Trade Policy Instability Index:
The effect of trade policy instability on economic growth

By

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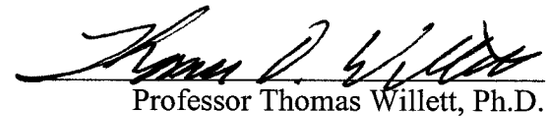

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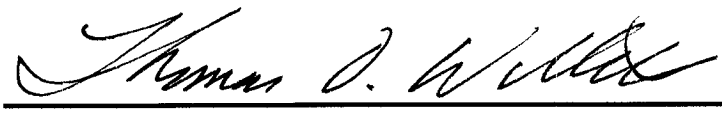

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Abstract

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Claremont Graduate University: 2005

This dissertation provides evidence on the effects of trade policy instability on economic growth. Numerous studies have evaluated trade reforms in developing countries; however, analysis of the effect of trade policy instability has been quite limited. This study argues that previous indicators offer only partial information on policy instability and develops a new Trade Policy Instability Index (TPI) as a more accurate measure. The TPI consists of three components: the commitment by the authorities to trade policy, the volatility, and consistency among trade policies. Results derived from a panel of 90 countries for the period 1970-2000 indicate that trade policy instability has a negative impact on growth. Extensive testing finds these results to be quite robust.

Dedication

To Cleo, Michelle, Sammy, and Biso with all my love

Acknowledgement

I would like to express my profound gratitude to the people that contributed to the realization of this work. I am confident that this dissertation would not be possible without the help and support of family, friends, professors, and organizations involved in my education. I want to thank Paul Zak, my professor, mentor, and a truly good friend. Thomas Willett, whom I admire for his exceptional cleverness, enormous collaboration, and brilliant observations to this dissertation. To Claudia, Julia, and Dino Metzler, a family that made me feel like another member of the family since the first day I met them. To my family who shared my aspirations and dreams, and to all my friends.

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Introduction

Trade policy reform has been an intensive area of study since the liberalization process was initiated by a large number of developing countries throughout the 1980's. During the early 1970's, market imperfections in the form of non-competitive environment were the justification for a massive wave of protectionist policies where "Import-Substitution" and the "Infant-Industry" approaches were the trademarks of the period (Prebisch, 1984). Unfortunately, a complex system of protectionism was drafted not only to shield the industrial sector, but also to attain revenues and patronage. After the 1982 debt crisis, most of the costs of protectionism were recognized and economic policy attitudes moved toward establishing market-oriented economies. These changes in the international trade strategy called for a new examination of trade policy and its effects on economic growth.

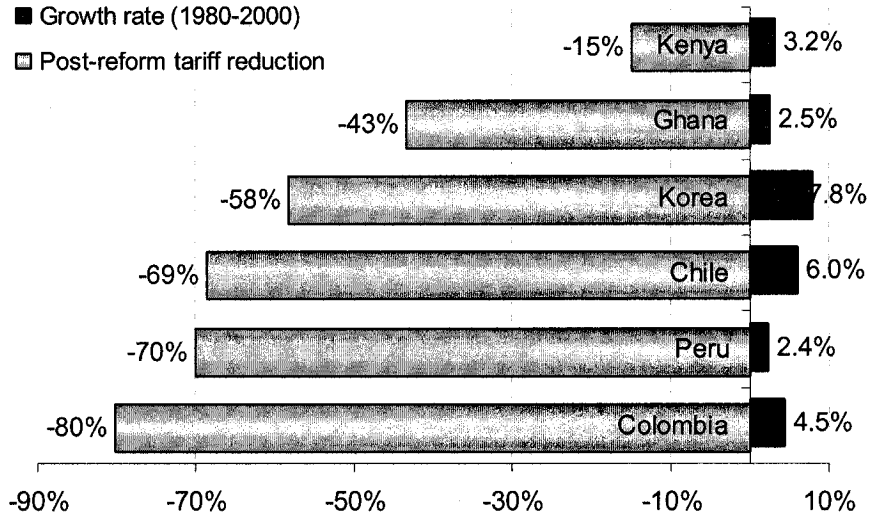
Krueger (1997), Edwards (1998), and Greenaway, Morgan, and Wright, (2002) have shown that countries perform better after trade reform. The argument is that liberalization policies reduce anti-export bias, which results in a better resource allocation. However, Rodriguez and Rodrik (1999) found no statistical relevance between several trade liberalization indicators and growth and Greenaway et al, (1997) obtained poor evidence on the relation between trade reform and economic performance

after studying openness episodes for several countries[1]. Research in this field is extensive and empirical results are still under debate. For instance, Figure 1 shows tariff rates for a selected number of countries during their period of liberalization. It is evident that trade reform has been highly effective for some economies but not for others. Chile and Peru reduced tariffs by 70 percent but average economic growth was 6 percent in Chile while only 2.4 percent in Peru. One important element in Chile's trade policy to be analyzed in Section 1 was the commitment by authorities in conducting the reform along with a consistency among trade and macro policies. Conversely, Peru underwent constant policy reversals, creating an environment of policy instability. This study expands on the concept of instability by addressing the following questions: how can trade policy instability be measured and what is the effect of such instability on economic growth? Rather than considering the merits of trade policy in a particular period, the analysis focuses on the stability of such policy and its effect on economic growth.

The announcement of a policy reform is often a sign of authorities' intention to move the economy in a new direction. Credibility of policy announcement becomes a key factor for economic agents to take actions in order to adjust to the new reform. Credibility refers to the public's belief that policy makers will carry out their plans. Such credibility influences expectations affecting macro variables such as interest and exchange rates and thereby output and employment.

[1] In terms of economic theory, the positive relationship between a less restricted economy and growth is also ambiguous. See Rodriguez and Rodrik (1999, p. 6-7).

Figure 1
Tariff Rates: Pre-reform and Post-Reform Vs Economic Growth [a]



[a] Source: Greenaway et al, (2002)

In developing countries, the announcement alone is insufficient for agents to redirect their economic actions since there is a lack of credibility of the policy stability. In these economies, there is a history of persistent reversals, policy inconsistencies, and failed reforms that makes credibility of present reforms almost nonexistent (Greenaway, 1998). Economic agents in these regions are concerned not only on the policy effects (losers and winners) but also on the stability of the policy when making economic decisions. For example, firms may be reluctant to commit to long-term investment when facing policy instability until new information confirms the continuity of such policy. The delay in investment decision could lead to suboptimal levels of output.

Rodrik (1991) developed a model where an economy faces two types of government: a liberalizing and a protectionist one. In order to access international resources (e.g. from the IMF or the WB) authorities must consent to terms related to trade reform; but if the

government is in favor of protection, reform might be reversed shortly after acquiring the resources. The model shows that individuals will not commit to long-term investment until more information confirms the intentions of the government. Suboptimal level of investment is a consequence of policy reversals. Generally, these Bayesian models assume that agents infer the "type" of government by observing past actions of policymakers or they track the record of the government's actions after a policy announcement (Engel and Hamilton, 1990; Kaminsky, 1993; Evans and Lewis, 1995).

In numerous developing countries, government's ability to maintain policies after their announcements has been a difficult task since persistent reversals and policy inconsistencies seem the norm (World Bank, 1989). In this environment, trade reform is insufficient information for agents to redirect their economic actions. Stability of the reform is also important. The literature recognizes three important factors of policy instability: The first factor is *volatility* or high movements in policy indicators, which raises the costs of investment and growth (Calvo, 1988; Dixit, 1989). It is well recognized that individuals prefer stable incomes over those showing some volatility even if they face the same expected return. The second factor is authorities' *commitment* to the policy, which depends on the internal state of affairs (e.g. internal crisis or external shocks), the power of interest groups that may force the authorities to reverse newly implemented policies, and the reliance on income generated by old policies. Fernandez and Rodrik (1998) constructed a model where imperfect information leads to ex-ante uncertainty on losers and winners, creating opposition to the reform. If strong interest groups run the opposition, the reversion of the trade policy is feasible and the commitment of authorities to the new reform is jeopardized. Finally, several papers have

analyzed the importance of policy *consistency* referring to the policies that are mutually compatible and are more likely to be stable than policies working in opposite directions. For instance, authorities may reduce tariffs in an effort to cut distortions, but if high deviation between official and real exchange rates remains, lower tariffs may be ineffective at reducing price distortions. Further investigation of these three factors shows that they account for a better measure of trade policy instability than previous indicators.

With the notion of stability, empirical analysis faces two important challenges in deriving a methodology for testing the relationship between policy stability and economic growth. One is the measurement of *trade policy instability,* a concept employed, though not to its full potential, in several previous studies[2]. The other challenge is the application of a framework that allows one to capture economic responses due to expectations of policy instability.

Different approaches for measuring trade policy instability are presented in the following sections, and after a comprehensive comparative analysis, the construction of an *Index* surfaced as most appealing for the purpose of this work.

Once trade policy stability is defined and quantified, a *Trade Policy Instability Index (TPI)* is constructed. The TPI enters as an independent variable in a growth model where the test on the relationship between trade policy instability and economic performance is investigated. The model predicts that countries with higher policy instability experience lower growth rates. It also predicts that the positive effect of lower tariffs on growth is enhanced if accompanied by lower trade policy instability simultaneously.

[2] Bleaney and Greenaway (2001) test the relationship between volatility of trade policy and growth. Rodrik (1998a) also test the volatility of trade policy against government consumption and income. However, as it is shown in the next sections, volatility is a limited indicator of trade policy instability.

Following Greenaway's work (1998) on panel data and dynamic models, a panel setting is applied. Panel construction allows for inter-country and inter-temporal variation, which permits a more accurate assessment of agent's responses due to changes in trade policy.

This dissertation finds robust evidence on the relationship between trade policy instability and economic growth. Agents respond to the stability of the policy in order to make economic decisions. The relationship is robust to the inclusion of different control variables and changes in methodology (e.g. the main results prevail with cross-sectional and panel data analysis). This dissertation extends to previous research by constructing a more accurate measure of trade policy instability and a more robust test of the effects of trade policy instability on growth.

