73 .58	.57 .50	.62 .65	.69 .70
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table XII: Manufactured Exports Channel

Dep. Var: Manuf. Exp.	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	-75.796	-82.105	-46.472	-73.793	-38.292
	(-6.94)	(-12.76)	(-5.15)	(-8.23)	(-2.77)
Log Initial	7.289	8.482	3.718	7.497	5.310
Income	(5.18)	(11.15)	(4.32)	(6.99)	(3.18)
Trade Policy	**0.635**	**0.567**	**-0.369**	**0.676**	**0.619**
Openness	**(4.59)**	**(10.15)**	**(-4.82)**	**(6.87)**	**(4.32)**
BMP	-0.013	-0.024	-0.024	-0.020	-0.019
	(-5.49)	(-22.95)	(-19.90)	(-14.81)	(-7.69)
Secondary Sch.	0.291	0.205	1.743	0.232	0.164
Completion	(3.09)	(2.41)	(19.75)	(2.57)	(2.05)
Log Population	5.215	5.216	3.451	4.964	4.219
	(5.68)	(8.76)	(4.92)	(5.53)	(5.18)
Population	0.019	0.014	0.015	0.017	0.020
Density	(5.22)	(9.10)	(7.33)	(4.91)	(6.05)
Latin America	-	-	-	-	-20.070
Dummy					(-5.17)
South East	-	-	-	-	-18.118
Asia Dummy					(-3.97)
Sub-Saharan	-	-	-	-	-18.010
Africa Dummy					(-4.65)
OECD	-	-	-	-	-5.017
Dummy					(-1.15)
R-squared	.50 .52	.48 .48 .43	.21 .38	.51 .53	.55 .59
	.49 .53	.51 .50	.34 .53	.49 .53	.54 .62
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table XIII: Foreign Direct Investment Channel

Dep. Var.: FDI share	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	1.177	1.124	1.805	1.149	1.679
	(5.73)	(8.52)	(13.55)	(7.24)	(4.90)
Trade Policy	**0.045**	**0.059**	**0.085**	**0.036**	**0.057**
Openness	**(4.01)**	**(9.62)**	**(13.82)**	**(3.41)**	**(4.29)**
BMP	-0.001	-0.001	-0.001	-0.001	-0.0002
	(-3.60)	(-20.54)	(-3.48)	(-3.09)	(-0.92)
Government	-0.054	-0.048	-0.047	-0.051	-0.060
Consumption	(-4.15)	(-11.70)	(-6.67)	(-4.36)	(-5.82)
Postwar	0.928	1.009	0.329	0.787	0.634
Dummy	(3.96)	(6.17)	(1.92)	(3.41)	(3.23)
Island Dummy	0.988	1.192	1.239	1.076	0.943
	(4.74)	(6.07)	(13.17)	(4.87)	(4.29)
Latin America	-	-	-	-	0.086
Dummy					(0.31)
South East	-	-	-	-	0.150
Asia Dummy					(0.36)
Sub-Saharan	-	-	-	-	-0.261
Africa Dummy					(-1.34)
OECD	-	-	-	-	-0.748
Dummy					(-1.96)
R-squared	.33 .36	.22 .32 .31	.45 .50	.34 .35	.37 .39
	.28 .23	.24 .26	.40 .29	.28 .23	.35 .24
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table XIV: Summary of Channel Effects (Baseline Model)

Channel	Effect of the Channel on Growth	Effect of Trade Policy on Channel	Effect of Trade Policy on Growth
Distortions	-0.007	-0.344	0.002
	(-9.08)	(-0.63)	(0.63)
Government Consumption	-0.042	0.154	-0.007
	(-1.57)	(3.73)	(-1.52)
Manufactured Exports	0.004	0.635	0.002
	(0.45)	(4.59)	(0.45)
Investment Rate	0.143	0.317	0.045
	(6.86)	(6.72)	(5.12)
Foreign Direct Investment	0.320	0.045	0.014
	(4.68)	(4.01)	(3.79)
Macro Policy Quality	0.489	0.027	0.013
	(4.22)	(2.19)	(1.90)
Total Effect			**0.071**
			(5.94)

(t-ststistics based on heteroskedastic-consistent (White-Robust) standard errors in parentheses)

Table XV. Channel Effects under Alternative Models

I	II	III	IV	V	VI
	Baseline 1970-89	**1970-92**	**Devel. Countries**	**SUR**	**Regional Dummies**
Distortions	0.002	0.005	0.009	0.005	0.007
	(0.63)	(7.28)	(2.51)	(1.73)	(1.71)
Wald Test	0.399	53.042	6.315	2.983	2.924
p-value	(0.53)	(0.00)	(0.01)	(0.08)	(0.09)
Govt.	-0.007	-0.007	-0.001	-0.004	-0.011
Consump.	(-1.52)	(-5.85)	(-1.14)	(-1.57)	(-1.93)
Wald Test	2.309	34.184	1.291	2.477	3.709
p-value	(0.13)	(0.00)	(0.26)	(0.12)	(0.05)
Manuf.	0.002	0.001	-0.002	0.005	-0.003
Exports	(0.45)	(0.53)	(-1.00)	(1.11)	(-0.70)
Wald Test	0.201	0.282	0.994	1.228	0.490
p-value	(0.65)	(0.60)	(0.32)	(0.27)	(0.48)
Investment	0.045	0.021	0.039	0.033	0.022
Rate	(5.12)	(7.98)	(5.20)	(4.37)	(3.54)
Wald Test	26.199	63.639	27.076	19.075	12.567
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Foreign Dir.	0.014	0.015	0.023	0.013	0.010
Investment	(3.79)	(6.02)	(4.90)	(3.46)	(2.37)
Wald Test	14.385	36.236	24.058	11.967	5.637
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
Macro Policy	0.013	0.011	0.017	0.016	0.004
Quality	(1.90)	(4.24)	(3.36)	(2.84)	(1.18)
Wald Test	3.609	17.980	11.293	8.078	1.402
p-value	(0.06)	(0.00)	(0.00)	(0.00)	(0.24)
Total Effect	**0.071**	**0.046**	**0.085**	**0.067**	**0.030**
	(5.94)	**(11.71)**	**(7.85)**	**(5.73)**	**(2.38)**
Wald Test	35.332	137.215	61.624	32.888	5.688
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)

Table XVI - Sensitivity to the Time Period Coverage

	excl. 1970-84	excl. 1975-79	excl. 1980-84	excl. 1985-89
Distortions	-0.007	-0.002	0.013	0.001
	(-1.15)	(-0.37)	(1.30)	(0.07)
Wald Test	1.315	0.133	1.679	0.005
p-value	(0.25)	(0.72)	(0.20)	(0.94)
Government	-0.006	0.002	0.005	-0.010
Consumption	(-1.09)	(0.19)	(0.62)	(-1.53)
Wald Test	1.196	0.035	0.391	2.351
p-value	(0.27)	(0.85)	(0.53)	(0.13)
Manufactured	0.013	0.009	0.004	0.010
Exports	(1.83)	(0.89)	(0.54)	(0.70)
Wald Test	3.357	0.792	0.294	0.494
p-value	(0.07)	(0.37)	(0.59)	(0.48)
Investment	0.032	0.093	0.021	0.035
Rate	(2.62)	(5.05)	(1.80)	(2.07)
Wald Test	6.863	25.508	3.229	4.281
p-value	(0.01)	(0.00)	(0.07)	(0.04)
Foreign Dir.	0.021	0.004	0.012	0.016
Investment	(4.09)	(1.17)	(2.43)	(2.41)
Wald Test	16.705	1.368	5.924	5.830
p-value	(0.00)	(0.24)	(0.01)	(0.02)
Macro	-0.026	0.001	0.008	0.009
Policy	(-1.98)	(0.11)	(0.78)	(1.08)
Wald Test	3.906	0.013	0.610	1.163
p-value	(0.05)	(0.91)	(0.43)	(0.28)
Total Effect	**0.027**	**0.108**	**0.061**	**0.060**
	(1.48)	(3.87)	(3.62)	(2.53)
Wald Test	2.203	15.008	13.140	6.399
p-value	(0.14)	(0.00)	(0.00)	(0.01)

Table XVII. Unconditional Effect of Trade Policy in the Growth Regression

	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	2.666	1.744	1.686	4.159	4.780
	(1.42)	(2.24)	(1.13)	(2.34)	(1.61)
Log Initial	-0.078	0.037	0.006	-0.259	-0.086
Income	(-0.32)	(0.38)	(0.03)	(-1.12)	(-0.23)
Male Human	0.725	0.948	1.893	0.671	-0.285
Capital	(2.11)	(5.30)	(13.54)	(2.18)	(-0.92)
Female Human	-0.926	-1.265	-1.840	-0.837	0.019
Capital	(-3.04)	(-8.02)	(-7.48)	(-2.99)	(0.06)
Trade Policy	**0.066**	**0.061**	**0.095**	**0.091**	**0.073**
Openness	**(3.00)**	**(7.18)**	**(5.97)**	**(4.44)**	**(2.93)**
Latin America	-	-	-	-	-2.198
Dummy					(-6.74)
South East	-	-	-	-	0.970
Asia Dummy					(1.77)
Sub-Saharan	-	-	-	-	-3.090
Africa Dummy					(-5.70)
OECD	-	-	-	-	-1.438
Dummy					(-3.71)
R-squared	.12 .06	.12 .09 .09	.23 .20	.12 .06	.11 .31
	.09 .03	.04 .11	.22 .02	.08 .03	.45 .11
Obs (Periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table XVIII. Regression of the residuals from the growth equation on the trade policy index

	Baseline 1970-89	1970-92	Devel. Countries	SUR	Regional Dummies
Intercept	0.033	0.042	-0.183	0.048	-0.138
	(0.18)	(0.24)	(-0.81)	(0.30)	(-0.94)
Trade Policy	**0.013**	**0.019**	**-0.004**	**0.010**	**0.019**
Openness	**(0.83)**	**(1.20)**	**(-0.25)**	**(0.64)**	**(1.36)**
R-squared	.0009 .01	.00003 .007	.07 .07	.000004 .006	.002 .01
	.02 .0002	.02 .005 .02	.01 .04	.02 .00003	.03 .002
Obs. (periods)	57(4)	49(5)	36(4)	57(4)	57(4)

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table A-III-I. Trade Volumes Regression

Dependent Variable: Imports + Exports / GDP	3SLS*
Constant	182.561 (9.70)
Growth of per capita income	0.322 (1.12)
Land Area	-8.029 (-3.69)
Log of Population	-9.121 (-3.42)
Import duties over total imports	-34.733 (-1.16)
Pre-Uruguay Round NTB coverage	-0.217 (-0.73)
Sachs/Warner liberalization status	11.2622 (2.12)
Adj. R-squared	.60 .55 .53 .49
# of obs. (# of periods)	71 (4)

(t-statistics in parentheses)

* The instruments used were: Initial income, population density, religious dummies, oil producer dummy, postwar independence dummy, log of population, share of population over 65, log of area.

Table A-III-II. Correlations between the Components of the Index and the Index Itself

	Index 1970-74	Index 1975-79	Index 1980-84	Index 1985-90
Duty 70-74	-0.72	-0.70	-0.67	-0.64
Duty 75-79	-0.72	-0.75	-0.72	-0.69
Duty 80-84	-0.66	-0.68	-0.73	-0.71
Duty 85-90	-0.63	-0.64	-0.70	-0.77
NTB	-0.47	-0.48	-0.45	-0.50
Liberalization 70-74	0.88	0.87	0.85	0.75
Liberalization 75-79	0.87	0.87	0.85	0.73
Liberalization 80-84	0.83	0.83	0.86	0.73
Liberalization 85-90	0.79	0.79	0.79	0.84

(Number of observations: 71)

Table A-III-III. Correlations between the Underlying Components of the Index

	Duty 1970-74	Duty 1975-79	Duty 1980-84	Duty 1985-90	NTB	Liber. 1970-74	Liber. 1975-79	Liber. 1980-84
Duty 70-74	1.00							
Duty 75-79	0.94	1.00						
Duty 80-84	0.84	0.89	1.00					
Duty 85-90	0.74	0.78	0.92	1.00				
NTB	0.07	0.14	0.11	0.17	1.00			
Liber. 70-74	-0.52	-0.52	-0.50	-0.46	-0.13	1.00		
Liber. 75-79	-0.53	-0.53	-0.50	-0.46	-0.10	1.00	1.00	
Liber. 80-84	-0.51	-0.51	-0.48	-0.44	-0.07	0.95	0.97	1.00
Liber. 85-90	-0.49	-0.52	-0.46	-0.47	-0.15	0.87	0.86	0.87

(Number of observations: 71)

Table A-III-IV. Summary Statistics for the Macroeconomic Policy Index and its Components

Variable	Mean	Std. Dev.	Minimum	Maximum
Macro Index 70-74	5.26	1.84	1.33	9.33
Macro Index 75-79	5.13	1.84	1.33	8.67
Macro Index 80-84	5.20	1.99	1.00	9.33
Macro Index 85-89	5.47	1.86	1.00	9.00
Deficit ratio 70-74	-2.61	3.20	-19.44	3.60
Deficit ratio 75-79	-4.72	4.49	-16.53	5.29
Deficit ratio 80-84	-6.34	6.18	-43.62	2.43
Deficit ratio 85-89	-5.30	6.19	-47.02	3.64
Public Debt Ratio 70-74	25.15	18.74	0.00	118.67
Public Debt Ratio 75-79	33.51	26.33	0.00	174.86
Public Debt Ratio 80-84	52.29	50.74	0.00	332.28
Public Debt Ratio 85-89	74.08	67.87	0.00	436.85
Excess Money Growth 70-74	13.99	15.59	-0.33	143.14
Excess Money Growth 75-79	17.06	20.08	3.15	158.29
Excess Money Growth 80-84	22.37	36.75	3.49	233.15
Excess Money Growth 85-90	34.97	106.83	-7.01	853.53

Number of Observations: 88

Table A-III-V. Correlations of the Macroeconomic Policy Index with its Components

	Macro Index 1970-74	Macro Index 1975-79	Macro Index 1980-84	Macro Index 1985-89
Deficit ratio 70-74	0.75	0.65	0.50	0.49
Deficit ratio 75-79	0.53	0.76	0.56	0.49
Deficit ratio 80-84	0.46	0.52	0.73	0.63
Deficit ratio 85-89	0.37	0.39	0.49	0.64
Public Debt Ratio 70-74	-0.65	-0.62	-0.46	-0.42
Public Debt Ratio 75-79	-0.64	-0.72	-0.63	-0.52
Public Debt Ratio 80-84	-0.48	-0.55	-0.67	-0.54
Public Debt Ratio 85-89	-0.41	-0.47	-0.65	-0.66
Excess Money Growth 70-74	-0.33	-0.07	0.04	-0.06
Excess Money Growth 75-79	-0.30	-0.26	-0.12	-0.23
Excess Money Growth 80-84	-0.35	-0.34	-0.40	-0.40
Excess Money Growth 85-90	-0.19	-0.22	-0.24	-0.38

Number of Observations: 88

Table A-IV-I: Openness and Growth

Dep.= Growth (%)	3SLS
Constant	14.041 (4.88)
Log of Initial Income	-1.865 (-4.89)
Trade to GDP ratio (% GDP)	0.017 (1.91)
Years of schooling (male)	2.03 (3.33)
Years of schooling (female)	-1.82 (-2.79)
Black Market Premium	-0.839 (-5.08)
Investment share (% GDP)	0.155 (4.53)
Government consumption (% GDP)	-0.119 (-2.77)
R-Squared	.31 .22 .22 .28

(t-statistics in parentheses)

Dep.= Trade ratio (%)	3SLS
Constant	150.545 (10.50)
Growth rate (%)	1.092 (5.60)
Log of land area	-3.628 (-2.40)
Terms of trade shocks	20.972 (3.55)
Log of population	-7.464 (-4.37)
Sachs-Warner dummy (averaged)	7.54 (1.82)
Log of distance	-8.282 (-2.05)
R-squared	.51 .57 .56 .55

Table A-IV-II. Gravity Equation

Dep= Trade ratio (%)	3SLS
Constant	157.131
	(10.72)
Growth rate (%)	0.943
	(4.68)
Log of land area	-3.719
	(-2.39)
Terms of trade shocks	23.503
	(3.76)
Log of population	-7.048
	(-4.12)
Log of distance	-12.031
	(-3.26)
R-squared	.51 .56 .52 .55

(t-statistics in parentheses)

Table A-IV-III. Summary Statistics (Openness Decomposition)

	Mean	Std dev.	Minimum	Maximum
Gravity component 1970-74	53.23	15.87	7.81	81.34
Gravity component 1975-79	53.42	16.35	9.25	81.45
Gravity component 1980-84	51.28	16.34	8.93	77.98
Gravity component 1985-89	48.44	16.30	11.15	77.45
Policy component 1970-74	-4.66	15.76	-44.51	33.53
Policy component 1975-79	1.44	16.82	-33.23	36.53
Policy component 1980-84	5.11	20.28	-35.07	65.03
Policy component 1985-89	5.93	17.89	-31.32	65.63

Table A-IV-IV. Growth Regression with Decomposed Trade Effects

Dep = Growth rate (%)	3SLS
Constant	13.503
	(4.56)
Log of Initial income	-1.690
	(-4.13)
"Trade policy component"	0.027
	(2.08)
"Gravity component"	0.0036
	(0.28)
Years of schooling (male)	1.884
	(3.01)
Years of schooling (female)	-1.806
	(-2.72)
Black Market Premium	-0.834
	(-5.01)
Investment share	0.155
	(4.48)
Government consumption	-0.118
	(-2.69)
R-squared	.33 .22 .22 .28

(t-statistics in parentheses)

Table A-V-I. Summary Statistics for the Main Variables

	Mean	Std. Dev.	Mean	Std. Dev.
Summers Heston v.4.0				
Initial GDP 1960 (thsds of US$)	0.739	0.366	1.79	1.753
Growth 1960-1980 (annual)	0.0187	0.018	0.020	0.019
Number of countries	64*	64*	113	113
Summers Heston v.5.6				
Openness 1960-85 (share)	0.563	0.282	0.615	0.391
Initial GDP 1960 (thsds of US$)	0.747	0.364	1.800	1.755
Growth 1960-1980 (annual)	0.0187	0.018	0.020	0.018
Number of countries	63*	63*	112	112

(* All part of the AG 65 country sample)

Table A-V-II. OLS Estimates of the AG regressions

	AG dev. countries sample			Full sample		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.00704	-0.014	-0.0096	0.022	0.0015	0.0021
	(1.39)	(-1.29)	(-1.02)	(10.63)	(0.34)	(0.43)
Initial income	0.015	0.033	0.016	-0.001	0.0038	-0.0021
	(2.47)	(2.63)	(1.40)	(-2.63)	(2.03)	(-1.37)
Openness	-	0.041	0.045	-	0.028	0.0201
		(2.28)	(2.80)		(4.13)	(3.83)
Openness*initial income	-	-0.035	-0.038	-	-0.0044	-0.0034
		(-1.813)	(-2.42)		(-1.64)	(-1.69)
Primary school enrollment	-	-	0.031	-	-	0.033
			(4.12)			(5.57)
Latin America	-	-	-0.016	-	-	-0.019
			(-3.06)			(-5.50)
Sub-Saharan Africa	-	-	-0.015	-	-	-0.017
			(-2.63)			(-4.59)
R-Squared	.088	.165	.505	.049	.186	.57
Obs.	65	64	63	115	113	111

(t-statistics in parentheses)

Data is from Penn World Tables v.4.0, except openness measure, from Penn World Tables v.5.6

Table A-V-III. Estimates of the Parameters in Equation (3)[1]

	OLS
α (human capital)	-0.045
	(-1.00)
β (physical capital)	0.614
	(10.27)
Number of Obs.	43
R-squared	.55

(t-statistics in parentheses)

Table A-V-IV - Extent of the Market and the Sources of Growth

Dep. var.:	Growth of per cap. capital (1960-85)	Growth of human capital (1960-85)	Residual from equation (3)
Constant	0.177	0.521	0.132
	(0.45)	(0.91)	(0.28)
Extent of the Market	1.208	0.970	1.783
	(1.67)	(0.86)	(2.06)
Number of Obs.	42	42	42
R-squared	.06	0.018	.10

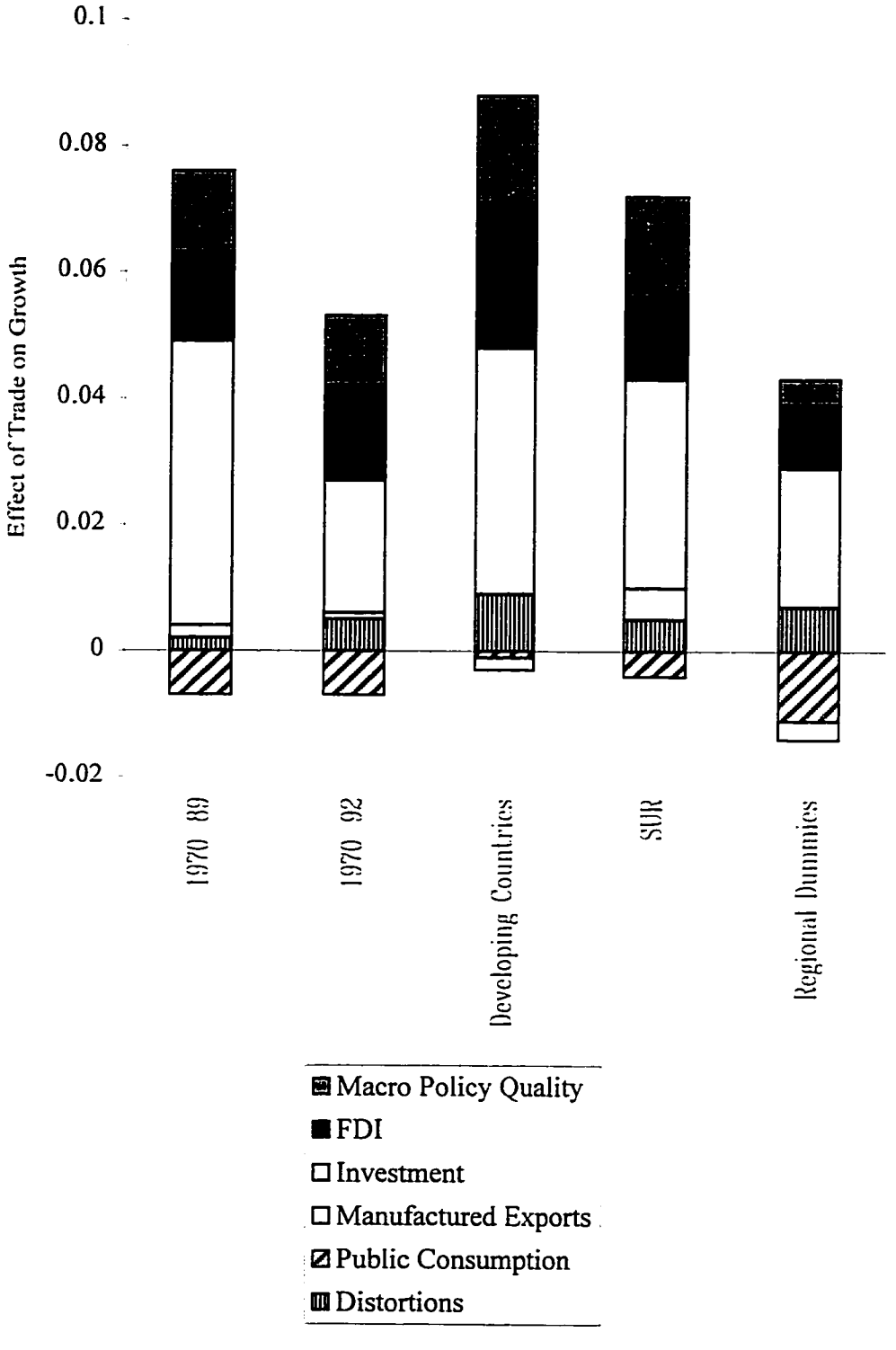
(t-statistics in parentheses)

[1] Data for the capital stock are from Dhareshwar and Nehru (1994), population data and the human capital measure (percentage of the population having completed secondary schooling) are from Barro-Lee.

Table A-V-V- Channel Effects of the Extent of the Market

Channel	Estimated effect
Via Human Capital	-0.044
Via Physical Capital	0.742
Via the unexplained residual (productivity gains)	1.783
Total Effect	2.481

Figure I - Graphical View of the Channel Effects



Chapter III. Economic Integration and Political Disintegration

"In a regime of Free Trade and free economic intercourse it would be of little consequence that iron lay on one side of a political frontier, and labor, coal, and blast furnaces on the other. But as it is, men have devised ways to impoverish themselves and one another; and prefer collective animosities to individual happiness." John Maynard Keynes, The Economic Consequences of the Peace, p. 99.

1 Introduction

The number of countries in the world increased from 74 in 1946 to 192 in 1995. In 1995, 87 countries had less than 5 million inhabitants, 58 less than 2.5 million and 35 less than 500,000. More than half of the world's countries are smaller (in population) than the State of Massachusetts.[1] In the same half century, the volume of imports plus exports as a share of world GDP, in a sample of 61 countries, has increased by roughly 40%.

Figure I displays a strong positive correlation, from 1870 to today, between the number of countries in the world and a measure of trade openness, the average ratio of imports plus exports to GDP in a group of nine countries[2]. Similarly, Figure II shows an inverse relationship between average tariff rates on manufactured products and the number of countries, in a selected group of countries for which tariff data were available. Tariff rates were slowly increasing between 1870 and the 1920s, while the number of countries was stable or slowly decreasing. After the Second World War tariff rates fell dramatically and the number of countries increased rapidly.

This paper argues that trade openness and political separatism go hand in hand: economic integration leads to political "disintegration".

We build upon a very simple idea. Consider a model where the size of the market influences productivity. In a world of trade restrictions, the political boundaries of a country

[1] In 1990 Massachusetts had a population of 6,016,425. 98 countries have smaller populations.

[2] These countries are France, Britain, Denmark, Italy, Norway, Portugal, Australia, Brazil and Sweden, the only countries for which reliable trade data were available continuously since 1870. These countries are representative of trends that affected world trade volumes, however, as the correlation between their average trade to GDP ratio since 1950 and that of a much wider sample of 61 countries since 1950 is 0.93.

influence the size of the country's market, and therefore its productivity level. On the contrary, with free trade the size of countries is irrelevant for the size of markets, so the size of a country is unrelated to its productivity.[3] It follows that the equilibrium number of countries and the extent of economic integration are interdependent.

More specifically, this paper pursues two goals: Firstly, we develop an explicit model of geography and trade which endogenously derives the equilibrium number and size of countries as a function of the trade regime. Secondly, we provide empirical evidence for two critical implications of the model: i) the effect of country size on economic growth should be mediated by the degree of openness; ii) the long term history of country formation and separation has been influenced by the pattern of trade openness and economic integration and vice versa. In particular, we emphasize a trade-off between the economic benefits of size, which are a function of the trade regime, and the costs of heterogeneity resulting from large and diverse populations.

On the theory side, this paper links the literature on geography and trade with a recent formal literature on country formation, and, in particular, the paper by Alesina and Spolaore (1997).[4] It also relates to the analysis of economic integration and preferential trade agreements, but unlike the traditional analysis of trade blocs, we focus on the endogenous formation of sovereign jurisdictions.[5] Empirically, our paper is related to the recent literature on the effects of openness on economic growth, such as Ades and Glaeser (1994), Sachs and Warner (1995) and Wacziarg (1997), and the effects of openness on public policy, such as Rodrik (1996) and Alesina and Wacziarg, (1997).

The organization of this paper is as follows: Section 2 presents the model linking country size to productivity. Section 3 provides cross-country evidence on how the interaction between country size and the degree of trade liberalization influences economic growth. Section 4 derives endogenously the equilibrium number of countries as a function, among

[3]These ideas are discussed informally by historians of nation building, such as Hobsbawm (1990), are tested by Ades and Glaeser (1994) and are modeled in a stylized fashion by Alesina and Spolaore (1997), Spolaore (1995) and Mansori (1996). Wittman (1991) also mentions this point.

[4]For a recent survey of this literature, see Bolton, Roland and Spolaore (1996).

[5]The classical reference is Viner (1950). More recent contributions to this large literature include Krugman (1991a, 1991b) and the papers in the volumes edited by De Melo and Panagariya (1993) and Frenkel (1997).

other things, of the trade regime. Section 5 discusses, with a brief historical excursion, the relationship between country formation and trade regimes throughout the past two centuries. The last section concludes.

2 The Model: Country Size and Production

2.1 Assumptions and description of the model

The world is composed of W "economic units" (in short "units"), which are the basic entities carrying out economic activities. These units are not geographically mobile. They can be interpreted as homogeneous regions, themselves composed of one or more identical and geographically immobile individuals. A "country" k is made of S_k units, where $1 \leq S_k \leq W$. A country is identified by borders which separate members of country k from those of country k'.

A unique final good, Y, is produced and consumed in each unit i with the following production function:

$$Y_i = A_i \left(\sum_{j=1}^{n} X_{ji}^{\alpha} \right) L_i^{1-\alpha} \tag{1}$$

with $0 < \alpha < 1$. In equation (1), X_{ij} denotes the amount of intermediate input j used in unit i and L_i is unit i's labor, which is supplied inelastically. There is no labor mobility across units. We assume that $n = W$, which implies that every unit can use the intermediate inputs produced by all other units in order to produce the final good. The markets for final goods and labor inputs are perfectly competitive.

Each unit produces one and only one intermediate input (X_i for unit i) using a unit specific stock of an inexhaustible natural resource. In the static version of our model, we assume that this stock yields K_i units of the intermediate good. In the dynamic version, we assume that the unit-specific intermediate good can be accumulated like capital, so that resources must be diverted away from consumption to finance any increase in the stock of K_i. Intermediate goods are sold in a competitive market within the unit. They can also be sold to other units, in which case one incurs costs associated with trade. We model these costs with a standard "iceberg" assumption:

Barriers to Trade: When Z units of an intermediate good are shipped from unit i' to unit i'', only $q(i', i'')Z$ arrive, with $0 < q(i', i'') < 1$ for any i', i'' units with $i' \neq i''$.

The parameter $q(.)$ is a function of all the obstacles which make inter-unit trade costly. These obstacles can be geographical, technological or political. Generally, costs associated with exchange across political borders arise because trade takes place between different political and legal systems. A simple and useful specification of $q(.)$ is the following:

$$q(i', i'') = (1 - \beta_{i'i''})(1 - \delta_{i'i''}) \tag{2}$$

where $0 \leq \beta_{i'i''} \leq 1$ and $0 \leq \delta_{i'i''} \leq 1$. The parameter $\beta_{i'i''}$ measures political trade barriers between i' and i'', while $\delta_{i'i''}$ measures physical barriers.[6]

2.2 Solution of the static model

In order to obtain a closed form solution for the model, we make the following simplifying assumptions:

A1. $A_i = A$; $K_i = K$; $L_i = 1$ for $i = 1, 2, ...W$.

A2. $\delta_{i'i''} = 0$ for every i', i'' .

A3. Policy induced trade barriers are zero for units belonging to the same country and constant for international trade. More formally:

$$\begin{aligned} &\beta_{i'i''} = 0 \text{ if } i' \text{ and } i'' \text{ belong to the same country} \\ &\beta_{i'i''} = \beta \text{ otherwise} \end{aligned} \tag{3}$$

The first two assumptions impose symmetry in the model.[7] Although they considerably simplify the algebra, they should not affect the qualitative nature of our results. A2 is relaxed in the Appendix, with no important changes. Assumption A3 is, in a sense, the definition of a country in our model: unlike exchange within countries, trade across borders entails some costs.

In the static version of the model, maximizing utility is equivalent to maximizing production, i.e. consumption. The solution of the model is as follows (more details can be found in the Appendix):

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[6] Note that certain policy induced trade barriers, for example tariffs, generate fiscal revenues. We are assuming that these revenues do not influence the volume of production. This would not be the case, for instance, in a model where productive public goods were used in production.

[7] A1 implicitly assumes that capital cannot be accumulated, which means that our model can be solved separately for each period, i.e. we are solving a static model. The dynamic version of the model is developed below.

i. Define: $\theta \equiv (1-\beta)^{\frac{\alpha}{1-\alpha}}$. The amount of intermediate good that unit i ships to another unit belonging to the same country, Z_i^d, (where the superscript d stands for domestic and S_i refers to the number of units in unit i's country) is:

$$Z_i^d = \frac{K}{S_i + \theta(W - S_i)} \tag{4}$$

ii. The amount of intermediate good that unit i ships to another unit not belonging to the same country, Z_i^f, (where the superscript f stands for foreign) is given by:

$$Z_i^f = \frac{\theta K}{S_i + \theta(W - S_i)} \tag{5}$$

iii. Each unit's final output is:

$$Y_i = AS_i \left(\frac{K}{S_i(1-\theta) + \theta W}\right)^{\alpha} + A \sum S_j \theta \left(\frac{K}{S_j(1-\theta) + \theta W}\right)^{\alpha} \tag{6}$$

where the summation is over countries other than unit i's. Note that the parameter θ, which is inversely related to the level of international barriers β, represents the *degree of openness* in each country: if $\theta = 0$, all trade is domestic, while if $\theta = 1$, each unit will export the same amount of the intermediate good to each other unit, irrespective of whether they belong to the same country or not.

The difference between the incomes of two units i' and i'', belonging to different countries of size $S_{i'}$ and $S_{i''}$ respectively, can be written as follows:

$$Y_{i'} - Y_{i''} = AK^{\alpha} \left[\frac{(1-\theta) S_{i'}}{((1-\theta) S_{i'} + \theta W)^{\alpha}} - \frac{(1-\theta) S_{i''}}{((1-\theta) S_{i''} + \theta W)^{\alpha}}\right] \tag{7}$$

Equation (7) implies the following results:

a). When $\theta = 1$ (complete openness), each region has the same income independently of the size of its country: $Y_{i'} = Y_{i''}$. In this case, country size imposes no constraint on the level of income within each country.

b). When $\theta < 1$, larger countries have larger incomes and the difference $|Y_{i'} - Y_{i''}|$, for $S_{i'} \neq S_{i''}$, is decreasing in θ. This means that, at higher levels of openness, country size imposes less of a constraint on income; equivalently, larger countries experience lower gains from increased openness than smaller countries:

$$\frac{d|Y_{i'} - Y_{i''}|}{d\theta} < 0 \tag{8}$$

In order to illustrate these results more clearly, we now examine the case of equal country sizes. When all countries have equal size S, equation (6) simplifies as follows:

$$Y = A\left[S + (W - S)\theta\right]^{1-\alpha} K^{\alpha} \tag{9}$$

In equation (9), S denotes country size, and $(W - S)$ is the size of the "rest of the world". Inspection of equation (9) reveals the following result:

Proposition 1. The amount of production of the final good, Y, is increasing in openness θ (for a given country size), increasing in country size S (for a given level of openness), and decreasing in size of countries multiplied by openness, $S\theta$.

2.3 The dynamic framework.

We now extend the model to a dynamic setting in which we relate economic growth to country size and openness. Consider the following intertemporal utility function, with a constant elasticity of intertemporal substitution:

$$U = \int_0^{\infty} \frac{C_i^{1-\sigma} - 1}{1 - \sigma} e^{-\rho t} dt \tag{10}$$

where C_{it} denotes consumption at time t by the representative individual living in unit i. For notational simplicity, we will drop the time subscript.

As before, the production function is given by equation (1). But now, unlike our previous analysis, we assume that individuals can increase the stock of K_i: output can be converted in new units of K_i one-to-one (to simplify, we assume no depreciation):

$$\dot{K}_i = Y_i - C_i = r_i K_i + w_i - C_i \tag{11}$$

where r_i denotes capital rental and w_i is total labor income.

From standard intertemporal optimization:

$$\frac{\dot{C}_i}{C_i} = \frac{1}{\sigma}\left(r_i - \rho\right) \tag{12}$$

Owners of K_i are paid its marginal product. Since each unit of K_i produces one unit of input X_i, we can write the marginal product of K_i as follows:

$$r_i = \frac{\partial Y_i}{\partial K_i} = \alpha A X_i^{\alpha-1} = \alpha A \left(Z_i^d\right)^{\alpha-1} = \alpha A \left[(1-\theta) S_i + \theta W\right]^{1-\alpha} K_i^{\alpha-1} \tag{13}$$

where Z_i^d is derived as in section 2.2.

By substituting equation (13) into (12), we obtain the growth rate of consumption:

$$\frac{\dot{C}_i}{C_i} = \frac{1}{\sigma}\left(\alpha A\left[(1-\theta)S_i + \theta W\right]^{1-\alpha} K_i^{\alpha-1} - \rho\right) \tag{14}$$

Note that (14) is also the solution for the consumption path that would be chosen by a social planner who maximizes world welfare (taking S_i as given). The steady state level of capital is given by:

$$K_i^{ss} = \left(\frac{\alpha A}{\rho}\right)^{\frac{1}{1-\alpha}}\left[(1-\theta)S_i + \theta W\right] \tag{15}$$

Assuming that all countries have equal size S, the steady state level of income will be:

$$Y^{ss} = A^{\frac{1}{1-\alpha}}\left(\frac{\alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}}\left[(1-\theta)S + \theta W\right] \tag{16}$$

Around the steady state, the growth rate of output can be approximated by:

$$\frac{\dot{Y}}{Y} = \xi e^{-\xi}\left(\ln Y^{ss} - \ln Y(0)\right) \tag{17}$$

where $\xi \equiv \frac{\rho}{2}\left[\left(1 + \frac{4(1-\alpha)}{\alpha\sigma}\right)^{\frac{1}{2}} - 1\right]$ and $Y(0)$ is initial income.

Equations (16) and (17) imply the following implication:

Proposition 1'. The growth rates of income (in the neighborhood of the steady state) and consumption are increasing in size S, increasing in trade openness θ and decreasing in size S times openness θ.

3 Size, Openness and Growth.

In this section, we provide empirical evidence consistent with the theory presented in Section 2. Table Ia displays parameter estimates for cross-country growth regressions in which the rate of per capita GDP growth is regressed on openness, country size and the interaction of the two variables. In order to interpret this regression as a levels regression (in which lagged per capita income appears on the right-hand side), we added the log of initial per capita income as a regressor to this basic specification (Table Ib). Indeed, the control variables in this regression represent the determinants of the steady state *level* of income in "augmented" versions of the neoclassical growth model.[8]

[8]We report results based on growth, but the relationship between 'levels' and 'growth' is well known: If y_{it} is GDP per capita at time t in country i, we can write:

Country size is measured either by the log of population or by the log of total GDP, while openness is measured by the ratio of imports plus exports to GDP. In Tables Ia and Ib we include no other controls; these are added in Tables IIa and IIb.

All of the results presented in Tables I and II are based on multivariate regression estimates, as in Barro and Sala-i-Martin (1995). The growth equation is formulated for each of six time periods (variables are averaged over 5-year periods, for 1960-64, 1965-69, ..., 1985-89), with coefficients constrained to equality across periods (the number of countries included in the regressions is solely determined by data availability). The equations are estimated jointly, which allows for efficiency gains associated with error term correlations across periods for each country. Hence, the estimators used in this section are panel data-random effects estimators. In the SUR version of the estimates, we do not instrument for any of the right hand side variables, while the 3SLS version attempts to control for endogeneity bias induced by potential reverse causation between openness and growth (Frankel and Romer, 1995).

The instruments used for the 3SLS estimates are common 'gravity' variables such as land area, country size, terms of trade shocks, which are thought to affect the volume of a country's trade. To investigate whether these instruments can be validly excluded from the growth regression, we conducted exclusion restriction tests. These are based on the quasi-likelihood ratio (QLR) tests proposed by Gallant and Jorgenson (1979). QLR statistics are asymptotically distributed as chi-squared variables with degrees of freedom equal to the number of exclusions. Results from Table Ia and Ib show that the null hypothesis that the excluded instruments jointly do not belong in the growth regression cannot be rejected even at very low levels of confidence.