The document is organized as follows: In order to construct the Trade Policy Instability Index, three steps must be completed in advance. First, the definition and the components of policy stability are developed in Section 1; second, the most adequate trade policy indicators must be selected and section 2 describes them in detail (e.g. tariff rates, quotas, black market premiums) and offers some preliminary evidence of the importance of trade policy on economic activity. The third step is to show that after analyzing different alternatives to compute trade policy instability the construction of the Index is the most appealing one. Section 3 presents the Index as the most suitable approach in measuring policy instability. Once definition, policies, and measures of trade policy instability are set in place, Section 4 depicts how these factors are combined into the Trade Policy Instability Index or TPI. In Section 5, a growth model specification is defined where a range of control variables and the TPI account for the independent

variables. In the model, the following hypothesis is examined: Does trade policy instability, measured through the TPI, negatively affect economic growth? Given the limitations of the construction of indexes described in Section 3 and the limitations on empirical growth models described in Section 4, it is crucial to test the robustness of the results. Section 6 reports the results and tests for robustness on these results. Finally, Section 8 concludes.

Section 1: Definition of Trade Policy Instability

The role of policy stability on economic development

The East Asian crisis and the subsequent spread of financial downturns among different regions in the world have brought the topic of trade and financial instability to the forefront. The emergence of theories along with empirical studies have altered the view on expectations, policy credibility, and policy stability, leading to a more dynamic approach on the topic of international economics (Easterly, Islam and Stiglitz, 2001).

The source of trade instability was a concern in the 1970s, when commodity price volatility was a major factor in defining trade policies in developing countries. During this period, persistent shocks in the current account caused trade policies to focus on reducing commodity export reliance. The financial crisis of the 1990's also brought attention to the sources of economic instability, leading theorists to debate between two trends of thought: is it external factors that drive the swings in agents' expectations or is it the lack of transparency and commitment to domestic policies? Arguments in favor of exogenous factors as the source of instability led to categorize most developing countries as "victims" at the mercy of international markets. However, recent studies have recognized that policymakers play an active role in affecting economic stability.

In order to shed new ideas into the analysis of the policy instability concept, this section describes three theoretical models of trade policy instability, identifies important sources of trade policy instability, and recognizes the constraints in terms of methodology and data availability in the empirical work.

During the last twenty years of trade liberalization in less developed economies, several international organizations have anticipated positive effects between trade

reforms and economic growth (OECD, 1998; IMF, 1997). However, this relationship has been difficult to confirm due to data availability and methodological limitations. Rodriguez and Rodrik, (1999) consider that previous indicators of trade liberalization represent poor measures of trade policy and argue that "simple measures of trade barriers tend not to enter significantly in well-specified growth regressions". Greenaway et al. (1997) analyzed different liberalization episodes and found no evidence of trade reform affecting growth. However, Krueger (1997) found evidence that economies with more open trade orientation grow faster. Sala-i-Martin (1997) showed that market distortions related to trade policy hinder economic growth; and Sachs and Warner (1995) concluded that trade policies deterring openness negatively affect aggregate income. The conclusion from these studies reveals weak evidence on the effect of trade policy on economic performance.

One study that may shed some light on the controversy of the link between trade policy and growth was presented by Dollar (1992). He constructed two trade policy indexes: the index of real exchange rate distortion (Index-1) and the index of real exchange rate variability (Index-2), where the later captures factors of volatility or changes in the exchange rate. In the econometric analysis between Index-1 and growth, he found various "anomalies" or countries that did not fit the model. However, when applying Index-2, the number of anomalies declined substantially. This may indicate that a stronger relationship exists between growth and trade policy instability rather than between growth and trade policy itself.

Among the most outstanding analytical representations of the effects of trade policy instability on macroeconomics are: Rodrik's (1991) liberalizing versus redistributive

government model, Calvo and Drazen (1997) model of intertemporal consumption, and the Fernandez and Rodrik (1998) interest groups model. All of them emphasize the relevance of policy uncertainty, agent's expectations, and instability of trade reform.

Rodrik (1991) formulates a model where economic agents are skeptical about the commitment of the government to a particular trade policy. In the model, individuals recognize the existence of two "types" of governments: liberalizing or redistributive. The former is in favor of trade liberalization and the latter in favor of protectionism; however, it is difficult to differentiate between both types. Rodrik presents the case of IMF agreements as an incentive for a redistributive-type to disguise as a liberalizing one. In order to access financial resources from the IMF, governments must consent on the terms and conditions related to trade reforms. Therefore, it is convenient for the authorities not to reveal their true type and act as a liberalizing-type. The model shows that individuals will not commit to long term economic actions until most of the uncertainty regarding the type of government is eliminated. If such uncertainty persists over time, a possible result is a private sector that may oppose the reform, invalidating any policy efficacy. Rodrik considers that "even moderate amounts of policy uncertainty can act as a tax on investment". The negative response from investment is a direct consequence of the uncertainty about trade policy stability.

Calvo and Drazen (1997) suggest that uncertainty about the permanence of a trade reform tends to generate distortions in consumption. In their model, authorities announce new trade policies with the intention of shifting resources. However, resource reallocation may never take place since economic agents modify their decisions based on the expectation on policy stability rather than policy announcement. The economy

presents a different path of consumption than the one characterized by the theory under perfect foresight of trade policy stability.

Finally, Fernandez and Rodrik (1998) developed a model based on the median-voter hypothesis, where uncertainty of losers and winners from a trade reform inhibits labor reallocation from the import to the export-oriented sector. Any proposal to remove trade barriers may be opposed by the importing sector and this opposition becomes more effective when agents observe a lack of commitment in the reform. These models explain the mechanisms by which there are limited supply-side responses when instability of trade policy is perceived.

Trade Policy Instability: Definition

Stability is a concept frequently applied in current growth models, where policy as well as political stability are deemed key factors in shaping growth (Feng, 2003); however, its interpretation and definition varies across studies. For instance, Ghate, Le and Zak (2003) use the concept of sociopolitical instability where violent and nonviolent actions taken by both government and agents are considered in the concept. The variables measuring government and agent actions are tax revenue, assassinations, and riots among others. Feng (2003) measures political instability by using a regression-base estimation to obtain a continuous variable of government changes. Some of the independent variables in his estimation are inflation, strikes, government crises, and anti-government demonstrations. These studies have focused on political stability.

Economic policy instability is generally measured via the observation of institutional changes or via the standard deviation of the policy indicator. Brunetti and Weder (1998)

review different empirical approaches to economic and political instability. Using a set of 60 countries and 24 variables applied in past empirical studies, they test the relationship between uncertainty and investment. Variables defined as economic "policy uncertainty" include the standard deviation of the black market premium, the standard deviation of inflation, and the standard deviation of the exchange rate. The result is that most of these instability indicators significantly affect investment. Ramey and Ramey (1995) estimate a measure of "government spending volatility" or standard deviation of government expenditure and provide evidence on the negative correlation between this measure and economic growth.

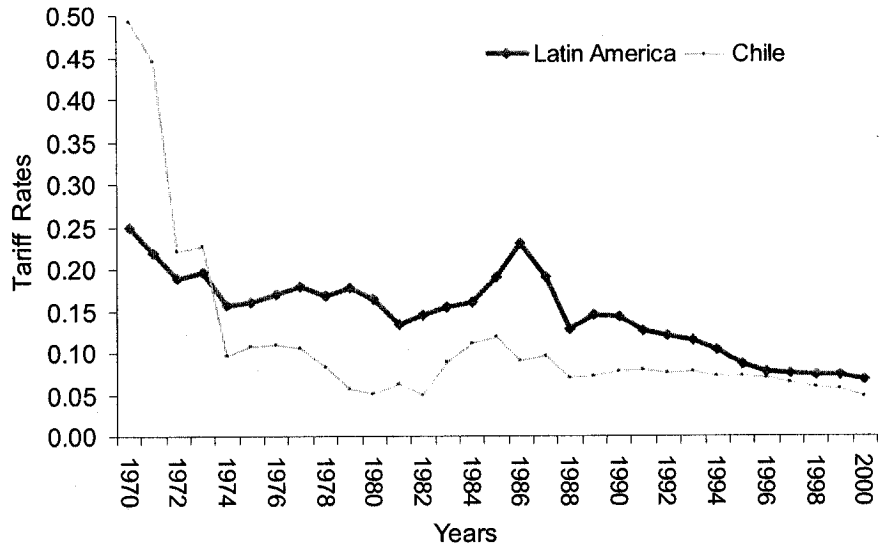
In general, *Policy Stability* is the government's ability and commitment to enduring policies. Policy stability will encourage long-term investment which promotes economic growth (Rodrik, 1991). Although most developing economies have pursued trade liberalization programs that are similar in terms of the policy combination –tariffs unification, decline in exchange rate black market activity, and cuts on non-tariff barriers–, they vary in the stability, commitment, and consistency of the reform process. The cases of Chile, Peru, and Ghana's trade strategy may clarify this difference.

Economic and Trade Reform of Chile

Chile's recipe for its remarkable economic performance is a combination of political and economic factors but also of policy "experiments". In 1975 Chile was one of the first Latin American countries that followed deep trade reforms, and it was not until ten years later that other neighboring countries pursued similar policies.

Before the reform, Chile's trade sector had a complex tariff system and a clear dependency on copper export (more than 80 percent of total exports). Multiple foreign exchange rates (fifteen official exchange rates) and confiscatory deposits on imports existed during this period (Pineres and Ferrantino, 1997). In 1970, Chile attempted a reform but with little effect on the exporting sector since a period of high inflation (monetary supply was expanded at triple-digit rates) forced the country to reverse most of the policies.

Figure 2
Chile' Tariff Rates (1970-2000)



In 1975 trade policy took a different direction. The government put into operation a massive devaluation, exchange rate reductions (the *tablita* system), tariff unification, and abolition of quotas, followed by a gradual reduction of money supply. The commitment and consistency of policies reduced inflation rate from 665 percent in 1975 to 25 percent in 1979 and moved resources to new exporting sectors, changing the dependency on copper to less than 50 percent in 1985. The reform was kept in place even after the 1982 debt crisis in Latin America. Figure 2 exhibits Chile's tariff rates of the last 30 years.

The country experienced higher than average tariff rate in Latin America previous to the liberalization (50 percent vs. 25 percent) with an average of 10 percent points lower than the region after the reform.

Peru's failed trade reform

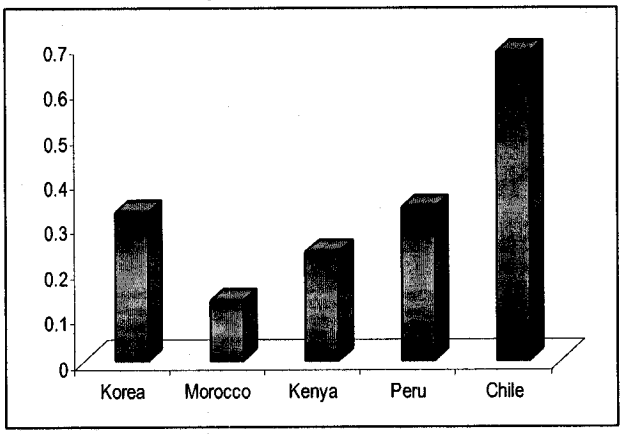
Peru's poor economic performance after reform can be partly explained by the persistent reversals in the trade policy. In 1990, Peru initiated its liberalization program by substituting the multiple exchange rate structure and eliminating obligations on exchange of US dollars to the Central Bank. Similar to most Latin American countries, Peru followed a deep reduction of the maximum tariff rates (from 84 percent in August 1990 to 10 percent in November of the same year), a cutback of all non-tariff barriers, privatization of state-owned companies, and the simplification of custom procedures; however, a year later it introduced "temporary" *ad valorem* surcharges on agricultural items. Peru entered the Andean Free Trade Area (AFTA) in 1989 agreeing upon common external tariffs; however, in 1992 Peru filed a temporary suspension of its obligations in the adoption on the tariff reduction program partially due to fiscal revenue dependency on tariffs (Gonzalez Vigil and Kuriyama, 2000). Peru returned to the AFTA program in 1994 but it did not meet all agreements until 1997.

Ghana's official exchange rates

Since its independence in 1966 Ghana coped with economic and political instability. Overthrown of two presidents by a military coup after attempts of devaluations kept the official exchange rate fixed from 1973 to 1983 with severe trade controls. During the

reallocation and economic growth. Investors dislike policy volatility since it raises instability in revenues; however, certain level of volatility is unavoidable when new policy reform is implemented. For example, South Korea's trade reform was launched in 1962 with the "Five Year Plan of Export Promotion" where the government targeted strategic export assistance and policy implementation was a process of negotiation that required frequent changes in policies (Dent, 2000). Figure 3 shows Korea's tariffs volatility relative to other countries during the period 1970-2000, where Korea's volatility is higher to Kenya's and comparable to Peru's.

Figure 3
Tariff Rates Volatility for Selected Countries (1970-2000)



1.1.2. Measuring Trade Policy Volatility

Empirically, Harrison (1995) showed that both levels and *volatility* of different measures of openness have a strong impact on economic growth. Aizenman and Marion (1995) also studied various policy volatility measures and its effect on investment, where volatility is constructed by calculating the standard deviation of government consumption, money growth, and the term of trade as a measure of openness. Their results showed a negative relationship between policy volatility and investment. Rodrik

same period inflation rose over 5000 percent due to an expansive monetary supply, which resulted in a black market premium of 3000 percent (official exchange rate minus parallel market exchange rate; Younger, 1992). Although Ghana initiated the period of liberalization with an elimination of virtually all restrictions on current account transactions, authorities maintained a highly overvalued exchange rate, signaling inconsistency among trade policies and diminishing government credibility to carry on the trade reform.

Chile's successful trade reform in terms of economic performance accounts to factors of policy consistency and government commitment. For instance, most East Asian countries followed consistent macroeconomics and trade policies, while such consistency was less evident in Latin America and almost nonexistent in African countries. Many of these economies followed a strong reduction in tariff rates but preserved high black market premiums and macroeconomic instability.

Recognizing volatility, commitment, and consistency as key factors of the success of trade policy implementation in developing countries, the following section describes in detail each of these factors.

1.1. Trade Policy Volatility

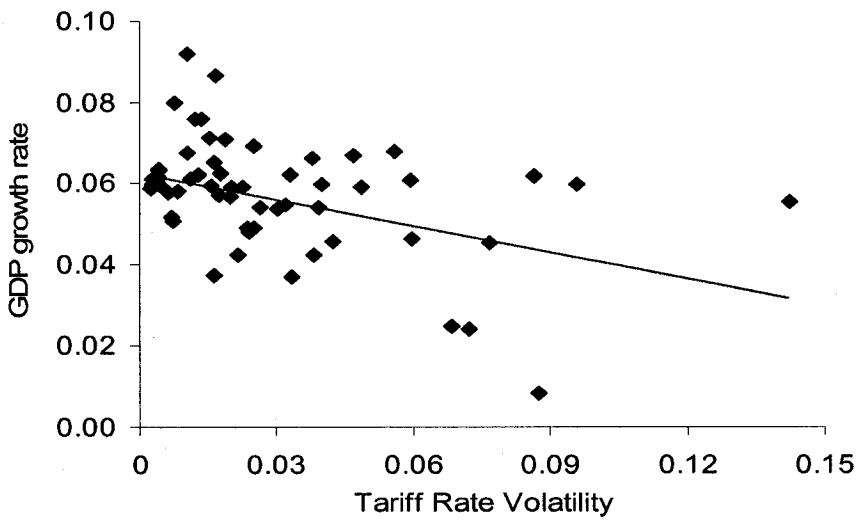
1.1.1. Analytical Framework of Trade Policy Volatility

Calvo (1988) developed a model where capital responds to new trade policies if profits are high enough to compensate not only for the costs of shifting to the new exporting sectors but also for the expected costs of "shifting back" in the event of policy changes. Policy volatility increases these transaction costs, discouraging resource

(1998a) applied both the standard deviation of the *level* and the *first-difference* on trade policy in assessing volatility. By using first-difference as a measure of changes, his results exhibited an improvement in the fit of the regression (the R^2 increased from 0.395 to 0.445). Figure 4 presents a preliminary relationship between volatility of tariff rates against economic growth. Partial evidence of the negative effect of tariff volatility on economic growth is observed.

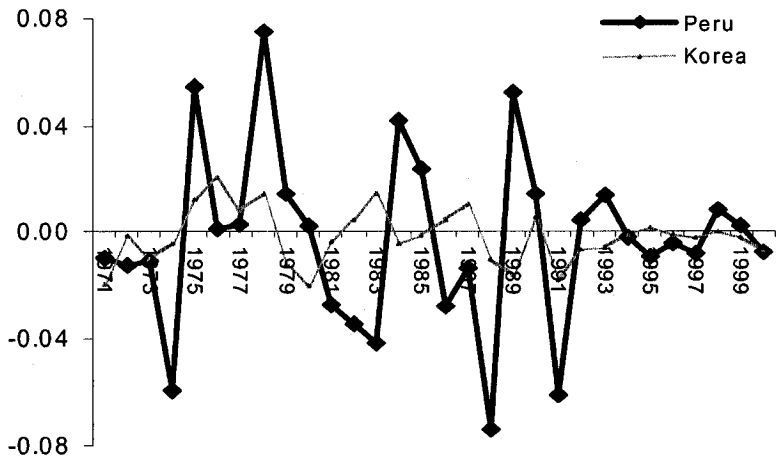
Figure 4

Volatility of Tariff Rates versus Economic Growth



In line with Rodrik (1998a), volatility can also be measured with the first difference of the original time series. Figure 5 contrasts the first-difference of Peru and Korea for the period 1970-2000. The dissimilarity in tariff volatility between these two economies is now evident (compared with Figure 3), showing Peru with considerable large tariff changes from one year to another than Korea.

Figure 5
First Difference Tariff Rates: South Korea and Peru



While previous studies have measured volatility by the standard deviation of the trade policy indicator, this study follows Rodrik's first difference approach (1998a) but only considering the extreme values[3]:

> "If the observation (in first-difference) lies outside one standard deviation of its mean, it denotes high volatility and the indicator takes the value of one. Otherwise, it is zero".[4]

Applying first difference instead of standard deviation as a measure of volatility has two important advantages: First, as evidenced by the example of Peru and South Korea, the standard deviation may lead to conclude that these two countries have similar volatility patterns (figure 3) but their outcomes in terms of resource reallocation and

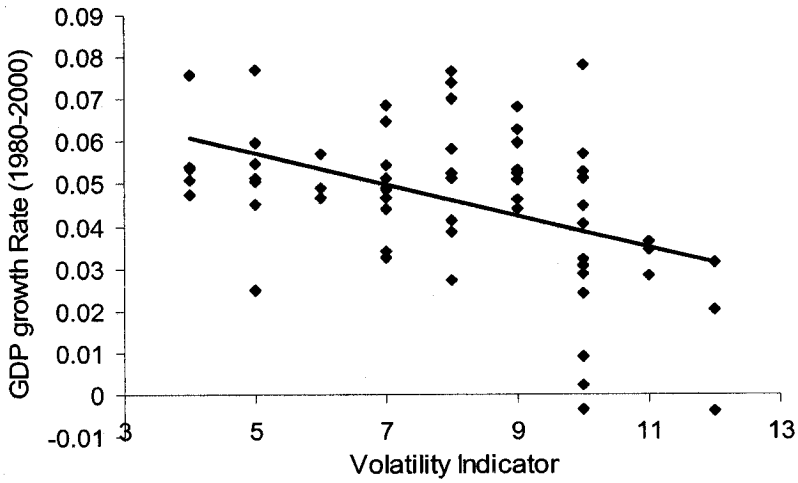
[3] Rodrik (1998b) applies first-difference of an indicator of trade openness while in this section the first-difference is applied to an indicator of trade policy. In Rodrik (1998a), he uses first-difference of a fiscal policy indicator.