According to the theory presented in Section 2, we should expect the coefficients on size and openness to be positive, while the coefficient on their interaction should be negative. This is, in fact, precisely what we find. The sign and magnitude of the coefficients, which are highly significant statistically, are robust with respect to the two methods of estimation

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$\log y_{it} - \log y_{it-1} = \alpha + \beta \log y_{it-1} +$ other controls.

This is the standard growth regression which allows for conditional convergence. One can rewrite this regression in levels:

$\log y_{it} = \alpha + (\beta + 1) \log y_{it-1} +$ other controls.

and to alternative measures of country size.

The estimates from Table Ia suggest that, for a hypothetical small country (that is, for log population equal to zero, or a population of one thousand), a 10 percentage point increase in the ratio of imports plus exports to GDP is associated with a 0.41 (SUR) to 0.75 (3SLS) percentage point increase in annual per capita growth, a large effect indeed (the standard deviation of the openness measure averaged over all time periods is 39% in our sample). These effects fall to 0.18 points of growth (SUR) and 0.34 (3SLS) when the log of population is 9.16 (the sample average, which corresponds to a country of 9.5 million inhabitants). For a hypothetical closed country (zero trade), we find that a one standard deviation difference in the log of population (equal to 1.34) is positively associated with a 0.59 (SUR) to 1.09 (3SLS) percentage point difference in growth. At the sample average openness level (i.e. for a trade to GDP ratio equal to 57.7%), these effects fall to 0.40 points of growth (SUR) and 0.74 (3SLS) [9]. These rough orders of magnitude should only be taken as indicative, since we are obviously omitting important variables from the growth specification.

Tables IIa and IIb add additional controls to our basic regression in order to account for potential omitted variable bias. In the first table, country size is measured by the log of population, while in the second table it is measured by the log of total GDP. Both tables employ the SUR estimation methodology but the results are qualitatively unchanged when using 3SLS.[10] The additional conditioning variables are the 'basic' growth determinants usually considered in cross-country growth empirics, following, for instance, Barro and Sala-i-Martin (1995). We add these controls one at a time, in order to examine the robustness of our 'coefficients of interest', namely those that involve country size and openness. The sign, magnitude and statistical significance of these controls are consistent with past findings in the empirical growth literature: A higher rate of fertility, a higher level of government-induced price distortions (as proxied by the black market premium on the exchange rate) and a higher share of government consumption in GDP are all associated with lower growth rates. The pattern of human capital coefficients reproduces estimates in Barro and Sala-

[9]The effect of openness on growth never becomes negative, even when evaluated at the sample maximum of country size; however, the effect of size does become negative at extreme values of openness.

[10]Results are available upon request.

i-Martin (1995). We also find evidence of conditional convergence, as witnessed by the significantly negative effect of the log of per capita initial income.

As for the coefficients on the three variables that concern us, the results are robust with one exception. While the coefficient on openness and on the interaction of openness and size both remain significant through all of the specifications, the coefficient on country size alone becomes progressively less significant as one adds more controls (columns (4) and (5)). This should not be of great concern, since it just means that we are increasingly controlling for factors that are associated with the overall existence of increasing returns. In particular, country size and the government consumption ratio are negatively correlated, so that the inclusion of government size reduces the precision of the estimate on country size due to multicollinearity.[11] In other words, Table I indicates the existence of increasing returns (conditional on countries being closed to trade), while Table II may provide some indication that such increasing returns are correlated with common conditioning variables of cross-country growth regressions. On the other hand, the negative coefficient on the interaction of size and openness confirms the result that increasing returns with respect to country size are less and less important as countries become more open. In other words, open countries are able to reap the benefit of access to a large market, thereby avoiding the costs associated with being small.

4 The number and size of countries

4.1 Heterogeneity and Country Size in the Static Model

We now turn to the determination of the equilibrium number of countries. In a world described by the model of Section 2, everybody's income would be maximized if the entire world belonged to the same country, so that $S = W$ (recall equation (9)).[12] This is clearly an extreme and uninteresting case since it ignores any costs associated with the excessive size of countries and the heterogeneity of their populations. Indeed, it seems clear that the British and Irish, Israeli and Arabs, Turks and Greeks, Tutsi and Hutu do not wish to belong to the same country, with the same governments, laws and public goods. We model

[11] On this point, see Alesina and Wacziarg (1997).

[12] Only in the case of $\theta = 1$, namely complete free trade, would the size of each country be uninfluential (equation (9)). Needless to say, if $S = W$, the trade regime, i.e., the value of θ, is irrelevant.

this feature by assuming that each individual bears some *heterogeneity costs* $h(.)$ which are a function of the size of the country:

$$\begin{aligned} h(.) &= h(S) \\ h'(.) &> 0 \; ; \; h''(.) \geq 0 \end{aligned} \tag{18}$$

While it is a priori reasonable to assume that heterogeneity is not decreasing in the size of a country, there are obvious exceptions. Relatively small countries can be non-homogeneous (for example, Rwanda) while larger countries, in terms of population can be much more homogeneous (for example, Japan). Equation (18) is a rough reduced form for a model capturing the costs of heterogeneity. Alesina and Spolaore (1997) provide a model consistent with the reduced form in equation (18). In their model a group of heterogeneous individuals forming a country have to agree on a common set of public policies. Individuals are uniformly distributed on an ideological segment, so that the larger the country, the larger the average distance between the common policy adopted and each individual's preferred policy. In other words, *average heterogeneity* in each country is increasing in size. Equation (18) also implies that the cost function is weakly convex.

The most general formulation for the utility function, defined over consumption (which equals income in the static model) and heterogeneity costs, is $U(C, h)$. Without loss of generality, we assume that the utility function is separable in consumption and heterogeneity costs (in the Appendix we generalize the utility costs of heterogeneity without any qualitative changes in the results). In particular, we assume that the utility of an individual living in country i is given by:

$$U(C_i, h(S_i)) = \frac{C_i^{1-\sigma} - 1}{1-\sigma} - h(S_i) \tag{19}$$

Note that heterogeneity costs are identical for everyone regardless of their location within countries. We compute the optimal number of countries as if it were chosen by a social planner maximizing the sum of individual utilities.

We assume that the solution involves *equal country sizes.* This should follow naturally from the symmetric structure of the model. While we do not derive this as a result, one could extend the model in this direction, following, for example, Alesina and Spolaore (1997).[13]

[13]The equal size assumption is made purely for analytical convenience. The model could be extended to allow for different parameters across different regions (for instance, different heterogeneity costs, barriers to trade or technologies), which would imply different country sizes in equilibrium.

The optimal number of countries chosen by the social planner is also the number of countries that would be selected unanimously by referendum, if the world population were asked to vote on the number of equally sized countries in the world. However, the optimal number of countries (chosen either by a social planner or by a worldwide referendum) is not necessarily robust to unilateral secessions, an issue addressed below.

The country size S^* that maximizes individual utility solves the following first order condition:

$$(1-\alpha)(1-\theta)A^{1-\sigma}K^{\alpha(1-\sigma)}\left[(1-\theta)S^* + W\theta\right]^{(1-\alpha)(1-\sigma)-1} = h'(.) \tag{20}$$

where, as before, $\theta \equiv (1-\beta)^{\frac{\alpha}{1-\alpha}}$. Since $Y(S)$ is increasing and concave in S and the function $h(S)$ is weakly convex, equation (20) admits one and only one solution, identified implicitly.

In order to obtain a closed form solution and gain more intuition, it is useful to first examine the case of linear heterogeneity costs, namely:

$$h(S) = hS \tag{21}$$

Using (20) and (21), we obtain the equilibrium country size S^*:

$$S^* = \frac{1}{1-\theta}\left[\left(\frac{(1-\alpha)(1-\theta)}{hA^{\sigma-1}K^{\alpha(\sigma-1)}}\right)^{\frac{1}{1-(1-\alpha)(1-\sigma)}} - \theta W\right] \tag{22}$$

The equilibrium number of countries is then given by $N^* = W/S^*$.[14] From equation (22) one easily obtains the following:

Proposition 2: The equilibrium number of countries is: i) increasing in h; ii) decreasing in A and K; and iii) increasing in θ.

This result implies that countries should split up as heterogeneity costs increase and trade is liberalized. More specifically, Proposition 2 implies the following corollary which we explore empirically in Section 4:

Corollary: For given heterogeneity costs, the number of countries should increase with trade liberalization.

In the Appendix, we extend our model to the case of a more general utility function in which individual utility $U(Y,h)$ is, not only nonlinear, but also not necessarily separable

[14] We are abstracting from integer problems.

in Y and h. The Appendix also explores the endogenous determination of country size in the context of the steady state of the dynamic model presented in Section 2. Since the equilibrium of the static model and the steady state of the dynamic model share the same properties with respect to country size and openness, Proposition 2 and its corollary, not surprisingly, do not change in the dynamic version.

4.2 Unilateral Secessions

We now allow for unilateral secessions and explore under what conditions will S^* be "secession-free". More precisely, we investigate under what conditions, for a given S^*, no subset of regions would be willing to secede unilaterally and form an independent nation. For simplicity and without loss of generality, we assume that $\sigma = 0$ and $K = 1$ in this subsection.

When analyzing unilateral secessions, it is natural to assume that the regions contemplating a break away assume that all other borders will remain unchanged. Therefore, consider two alternative configurations of the world. In the first configuration, there exist W/S^* nations, each of size S^*. In the second configuration, after a secession of size Q there exist one nation of size Q, one nation of size $S^* - Q$, and $W/S^* - 2$ nations of size S^*. S^* is secession-free if and only if, for any subset of regions $Q < S^*$, the citizens of the nation of size Q in the second configuration of the world are not better off than in the first configuration of the world. Then the following proposition holds:

Proposition 3: S^* is secession free if and only if $W\left(\frac{h}{(1-\alpha)(1-\theta)}\right)^{\frac{1}{\alpha}} \geq \Psi$, where Ψ is the unique solution of the equation $(1-\alpha+\alpha\Psi)\theta^{\alpha}\Psi^{\alpha} = 1$.[15]

This means that for a given range of parameters (for W, h and θ "large enough", that is S^* "small enough"), S^* is secession free. If S^* is "too big" (because there is low heterogeneity and/or high barriers to international trade), some subset of the population might be better off seceding unilaterally.[16]

[15]The proof of proposition 3 is available from the authors upon request.

[16]The result that the optimal size of nations may or may not be self-enforcing is similar to results by Alesina and Spolaore (1997).

4.3 Endogeneity of Trade Barriers

In what precedes, we have assumed that the level of trade barriers β is exogenous. In particular, we have assumed that barriers to international trade do not depend on the number and size of countries. We now relax this assumption and allow barriers to change as a function of country size. Indeed, trade barriers can be affected directly or indirectly by governments through tariffs, quotas, administrative barriers, choice of legal rules and standards, or other policy variables that may increase or reduce the costs of international exchanges. Country size is likely to have an effect on these policies. In particular, because of market size effects documented in Sections 2 and 3, smaller countries may have incentives to adopt more open trade policies.

We do not model explicitly the political-economic mechanisms that determine β. Grossman and Helpman (1994), for instance, explicitly derive the level of trade protection as the result of lobbying and contributions by political interest groups. Presumably, the effectiveness of the arguments of these interest groups is negatively related to the potential costs of trade protection, which are themselves a function of country size.[17] Hence, we directly assume that equilibrium barriers are determined by the following reduced-form equation:

$$\beta = \beta_0 + \gamma(S) \tag{23}$$

In this specification, β_0 represents the "exogenous" portion of the barriers to international trade, related to the fact that such trade takes place between countries with different sets of legal, tax and institutional structures. $\gamma(S)$ represents the portion of trade barriers that is under more direct control of policy makers (such as trade policy), and may thus respond to factors such as country size. If, ceteris paribus, the net benefits from lower barriers are higher for smaller countries (as we argued in Section 2), we would expect that, in equilibrium, β would be increasing in S: i.e., $\gamma(S) > 0$. Under this assumption, and assuming for simplicity that $\sigma = 0$, income Y is still increasing in S as long as:

$$\gamma'(S) < \frac{1-\alpha}{\alpha}\frac{1-\theta}{\theta}\frac{\theta^{\frac{1-\alpha}{\alpha}}}{W-S} \tag{24}$$

Additional restrictions on the derivatives of $\gamma(S)$ would insure that Y is a concave function

[17] Spolaore (1995 and 1997) presents models in which barriers and sizes are jointly determined in equilibrium.

of S. To fix ideas, consider the special case in which $\gamma(S)$ is linear: $\gamma(S) = \gamma S$, and $\alpha = 1/2$. In this case, we have:

1) $Y(S) > 0$ if and only if $\gamma < \frac{\beta_0}{W-2S}$

2) $Y"(S) < 0$ if and only if $\gamma < \frac{1}{4}\frac{(\beta_0-\gamma W+2\gamma S)^2}{(1-\beta_0)W-\gamma WS+\beta_0 S+\gamma S^2} \equiv M$

Clearly, 1) will hold for every S if $\gamma \leq \frac{\beta_0}{W}$. If the above conditions are satisfied, we can obtain the equilibrium size S^* exactly as in Section 4, by solving:[18]

$$\frac{\partial Y(S)}{\partial S} = \frac{dh(S)}{dS} \tag{25}$$

Note that $\frac{dS^*}{d\beta_0} > 0$ if and only if $\gamma < \sqrt{M}$, a condition that is certainly satisfied as long as 2) is satisfied and $M > 1$.

The intuition for the above conditions is straightforward: our results for the exogenous case ($\gamma(S) = 0$) carry on to the case of endogenous tariffs as long as the effect of S on trade barriers is not "too large". It is interesting to note that, when the above conditions are satisfied,

a). Higher heterogeneity costs would lead to smaller nations and lower trade barriers.

b). An exogenous fall in trade barriers (lower β_0) may reduce overall trade barriers not only directly, but also indirectly (through $\gamma(S)$), by bringing about a smaller size S in equilibrium.

Finally, note that in our model, the number and size of countries adjust smoothly to underlying changes in the parameters; in practice, border changes and secessions or unifications are costly and lengthy processes. This implies that we may observe border changes only when the underlying parameters have suffered a sufficiently large change. Also, to the extent that border changes are less costly when many borders are changing, the process of country formation and destruction may be lumpy rather than continuous. The end of major wars provides a good example of this fact. In the next section we show

[18] In the case of a more general utility function:

$$\frac{du[y(S^*), h(S^*)]}{dS^*} = \frac{\partial u}{\partial Y}Y(S^*) + \frac{\partial u}{\partial h}h(S^*) = 0$$

The second order condition is identical to [A.9]. Provided that $Y(S)$ is an increasing concave function, the second order condition is satisfied under those same assumptions about the first and second derivatives of $U(S,h)$ and $h(S)$ that we listed in the Appendix after equation [A.9].

that, in fact, the process of country formation and secession was "lumpy" and occurred in geographical clusters.

5 Country Formation, Secessions and Trade

In this section we explore, with an historical excursion, the idea that the number of countries is related to the trade regime. In addition to trade and heterogeneity at least two other major factors influence country formation and destruction: military conflicts and the process of democratization. In the same spirit as the present paper, Alesina and Spolaore (1996) investigate the role of defense spending and wars for the equilibrium size of countries. Alesina and Spolaore (1997) study the effects of democratization. The first paper shows that secessions are likely to be more prevalent in a more peaceful world (i.e., with a lower probability of conflict), because the benefit of size for defense purposes becomes less important. The second paper shows that democratization should lead to secession, since dictatorial regimes maximize rents for the rulers by keeping together large countries formed by very different individuals who would want to separate, were they not forced together by the regime. Thus, one should find clusters of country creations as a consequence of wars, which is indeed the case (Figure I displays a surge in the number of countries after each of the two World Wars as well as after the end of the Cold War). Therefore, in what follows, we "hold constant", figuratively speaking, these other determinants of political secessions and unifications.

5.1 Building Nation States

The nation state, as we know it, is a relatively recent phenomenon. The widespread adoption of this political institution can be traced back to the first half of the 19th century, the period of triumph for the liberal ideas of Adam Smith. As the liberal theorists of the time knew well, nation-states are not necessary in a totally free market economy. Ideally, the world could be organized as a single free market area, a world market of free trading individuals. Nation-states were viewed as the second best, given the heterogeneity of individuals with different races, cultures and ideologies. According to liberal philosophy, a nation state had to be of sufficient size to form a viable unit of development but not more. In other words, given that a world of complete free trade was unattainable, countries had to reach a certain

size in order for the national economy to be a viable unit of development. For example, the Dictionaire Politique of Garnier-Pagès, in 1843, described as 'ridiculous' that Belgium and Portugal should be independent nations because they were too small to be viable economies.[19] Giuseppe Mazzini, one of the architects of Italian unification, thought that the optimal number of national states in Europe was 12, given economic considerations and the ethnic composition of Europe (Hobsbawm (1990), (1987)).[20] The unification of Italy (1861) and Germany (1871) can be viewed in this context as well: amongst other things, it was an attempt at building two economies of reasonable size, eliminating small polities protected by heavy trade barriers[21]. This was, to a large extent, facilitated by the relative cultural, linguistic and ethnic homogeneity of the groups that came together.

In fact, economic arguments were critical in the case of Germany's unification: As John Maynard Keynes put it, paraphrasing Bismarck, Germany was unified by "coal and iron".[22] The German Nation started in 1834 as a customs union (the Zollverein) which ensured low barriers to trade among its members. Participation in the customs union was viewed as an economic necessity for small and medium sized states which were too small to prosper without freer trade. As Breuilly (1996) notes, beyond this economic argument, "the German people were largely indifferent to the cause of national unity." To some extent, the pre-unification German customs union had some broad similarities with the current state of the European Union. Ex ante, it was not at all obvious that German unification would have progressed beyond an economic union, in much the same way that it is far from obvious that the current European Union will ever become a federal state. One reason why the European Union will most likely not follow the same fate as Germany is that it is characterized by a much greater degree of cultural and linguistic heterogeneity than pre-unification Germany.

In summary, European architects of the nation-state, in the first half of the 19th century, seemed to have in mind precisely the trade-off between the benefits of large economies and the costs of cultural heterogeneity.

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[19]This citation appears in Hobsbawm (1990).

[20]For instance, he did not take seriously the nationalistic aspirations of Sicilians, Bretons, Welsh and even the Irish, because he considered their economies to be too small.

[21]On these two unifications, see in particular Tilly (1975).

[22]This citation is from Breuilly (1996).

5.2 Empire Building

The two decades which followed the unrest of 1848 in Europe witnessed a spectacular increase in trade and the diffusion of capitalism. The last three decades of the century were, instead, characterized by a much slower growth, and, in particular, the period 1873 to 1879 became known as the "Great Depression",until the 1930s. In the last three decades of the century, the degree of trade protection increased, while the volume of trade remained roughly constant. While complete and reliable data are hard to obtain for the period, Figure I shows that, in the period between 1870 and the First World War, the ratio of trade to GDP, in the few countries for which data are available, did not change much. Figure II shows that average tariff rates for countries with available data did not decline and, if anything, showed a tendency to increase between 1870 and 1915. At the same time, ethnic problems and separatist movements increasingly became a major factor in domestic and international politics. At the end of the Nineteenth Century, the trade-off between trade and ethnic conflict was being stretched: on the one hand, increasing protectionism and the need for larger markets to absorb a newly developed mass production required "large" countries; on the other hand various ethnic or linguistic minorities were becoming more restless. The answer to these tensions was flag waving patriotism, and the building of colonial empires. Flag waving was useful to unify heterogeneous citizens against outsiders. Colonialism was a way to expand markets and to secure sources of raw materials.

The connection between the Depression of the 1870s, the increase in protectionism, and the need for markets has been noted not only by several historians, but also by contemporary observers. "'If you were not such persistent protectionists', the British premier told the French ambassador in 1897, 'you would not find us so keen to annex territories'"(Hobsbawm (1987) page 67).