[4] In order to add *intensity* to the volatility indicator, a three-tier measurement scale is adopted. The value of two is added to the original binary scale and is applicable when the policy indicator fluctuates higher than two-standard deviations (defined as TPI-2). The details of this transformation are presented in Section 6.

economic growth are entirely dissimilar. The application of first difference and the construction of bands in order to identify extreme movements in policy indicators may offer better assessment of policy volatility. Second, standard deviation may not be a reliable measure under the panel data framework applied in this work. Panel data are arranged into 5-year sub-groups where standard deviation of each sub-group would be calculated; this could lead to an inaccurate statistical measure since it is based only on five observations.

Figure 6 shows the Volatility Indicator applied to tariff rates against economic growth for 60 countries. The figure verifies a negative relationship between trade policy volatility and growth rates.

Figure 6
Volatility Indicator Vs Economic Growth: Tariffs



Appendix 3 presents the lists of countries ranked according to the volatility indicator where the first four positions correspond to African countries. An interesting observation is that South Korea and Malaysia are on the list of the highest trade policy volatility countries. This confirms that volatility as the only measure of policy instability could

weaken the analysis on economic performance since these countries exhibited high growth rates during the period 1970-2000. In order to increase the accuracy of a measure for trade policy instability, commitment and consistency of trade policy should be considered.

1.2. Trade Policy Commitment

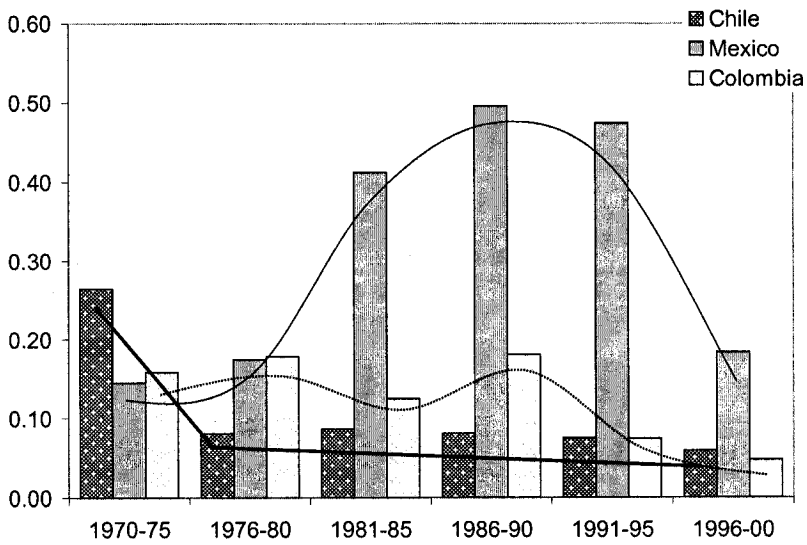
1.2.1. Analytical framework of trade policy commitment

The second trade policy instability factor is related to the *commitment* of the government to maintain a policy in the long run. Governments support reforms with different degrees of commitment which signal their willingness and capability to undertake a reform. This commitment depends on factors such as internal crisis or external shocks, power of interest groups that may force the authorities to revert newly implemented policies, and government reliance on income from the old policy. Trade reform creates a battleground between those who are in favor of the reform and those who oppose it; if opposition succeeds, the reform could be reversed (Fernandez and Rodrik, 1998).

Chile is an example of authorities' commitment to trade policy. In 1973 the new government under Augusto Pinochet implemented 'shock therapy' policies in order to reduce inflation. The government gave two clear signs that the country was moving toward a new trade policy during its economic liberalization. First, it reduced tariffs to a uniform level of 10 percent and a massive devaluation took place in 1979. Second, there was no hesitation in the new policies and no reversals were observed. Other Latin American countries such as Mexico and Colombia also adopted liberalization policies in

the 1980's but turnarounds in tariff rates were experienced throughout the following ten years. Figure 7 shows the five-year average tariffs for the three Latin American countries mentioned above from 1970 to 2000. It is evident that Chile experienced a higher commitment to the trade policy relative to Mexico and Colombia since no reversals are observed and a steady trend toward reduction of tariff rates is noted during the 30 years.

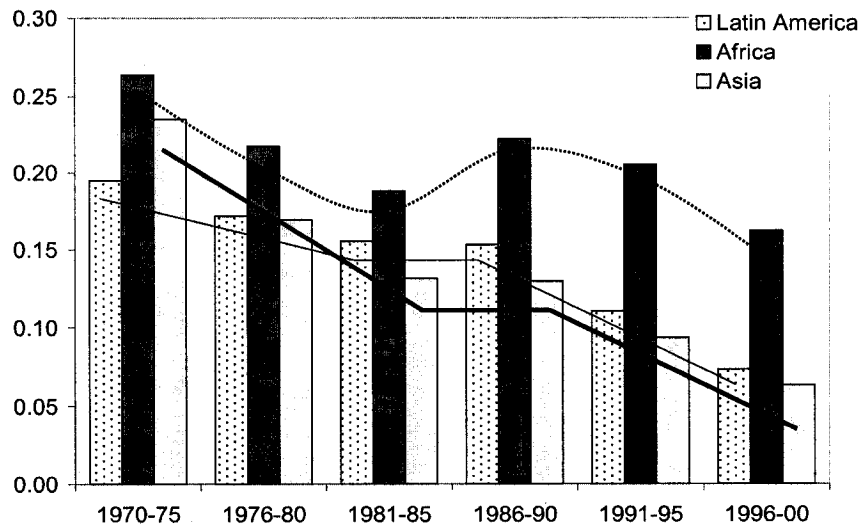
Figure 7
Tariff Rates for three Latin American Countries: 1970-2000



Africa is the region of the world that showed the least development during the last decade, largely explained by the inadequate implementation of policies (Metzel and Phillips, 1997) and the weak institutions that inhibit individuals to be represented in the political process. For example, Nigeria showed tariff and quotas reduction during the 1990s but "special" taxes on imports have been observed since then (Rodrik, 1998b). Even among the most aggressive reformers in Africa, various trade reform programs were reversed afterward.

Figure 8 shows the 5-year average tariff rates by region from 1970 to 2000. It is evident that tariffs in Africa remain high and unstable compared to other regions. As a result, the credibility of trade reform in most African countries tends to be quite low and the response in investment hardly ever materializes.

Figure 8
Tariff Rates by Region: 1970-2000



1.2.2. Measuring Trade Policy Commitment

Policy commitment relates to the capability of the government to sustain the policy after the announcement. One alternative in measuring commitment is by observing the reversal patterns of liberalization policies. Policies that have been reversed during short periods of time will indicate weak commitment. For instance, Papageorgio, Michaely, and Choksi (1991) applied the concept of reversals by categorizing countries under the following types of episodes: sustained, partially sustained, and collapsed liberalizing episodes. Under a sustained episode, countries kept the trade policy with no reversals; in partially sustained episodes, countries show some reversals but the trade regime remained

mostly liberalized; and under the collapsed episode, the reversals led the trade policy back to the pre-reform situation. The limitation of this arrangement is the subjectivity in the definition of reversals, which is largely based on judgments of country experts. Calvo and Reinhart (2002) use a less subjective approach. A reversal results when the *first difference* of the variable in question falls outside a particular threshold. For instance, they applied the *1* and *2.5* percent above/below the mean of the exchange rate as thresholds to define a reversal in exchange rates movements. In line with Calvo and Reinhart, a reversal of a trade policy indicator is characterized when[5]:

> "The observation (in first-difference) lies outside the one standard deviation band and the subsequent observation cross the zero line, indicating a change in the direction of the policy"

The difference between Volatility and Commitment is subtle. Commitment is a more restrained measure since it requires deep changes in policy, while volatility only entails high movements even when no change in the direction of the policy is observed. For example, Dent (2000) describes the strong commitment of the S. Korean government to trade policy as demonstrated by the few reversals observed during the period of liberalization even when the policy exhibits high volatility. Contrasting S. Korea and Peru, figure 9 shows that the number of reversals for Korea is three while Peru exhibits six.

---

[5] Robustness of the commitment measure is tested by creating another version of this indicator: only the observations that are outside the negative side of the band that cross the zero line are considered. Observe that a move from a negative to a positive value in the first-difference indicates a change of direction toward a more closed economy. The Index with this indicator is defined as TPI-3. The details of this transformation are presented in Section 6.2.

Figure 9
Number of Reversals in Tariff Rates

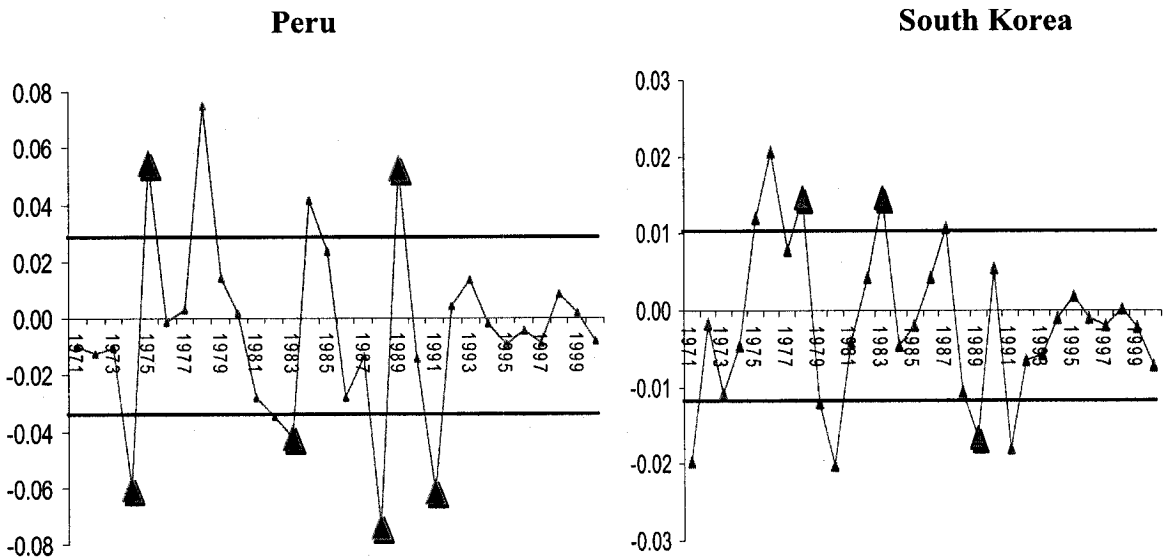
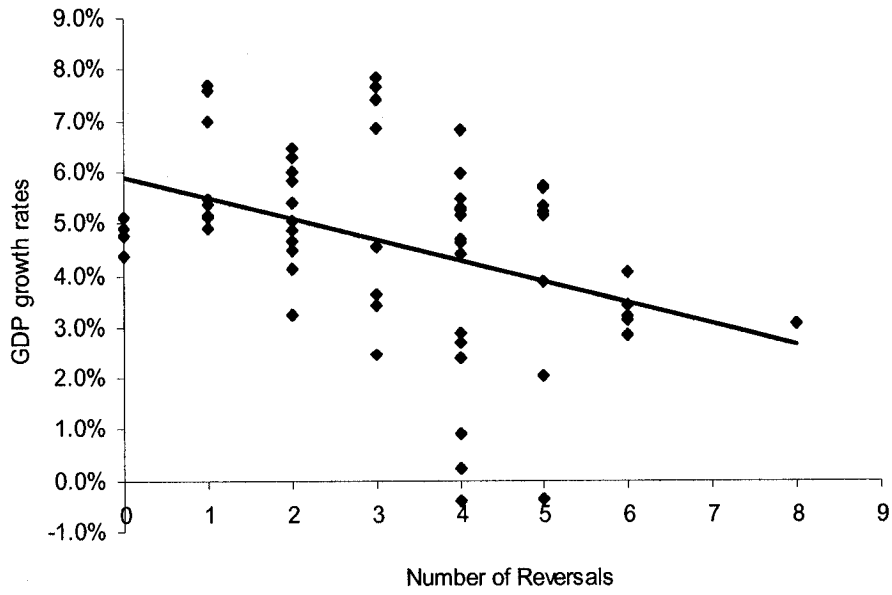


Figure 10 exhibits a preliminary evidence of the effect of the number of reversals on economic growth for 60 developing economies for the period 1970-2000. It is not surprising to observe that higher number of reversals is associated with lower GDP per capita growth rates.

Figure 10
Reversals in Tariffs vs. GDP growth rates



1.3. Trade Policy Consistency

1.3.1. Analytical Framework of Trade Policy Consistency

Consistency of policy relates to the coherence or uniformity among different policies. Complex external forces and policy arrangement may promote certain policy packages to be inconsistent with the new trade strategy or with the government objectives. For instance, monetary policies aiming to reduce inflation will not be viable if public budget commitments lack credibility. "Reform will not pass credibility because the public understands that it violates budget constraints or accounting identities" (Rodrik, 1998b). In his study of export subsidization, Rodrik (1993) shows the case of Bolivia. This country failed to implement and sustain a trade policy due to lack of consistency in the reform. A subsidy defined as CRA (Tariff Refund Certificates) was introduced in 1987 at a time when Bolivia was ending a period of hyperinflation. Firms were skeptical that a subsidy could work under a budgetary constraint that was aiming to reduce inflation, prompting policy instability. In contrast, South Korea and Taiwan represent examples of effective policy consistency since trade policy was accompanied by a well-managed fiscal expenditure avoiding macroeconomic instability and inflation during the period of trade reform (Rodrik, 1993). Bolivia's case is a clear example of inconsistency between trade and macroeconomic policies. Inconsistencies within trade policy have been also evident in developing countries. For example, authorities may reduce tariff rates in an effort to cut distortions, but if they preserve a high deviation between official and real exchange rates, agents will realize the policy inconsistency, stimulating instability and prompting the ineffectiveness of the tariff reduction.

In general, economic agents realize that inconsistency among policies will force the government to choose between abandonment of the old policies to adjust to the new trade strategy or an eventual reversal of the new trade policies. In any case, a change of policy must be observed and policy instability is expected.

1.3.2. Measuring Trade Policy Consistency

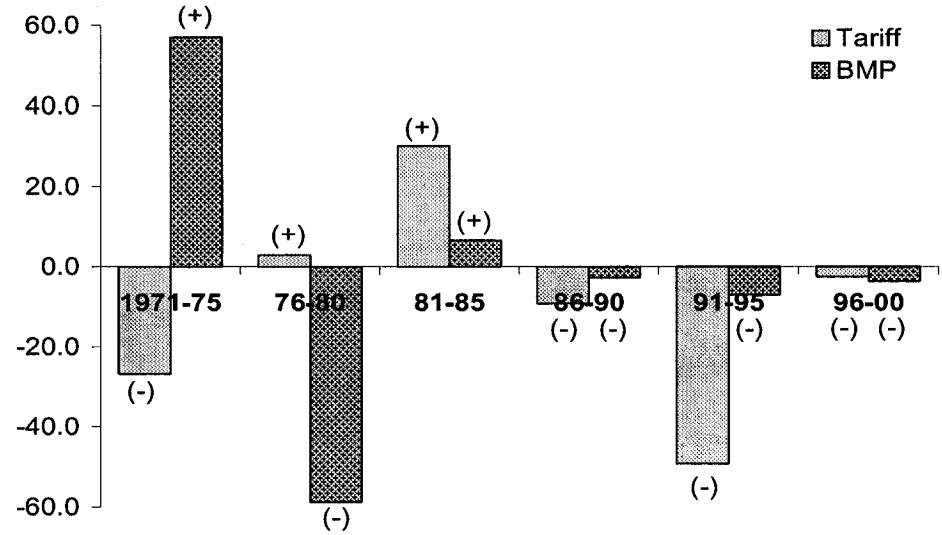
The study of policy consistency is thoroughly analyzed under rational expectation models (Von Hagen and Lutz, 1996), macroeconomic dynamic efficiency models (e.g. inconsistencies between inflation and government expenditure, Haliassos, 1991), or market access-Cournot models (Ibarra-Yunez, 2003). The other alternative in analyzing policy consistency is through case studies (e.g. the inconsistencies of the African integration process, El-Agraa, 2004) or by interviewing key officials to find their views on the policy inconsistencies (Ibarra-Yunez, 2003). For the purposes of this dissertation, the uniformity or coherence pertaining to the liberalization reform requires that all trade policies under analysis show the same direction toward openness and it will be measured as follows:

> "If the 5-year average policy indicator is positive (e.g. higher average tariffs), denoting movement toward protectionism and inconsistency with an open trade reform, the indicator takes the value of one; otherwise it is zero"

Figure 11 exhibits the 5-year average of Tariffs and Black Market Premium (BMP) for the case of Argentina. Observations from 1971 to 1985 show that at least one of the

policies has a positive sign, denoting inconsistency. Observations from 1986 to 2000 show both policies with negative signs, indicating that the economy is moving toward liberalization. The consistency indicator accounts only for the signs and not the value of the policy.

Figure 11
Argentina – 1970 to 2000: Average (First Difference) Tariff and BMP



As it is described in Section 3, tariffs and Black Market Premium (BMP) are selected as trade restrictions in which government may act to deter trade. Although they are not unique, these variables have the advantage of data availability for a panel data framework and are closely associated with trade policy. Tariffs and BMP have also been applied in numerous empirical growth models (Levine and Renelt, 1992; Edwards, 1993; Barro, 1997; Sala-i-Martin 1997; Rodrik, 1998b) and in most cases they exhibit the expected negative effect on income[6]. Figure 12 shows all possible combinations of the consistency indicator.

[6] Tariff and BMP as trade policy indicators have shortcomings. For example they show weak correlation between them and other trade policy indicators (Edwards, 1997a) and data on BMP for various countries tend to be unreliable and inaccurate since it is an illicit form of transaction (Obstfeld and Rogoff, 2000). Detail on the trade policy indicators chosen for this work are presented in Section 3.

Figure 12
Possible Outcomes and Values of the Consistency Indicator during a 5-year period

Tariff	+	−	+	−
BMP	+	+	−	−
All policies equal sign and Both policies toward openness	Yes = 0 No = 1	Yes = 1	No = 1	Yes = 0 Yes = 0
Total	**1**	**1**	**1**	**0**

Figure 13 shows preliminary evidence on the negative relationship between economic growth and the consistency indicator. A higher value of the indicator represents less consistency in trade policy, and thus, higher trade policy instability.

Figure 13
Consistency versus Economic Growth

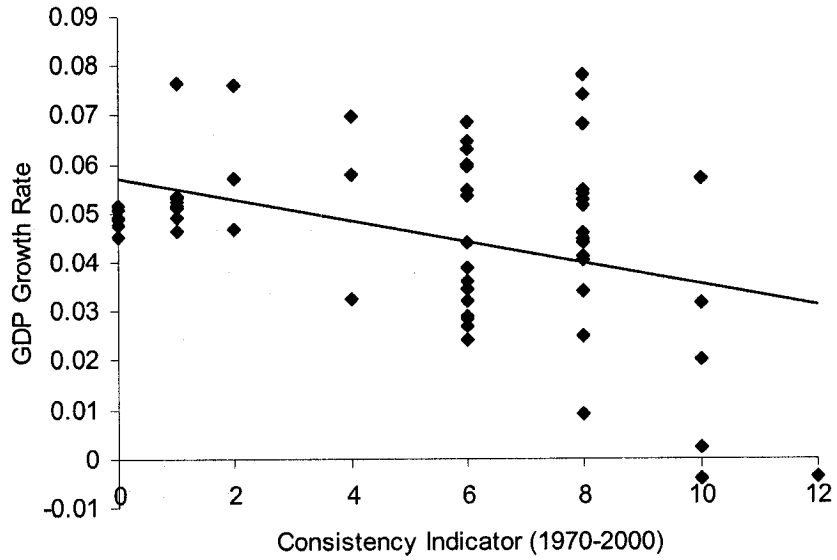


Figure 14 examines the volatility of the Tariff Rates and the BMP for different world regions for three periods. The table exhibits a clear trend toward lower activity in the black markets for all regions as a results of a trade openness strategy followed by most developing nations during the last decades; although by the end of the 1990s, Africa still maintains a high volatility (21.2) compared to Latin America and Asia (4.1 and 8.6

respectively). Volatility of the BMP was significantly high for Latin America during the "lost decade" (111.9), indicating the high price-distortion conditions during this period. Bolivia and Nicaragua accounted for the highest BMP volatility for this episode. For the case of tariff rates, the cross-country variance has decreased over time. Similar to the BMP, Africa has significantly reduced its trade policy volatility during the 1980's; nevertheless, by the end of the century it had failed to show a move towards a more stable trade policy relative to the rest of the regions in the world.