Similar considerations apply to American expansionism at the end of the Nineteenth Century. The conquests of Alaska, Hawaii, Samoa, Cuba and the Philippines (among other territories) between 1865 and 1898 was often justified in the United States on the basis of the necessity to expand American markets and supply routes. British and French hegemony over much of the world put a limit on the United States' access to many markets, justifying in the eyes of American advocates of expansion an overseas pursuit of America's Manifest

Destiny.[23] In the colonial era, when political control limited the potential for economic interactions with large portions of the world, building an empire was the only way to secure markets and supply routes.

The Spanish and Portuguese empires are also good examples of empire building related to trade flows and market size. These two countries were largely dependent on trade with their colonies and, in fact, "imposed a trading monopoly and monopsony" with them (Bulmer-Thomas (1994)). In particular, the Spanish economy was "dangerously dependent" (Parry (1990)) on its trade with overseas colonies and greatly suffered when the empire collapsed at the beginning of the Nineteenth century. For national movements in Latin America in the first decades of the nineteenth century, political independence was viewed as necessary to break "the external trade monopoly...and have a chance to raise capital on the international market" (Bulmer-Thomas (1994)). In other words, "political consolidation [of newly independent countries] was...hastened by the prospect of economic progress through international trade." (Williamson (1992)). All of the newly independent countries in Latin America in the mid-nineteenth century adopted an outward looking strategy, reduced trade barriers and embraced a strategy of export-led growth: "By mid-century a consensus had emerged throughout the countries of Latin America in favor of export-led growth" (Bulmer-Thomas, (1994)).[24]

In summary, building large empires, and waving the national flag around the world served the purpose of creating markets in a world of less than free trade, and kept cultural minorities in check.

5.3 The Interwar Period

This is not the place to discuss the causes of the First World War, which however, were not unrelated to the nationalistic problems of late 19th century Europe. The end of the First World War opens the short 20th century. Figure III shows the number of countries created and destroyed in five year periods from 1870 until today. It excludes Sub-Saharan Africa, for

[23] On this issue, see Wacziarg (1990) and the citations provided therein.

[24] Note, however, that the reliance on import duties as a source of fiscal revenue implied a lower bound on trade taxes, particularly because political instability and border disputes in the region had important fiscal consequences.

which the identification of "countries" in the Nineteenth Century is somewhat problematic. The German unification, in which 18 previously independent entities disappeared, explains the dip at the beginning of Figure III. This figure also shows that very few new countries were created from 1875 to the Treaty of Versailles, while some countries disappeared. As was argued above, this was also a period of growing trade restrictions.

The same figure identifies a peak, i.e., a large number of countries created with the Treaty of Versailles in 1919. A common view amongst historians is that this treaty vastly mishandled the process of border redrawing after the First World War. Nevertheless, international borders hardly changed at all in the interwar period, until the late thirties, with the unfolding of the Second World War. In fact, Figure III shows that in the interwar period very few new countries appeared in the world.[25] Figure IV, which includes Sub-Saharan Africa and begins in 1905, displays a similar pattern. This period also coincided with a collapse of international trade and a major upsurge of protectionist policies, largely as a response to the Great Depression.

5.4 The Post Second World War Period

In the fifty years that followed the Second World War, the number of independent countries exploded. As shown in Figure I, there were 64 independent countries in the world (outside Sub-Saharan Africa) in 1871, after the first German unification. This number declined slightly, to 59, until the First World War. In 1920, the world (including Sub-Saharan Africa) consisted of 69 countries. There were 89 in 1950 and 192 in 1995. As a consequence of this increase in the number of independent nations, the world now comprises a large number of relatively small countries: in 1995, 87 of the countries in the world had a population of less than 5 millions, of which, 58 had a population of less than 2.5 millions, and 35 less than 500 thousands!

Two major developments, after the border arrangements following the end of the Second World War, influenced the process of country formation in the post-1945 era:

[25]Note that, among the very few new country creations, at least one, Egypt (independent in 1922) results from a classification problem: Egypt in 1922 was already largely independent from Britain, but its status switched from a protectorate to a semi-independent country. Leaving aside Vatican City, the only other countries created between 1920 and the Second World War were Ireland (1921), Mongolia (1921), Iraq (1932) and Saudi Arabia (1932) (although, again, Saudi Arabia was de facto independent since the mid-1920s).

a) Decolonization in the developing world, particularly in Asia and Sub-Saharan Africa;

b) The collapse of the Soviet bloc, which may also be seen as a case of decolonization.[26] In fact, this event led to the most significant episode of country creation in Europe since 1870.

Both phenomena are related to the dramatic increase in openness, international trade and the progressive reduction of policy-induced impediments to commerce. If Europe and the United States had reacted to the Second World War with the same retrenchment into protectionism as in the aftermath of the First World War, decolonization would probably have occurred much more slowly. If the former colonizers had been entangled in trade wars among themselves, their empires would have remained much more vital to them. It would also have been substantially more difficult for former Soviet Republics, some of them quite small, to break away after perestroika, had they expected to become economically isolated in a protectionist world.[27] The same applies to the peaceful separation of Czechoslovakia which led to the creation of two new, rather small, independent countries.[28] In fact, these new countries could follow the example of several economically successful small countries: Singapore, created in 1965, is indeed the quintessential example of a country with a borderless economy. The eagerness with which countries of the former Soviet bloc wish to enter the European Union adds credence to this idea.[29] Note that the pattern of trade of former Soviet Republics and Eastern European countries has changed substantially after the break-up of the Soviet Union. Trade flows between these countries and the West have increased dramatically.[30] In a world of high trade barriers, the former Soviet republics would have experienced much greater difficulties in redirecting their trade.

[26]Note, however, that Eastern European countries were always classified as independent countries, even in the darkest periods of Soviet influence.

[27]For example, Latvia has a population of less than 3 million, Estonia of about 1.5 million, and the Kyrgyz Republic of less than 5 million. For a recent in depth discussion of nationalism and ethnicity in Eastern Europe, see Brubaker (1990).

[28]The Czech Republic has about 10 million inhabitants, and the Slovak Republic about 5 million.

[29]For instance, Bugajski (1993) writes that: "The objective of every Eastern European state is full incorporation in all multilateral European institutions...Economic integration would provide many tangible benefits related to trade."

[30]See the data presented by Michalopoulos and Torr (1992) and Van Selm (1997). For a discussion of economic reforms following the Soviet coup of 1991, see Nordhaus, Peck and Richardson (1991).

At first glance, the process leading to a European Union could be seen as contrary to the thrust of our argument, because several major countries are 'unifying' in a period of increasing economic integration and trade liberalization. This interpretation would be superficial. The European Union will never be a classical nation-state. At most, it will be a loose federation of independent states, joined in a common currency area, coordinated macroeconomic policies to support this common currency, in addition to a free trade area supplemented by a harmonization of regulations and standards. In fact, while economic integration is progressing at the European level, regional separatism is more and more vocal in several member countries of the Union, such as Spain, Belgium, Italy and even France.[31] So much so, that many an observer has argued that Europe will (and, perhaps should) become a collection of regions (Brittany, the Basque Region, Scotland, Catalonia, etc.) loosely connected within a European federation.[32] The motivation of these developments is consistent with our argument: linguistic, ethnic and cultural minorities feel that they are economically "viable" in the context of a truly European common market, thus they can "safely" separate from the home country. In other words, the nation-state in Europe is threatened from above because of the necessity of developing supranational juridical institutions, and from below because of rampant regional movements. These movements feel they do not really need Madrid, Rome or Paris, when they can be loosely associated to the "Europe of Regions" politically, and be fully integrated in the Union economically. Newhouse (1997) puts it rather starkly: "[In Europe], the nation-state is too big to run everyday life and too small to manage international affairs."

Similar considerations apply to Québec's separatism in the context of NAFTA. In fact, an important issue in the discussion of Québec's independence is how this region benefits, in terms of trade flows, from being part of Canada relative to being an independent country in NAFTA. In studying precisely this point both McCallum (1995), and Helliwell (1996) conclude that, at least for Canada, national borders still matter, so that trade among Canadian provinces is ceteris paribus much easier than between Canadian provinces and US states. This implies that there might be a cost for Québec in terms of trade flows if it were to become independent. Such arguments were made by the proponents of the "no"

[31]For a recent discussion of "rising regionalism" in Europe, see Newhouse (1997).

[32]See Drèze (1991) on this point.

in the self-determination referendum of 1996. As the perceived economic costs of secession fall with greater North American economic integration, the likelihood of Québec gaining independence can be expected to increase. In fact, the development of a truly free-trade area in North America might reduce these costs and make Québec's separatism more attractive.

In the post-war period the only major example of reunification, i.e., of a change apparently inconsistent with increasing trade liberalization, is German reunification.[33] Clearly, this change corrected an artificial division of this country following its military defeat, and had largely political and cultural motivations. Even so, the economic costs of reunification have been quite substantial and have led a good portion of the public in the former Federal Republic to question the reunification. In particular, this illustrates one aspect of our trade-off, namely that a culturally homogeneous country will tend to remain "in one piece", even in a period of increased integration. Similarly, a country that has broken up for extraneous reasons can be expected to reunite at some point: once the force that generated the initial division (namely the Cold War) was no longer in place, there was no constraint to the "natural" reunification of Germany.[34]

Finally, the last two decades have witnessed, not only an increase in openness and international trade, but also the transformation of some sectors of the economy into real transnational economies. Indeed, in a truly global and integrated world economy, one does not need traditional nation-states. On the other hand, one needs to develop supranational legislation and courts to enforce contracts and facilitate economic activities that transcend national boundaries.[35]

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[33]There were others, such as the reunification of North and South Vietnam in 1975, the reunification of South and North Yemen in 1992, among very few examples. In all of these, very homogeneous populations were reunited after separations that were largely due to extraneous political factors.

[34]Along these lines, the reunification of South and North Korea appears as a very likely event. Predicting its date is another matter altogether; this largely depends on the evolution of domestic politics in China, in much the same way German reunification depended on the collapse of Soviet authority.

[35]For a recent discussion of this and related points, see Mathews (1997). For a more formal treatment see Casella and Feinstein (1990).

6 Conclusion

Trade liberalization and average country size are inversely related. The 'globalization' of markets goes hand in hand with political separatism.

While this paper has emphasized the link from trade regime to country size, one may argue that the opposite channel may also be operative; namely a world of small countries has to adopt a relatively free trade regime, because this is in the interest of small countries. The two channels are not mutually exclusive. Suppose that a certain region (say, Québec, Catalonia, Ukraine, etc.) considers demanding independence. Each of these regions takes the trade regime in the world, at the moment of their declaration of independence, as given. However, if the process of political separatism continues, and average country size declines, more and more 'players' in the international arena have an interest in preserving free trade, thus reinforcing the movement toward trade liberalization that may have influenced their decision about secession in the first place.

An implication of this paper is that as the process of economic 'globalization' will progress, political separatism will continue to be alive and well. The concept of relatively large and centralized nation-states is and will be more and more threatened by regional separatism from below, and the growth of supranational institutions from above, in a world of 'global' markets.

Appendix

In this appendix we briefly discuss simple derivations and extensions for the basic model.

1. Derivation of equations (4) and (5)

Call P_{ji} the price of input j in units of final output, to be paid to the owners of input j for the shipping of one unit of input j to unit i. When Z units of input j are shipped to unit i, the amount available for production will be Z if units i and j belong to the same country, $(1-\beta)Z$ if units i and j belong to different countries. Denote with i' a unit belonging to the same country as unit j, and with i'' a unit that belongs to a different country.

As each input is paid its marginal product, in equilibrium we have:

$$A\alpha Z_{ji'}^{\alpha-1} = P_{ji'} \text{ for all } i' \qquad \text{[A1]}$$

$$A(1-\beta)^{\alpha}\alpha Z_{ji''}^{\alpha-1} = P_{ji''} \text{ for all } i'' \qquad \text{[A2]}$$

As the price of one unit of input j is the same no matter where it is shipped (no tariffs or other forms of price discrimination), we have that [A1] = [A2] = P_j , and therefore:

1) All units belonging to the same country as unit j receive the same amount of input j (call it Z_j^d, where $Z_j^d = Z_{ji'}$ for all i');

2) All units that do not belong to the same country as unit j receive the same amount of input j (call it Z_j^f , where $Z_j^f = Z_{ji''}$ for all i''), and the following relationship holds:

$$\frac{Z_j^f}{Z_j^d} = (1-\beta)^{\frac{\alpha}{1-\alpha}} \equiv \theta \qquad \text{[A3]}$$

The resource constraint for each input is:

$$S_i Z_j^d + (W - S_i) Z_j^f = K \qquad \text{[A4]}$$

Equations [A3] and [A4] imply equations (4) and (5) in the text. It can be easily shown that (4) and (5) are also the solutions for a social planner who maximizes world output.

2. Transportation Costs

Suppose now that $\delta > 0$, so that Assumption A2 is relaxed. The amount of input that unit i ships domestically is now given by:

$$Z_i^d = \frac{(1-\delta)^{\frac{\alpha}{1-\alpha}} K}{1+(1-\delta)^{\frac{\alpha}{1-\alpha}}(S-1)+(W-S)\left[(1-\delta)(1-\beta)\right]^{\frac{\alpha}{1-\alpha}}} \qquad [A5]$$

The amount of intermediate good that unit i ships abroad is given by:

$$Z_i^f = \frac{\left[(1-\delta)(1-\beta)\right]^{\frac{\alpha}{1-\alpha}} K}{1+(1-\delta)^{\frac{\alpha}{1-\alpha}}(S-1)+(W-S)\left[(1-\delta)(1-\beta)\right]^{\frac{\alpha}{1-\alpha}}} \qquad [A6]$$

Using equations [A5] and [A6] instead of (4) and (5) in the text, one can derive all of our previous results, which remain qualitatively unchanged.

3. Generalization of the Utility Costs of Heterogeneity

$\frac{C_i^{1-\sigma}-1}{1-\sigma} - h$ is a special case of the more general utility function $U(C,h)$, where:

$$U_C > 0 \text{ and } U_h < 0 \qquad [A7]$$

The first order condition $U(S) = U_C\frac{dC}{dS} + U_h h(S) = 0$ identifies the unique optimal size $S^* = U^{-1}$ as long as:

$$1 \leq U^{-1} \leq W \qquad [A8]$$

and:

$$U"(S) = U_{CC}(\frac{dC}{dS})^2 + 2U_{Ch}\frac{dC}{dS}h + U_{hh}(h)^2 + U_C\frac{d^2C}{dS^2} + U_h h" < 0 \qquad [A9]$$

As $C(S)$ and $h(S)$ are both increasing in S, and $C(S)$ is concave for nonzero trade barriers, [A9] holds if the following three sufficient conditions are simultaneously satisfied:

1) [A7];

2) $h'' \geq 0$; and

3) All second derivatives of U are nonpositive, i.e.:

$$U_{CC} \leq 0\,;\, U_{hh} \leq 0;\, U_{Ch} \leq 0 \qquad [A10]$$

4. The Number of Countries in a Dynamic Framework

If we revert to the dynamic model of Section 2.3, the determination of the number of countries can be obtained by introducing heterogeneity costs in the instantaneous utility function:

$$U(C_i, h_i) = \int_0^{\infty} \left(\frac{C_i^{1-\sigma} - 1}{1-\sigma} - h_i \right) dt \tag{26}$$

where $h_i$denotes heterogeneity costs at time t in region i. As in Section 4.1, these heterogeneity costs enter in a linear and separable fashion. In principle, one could now derive an optimal path for S_{it}, that would depend, among other things, on the costs of changing borders. We limit our analysis to steady-states and equal country sizes in order to determine the optimal S^*. Since we have assumed away depreciation, technological progress and population growth, the steady-state level of consumption is equal to the steady-state level of income, that is:

$$C^{ss} = Y^{ss} = A^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{\rho} \right)^{\frac{\alpha}{1-\alpha}} [(1-\theta)S + \theta W] \tag{27}$$

Note that Proposition 1 applies to steady state levels of consumption and income. Hence, $S^*$is given by:

$$\frac{d}{dS} \left[\frac{\left[Y^{SS}(S^*) \right]^{1-\sigma} - 1}{1-\sigma} \right] = h'(S^*) \tag{28}$$

For instance, if $h(S)$is linear and equal to hS, we obtain:

$$S^* = \frac{A_0 (1-\theta)^{\frac{1-\sigma}{\sigma}}}{h^{\frac{1}{\sigma}}} - \frac{\theta}{1-\theta} W \tag{29}$$

where:

$$A_0^{\frac{\sigma}{1-\sigma}} \equiv A^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{\rho} \right)^{\frac{\alpha}{1-\alpha}} \tag{30}$$

As in the static case, the following result holds:

Proposition 2'. The number of countries $N^* = W/S^*$is negatively related to trade openness θ.

Appendix I - List of Countries (Section 3 regressions)

Algeria	Cyprus	Iraq	Nicaragua	Syria
Argentina	Denmark	Ireland	Niger	Taiwan
Australia	Dominican Rep.	Israel	Norway	Tanzania
Austria	Ecuador	Italy	Pakistan	Thailand
Bangladesh	El Salvador	Jamaica	Panama	Togo
Belgium	Finland	Japan	Paraguay	Tunisia
Benin	France	Jordan	Peru	Turkey
Bolivia	Germany, West	Kenya	Philippines	U.S.A.
Botswana	Ghana	Korea	Portugal	Uganda
Brazil	Greece	Lesotho	Rwanda	U.K.
Cameroon	Guatemala	Liberia	Senegal	Uruguay
Canada	Haiti	Malawi	Singapore	Venezuela
Central Afr. Rep.	Honduras	Malaysia	South Africa	Yugoslavia
Chile	Hong Kong	Mexico	Spain	Zaire
Colombia	India	Nepal	Sri Lanka	Zambia
Congo	Indonesia	Netherlands	Sweden	Zimbabwe
Costa Rica	Iran	New Zealand	Switzerland	

Appendix II - Number of countries data: Definitions

In most cases the determination of when a country appeared or disappeared is fairly uncontroversial. For example it is clear that the first German unification happened in 1871, that Algeria was born in 1962, and so on. In a number of cases, however, it may be unclear whether a country was independent or not. For instance, Afghanistan was under British 'influence' for some time, but never became a crown colony. For such cases, we had to use decision rules to determine the number of countries in any single year. These rules are the following:

1. For most of the countries, the dates of colonization and independence are specified in Encyclopedia Britannica, so we used those dates. We also double checked with Centennia, a computerized map program, whenever the data in Centennia was available. If conflicts occurred, we consulted country specific history books.

2. For a few countries, the process of colonization and gaining independence took a long time. We used the year in which a country lost control over its foreign policies as the starting point of colonization and the year that a country "fully" gained its independence as the year that it became independent. The word "fully" is usual terminology in the Encyclopedia Britannica and implies that the colonizer has left all powers to the local government.

3. If formal colonization did not occur for a given country, e.g. Bhutan, we used the criterion that its foreign policies was controlled by a foreign power as the starting point of colonization.

4. Countries that were under suzerainty of another country, e.g. Serbia and Romania under the Ottoman Empire, were classified as colonies.

5. A few countries, e.g. Afghanistan, were not colonized but were under the influence of foreign countries. They were classified as independent countries.

Appendix III - Data Sources and Description

Variable Name: Growth

Source: Summers-Heston v. 5.6. **Unit:** % points

Definition: Growth rate of PPP adjusted Gross Domestic Product

Variable Name: Trade/GDP Ratio

Source: Summers-Heston v. 5.6. **Unit:** %

Definition: Ratio of imports plus exports to GDP.

Variable Name: Initial Income per capita

Source: Summers-Heston v. 5.6. **Unit:** Log of per capita GDP in Dollars

Definition: Real Gross Domestic Product per capita in a given year (PPP adjusted)

Variable Name: Human Capital (male and female)

Source: Barro-Lee. **Unit:** Years

Definition: Avg. years of secondary and higher educ. in the total population over age 25.

Variable Name: Black Market Premium

Source: World Currency Yearbook / IMF. **Unit:** (Black mkt rate-official rate)/official rate.

Definition: Black market premium on the exchange rate.

Variable Name: Public Consumption

Source: Summers-Heston v. 5. **Units:** %

Definition: Share of government consumption of goods and services in GDP, excluding transfers and public investment.