Figure 14
Standard Deviation of Tariff Rates and BMP by Region

	Tariff - Std. Dev.		
	1970-1980	1980-1990	1990-2000
Latin America	2.787	1.881	2.238
Africa	5.106	1.982	2.771
Asia	5.207	0.701	1.923
Developed countries	2.159	0.344	0.613
	BMP - Std. Dev.		
	1970-1980	1980-1990	1990-2000
Latin America	16.149	111.945	4.055
Africa	11.534	38.627	21.192
Asia	13.665	9.225	8.629

1.4. Data and Sources

The dataset is constructed from the World Penn Tables (Heston, Summers, and Atens, 2002) and other sources detailed in Appendix 1. The sample comprises 90 countries, where Eastern Europe, the former Soviet Union, and most of the oil-exporting countries are excluded due to the lack of reliable data and the distortions for the oil exports on GDP respectively. A list of the countries is given in Appendix 2. The years considered in the analysis are 1970-2000, although, when not available the data covers only 1980-2000.

The panel is constructed using 5-year sub-periods; thus, each country shows six observations. With 90 countries and 30 years, the data set provides 450 observations (90 countries * 30 years / 6 obs per country = 450). When adding variables of corruption, Law and Order, property rights, among others, the data set is reduced in size by 354 observations since the period covered is 1984-2000. The treatment of the data differs from earlier studies by the construction of a single indicator that measures trade policy instability and by the examination of growth performance within a panel setting.

Section 2: Trade Policy and Economic Growth

Quantitative Restrictions (QR's) correspond to tariff rates or taxes on imports, non-tariff restrictions (quotas and other prohibitions) that limit the quantity of imports, and export taxes. QR's have been systematically applied by most developing nations as part of their protectionism system and also as a source of government revenue. In most cases, QR's are accompanied by exchange rate policies (official overvaluation of the domestic currency) aiming to promote the importing sector.

Figure 15
Revenues from QR's relative to Total Government Revenue [a]

	1970s		1980s		1990s
Gambia, The	64.4%	Gambia, The	68.6%	Madagascar	50.3%
Brazil	54.7%	Uganda	56.5%	Belize	46.1%
Rwanda	52.6%	Mauritius	49.7%	Sierra Leone	42.9%
Burkina Faso	49.9%	Belize	48.7%	Gambia, The	42.5%
Belize	49.6%	Sierra Leone	42.1%	Dom Republic	40.0%
Uganda	47.5%	Honduras	39.8%	Senegal	39.3%
Burundi	46.0%	Ghana	37.7%	Mauritius	36.3%
Sierra Leone	45.6%	Burkina Faso	35.5%	Uganda	35.6%
Ecuador	45.4%	Senegal	35.3%	Ghana	33.1%
Ghana	43.1%	Sri Lanka	34.8%	Rwanda	29.5%
Dom Republic	42.8%	Rwanda	34.5%	Nepal	28.1%
Cameroon	42.5%	Dom Republic	32.8%	Papua N Guinea	27.0%
Botswana	42.4%	Madagascar	32.3%	Fiji	25.1%

[a] Source: World Development Indicators, WB. 1970-2000

Figure 15 shows revenues from QR's relative to total government revenue by decades for a selected number of countries. It is evident that QR's represented an essential source of government income as more than 50 percent of total revenues were originated from such policies in various developing countries[7]. For example, Gambia maintained an average of 65 percent QR's revenue to total revenue for twenty years and Brazil's average ratio was 55 percent during the 1970's while Uganda's was 57 percent during the

[7] Rodrik (1998a) tested the relationship between different international trade measures, including tariff rates, and government consumption for the case of Sub-Sahara Africa, with positive and significant results.

1980's. Currenlty, Madagascar and Belize heavily depend on QR's revenues with an approximate 50 percent ratio.

Gathering data on QR's and other policy variables (e.g. the black market activity) has been a challenge for empirical analysts. Earlier research applied trade ratios (exports plus imports as a share of GDP) or rate of growth of exports as proxies of trade policy; however, it has been recognized that such measures are also shaped by factors different from the domestic trade policy (e.g. external shocks). Other alternatives for trade policy proxies are the constructions of indicators. For example, Greenaway et al, (2002) constructed a dummy variable based on the Statements of Intent from the World Bank; and Sachs and Warner (1995) constructed a zero-one openness index based on tariff and non-tariff barriers, the black market premium, the type of economic system, and the monopoly condition on exports. The limitation with these trade policy indexes constructed in earlier studies is the small number of observations, particularly under a panel framework. Additionally, dummy variables and binary indexes show limited capacity in capturing intensity: as long as the policy indicator surpasses a specific threshold, the index shifts from zero to one. This approach equally classifies countries that fall right above the threshold together with those that went far beyond the defined bound.

To account for trade restrictions in which government may act to deter trade, Tariffs and Black Market Premium (BMP) are selected as the most appropriate. Although they are not the most important ones nowadays[8], most economies have amply used them as a policy mechanism. These variables have the advantage of data availability and are

[8] Tariff and BMP are trade barriers that reduce openness but not the most important ones today. Rodrik (2004) states that most important than tariffs are the "institutional discontinuities", but measurement of adequate institutions has not been a straightforward task.

closely associated with trade policy and economic instability. Additionally, tariffs and BMP have also been applied in empirical growth models in numerous studies with positive results in terms of the relationship with trade ratios, economic growth, productivity, and other macroeconomic variables. Levine and Renelt (1992), Edwards (1993), Barro (1997), Sala-i-Martin (1997), and Rodrik (1998b) recognized tariffs and BMP as good proxies of trade policy. They constructed series on these variables in order to test their effect on government consumption, investment, productivity, and growth. In most cases, Tariff and BMP have shown the expected negative effect on income[9]. Non-tariff barriers and economic institutions (e.g. regulations, financial systems) have also played an important role in trade policy of many developing nations; however, data on these variables is not readily available for most countries. This section presents the theory and empirics supporting the relevance of Tariffs and Black Market Premium as trade policy mechanisms and also some preliminary evidence on the historical relationship between these trade policy instruments and economic growth.

2.1. Nominal Tariff Rates

If a country is small in terms of its inability to affect international prices and terms of trade, the elasticity of demand of imports is likely to be high: any small increase in the price of imported goods due to the tariff rate would reduce demand and enlarge local production of importable goods. The inefficiencies arising from this protected environment will lead to losses in terms of wealth since consumers may face higher prices and lower quality. Most developing nations observe this condition on elasticity of

[9] Tariff and BMP as trade policy indicators have shortcomings. For example, they exhibit weak correlation between them and other trade policy indicators (Edwards, 1997a).

demand corroborating free trade as a superior strategy to protectionism. Nonetheless, most economies have used tariffs as a trade policy mechanism. Rodrik (1994) proposed that tariffs have been an important mechanism of trade policy as a result of[10]:

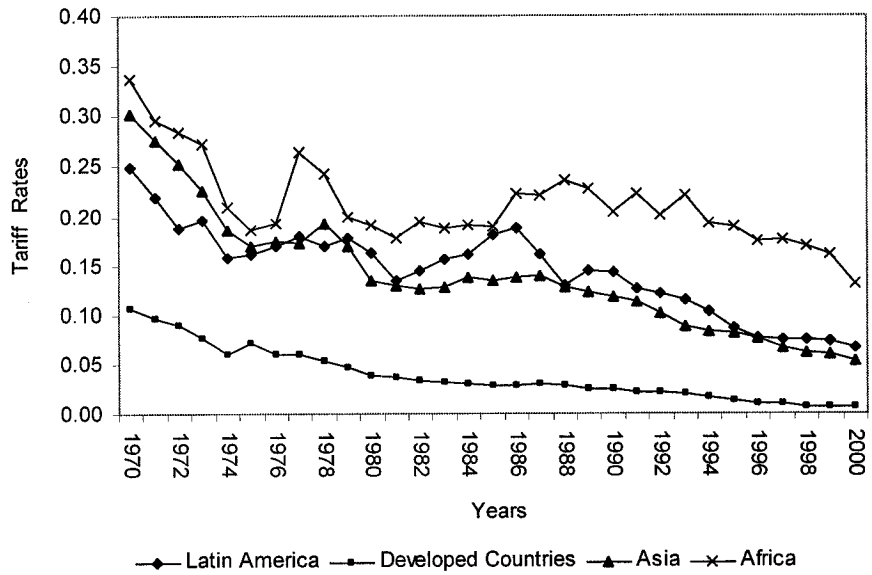
1. Politically powerful sectors that benefit from protection (exporters and domestic produces competing with importing goods) lobby for policymakers that support protectionism.
2. Tariffs are more appealing than subsidies for their low costs in terms of redistribution of transfers. For example, policymakers may prefer to support transfers that favor many interest groups making the subsidy undesirable due to its narrow focus on specific firms. Tariffs, on the contrary, are more industry-specific with potential benefits for broader groups (Rodrik, 1986).
3. Tariff rates become an important source of government income when poor administrative capability to raise taxes from income governs the economy.

Tariff Rate is defined as income from taxes on international trade divided by total imports, a definition used by the World Bank in its World Development Indicators. Tariff rates were widely used during the 1970's as a mechanism for protection to the "Infant Industry", yet the globalization process initiated with the Washington Consensus (Williamson, 1990) effectively diminished tariffs as a trade policy device. Tariffs are still a valuable tool for research since the dataset on this variable is exceptionally accurate. It allows for the construction of a consistent time-series for more than 80 developing countries. Tariffs as a trade policy indicator have important shortcomings.

[10] Rodrik (1994) also describes various models that formalize each argument of the existence of tariff rates as trade policy mechanism.

They underestimate the real restrictiveness in trade since most developing countries applied additional non-tariff barriers over the official rates (e.g. smuggling) and other institutional framework (e.g. control over exchange rates). Rodrik (2004) states that, up to today, tariff rates accounts to approximately 5 percent from the estimates of total transaction costs of 40 percent for a developed nation. However, Dean, Desai and Riedel (1994), Barro and Lee (1994), and Sala-i-Martin (1997) used nominal tariff rates as control variables in their estimates of growth equations under a cross-sectional framework. In most of the cases, the value of tariffs shows the expected negative sign and is statistically significant. Tariff rates have also been applied in the construction of trade indexes. For example, one of the five elements in the Sachs and Warner's *Composite Openness Index (1995)* is tariff rates.

Figure 16
Tariff Rates by Region: 1970-2000

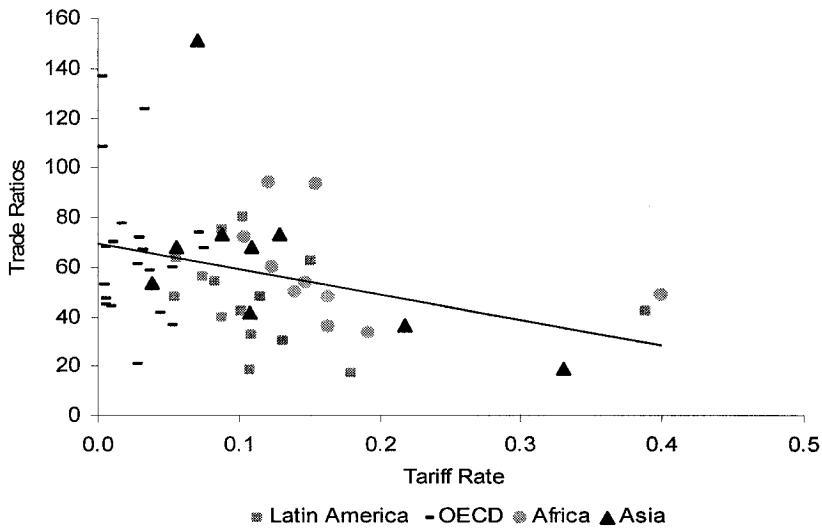


Figures 16 to 19 confirm the validity of the results from previous studies. Figure 16 shows a graph of the trend of tariff rates for different regions of the world for the period

1970-2000. The African region maintained an average tariff rate of 16 percent by the end of the century where countries like Mauritius and Cameroon exhibited 40 percent and 26 percent tariff rates respectively. The graph also shows that Africa and Latin America display higher tariff rate volatility than Asia. The trend of this variable during the 1980's was not clear for Latin America and Africa, while Asia initiated a steady reduction of tariffs at the beginning of the 1970s.

Figure 17 shows a scatter plot of *trade ratios* against tariff rates for different regions of the world for the period 1980-2000. Preliminary evidence from the graph suggests that tariff rates negatively affect international trade; thus, "this measure (tariff) may be an adequate proxy in capturing one dimension of trade policy" (Rodrik, 1998c).

Figure 17
Tariff Rates vs. Trade Ratios



In Figure 18, the plot of tariff rates against government consumption for the period 1970-2000 is displayed, confirming the positive relationship between income from international trade and government consumption. Finally, Figure 19 exhibits a

preliminary relationship between tariff rates and GDP growth rates for 60 countries. The negative link corroborates the distortion of tariffs on economic performance.

Figure 18
Tariff Rates vs. Government Consumption

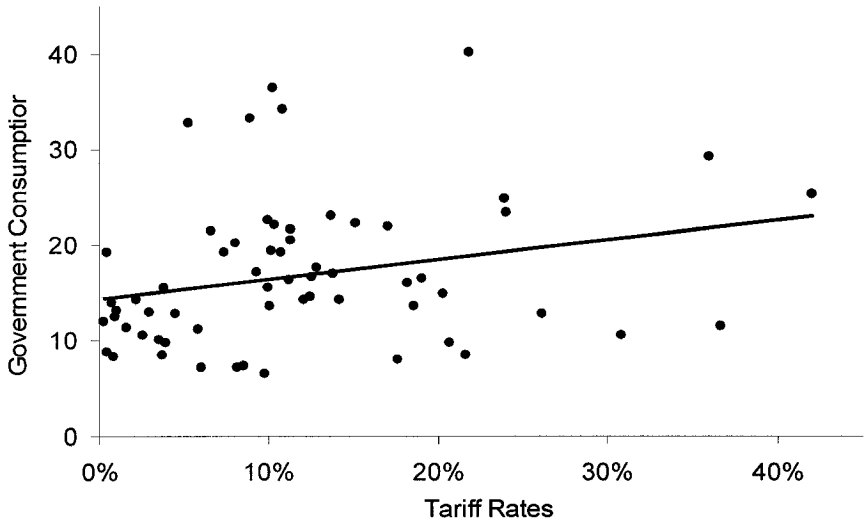
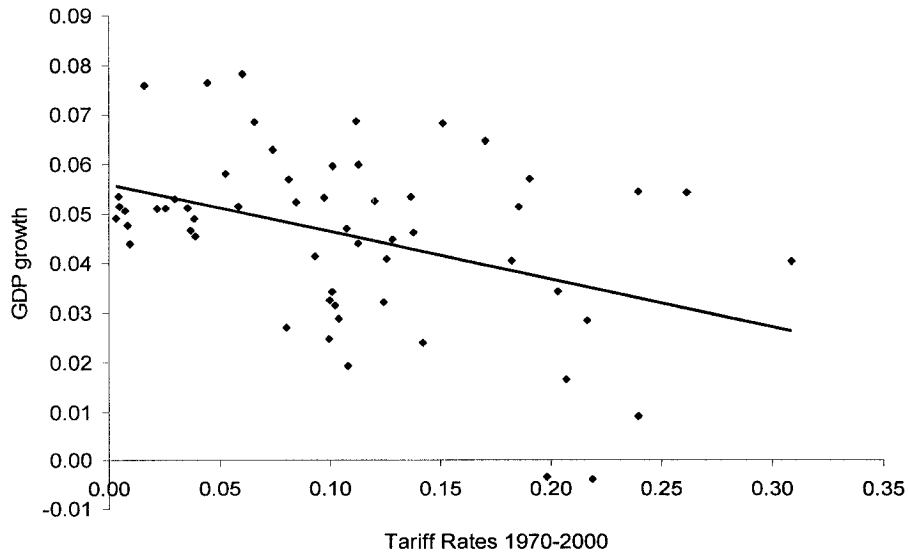


Figure 19
Tariff Rates vs. GDP growth



2.2. The Black Market Premium (BMP)

Official changes in exchange rates (changes of the rate at which the central bank is willing to purchase foreign currency and/or foreign exchange rationing) is regarded as trade policy since they are conceptually equivalent to an export or import tax. For instance, overvaluations operate as export-tariff/import-subsidy since they raise the prices of exports and reduce the prices of imports in terms of local currency. Generally, governments adopt an official exchange system in response to balance of payment deficits and parallel markets (or black markets) tend to emerge as authorities impose restrictions on foreign currency (Kiguel and O'Connell, 1995). Overvalued official exchange rates as trade policy have been a common practice in most developing economies during the last thirty years.

If the divergence of official exchange rates from market exchange rates represents a distortion in the economy, why do governments make use of official rates? Parallel markets allow any excess of demand of foreign currency to translate in a depreciation of parallel rates rather than a loss of reserves. It also allows authorities to maintain domestic price stability since most current account transactions are conducted at the managed official rate. Dual exchange rates provide a temporary delay in international reserve adjustments, but it is not an effective mechanism for long term stability.

BMP is defined as the log of the ratio of the black market to the official exchange rate and is interpreted as government distortions in the trade market. When BMP is high, implying a major gap between official and market exchange rates, the cost of international transactions becomes an important concern for economic agents. Figure 20

shows the largest BMP in selected developing economies during the period 1980-1989. It is evident that BMP was a very active strategy during the 1980's in these economies.

Figure 20
Largest BMP value in selected countries (1980-1989)

Country	Largest BMP value
Mexico	66.0
Venezuela	213.0
Brazil	173.0
Bolivia	293.0
Peru	278.9
Tanzania	809.1
Ghana	4,263.7

Source: Kiguel and O'Connell (1995)

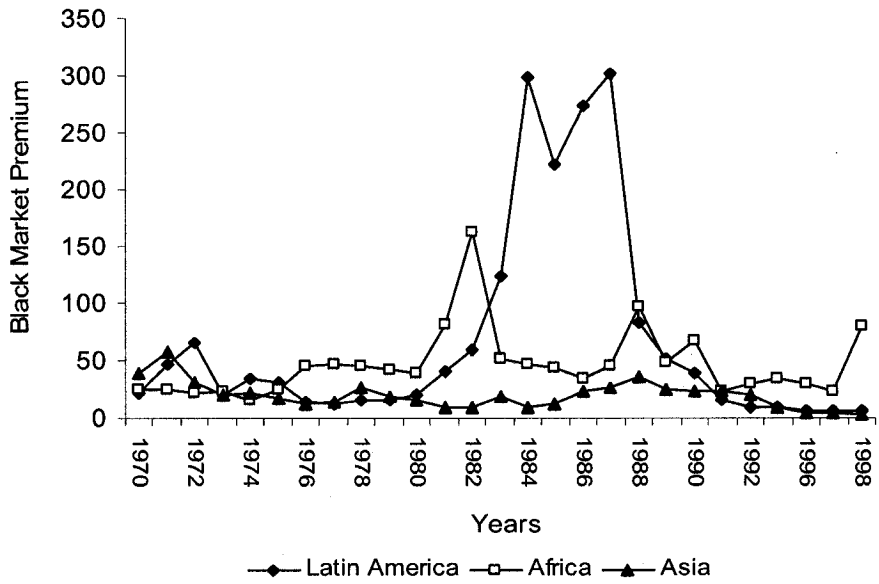
In his study on Sub-Sahara Africa, Rodrik (1998b) found evidence that BMPs negatively affect international trade[11]. Barro and Lee (1993), Easterly (1994), Harrison (1995), Barro (1996), and Sala-i-Martin (1997) also applied BMP as independent variables in their empirical growth models. In all of these studies the BMP negatively affects economic growth, and in all of them, except for Easterly, the BMP parameter showed a statistical significance at the ninety-five percent level. Similar to tariff rates, BMP has been applied in the construction of trade policy indexes. The availability of information on both official and unofficial exchange rates makes the BMP an acceptable proxy for trade policy[12].