Variable Name: Population

Source: Barro-Lee **Unit:** Logarithm of population.

Definition: Country population

Variable Name: Terms of Trade Shocks

Source: World Bank **Unit:** %

Definition: Growth rate of merchandise export prices minus growth rate of merchandise import prices.

Variable Name: Log of area

Source: Barro-Lee **Unit:** log of million of square kilometers.

Definition: Log of country land area

Variable Name: Landlocked dummy, Island dummy, Small country dummy.

Source: Authors. **Unit:** dummy variables

Definition: geographic dummy variables.

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Table Ia: Growth regressions including country size, openness and their interaction.
Basic Specification (without any controls)

Dependent Variable: Growth of per cap. GDP (%)	Country Size =Log of GDP		Country Size =Log of Pop.	
	3SLS*	SUR / GLS	3SLS*	SUR / GLS
Constant	-7.963 (-3.42)	-4.242 (-2.63)	-7.383 (-2.78)	-2.866 (-1.91)
Trade/GDP ratio	**0.066** **(4.87)**	**0.039** **(6.11)**	**0.075** **(4.02)**	**0.041** **(5.55)**
Size*openness	**-0.0021** **(-4.80)**	**-0.0012** **(-4.71)**	**-0.0045** **(-4.63)**	**-0.0025** **(-4.56)**
Country Size	**0.496** **(4.09)**	**0.325** **(3.57)**	**0.814** **(3.57)**	**0.443** **(3.04)**
Adj. R-squared	.04 .12 .18 .09 .17 .16	.04 .12 .17 .09 .17 .17	.01 .11 .18 .10 .18 .14	.01 .11 .18 .10 .18 .14
QLR stat. (DF=7)	8.02		3.14	
χ^2 crit. value (95%)	14.07		14.07	

(t-statistics based on heteroskedastic-consistent (White-robust) standard errors in parentheses)
Number of Observations = 84

* Instruments are: Terms of trade shocks (all 6 periods), log of land area, island dummy, small island dummy, small country dummy, landlocked country dummy, log initial income (all periods), log country size (as measured in relevant columns, all periods).

Table Ib. Growth regressions including country size, openness and their interaction.
Basic Specification (includes the log of initial income)

Dependent Variable: Growth of per cap. GDP (%)	Country Size =Log of Pop.		Country Size =Log of GDP	
	3SLS	SUR/GLS	3SLS	SUR/GLS
Constant	-7.907 (-3.07)	-4.066 (-2.52)	-8.166 (-3.17)	-4.177 (-2.59)
Log per capita initial income	0.081 (0.52)	0.192 (1.44)	-0.598 (-2.03)	-0.156 (-0.74)
Openness ratio	**0.075** **(3.94)**	**0.040** **(5.46)**	**0.075** **(4.00)**	**0.040** **(5.53)**
Openness*size	**-0.0045** **(-4.72)**	**-0.0025** **(-4.68)**	**-0.0022** **(-4.60)**	**-0.0012** **(-4.65)**
Country size	**0.807** **(3.45)**	**0.418** **(2.89)**	**0.754** **(3.42)**	**0.388** **(2.75)**
Adj. R-squared	.02 .11 .17 .10 .18 .15	.03 .11 .16 .09 .18 .17	.02 .12 .19 .10 .18 .15	.03 .12 .18 .10 .18 .17
QLR Stat. (DF=6)	3.09	-	2.81	-
χ^2 crit. value (95%)	12.59		12.59	

(t-statistics based on heteroskedastic-consistent standard errors (White-robust) in parentheses)
Number of Observations = 84

* Instruments are: Terms of trade shocks (all 6 periods), log of land area, island dummy, small island dummy, small country dummy, landlocked country dummy, log initial income (all periods), log country size (as measured in relevant columns, all periods).

Table IIa. Robustness analysis. Size = Log of Population

Dependent Variable: Growth of per Capita GDP (%)	(1)	(2)	(3)	(4)	(5)
Constant	5.771	5.442	5.277	8.366	10.659
	(1.76)	(1.77)	(1.75)	(3.00)	(4.42)
Log per capita initial income	-0.649	-0.525	-0.481	-0.641	-1.409
	(-2.34)	(-1.89)	(-1.75)	(-2.49)	(-5.73)
Openness ratio	**0.036**	**0.033**	**0.033**	**0.030**	**0.021**
	(4.67)	**(4.59)**	**(4.74)**	**(4.30)**	**(4.02)**
Openness*size	**-0.0025**	**-0.0026**	**-0.0025**	**-0.0022**	**-0.0017**
	(-4.62)	**(-4.59)**	**(-4.58)**	**(-4.23)**	**(-3.82)**
Country size	**0.374**	**0.287**	**0.263**	**0.203**	**0.152**
	(2.69)	**(2.22)**	**(2.02)**	**(1.66)**	**(1.38)**
Fertility rate	-0.595	-0.578	-0.543	-0.506	-0.253
	(-3.89)	(-4.17)	(-3.99)	(-4.02)	(-1.98)
Male human capital	-	1.224	1.149	1.019	0.839
		(2.64)	(2.39)	(2.20)	(1.95)
Female human capital	-	-1.389	-1.359	-1.227	-0.861
		(-3.08)	(-2.93)	(-2.77)	(-2.02)
Black market premium	-	-	-0.001	-0.001	-0.001
			(-5.44)	(-5.07)	(-6.33)
Government share of GDP	-	-	-	-0.074	-0.063
				(-3.33)	(-2.60)
Investment rate	-	-	-	-	0.172
					(6.41)
Adj. R-squared	.06 .19 .09	.07 .22 .12	.07 .22 .13	.08 .25 .20	.10 .35 .34
	.05 .22 .38	.08 .25 .34	.10 .25 .32	.06 .23 .34	.12 .24 .34
Log likelihood	-1228.60	-1224.49	-1218.49	-1212.52	-1183.67

(t-statistics based on heteroskedastic-consistent (White robust) standard errors in parentheses)

# of Observations: 84.

Estimation Method: SUR/GLS. Results (available upon request) are qualitatively unchanged when using 3SLS.

Table IIb. Robustness analysis. Size=Log of Total GDP

Dependent Variable: Growth of per Capita GDP (%)	(1)	(2)	(3)	(4)	(5)
Constant	5.672	5.372	5.217	8.333	10.655
	(1.73)	(1.74)	(1.72)	(2.98)	(4.40)
Log per capita initial income	-0.957	-0.748	-0.681	-0.790	-1.522
	(-3.11)	(-2.44)	(-2.22)	(-2.65)	(-5.75)
Openness ratio	**0.036**	**0.033**	**0.032**	**0.030**	**0.021**
	(4.74)	**(4.62)**	**(4.76)**	**(4.30)**	**(4.04)**
Openness*size	**-0.0012**	**-0.0012**	**-0.0012**	**-0.0011**	**-0.0008**
	(-4.56)	**(-4.43)**	**(-4.42)**	**(-4.11)**	**(-3.81)**
Country size	**0.346**	**0.258**	**0.235**	**0.178**	**0.133**
	(2.56)	**(2.07)**	**(1.86)**	**(1.49)**	**(1.24)**
Fertility rate	-0.597	-0.580	-0.545	-0.508	-0.253
	(-3.87)	(-4.14)	(-3.97)	(-4.00)	(-1.97)
Male human capital	-	1.192	1.115	0.988	0.817
		(2.59)	(2.35)	(2.16)	(1.91)
Female human capital	-	-1.355	-1.324	-1.194	-0.838
		(-3.03)	(-2.88)	(-2.72)	(-1.97)
Black market premium	-	-	-0.001	-0.001	-0.001
			(-5.50)	(-5.12)	(-6.37)
Government share of GDP	-	-	-	-0.075	-0.064
				(-3.32)	(-2.61)
Investment rate	-	-	-	-	0.172
					(6.37)
Adj. R-squared	.06 .19 .10	.07 .22 .12	.07 .22 .14	.07 .25 .21	.10 .35 .35
	.06 .22 .39	.09 .25 .35	.10 .24 .33	.06 .22 .34	.12 .24 .34
Log likelihood	-1228.45	-1224.56	-1218.57	-1212.54	-1183.80

(t-statistics based on heteroskedastic-consistent (White robust) standard errors in parentheses)

# of Observations: 84

Estimation Method: SUR/GLS. Results (available upon request) are qualitatively unchanged when using 3SLS.

Table III. Summary Statistics for 1960-89 sample averages

Variable	Mean	Std. Dev.	Minimum	Maximum
Growth in per capita GDP (%)	2.384	1.708	-0.556	6.730
Log initial per capita income (%)	7.842	0.949	6.062	9.499
Trade to GDP ratio (%)	57.689	39.037	12.648	306.901
Male human capital	1.232	1.001	0.095	4.844
Female human capital	0.871	0.920	0.021	4.695
Fertility rate	4.848	1.891	1.892	7.988
Government consumption / GDP (%)	17.594	6.789	6.097	39.445
Investment rate (%)	17.646	7.812	2.453	34.843
Log of land area	5.457	1.772	0.000	9.208
Log of population	9.160	1.338	6.417	13.287
Black market premium (%)	52.226	237.574	-0.564	2146.655
Log total GDP	17.032	1.764	13.604	21.771

Number of Observations: 84

Figure I. Trade Openness and the Number of Countries

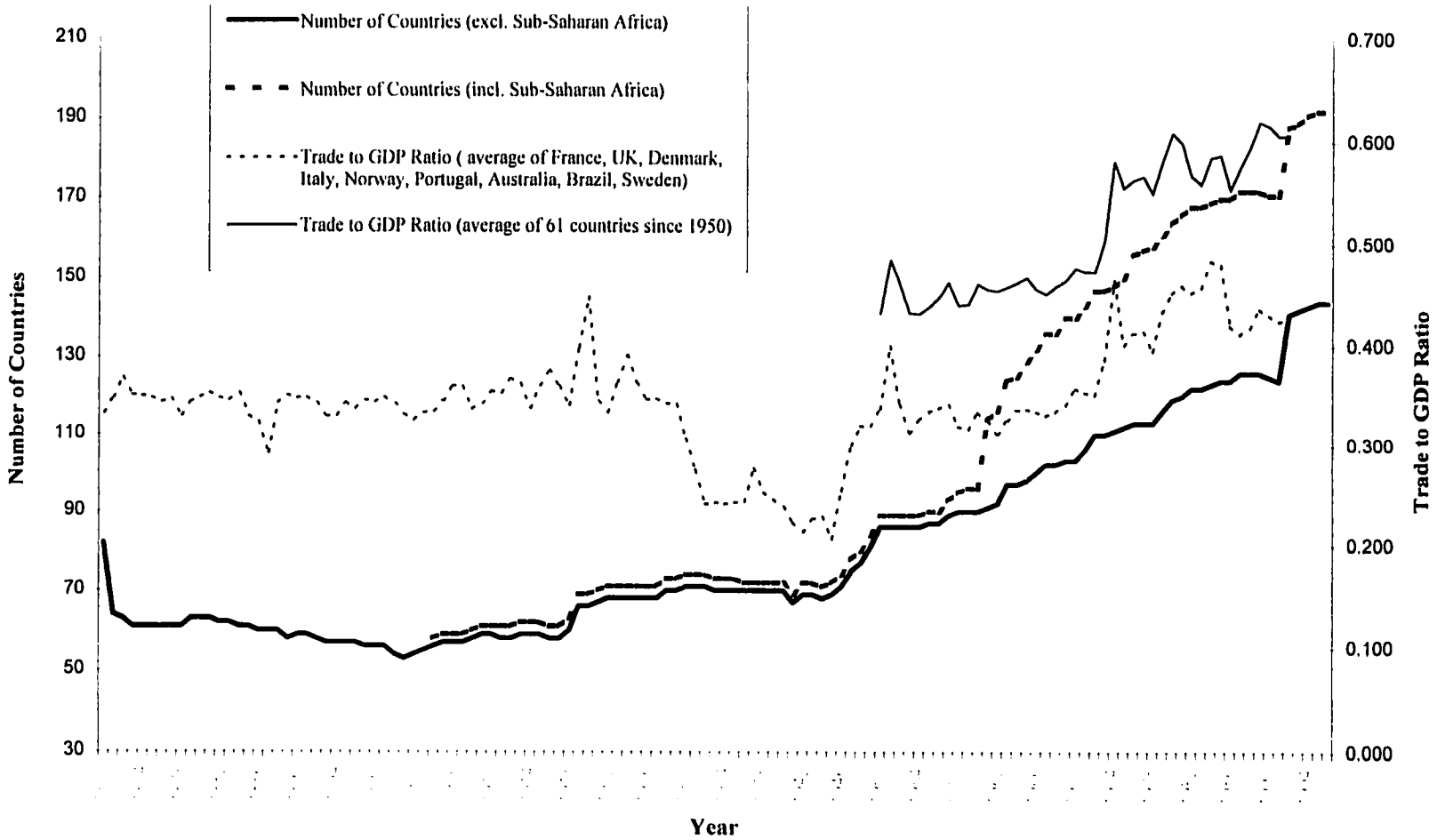


Figure II: Average Tariff Rate and the Number of Countries
(Unweighted country average of average tariff rate for Austria, Belgium, France, Germany, Sweden, USA)

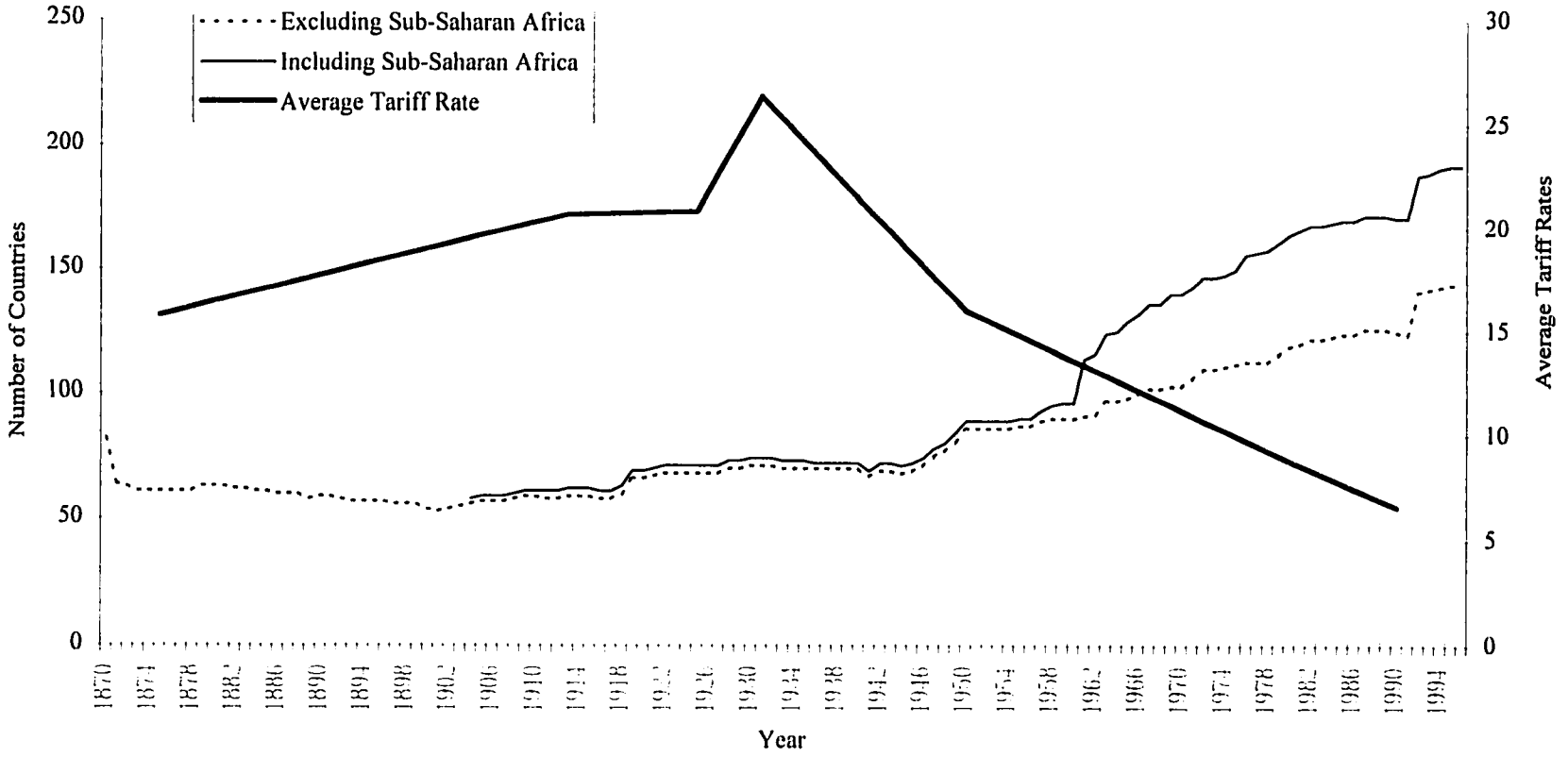
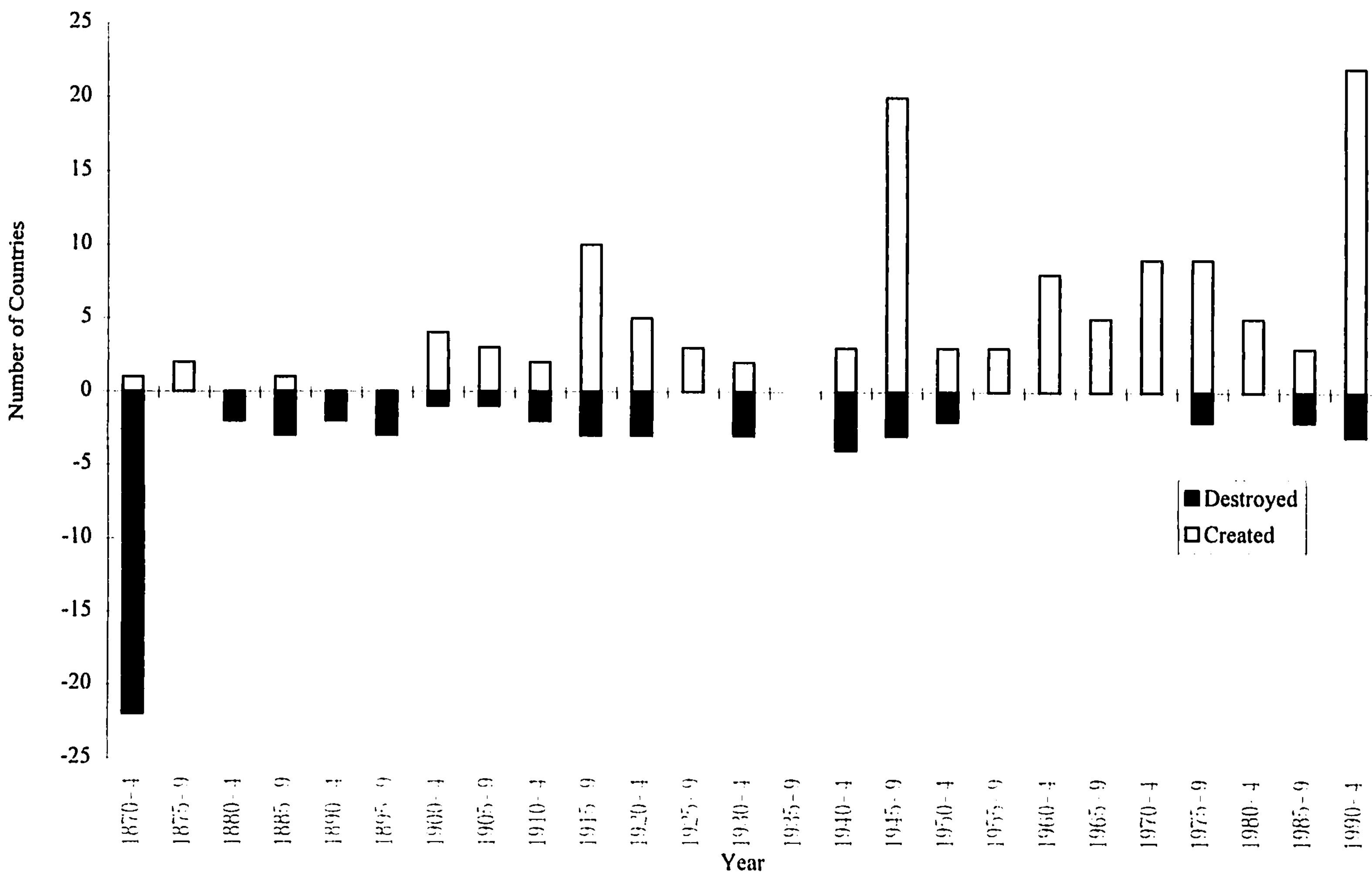


Figure III. Countries Created and Destroyed
(5-year periods, excludes Sub-Saharan Africa)



Chapter IV - How Democracy Affects Growth

1 Introduction

Democracy is valued independently of its effects on material well-being. Equal participation in the election and evaluation of government officials is universally perceived as a precondition for social justice. As a result, studying the effects of democracy on economic growth, because it focuses on its material consequences, is often deemed a futile endeavor. We believe, instead, that this issue deserves close examination. Whether the development of political rights is a determinant or a consequence of material progress is a key policy question. This is particularly important in the 1990's, in the wake of Latin American, Eastern European and African democratization episodes. As political liberalization becomes a frequent precondition for providing financial support to the developing world, determining its costs and benefits is essential to define policies that further both development and democracy.

As shown in Table II, the simple correlation between an index of democracy and economic growth is positive but weak over the period 1970-1989. Thus, it comes as no surprise that the empirical literature on this topic is largely inconclusive. Borner et al. (1995) report that out of sixteen empirical studies, three uncover a positive association between democracy and growth, three find a negative association and the remaining ten are inconclusive. Recent research focusing explicitly on the role of democracy, such as Helliwell (1994) and Barro (1996), find a non-significant negative effect of democracy on growth once several growth-determining variables are held constant. However, finding that democracy has a weak negative partial effect on economic growth may hide the fact that it entails both costs and benefits. This paper argues that specifying precisely the channels of influence from democracy to economic growth allows us to better understand the economic costs and benefits of democracy.

We start by defining democracy in purely *procedural* terms, that is, as a body of simple rules and procedures that regulates the transfer of political power and the free expression of disagreement at all levels of public life. In particular, democracy must be distinguished from its outcomes. Huntington (1991) makes this point elegantly: "Democracy is one public

virtue, not the only one, and the relation of democracy to other public virtues and vices can only be understood if democracy is clearly distinguished from other characteristics of political systems". The Freedom House data on the degree of democratization across countries and across time, which we use in this paper, is based on this procedural definition of democracy but the implications of this fact have not been fully exploited by researchers.[1]

Indeed, all previous studies focus on the *direct* effect of democracy on growth, conditional on other growth-determining factors. This procedure should be questioned: in theory, if such a comprehensive institution as democracy matters, it should matter *indirectly* through its effect on variables that in turn determine economic growth.[2] Existing theoretical arguments point to links between democracy and a number of societal characteristics that influence growth, but none of them suggest that it should have a direct impact on growth, as would be the case if it entered explicitly in the production function of the economy.

In this paper, we start by selecting, from the political science and the economics literatures, variables that both determine growth and are affected by democracy. For instance, it has been argued that democratization influences government consumption. A larger government may in turn lower economic growth when the cost of financing its activities through distortionary taxation outweighs the economic benefits of public goods. Hence, there are reasons to believe *a priori* that democracy affects growth through government consumption. In this paper, we formally test this and other possible linkages. In particular, we formulate and estimate a full system for the joint determination of growth and democracy in which we endogenize the relevant channels.

Our methodology allows us to decompose the overall effect of democracy into several components. We find that democracy fosters growth by improving the accumulation of human capital and lowering income inequality. On the other hand, it hinders growth by

[1]See Freedom House (1972-90) for the methodology underlying the democracy index used in this paper.

[2]Barro (1996) concludes that: "With respect to the determination of growth, the cross-country analysis brings out favorable effects from maintenance of the rule of law, free markets, small government consumption, and high human capital. Once these kinds of variables and the initial level of GDP are held constant, the overall effect of democracy on growth is weakly negative". A sensible account of the channels linking democracy and growth must emphasize precisely the aforementioned variables. Helliwell (1994) mentions that: "(...) some aspects of democratic systems are more helpful to subsequent growth than others", providing further motivation for our approach.

reducing the rate of physical capital accumulation and, less robustly, by reducing the degree of openness to trade. The overall effect is in line with previous studies: we uncover a moderate, statistically insignificant, negative impact of democracy on growth.

The paper is organized as follows: Section 2 discusses the theoretical arguments for each channel of causation. Section 3 describes the econometric method and the specification search underlying our estimation strategy. Section 4 presents the results and analyzes their sensitivity. Section 5 concludes.

2 Democracy and Growth: The Channels of Causation

The democracy-growth channels involve many of the "usual suspects" studied in the empirical growth literature. The variables under study are directly or indirectly associated with the exercise of governmental power. It will become clear that we view democracy as a political system characterized by two main features:

1. It adds the voice of the great number of poor to that of the few rich, changing the composition of the citizenry effectively influencing the political process.

2. It decreases the discretionary nature of power, in the sense that political decisions become more responsive to constraints lying outside the control of politicians.

Each of the channels of causation examined below can be thought of in the context of these two forces.

2.1 Political Instability

The *stability of governance* is a desirable feature of a political system. Political instability leads to uncertainty about future policies and creates an incentive for rulers to adopt predatory behavior vis-à-vis the private resources of the economy. One of the important characteristics of democracy is the provision of transparent rules for the alternation of political forces in power. Furthermore, by encouraging an open debate over the choice of policies and policy-makers, it discourages extremism and the take-over of power by illegitimate means. Thus, democracies may exhibit peaceful and predictable transfers of political

power where autocracies experience violent and erratic changes.[3] The lower degree of uncertainty that results from reduced political instability is likely to foster investment and growth. On the empirical side, Alesina et al. (1996), among others, showed that political instability has a negative effect on growth.

2.2 Distortions

Democracy can also influence the *quality of governance*: rulers with discretionary power tend to set up distortionary policies that benefit a small set of insiders at the expense of the general population. Democracies make it easier to keep these abuses in check and control the quality of policy-making, by submitting politicians to regular public scrutiny and promoting viable alternatives in the form of opposition parties. In other words, the exercise of power is potentially more arbitrary in autocratic regimes that lack public scrutiny of policy-makers. We use the black market premium on the exchange rate (BMP), which is the ratio of the difference between the local currency's official and black market exchange rates to its official value, as a measure of government-induced distortions.[4] We expect a higher BMP to lead to lower rates of capital accumulation and lower growth in per capita GDP.

2.3 Government Size

Lastly, several theoretical arguments point to a causal link between the nature of political institutions and the size of government, as measured by the ratio of *public consumption* to GDP. Meltzer and Richard (1981) have elegantly shown how a government that delivers uniform benefits financed by proportional taxes creates the stimulus for its own expansion. This model summarizes the incentives at work in democratic states, as far as government

[3]On the other hand, democracies may just substitute constitutional for non-constitutional transfers of power (that is, elections for coups) and the number of transfers of power may actually increase. In this case there may be a trade-off between type and quantity of political changes as a country becomes more democratic.

[4]More direct measures of bureaucratic performance, such as the independence and the effectiveness of the judiciary, the level of corruption and the amount of red tape, have been shown by Mauro (1995) to have an adverse effect on economic growth. These variables are only available for the 1980's and so their use would considerably limit the time span and the number of countries in our study. We resorted to the use of the black market premium as a proxy for the quality of governance: distortions on the foreign exchange market are strongly associated with other inefficient policies, as argued in Barro (1991).

intervention is concerned: taxes discourage economic activity and the increased number of poor vote for more government intervention financed by higher taxes. Moreover, Mancur Olson (1982), among others, has argued that policy-making in democracies tends to be captured by interest groups whose demands increase the size and scope of government. On the other hand, abuses by the few can be better kept in check in a political system that gives voice to the many, that is, in democracies.[5]

Autocrats also face incentives to increase the sphere of governmental activity to maximize their leverage over the economy.[6] However, some have also argued that minority rule can be advantageous if the characteristics of the few wielding power encourage them to act in the interest of society at large. However elitist this argument may sound, autocrats who own a disproportionately high share of the economy's capital have an incentive to select the growth-maximizing size of government. Giving a larger say to the poor in policy-making leads to more distortions and lower growth. Since it is theoretically unclear whether democracies spend less or more than autocracies, this issue warrants empirical examination.

The effects of public activity on growth involves a trade-off between the costs of distortionary taxation required to finance it and the benefits it provides. Barro and Sala-i-Martin (1992) show that, in a simple endogenous growth model where government spending is productive, there exists a growth-maximizing rate of taxation. Alesina and Rodrik (1994) study an economy with unequal distribution of capital and labor where individuals vote

[5]Pommerehne and Schneider (1982) estimate the demand for government services from 48 swiss municipalities which operate under direct democracy. They then use the resulting parameter estimates to compute demand for public service in the 62 swiss municipalities that have a representative form of government. They find that *all* the individual spending categories are underestimated: representative democracies spend 28 percent more than direct democracies. Furthermore, government spending is smaller in municipalities with representative governments when citizens have a right to call a referendum and reverse government decisions. We interpret these results as suggesting that a decrease in the discretionary power of politicians is likely to be associated with a reduction in government size. Similar effects may come into play when contrasting autocracies with democracies, since what matters for the argument is how closely the citizenry is associated with the control of public officials.

[6]This may be seen as a generalization of the view in Niskanen (1971), who stressed that the main motivation of bureaucrats is to increase the size of their bureau, since their power derives directly from the pool of resources under their control. Even if one expects the psychologies of dictators and bureaucrats to be substantially different, they can express themselves through the same means.

over taxation: the lower the capital income to labor income ratio of the median voter, the larger the tax rate and thus the lower growth. The growth-maximizing tax-rate would only be chosen in an economy where the median voter owns only capital. Taken together, these theories point to a negative effect of government size on growth. Indeed, Barro (1991) documents a negative relationship between government consumption and growth.

2.4 Human Capital

The political regime may lead to different choices of social attributes. Consider *human capital*: a substantial part of education spending is publicly financed and thus contains a redistributive element; if democracies are more responsive to the basic needs of the population than dictatorships, they will choose policies that promote human capital accumulation. Saint-Paul and Verdier (1993) present an endogenous growth model where redistribution, in the form of public education, is determined by political equilibrium. They show that, since human capital enhances productivity, the higher education spending delivered by the political process leads to higher growth. Previously, Mankiw, Romer and Weil (1992) had shown empirically that human capital impacts growth positively. In conclusion, human capital is a potentially important channel of causation from democracy to growth.[7]

2.5 Income Inequality

The degree of *income inequality* also results from societal choices that can be shaped by the political regime. A move from dictatorship to democracy is expected to give a greater weight to the preferences of the poor in collective decision-making. One can expect the enfranchised poor to use the political process to their benefit and influence government to carry out inequality-reducing income redistribution.[8] The effect of income inequality on growth, the other link in the chain, has also been widely studied. Alesina and Rodrik (1994)

[7]As far as human capital is concerned, a serious problem of endogeneity needs to be considered: a higher level of human capital is likely to be a determinant of democracy as well as one of its outcomes. The link between democracy and development may originate in the fact that education increases the demand for democracy. Such an argument is pervasive throughout Tocqueville's treatise on democracy in America (1990), in which he associates the diffusion of democracy with the spread of the "Spirit of the Enlightenment" ("l'Esprit des Lumières"). In what follows, we address the issue of reverse causality by instrumenting for democracy in the human capital channel.

[8]This is the case in Saint-Paul and Verdier (1993), and more recently in Acemoglu and Robinson (1996)

model an economy where higher income inequality leads to the adoption of a suboptimally high rate of taxation and thus to lower growth. Alesina and Perotti (1996) document a negative empirical linkage between inequality and growth.

2.6 Trade Openness

Trade openness can also be affected by the extent of political freedom. Protectionist policies tend to be imposed to benefit a few producers at the expense of a great mass of consumers, and democracies may weigh the preferences of the latter more heavily than autocracies. But political economy models of endogenous protection with voting and lobbying can easily generate a high level of protection even when the benefits are concentrated.[9] Hence, in democracies as well as in autocracies, particular groups face incentives to voice their concerns (via political contributions or media campaigns) when they face high stakes, while it is harder to mobilize the greater numbers who stand to gain from free trade. The effect of democracy on the trade regime remains an open empirical question.[10]

Numerous studies document a robust positive effect of trade openness on economic growth.[11] International trade allows countries to reap the full benefits of their comparative advantage, thus raising the steady state level of per capita income and the transitional growth rate. It also increases the internal degree of product market competition, spurs technological transmissions, allows access to larger markets and may provide incentives for greater policy discipline through regional or global economic arrangements.

2.7 Physical Capital Accumulation

Lastly, we investigate the possibility that democracy may affect the rate of *physical capital accumulation.*[12] In theory, there are several ways in which institutions may affect the rate of return to physical investment, independently from the channels already examined above.

[9]See, for instance, Grossman and Helpman (1994).

[10]Tavares (1998) argues, on the basis of factor proportions trade theory, that democratization should lead to increased trade openness in poor, labor abundant countries and not in rich, capital abundant countries.

[11]See for instance, Sachs and Warner (1995) and Wacziarg (1997), among many others.

[12]In an earlier version of this paper, we investigated whether democracies devote a larger share of their GDP to public investment. We found little evidence of this and decided to lump private and public investment into a single channel. This allowed to enlarge our basic sample.

The political process may lead to a distribution of national income between capital and labor that is favorable to the latter, by giving a greater voice to unions and labor interests. Ceteris paribus, higher wages decrease the return to capital in democracies and thus lower private investment. Rodrik (1998) provides some support for this hypothesis by showing empirically that democracies pay higher wages. On the other hand, by better securing property rights and facilitating contract enforcement, democracies may raise the returns to investment.[13] They may do so also by reducing the extent of political, social and economic uncertainty.[14] These opposing effects suggest that this issue deserves to be examined empirically. The rate of physical capital investment is one of the most robust determinant of economic growth, as shown in Levine and Renelt (1992).

3 Econometric Methodology

Our analysis of the channels through which democracy affects growth involves an estimation procedure based on combining the features of panel data models with features of simultaneous equations models. The basic econometric specification consists of a series of M structural relationships describing the behavior of the endogenous variables. The model consists of a cross-country growth equation and of seven channel equations in which the dependent variables are the channel variables discussed in Section 2. In addition to these variables, we account for the possibility that the level of democracy itself may be endogenous by instrumenting for it with the full set of exogenous variables in the system. We use a panel of countries across time, so each of the $M = 8$ relationships can be formulated for each of $T = 4$ time periods, with parameters constrained to be equal across time-periods.

As far as the channel relationships are concerned, the parameters of interest are those that describe the effect of a marginal change in the democracy index on the channel variable. The product of the democracy coefficients in the channel equations by the channel coefficient in the growth equation indicates whether and how democracy affects growth. In addition to an index of democratization, each channel equation contains other control variables,

[13]Clague at al. (1996) propose such an argument. They find that long lasting democracies are better able to secure property rights and to guarantee the enforcement of contracts than autocracies.

[14]Although part of this effect may be captured by the political instability channel, democracy may also affect other types of uncertainty that will be picked up by the investment channel.

some of which are endogenous in our system. This highlights the importance of using an instrumental variables estimator.

3.1 Structural Form

Our model contains T time periods ($t = 1...T$), M theoretical relationships ($m = 1...M$) and K exogenous variables ($k = 1...K$). The data consists of N countries ($i = 1...N$). The most unrestricted version of the structural model is a set of TM equations of the form (superscripts index equations while subscripts index variables):

$$\begin{aligned} &\gamma_{11}^{tm} y_{i11} + ... + \gamma_{T1}^{tm} y_{iT1} + ... + \gamma_{1M}^{tm} y_{i1M} + ... + \gamma_{TM}^{tm} y_{iTM} + \\ &\delta_{11}^{tm} x_{i11} + ... + \delta_{T1}^{tm} x_{iT1} + ... + \delta_{1K}^{tm} x_{i1K} + ... + \delta_{TK}^{tm} x_{iTK} = \epsilon_i^{tm} \end{aligned} \tag{1}$$

Of course, this formulation is far too general. In particular, without further restrictions, the structural parameters will not be identified. We start by imposing the following restrictions:

1. For all m relationships, we constrain non-contemporary coefficients to zero, that is, $\gamma_{sm}^{tm} = 0$ and $\delta_{sk}^{tm} = 0$, for all s different from t. This ensures that the model will not be dynamic.

2. All coefficients on the same variables in each relationship are constrained to being equal across time, that is, $\gamma_{tm}^{tm} = \gamma_{tm}^{sm}$ and $\delta_{tk}^{tm} = \delta_{tk}^{sm}$ for all s.[15]

3. We can impose a normalization whereby, in every equation of the structural model, the coefficient on the endogenous variable designated as the dependent variable for this equation, is set equal to one: $\gamma_m^m = 1$. This effectively identifies the m^{th} endogenous variable as the dependent variable for the m^{th} equation..

So each set of T equations corresponding to one of the $m = 1...M$ relationships can be written as follows:[16]

$$y_{im} = \epsilon_i^m - \gamma_1^m y_{i1} - ... - \gamma_M^m y_{iM} - \delta_1^m x_{i1} - ... - \delta_K^m x_{iK} \tag{2}$$

where y_{ij}, x_{ik} and ϵ_i^m are the $(T \times 1)$ vectors that stack each endogenous variable $j = 1...M$, each exogenous variable $k = 1...K$ and each disturbance $m = 1...M$, over the T time periods.

[15] For some of our reported estimates, we will relax this assumption for the intercepts of each equation to allow for time-specific effects.

[16] We now drop the time subscript on the parameters since we have already imposed cross-time parameter equality restrictions.

Equation (2) shows that our original model, with each relationship formulated for each time period, is equivalent to a panel data model where the data for each individual country have been stacked over time. Additional identifying restrictions will be discussed below.[17]

If we stack the ε_i^m errors into a vector ε_i, we are able to formulate the usual assumptions on the error vector, namely: $E(\varepsilon_i) = 0$ and $E(\varepsilon_i \varepsilon_i^{'}) = \Sigma$. The off-diagonal elements of Σ are the error covariances across time and across structural relationships, which are unconstrained. Stacking the error terms over all observations $i = 1...N$ leads to a block diagonal covariance matrix, with the blocks corresponding to the individual covariance matrix Σ. The assumption that the reduced form error terms can covary across time for a single relationship is tantamount to allowing the error term to contain a country specific effect that is independent from the right hand side variables, an approach exactly equivalent to the random effects model. Given the above, important additional restrictions imposed on the covariance matrix of the full $(MTN * 1)$ disturbance vector stem from the assumption that Σ does not depend on the country subscript i. This rules out heteroskedasticity and spatial autocorrelation.[18]

3.2 Estimation of the Structural Parameters

Several estimation procedures have been proposed for the type of system that we are analyzing.[19] The most obvious one is indirect least squares or indirect feasible generalized least squares: first estimate the reduced form coefficients using least squares or the

[17]The formal conditions for identification are the familiar rank and order conditions (Greene, 1993). Basically, we need to exclude as many exogenous variables from each equation as we include endogenous variables. A previous version of this paper, available upon request, formally derives these conditions for the econometric framework that we are considering.

[18]However, we report standard errors that are robust to heteroskedasticity (White-robust).

[19]The first estimation method that can be considered is equation-by-equation instrumental variables (or 2SLS) estimation on the structural form model. This yields consistent estimates, but efficiency is not attained because cross-equation disturbance correlations are neglected. In order to impose cross-period parameter equality restrictions and to exploit efficiency gains from the correlation of error terms for each structural relationship across time, one could use a variant of single-equation IV whereby each structural relationship is estimated for all time periods jointly using three-stage least squares, as in Barro (1996). This method takes into account cross-period correlations, but does not exploit the information inherent in the fact that error terms may not be independent across structural relationships.

SUR technique on the full set of reduced form equations; second, retrieve the structural parameters and the corresponding standard errors using minimum distance estimation (Delta method). This, however, is computationally demanding and yields no gain in efficiency or consistency compared to the systems method of estimation to which we now turn.

We estimate the full set of $(T \times M)$ equations *jointly* using three-stage least squares. This is an IV-GLS estimator which achieves consistency through instrumentation and efficiency through appropriate weighting. The 3SLS estimator can be obtained as follows:

1. Estimate the reduced form coefficient matrix via OLS and retrieve the fitted values for the endogenous variables for each equation of the structural model.

2. Estimate the structural system equation-by-equation via 2SLS and retrieve the estimated covariance matrix of the residuals from this procedure.

3. Finally, use the estimated covariance matrix from stage 2 and the fitted values of the endogenous variable from stage 1 in an IV-GLS procedure applied to the stacked structural model.

In order to examine the impact of instrumenting for the endogenous variables on our results, we also report Seemingly Unrelated Regression (SUR) estimates of the model's parameters. These exploit the efficiency gains derived from our assumed error structure, without using instrumental variables.

3.3 Specification and Exclusions

In order to determine the exclusions needed for the identification of our system, we follow two different strategies. Firstly, we estimate a system based on a priori theoretical exclusions, which constitutes our benchmark model. Secondly, we submit the estimates of this benchmark model to a sensitivity test based on an "empirical specification search", in which we let the data determine which variables should appear in each equation.

3.3.1 Choice of Exogenous Variables

The estimation framework presented above implies that we need a relatively wide set of exogenous variables, labeled $x_{i1}...x_{iK}$. These variables are exogenous in the sense that they do not appear on the left-hand side of any of our structural relationships. By choosing

a sufficiently wide set of variables, we will limit the scope for omitted variables bias. We consider different types of variables to serve as controls and/or instruments in the various equations:[20]

-Cultural variables (religion dummies and ethnolinguistic fractionalization).

-Demographic variables (log of population, share of the population over 65 and under 15).

-Gravity variables (country land area, distance from major trading partners, landlocked country dummy, island dummy, oil exporter dummy, terms of trade shocks).

-Historical variables (post-war independence dummy, dummy if ever a colony, number of war casualties).

-The log of income per capita and its squared value. The log of initial income will appear in every relationship of our base specification, so that it will never be operative as an instrument - only as a control. In other words, it will not provide identifying information.

3.3.2 Theoretical Specification

We determine the set of endogenous and exogenous variables that appear on the right-hand side of each equation based on existing specifications for growth and the various channel equations. Throughout, we include democracy in every channel equation but exclude it from the growth regression. We also excluded all lags and leads from every equation. The set of exclusions and inclusions for the base specification can be inferred from Appendix 3 (Table VII). In every equation, the number of exclusions is sufficient for the order condition for identification to be satisfied. The rank condition can safely be assumed to hold in a model of this size.

For the growth equation, we choose a specification commonly accepted in the cross-country growth literature (see for instance, Barro (1991) and Barro (1996)). It is derived from an augmented Solow model, with initial income and the set of channel variables as regressors.[21] In the neoclassical growth framework these variables can affect the long-run steady state of the economy and, consequently, its transitional growth rate. In augmented

[20] See Appendix I for a complete description.

[21] When we turn to our empirical specification, we will allow some of the exogenous variables to appear in the growth regression. The current specification is equivalent to assuming that these variables only affect growth through the channel variables. The results are not sensitive to this assumption.

versions of this model, and in endogenous growth models, these variables may also affect long-run growth rates. This common specification of the growth regression allows comparability of our results with the previous literature.

Turning to the channel equations, we relied, when possible, on existing empirical work. The specification of the human capital equation involved, among others, the inclusion of cultural variables (religion and ethnolinguistic fractionalization), income inequality and government size. For the inequality channel, we started from an "augmented" Kuznets-curve: the specification contains the log of initial income and its square, as well as several cultural variables and measures of country size. The openness equation involves mostly gravity variables, such as country size, the distance from major trading partners, and the country's area. The specification of the government size equation is based on Rodrik (1996), and the investment equation is close to that estimated by Barro and Sala-i-Martin (1995). For instability and distortions, we relied on reasonable priors for the inclusion of both endogenous and exogenous variables. The validity of these theoretical choices was checked using an empirical specification search, to which we now turn.

3.3.3 Empirical Specification Search

In the growth and channel equations, the estimated coefficient on the democracy index may be sensitive to the chosen specification, and in particular to the exclusion of several of the endogenous or exogenous variables. The sets of included and excluded variables also determine the extent of overidentification for each equation. To obtain an empirical specification, we used the identifying information inherent in the exclusion of all leads and lags of the exogenous variables from every equation.

The exclusion of leads and lags of exogenous variables ensures that the number of excluded instruments exceeds the number of included endogenous regressors, even when all contemporary exogenous and endogenous regressors are included in every channel equation.[22] We used this identifying information in the first stage of our systematic specification search: the full system, with all contemporaneous variables on the right hand side, was estimated

[22] As a variant of this procedure, we also report results based on excluding all of the channel variables for every channel equation. The procedure then amounted to choosing the set of excluded *exogenous* variables for each equation. This modification had little impact on the estimates of the channel effects.

using 3SLS. At this stage, the number of overidentifying restrictions is limited and the operative instruments are weak, so there is much to be gained by simplifying the specifications. Hence we removed all the variables with coefficients that were insignificantly different from zero at the 95 percent confidence level. A total of 86 variables were thus removed from our 8 structural relationships. We were left with a subset of the original variables, which included both endogenous and exogenous regressors.

The criteria for excluding variables from the various equations is based on tests for the individual significance of each coefficient. To check whether the exclusion of these variables is legitimate, in the sense that the excluded variables are *jointly* insignificant, we can compute a joint test for the exclusion restrictions of the whole system. These *quasi-likelihood ratio* tests are based on the difference between the value of the minimum distance criterion in the null or restricted model and in the initial model.[23] The QLR statistic is asymptotically chi-squared with degrees of freedom equal to the number of excluded variables. Testing the validity of all the exclusions jointly, we find that the QLR statistic is equal to 21.97. The 95% critical value for the chi-squared distribution with 86 degrees of freedom is equal to 112.02, so we fail to reject the null hypothesis that the excluded variables are jointly insignificant at a very high level of significance, and conclude that their exclusion was indeed justified statistically.

Most of the determinants of the channels that survived the specification search make sense. In fact, there was a significant overlap between the retained theoretical and empirical specifications. 64% of the variables appearing in the theoretical specification also appeared as a result of the systematic specification search.

4 Analysis of the Channel Effects

4.1 Overview of the data

This section describes the nature and broad characteristics of the data used in this paper. The time period under study is 1970-89 and the data refers to a diverse cross-section of 57 countries.[24] Most of the variables, including growth and the democracy index, enter

[23] See Gallant and Jorgenson (1979).

[24] A complete description of the data, including sources and definitions, is provided in Appendix I. Appendix II lists the countries included in this study. The sample is smaller than is usually the case in cross-country

as five-year averages, which limits the potential for measurement error and business cycle effects driving our results. In fact, our panel consists of four time periods corresponding to five year intervals. The democracy index is a continuous variable ranging from 0 (full autocracy) to 1 (country with fully developed democratic institutions). It is constructed on the basis of a yearly survey that evaluates political institutions in each country according to how it fares on 9 criteria, related with the freedom to elect representatives and the existence of a meaningful opposition.[25]

In the period under study countries became on average more democratic, with the mean level of democracy changing from 0.59 in 1970-74, to 0.72 in 1985-89. Furthermore, democracy is highly persistent over time: the first-order autocorrelation of its five-year average is always greater than 0.85. In contrast, growth has fluctuated between 3.65 (1970-74) and 0.32 (1980-84) percentage points and the first order autocorrelation of its five-year average was never greater than 0.43. Hence, economic growth displays much more variability over time than the index measuring democracy. The correlation between democracy and growth is always very low and varies from -0.10 in the 1970-74 period to 0.20 in the 1985-89 period. Based on these unconditional correlations, it is not surprising that past studies uncovered no significant relationship between the two variables.

Table I contains summary statistics for the main variables in this study; these may help to interpret the coefficient estimates by providing the scale of the relevant variables. The first column of Table II correlates growth with all the endogenous variables. The sign of these correlations is consistent with our priors. Public consumption and the black market premium show particularly strong negative correlations with growth. The second column contains the correlations between democracy and the various channel variables, which are all relatively high. The signs of the correlations are as expected, with the possible exceptions of public consumption, which is negatively correlated with the democracy index. We interpret these relatively high simple correlations as supporting our choice of channels and our empirical approach. Looking at the democracy-channel and channel-growth correlations together (columns 1 and 2), we can gain some insights into the direction of the

growth studies because the estimation procedure required a large set of variables - many of which are available for a restricted set of countries only. In particular, the income inequality data constrained our sample quite considerably.

[25]See Freedom House (1972-1990).

channel effects. So, for instance, democracy is associated with higher levels of educational attainment and education correlates positively with growth, so that democracy seems to work positively for growth through human capital. In fact, taken at face value, the simple correlations suggest that democracy works for growth through *every single channel*. Of course, we need to control for other determinants of the endogenous variables. Indeed, the picture is quite different when we turn to conditional statements.

4.2 How Democracy Affects Growth

Appendix III (Table VII) contains the 3SLS estimates for the whole system, from which our base specification can be inferred. Table III summarizes our results for the channel effects of democracy on growth, as well as test statistics corresponding to the relevant non-linear functions of estimated parameters. For example, the product of the coefficient of democracy in the political instability equation and the coefficient of political instability in the growth equation provides the effect of democracy on growth via political instability. We are able to precisely quantify the magnitude of all the partial effects and test their statistical significance. The standard errors on the products of coefficients are calculated by a linear approximation around the estimated parameter values, using the formula for the variance of linear function of random variables to calculate the corresponding standard errors.

The first column of Table III contains the coefficients for democracy taken from the seven different channel equations in the system. These estimates provide evidence that a higher level of democracy leads to significantly higher education attainment, lower investment rates, a smaller degree of openness to trade and lower income inequality. On the other hand, democracy levels seem to bear no statistically significant relationship to political instability, distortions and government consumption.

The second column presents the estimated coefficients on the channel variables for the growth equation in the benchmark model. Results are in the spirit of past findings of the cross-country growth literature (see for instance, Barro, 1991). Growth is positively affected by educational attainment and the investment rate, while it is negatively affected by government consumption, income inequality, distortions and political instability. Trade shares, while positively related to growth, enter with a coefficient which is significant only

at the 92% confidence level.[26] In sum, results for the growth equation are very consistent with previous empirical work, and make us confident that the system will deliver sensible results overall.

The third column contains the product of the effects of democracy on the channel (column 2) with the effects of the channel on growth (column 1). The combined effect suggests that democracy significantly fosters growth by improving educational opportunities and decreasing income inequality. But democracy also entails costs to growth by lowering rates of physical capital investment, and, less significantly, by reducing the degree of trade openness. The largest effect by far is through the investment channel: the estimates suggest that a change from 0 to 1 in the democracy index is associated with a 0.87 reduction in the yearly growth rate of per capita GDP *through investment alone.*[27] Political instability, government consumption and distortions do not appear to be important channels.[28] This is not because they do not impact growth, but rather because the level of democracy does not affect them significantly. Overall, a shift from 0 to 1 in the democracy index, which is a large shift relative to the cross-sectional standard deviation of the democracy index (roughly 0.3), leads to a 0.49 percent decrease in the yearly growth rate, but this estimate is only significantly different from zero at the 88% confidence level.[29] Hence, we conclude that, in accordance with many existing studies, the overall effect of democracy is negative, small economically and not very significant statistically.

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[26]This result consistent with Levine and Renelt (1992). They could not reject the hypothesis that trade openness affects growth only through its effect on rates of physical capital accumulation.

[27]Helliwell (1994) also estimated the effect of democracy on physical capital accumulation, but found instead a positive and significant coefficient. Helliwell's estimate probably captured the positive simple correlation reported in our Table II: he only controlled for initial income in his investment equation, whereas we control for a wider set of variables.

[28]This is consistent with Perotti (1996). In his study of income inequality and growth, he found that democracy does not significantly affect fiscal variables or political instability.

[29]We also report a Wald test for the nonlinear hypothesis that the sum of the individual channel effects (themselves the products of coefficients in the channel and growth equations) is insignificantly different from zero. This produces the same p-value as the t-test reported in the text.

4.3 Sensitivity Analysis

Our base model may be sensitive to several specification choices. We examine the sensitivity of our results to several possible modifications of the benchmark model: first, we examine the sensitivity of the base estimates to several specification and estimation choices: region and time specific effects, the inclusion of initial income in the channel equations, and the estimation method. Second, we examine whether the exclusion of certain groups of countries affects the overall estimates. Lastly, we report estimates based on the results of the empirical specification search described in Section 3.3.3.

4.3.1 Sensitivity to Specification Choices and Estimation Method

Table IV presents several modifications of the base specification. The third column presents channel effects of democracy on growth, as well as the overall effect, when the intercepts of each relationship are allowed to vary across time periods. This is equivalent to allowing for time specific effects. Results are very robust to this change; the only differences lie in the fact that the trade openness channel becomes more significant, and that the magnitude of the investment effect is somewhat reduced. As a consequence, the overall effect of democracy is closer to zero.

In the fourth column of Table IV, we add regional dummies to this specification. The effect of time-invariant country-specific characteristics, not accounted for by our random effects estimation approach, may be driving some of the results. If such effects are correlated with determinants of the channel variables, their omission from the benchmark regression may result in a bias in the democracy coefficient. We try to account for regional fixed effects by including regional dummy variables in every channel equation. Specifically, we included dummy variables for OECD members, Latin America, East Asia, and Sub-Saharan Africa. We expect a reduction in the estimated effect of the democracy index on the channel variables: the inclusion of regional dummies is akin to disregarding some of the between-country variation in the determinants of the channels, which may drive much of their partial covariation with democracy. Indeed, this is generally the case, as the human capital effect is dampened and the inequality and trade openness effects disappear. However, most of the signs are preserved. The investment effect, although dampened as well, is still negative and statistically significant.

The benchmark specification includes per capita income as a control variable for every channel equation. Since the democracy index and the income level are very highly correlated, it may be difficult to interpret the effects of democracy on growth. In particular, until countries with high levels of democracy and low levels of income per capita can be included in the sample, the effects of democracy on the channel variables will be hard to disentangle from the effects of income levels. To evaluate the magnitude of this problem, we excluded income per capita from every channel regression (column 5). This is done for illustrative purposes only: we expect this exclusion to lead to an increase in the overall effect of democracy on growth, as the democracy index will capture much of the effect previously attributed to income. Indeed, the overall effect of democracy becomes positive and significant. However, this is almost entirely due to a reversal of the government consumption channel, which now becomes positive and significant. All of the other signs and magnitudes are preserved, in particular the human capital and physical investment channels, thus reinforcing our confidence in the benchmark estimates.

Lastly, we examine the sensitivity of our results to the estimation method by running the model without instrumenting for the endogenous variables. Admittedly, this should lead to inconsistent estimates, but may provide a further robustness check. In particular, the human capital effect is much reduced when using SUR. This must be due to the fact that reverse causation is likely to be very prevalent in the human capital - democracy relationship, as argued in Section 2. All of the other effects are roughly preserved compared to the base model.

4.3.2 Sensitivity to the Geographic Coverage

Table V focuses on the sensitivity of our base estimates to the sample under consideration. In order to examine this issue, we sequentially excluded subsamples corresponding to Latin America, the OECD, South-East Asia and Sub-Saharan Africa, and reestimated the system. The loss of degrees of freedom, as expected, translates into generally larger standard errors. However, the channel effects are remarkably robust. In particular, the positive effect through human capital and the negative effect through investment are preserved in all cases, with the exception of the sample that excludes Latin America.

The presence of a large number of industrial countries in our sample could be a driving

force behind the results. Focusing on less-developed countries is of greater interest from the viewpoint of policy, since these are precisely the countries where the economic effects of democratic institutions are most debated, and where changes in the nature of institutions are more widespread. Excluding OECD members from our sample (column 6), we find that the channel effects of democracy on growth, as well as the overall effect, are unchanged. In conclusion, the main results do not seem greatly affected by the extent of the geographic coverage.

4.3.3 Empirical Specification Search

Lastly, we present results based on an empirical specification search, as described in Section 3.3.3. Columns 3 and 4 of Table VI present estimates at each stage of the search: in the first iteration, all of the contemporaneous exogenous and endogenous variables appear on the right-hand side of each equation, and the only identifying restrictions are provided by the exclusions of leads and lags of the exogenous variables (all of which appear as part of the instrument list). As a consequence, the number of parameters to be estimated is very large, and we do not take advantage of much potential identifying information. In spite of this, the signs of the important channel effects, namely human capital and investment, are robust. When the insignificant variables are excluded from this specification (column 4), we revert to the major results uncovered using the theoretical specification: a positive human capital effect and a negative investment effect, leading to a moderately negative overall effect. However, the inequality and trade openness effects disappear, casting doubts on their robustness.[30] By and large, the choice of our benchmark specification did not seem to affect the most robust channels or the overall effect of democracy on economic growth.

5 Conclusion

This paper employs a new empirical methodology to investigate the impact of democracy on economic growth. By estimating a joint system of equations in which democracy is allowed to influence a number of growth determining variables, we are able to perform precise

[30]The last two columns of Table VI repeat this exercise, but excluding all of the channel variables from the right hand sides of the channel equations. The results are unaffected by this alternative procedure to determine the specification.

inference concerning the channels of influence from democracy to growth. There are three benefits from this approach. First, as argued above, indirect links between democracy and growth follow clearly from the literature, whereas a direct effect of democracy on growth is not theoretically well grounded. Second, if a particular causation channel is dismissed as irrelevant, we can determine precisely which link in the channel breaks down. Lastly, we quantify the magnitude of the various effects to uncover which characteristics of democracy are most important for growth. This may help design democratic institutions that maximize the benefits of democracy while minimizing its costs.

We find that the overall effect of democracy on growth is weakly negative, confirming results from previous studies. However, our methodology allows us to describe *why* this is the case: democracy increases human capital accumulation and decreases physical investment rates. These channels are robust to various changes in specification, estimation method and geographic coverage. Weaker effects also operate through income inequality (positively) and through trade openness (negatively), although these channels were not robust to certain changes in the specification of the model. Finally, we uncovered no evidence that democracy impacts growth through government-induced distortions, political instability or government consumption.

A possible interpretation of our results is that democratic institutions are responsive to the demands of the less well-off by increasing access to education and lowering income inequality, but do so at the expense of physical capital accumulation. The latter effect dominates, but higher human capital and a more equitable society are valued in themselves beyond their impact on income levels. This supports the view that democracy may entail a trade-off between measurable economic costs and social benefits which are harder to evaluate.

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Appendix I - Data Description

Growth. *Description*: Growth rate of Purchasing Power Parity (PPP) adjusted Real Gross Domestic Product per capita. *Source*: Summers and Heston (1991). *Unit*: Percent points.

Democracy. *Description*: Index measuring the extent of democracy in a particular country. *Source*: Bollen (1980, 1990) for 1965; Freedom House (1972-1990) for 1972-89. *Unit*: 0 (autocracy) to 1 (democracy). See the Freedom House publications for a detailed description of the index (also known as the Gastil Index).

Log Income per capita. *Description*: Real Gross Domestic Product per capita, PPP adjusted. *Source*: Summers and Heston (1991). *Unit*: Log of per capita GDP in 1985 dollars.

Human Capital. *Description*: Average years of secondary and higher education in the population over age 25. *Source*: Barro and Lee (1993). *Unit*: Years.

Income Inequality. *Description*: Gini coefficient. *Source*: Deninger and Squire (1995). *Unit*: Percent points.

Trade Openness. *Description*: Share of imports plus exports to GDP. *Source*: Summers and Heston (1991). *Unit*: Percent points.

Political Instability. *Description*: Number of revolutions and coups per year. *Source*: Barro and Lee (1993). *Unit*: Number of revolutions and coups.

Black Market Premium. *Description*: Difference between black market exchange rate and official exchange rate, divided by the official rate. *Source*: World Currency Yearbook. *Unit*: Percent points.

Public Consumption. *Description*: Share of government consumption of goods and services in GDP, excluding transfers and public investment. *Source*: Summers and Heston (1991). *Units*: Percent points.

Investment Rate. *Description*: Rate of physical capital investment. *Source*: Summers and Heston (1991). *Unit*: Percent points.

Muslim. *Description*: Takes value 1 if majoritarian religion is Muslim. *Source*: Encyclopedia Britannica. *Unit*: Dummy variables taking the values 0 or 1.

Catholic. *Description*: Takes value 1 where majoritarian religion is Catholicism. *Source*: Encyclopedia Britannica. *Unit*: Dummy variable.

Other Christian. *Description*: Takes value 1 where majoritarian religion is Christian, but not Catholicism. *Source*: Encyclopedia Britannica. *Unit*: Dummy variables taking the values 0 or 1.

Confucian *Description*: Takes value 1 where majoritarian religion is Buddhism, Xintoism, Confucianism, etc... (excludes Hindu). *Source*: Encyclopedia Britannica. *Unit*: Dummy variables taking the values 0 or 1.

War Casualties. *Description*: War casualties per capita. *Source*: Barro and Lee (1993). *Unit*: Ratio.

Ever a colony. *Description*: Takes value 1 if the country was ever a colony since 1776. *Source*: Barro and Lee (1993). *Unit*: Dummy Variable.

Postwar Independence. *Description:* Takes value 1 if country gained independence after the Second World War. *Source:* Barro and Lee (1993). *Unit:* Dummy variable.

Terms of Trade Shocks. *Description:* Growth rate of export prices minus growth rate of import prices. *Source:* World Bank IEC data. *Unit:* Percent points.

Oil Exporter. *Description:* Takes value 1 if country is oil exporter. *Source:* Barro and Lee (1993). *Unit:* Dummy variable.

Log Area. *Description:* Area. *Source:* Barro and Lee (1993). *Unit:* Logarithm of area in square kilometers.

Log Distance. *Description:* Average distance to the capitals to the world's 20 major exporters, weighted by the volume of bilateral imports. *Source:* Barro and Lee (1993). *Unit:* Thousands of kilometers.

Landlock. *Description:* Takes value 1 if country has no coastline. *Source:* Central Intelligence Agency World Fact Book (1996). *Unit:* Dummy variable.

Population under 15. *Description:* Percent of population 15 and under. *Source:* Barro and Lee (1993). *Unit:* Percentage points.

Population over 65. *Description:* Percent of population 65 and over. *Source:* Barro and Lee (1993). *Unit:* Percentage points.

Ethnolinguistic fractionalization. *Description:* Probability that two randomly selected persons from a given country will not belong to the same ethnolinguistic group. *Source:* Mauro (1995). *Unit:* Probability.

Appendix II - List of Countries for the Base Specification

Asia	Africa	Latin America	Industrialized Countries
India	Benin	Argentina	Austria
Pakistan	Kenya	Barbados	Belgium
Sri Lanka	Malawi	Bolivia	Canada
Indonesia	Senegal	Brazil	Denmark
Korea	Sierra Leone	Chile	Finland
Malaysia	Sudan	Colombia	France
Philippines	Tanzania	Costa Rica	Germany, West
Singapore	Uganda	Ecuador	Greece
Thailand	Zambia	El Salvador	Ireland
Taiwan	Zimbabwe	Guyana	Italy
Turkey	Tunisia	Jamaica	Japan
		Mexico	Netherlands
		Peru	New Zealand
		Trinidad/Tobago	Norway
		Uruguay	Portugal
		Venezuela	Spain
			Sweden
			United Kingdom
			U.S.A

(57 observations)

Table I - Summary Statistics for the Main Variables of Interest (1970-89 averages)

	Mean	Std. Dev.	Minimum	Maximum
Growth	2.057	1.960	-1.477	7.513
Democracy	0.643	0.307	0.000	1.000
Log Initial Income	8.121	0.966	6.154	9.586
Investment Rate (% GDP)	19.219	7.499	1.320	36.135
Human Capital	1.438	1.138	0.070	5.348
Gini Coefficient	41.664	9.697	25.100	63.150
Political Instability	0.159	0.254	0.000	1.100
Black Market Premium	35.161	61.739	-0.471	364.704
Trade Share (%GDP)	61.206	45.024	13.686	325.607
Government Consumption (%GDP)	15.840	6.281	7.831	33.962

Number of Observations: 57

Table II - Correlation Matrix for the Main Variables of Interest (1970-89 averages)

	Growth	Democracy	Log income	Investment	Human capital	Gini coef.	Polit. Instab	BMP	Openness
Democracy	0.108	1.000							
Log income	0.241	0.812	1.000						
Investment	0.550	0.506	0.687	1.000					
Human Cap.	0.225	0.667	0.751	0.483	1.000				
Gini Coef.	-0.366	-0.520	-0.534	-0.403	-0.532	1.000			
Pol. Instab.	-0.192	-0.319	-0.359	-0.340	-0.254	0.135	1.000		
BMP	-0.454	-0.445	-0.523	-0.496	-0.401	0.288	0.314	1.000	
Openness	0.333	0.033	0.137	0.319	0.068	-0.068	-0.252	-0.128	1.000
Gov. Cons.	-0.459	-0.520	-0.596	-0.475	-0.389	0.305	0.130	0.558	-0.007

Number of Observations: 57

Table III - How Democracy Affects Growth
(Base specification)

	Effect of democracy on the channel	Effect of the channel on growth	Effect of democracy on growth
Human Capital	0.636 (5.69)	0.448 (3.26)	0.285 (2.87)
Income Inequality	-7.834 (-5.81)	-0.052 (-4.24)	0.409 (3.55)
Political Instability	-0.076 (-1.27)	-0.731 (-2.27)	0.056 (1.21)
Distortions	3.471 (0.29)	-0.006 (-8.31)	-0.022 (-0.29)
Trade Openness	-40.497 (-8.38)	0.004 (1.73)	-0.156 (-1.79)
Govt. Consumption	1.205 (1.37)	-0.160 (-8.32)	-0.193 (-1.37)
Investment Rate	-3.548 (-3.50)	0.245 (15.28)	-0.871 (-3.60)
Total Effect			-0.491 (-1.56)
Wald test			2.425
p-value ($\chi^2(1)$)			0.119
# of Obs			57

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table IV - Sensitivity of the Base Estimates to Specification

	Base Model	Time Specific Intercepts	Time and region effects	Excluding initial Income	Base Spec. SUR estim.
Human Capital	0.285 (2.87)	0.255 (2.87)	0.063 (1.91)	0.590 (2.67)	0.085 (2.05)
Income Inequality	0.409 (3.55)	0.406 (3.40)	-0.006 (-0.13)	0.304 (3.14)	0.137 (2.39)
Political Instability	0.056 (1.21)	0.080 (1.54)	0.181 (2.14)	0.132 (1.97)	0.079 (2.03)
Distortions	-0.022 (-0.29)	-0.016 (-0.21)	-0.014 (-0.25)	-0.005 (-0.08)	-0.044 (-0.60)
Trade Openness	-0.156 (-1.79)	-0.207 (-2.52)	-0.064 (-1.54)	-0.059 (-1.70)	-0.121 (-2.30)
Government Consumption	-0.193 (-1.37)	-0.060 (-0.46)	-0.130 (-1.60)	0.406 (2.41)	0.088 (0.95)
Investment Rate	-0.871 (-3.60)	-0.552 (-2.42)	-0.442 (-3.24)	-0.455 (-1.73)	-0.453 (-2.84)
Total effect	-0.491 (-1.56)	-0.095 (-0.32)	-0.412 (-2.19)	0.913 (2.51)	-0.228 (-1.05)
Wald test	2.425	0.105	4.810	6.320	1.098
p-value ($\chi^2(1)$)	0.119	0.746	0.028	0.012	0.295
# of Obs	57	57	57	57	57

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table V - Sensitivity to Geographic Coverage

	Base Model	Excl. South East Asia	Excl. Sub-Saharan Africa	Excl. Lat. America	Excl. the OECD
Human Capital	0.285	0.134	0.199	-0.004	0.125
	(2.87)	(1.83)	(3.59)	(-0.18)	(2.43)
Income Inequality	0.409	0.271	0.130	-0.058	0.069
	(3.55)	(3.76)	(1.73)	(-1.45)	(1.44)
Political Instability	0.056	0.067	0.104	-0.001	0.116
	(1.21)	(1.33)	(2.03)	(-0.04)	(2.45)
Distortions	-0.022	-0.071	-0.031	0.016	-0.062
	(-0.29)	(-1.20)	(-0.34)	(0.58)	(-1.40)
Trade Openness	-0.156	0.009	-0.207	-0.107	-0.071
	(-1.79)	(0.53)	(-3.26)	(-2.59)	(-1.32)
Government Consumption	-0.193	0.247	-0.167	-0.004	0.196
	(-1.37)	(2.62)	(-2.70)	(-0.06)	(1.97)
Investment Rate	-0.871	-0.424	-0.686	-0.128	-0.723
	(-3.60)	(-2.11)	(-4.16)	(-1.07)	(-5.56)
Total Effect	-0.491	0.233	-0.656	-0.285	-0.351
	(-1.56)	(1.05)	(-3.22)	(-1.69)	(-1.80)
Wald test	2.425	1.098	10.363	2.854	3.236
p-value ($\chi^2(1)$)	0.119	0.295	0.001	0.091	0.072
# of Obs	57	50	47	41	37

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table VI - Systematic Specification Search

	Base Model	All endog Iteration #1	All Endog Iteration #2	No Endog Iteration #1	No Endog Iteration #2
Human Capital	0.285	0.367	0.387	0.467	0.411
	(2.87)	(3.60)	(3.71)	(4.19)	(3.98)
Income Inequality	0.409	-0.038	-0.046	-0.151	-0.019
	(3.55)	(-0.70)	(-0.81)	(-1.61)	(-0.47)
Political Instability	0.056	0.139	0.098	0.167	0.067
	(1.21)	(1.29)	(1.12)	(1.20)	(1.25)
Distortions	-0.022	-0.015	-0.011	-0.132	-0.067
	(-0.29)	(-0.34)	(-0.28)	(-2.38)	(-1.51)
Trade Openness	-0.156	0.095	0.078	0.145	0.159
	(-1.79)	(1.26)	(1.21)	(1.27)	(1.72)
Government Consumption	-0.193	-0.165	-0.175	-0.177	-0.310
	(-1.37)	(-1.01)	(-1.21)	(-0.98)	(-1.79)
Investment Rate	-0.871	-0.279	-1.071	-1.105	-0.947
	(-3.60)	(-0.95)	(-4.16)	(-4.04)	(-3.71)
Total Effect	-0.491	0.104	-0.740	-0.785	-0.706
	(-1.56)	(0.37)	(-2.86)	(-1.99)	(-1.86)
Wald test	2.425	0.136	8.156	3.971	3.454
p-value ($\chi^2(1)$)	0.119	0.712	0.004	0.046	0.063
# of Obs	57	57	57	57	57

(t-statistics based on heteroskedastic-consistent (White-Robust) standard errors, in parentheses)

Table VII - Base Specification

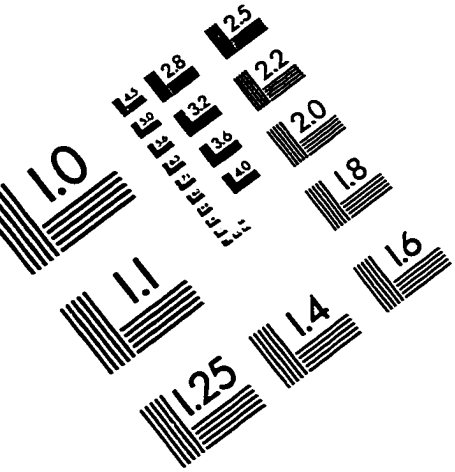
	Growth	Human Capital	Inequality	Instability	Distorsions	Openness	Govt. Consum	Investment
Intercept	20.778	-7.049	-76.807	0.873	19.483	-52.867	58.288	-14.684
	(10.58)	(-8.63)	(-1.54)	(2.37)	(0.34)	(-1.44)	(7.71)	(-1.54)
Democracy	-	0.636	-7.834	-0.076	3.471	-40.497	1.205	-3.548
		(5.69)	(-5.81)	(-1.27)	(0.29)	(-8.38)	(1.37)	(-3.50)
Log Initial	-2.374	0.935	24.946	-0.071	-11.598	23.841	-4.580	3.792
Income	(-10.71)	(10.40)	(2.06)	(-2.18)	(-1.79)	(6.45)	(-6.83)	(6.65)
Log Initial	-	-	-1.441	-	-	-	-	-
Income Sq.			(-1.92)					
Human	0.448	-	-0.483	-	-2.067	-	-	-0.590
Capital	(3.26)		(-0.65)		(-0.54)			(-1.81)
Gini	-0.052	-0.015	-	-0.001	-	-	0.166	-
Coefficient	(-4.24)	(-5.10)		(-0.62)			(6.07)	
Political	-0.731	-	-	-	27.429	-	-1.347	-2.492
Instability	(-2.27)				(2.66)		(-2.42)	(-4.89)
Black Market	-0.006	-	-	-	-	-	0.010	-0.009
Premium	(-8.31)						(9.01)	(-6.92)
Trade	0.004	-0.002	-0.030	-	-0.251	-	-0.004	0.030
Openness	(1.73)	(-1.60)	(-1.87)		(-2.97)		(-0.62)	(3.90)
Government	-0.160	0.013	0.584	-0.006	3.520	0.676	-	-0.063
Consumption	(-8.32)	(2.09)	(7.31)	(-1.64)	(6.37)	(3.06)		(-1.38)
Investment	0.245	-	-	-	-	-	-	-
Rate	(15.28)							
Muslim Dummy	-	0.371	1.435	-	6.575	-	-	-
		(2.62)	(0.46)		(0.54)			
Confucian	-	1.031	0.680	-	46.366	-	-	5.986
Dummy		(4.87)	(0.21)		(3.08)			(3.70)
Ever a Colony	-	0.395	1.917	0.011	19.082	-	-2.770	-
Dummy		(2.48)	(0.71)	(0.24)	(2.53)		(-2.70)	
War Casualties	-	-	-345.299	33.138		-	-	-
			(-5.51)	(5.24)				
Catholic	-	0.206	7.425	-	65.651	-	-	-
Dummy		(1.42)	(3.33)		(5.08)			

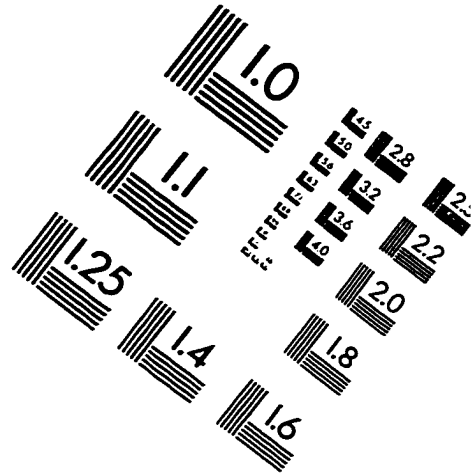
Table VII (continued) - Base Specification

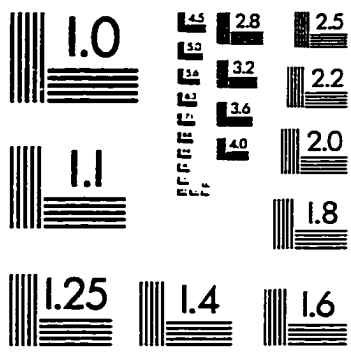
	Growth	Human Capital	Inequal-lity	Insta-bility	Distor tions	Open-ness	Govt. Consum	Invest-ment
Other Christians Dummy	-	0.674 (3.48)	5.980 (2.76)	-	55.698 (4.74)	-	-	-
Ethnolinguistic Fractionalization	-	0.009 (2.64)	-0.075 (-2.69)	0.001 (0.83)	-0.138 (-1.27)	-	0.057 (4.35)	-0.034 (-2.69)
Postwar Independence	-	-	-	-0.114 (-1.71)	17.328 (1.77)	24.025 (3.66)	0.080 (0.09)	-
Log Population	-	-	0.182 (0.31)	0.005 (0.32)	-	-0.560 (-0.27)	-1.203 (-6.01)	0.955 (2.97)
Population Over 65	-	-	-62.013 (-1.79)	-	-	-	23.210 (1.52)	10.210 (0.56)
Log Area	-	-	-	-	-	-12.191 (-5.26)	-	-
Log Distance	-	-	-	-	-	-2.522 (-0.38)	-	-
Terms of Trade Shocks	-	-	5.418 (1.42)	-	-	21.224 (2.41)	-4.539 (-2.42)	-10.770 (-4.64)
Population Under 15	-	-	26.236 (2.40)	-	-	-	-9.620 (-1.63)	-9.375 (-1.16)
Oil Exporter Dummy	-	-	-	-	-	10.796 (1.63)	-	-
Island Dummy	-	-	-	0.045 (0.97)	-	4.536 (0.72)	-	-
Landlocked Dummy	-	-	-	0.070 (0.75)	-	3.002 (0.60)	-	-
R^2	.35 .33 .47 .39	.58 .64 .66 .70	.45 .56 .63 .62	.15 .11 .39 .37	.35 .21 .48 .32	.57 .55 .55 .54	.35 .45 .58 .68	.48 .56 .63 .63

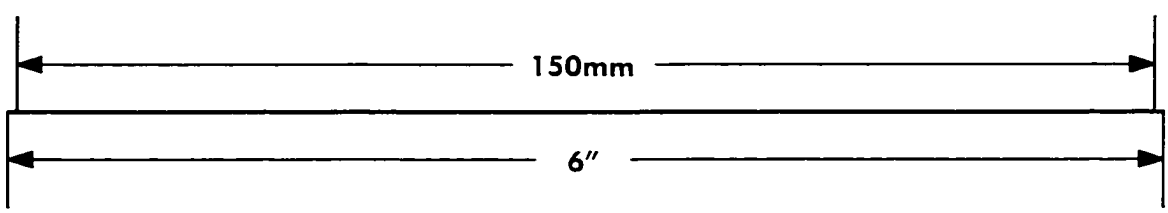
(t-statistics based on heteroscedastic-consistent (White-robust) standard errors, in parentheses)

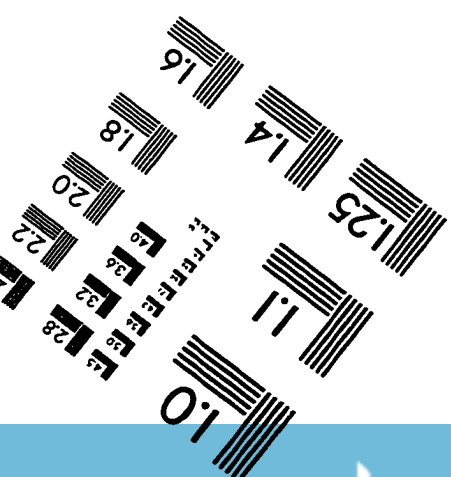
IMAGE EVALUATION
TEST TARGET (QA-3)

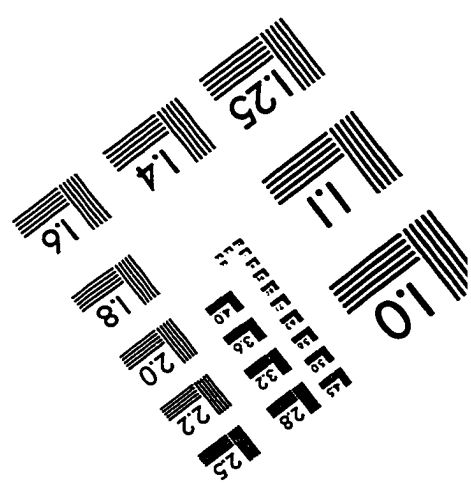












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