Figure 21 shows the historical performance of the black market premium for three developing regions. The figure indicates a trend toward less distortion in the exchange rate markets for Latin America and Asian regions. The liberalization trend of the past

[11] In the growth model, Rodrik (1998b) includes factors like ethno-linguistinc fragmentation, ethnicity, geography, and size of the country as control variables.
[12] The BMP has it limitations. Data for various countries tend to be unreliable and inaccurate since black markets are an illicit form of transaction (Obstfeld and Rogoff, 2000).

twenty years has promoted the removal of exchange rate restrictions and parallel markets. The drop of the BMP is evident during the 1990s, especially in Latin America. BMP volatility in the African region remains nowadays, indicating ongoing black market activity[13].

Figure 21
Black Market Premium



Figures 22 and 23 plot the BMP versus trade ratios and GDP growth rate respectively. The negative effect of parallel markets on the economy is observed in both figures; however, it is evident from the spread of the observations that other factors are needed in order to determine trade ratios and growth (e.g. other trade policies, control variables like education, initial levels of investment, etc.).

The fact that several developing countries still maintain positive values in the BMP is a result of governments' reluctance to allow exchange rates to be determined by the

[13] The average widespread of the BMP for Latin America during the period 1983-1987 is mainly due to the high value of Honduras. Removing Honduras from the sample would change the average from 243.79 to 61.28.

market. The concerns are the loss of one of the mechanisms that eases pressures on domestic policies and alleviates imbalances from external shocks. There is also the fear of the effects that free exchange rates have on economic stability (Calvo and Reinhart, 2002).

Figure 22
BMP Vs Trade Ratios

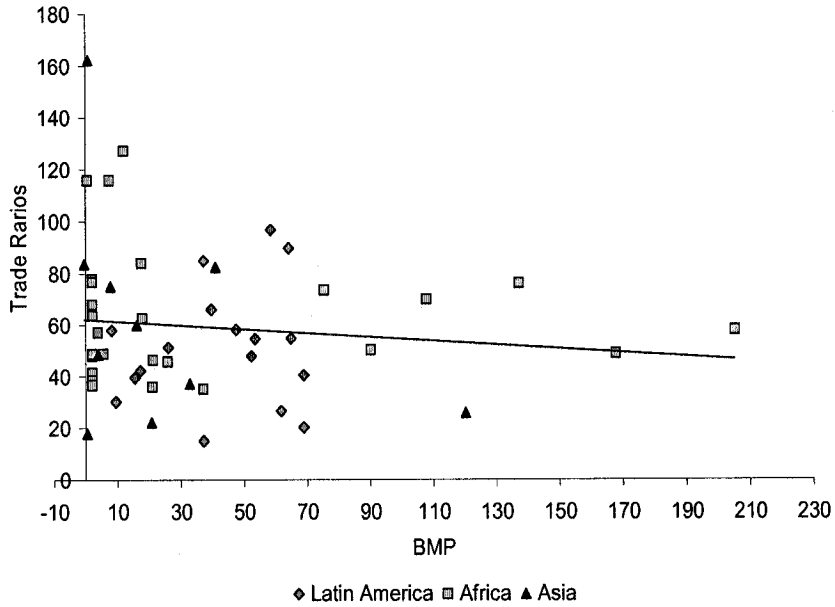
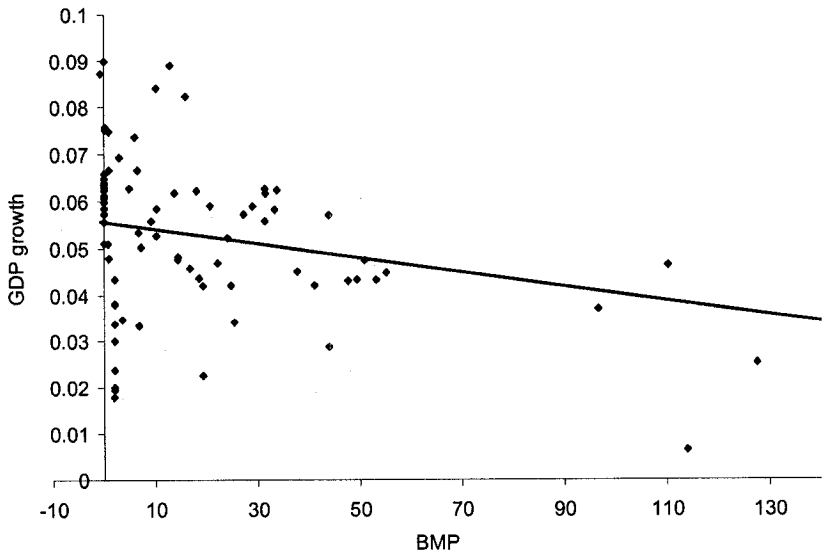


Figure 23
BMP Vs GDP Growth Rate



Section 3: Assessing Trade Policy

3.1. Different Indicators of Trade Policy

Two factors must be considered when choosing indicators as proxies for trade policy: First, they must be linked as much as possible to government's policies, and second, the data supporting the indicator must be available for a wide range of economies to allow for country comparison and robustness of regression results. Most trade policy measures are hard to disentangle from the influence of other factors (i.e. macroeconomic policies, external shocks, political factors), and data from developing countries tends to be particularly unreliable and incomplete. These two constraints on trade policy indicators have challenged empirical economists. This section describes three approaches applied in past empirical studies for measuring trade policy.

The first proposition is to directly use single variables directly linked to trade policies. Easterly (1993), Barro and Lee (1994), and Sala-i-Martin (1997) implement this approach in their cross-section analysis where Black Market Premium and Tariff Rates are used as single policy indicators. Other single-indicators used as trade policy are non-tariff barriers (Barro and Lee, 1994).

An advantage of the **single-variable** approach is that the input data is simple and readily available for many countries. The shortcoming is that individual variables as a single trade policy measure may limit the explanatory power of the parameters in a regression model since other factors may counteract in the form of *instrument substitution,* where single trade liberalization policy variables may be invalidated by the application of other anti-liberalization measures.

A second approach is the application of **anti-trade bias measures**. This method further expands on the single-variable approach by transforming the variable into a trade distortion indicator. Leamer (1988) constructed a model where a trade intensity ratio (TIR) is predicted. The residuals from a regression of trade ratio against "exogenous" variables like geography, size, and GDP per capita represent a measure of trade intensity (TIR) due to trade policy. The trade orientation of a country is measured by the deviation of the actual trade trend compared to the prediction from the model. In the same line, Rodrik (1996) constructed a variable of trade openness by regressing trade ratios on population growth and other "exogenous" regressors (ethnicity, geography, etc), where the values from the regression indicate how open a country is expected to be based on such exogenous determinants alone. Edwards (1998) and Bleaney and Greenaway (2001) used exchange rate misalignment values from a regression of the log real effective exchange rate on the log of the terms of trade. The results strongly support the thesis that distortions on the exchange rates negatively affect investment and growth. By design, these indicators add more information on trade policy but they are difficult to apply when measuring trade policy instability.

A third methodology is the construction of **indexes**. Due to its desirable qualities, the index is the approach applied in this study. Indexes can incorporate a group of related variables into one category or value and this feature is important since trade reforms tend to combine a group of different policies simultaneously (e.g. tariff rates, quotas, international taxes, and exchange rates, among others). As it was stated above, each individual policy may limit the explanatory power of the parameters on economic growth since other anti-liberalization policies may diminish the final outcome; yet, combining

them in an index may represent a more useful measure of trade liberalization reform. Edwards (1997a) suggests that empirical studies should apply more than one measure of trade restriction in their analysis and Pritchett (1996) considers that trade policy has different dimensions and that "outward orientation is not a simple, undifferentiated concept".

A second advantage of the index is its ability to combine quantitative as well as qualitative values. Most past empirical studies have assessed the instability through the standard deviation of the policy indicator (Aizenman and Marion, 1995; Greenaway, et al 1997); however, the standard deviation may also imply changes to improve the existing policy leading to incorrect conclusions about instability. Supplementary factors of qualitative nature should be considered as part of a policy instability definition (e.g. reversal patterns, gradualism of the reform, uniformity among policies, and so on) and the feature of combining quantitative as well as qualitative appraisals is an essential advantage of the index. The index will allow capturing the concepts of *commitment* and *consistency* as outlined in Section 2.

Index construction also has its limitations. For example, no reliable method for defining the weight of each component is available. Also, Edwards (1997b) considered that a large number of indexes that measure trade orientation use "subjective" criteria. Subjectivity becomes an inherent factor of the index due to the arbitrary assessment of thresholds. In overcoming these problems, past literature use different robustness techniques to enhance the explanatory power of indexes. Section 7 is devoted to various robustness procedures, including changes in the scale and in the thresholds of the index.

3.2. Overview of Trade Index Construction in the Economic Field

Index construction is a familiar approach in the political science as well as in the economic field. For instance, Keefer and Knack (2002) constructed an index using the International Country Risk Guide indicators of government credibility and property rights, where the variables are scaled from 0 to 6 points. A higher number represents a better score, implying that countries show stronger rule of law and higher quality of bureaucracy. In the particular case of trade policy, numerous studies have implemented indexes in order to understand the effects of trade policy "activity"[14]. The lack of reliable data available on trade policy and the challenges of measurement mentioned above suggest that "robust empirical analyses should rely on more than one measure of openness" (Edward, 1997a). Papageorgiou et al, (1991) constructed the *Subjective Index* on trade policy in order to study the relationship between intensity of the liberalization policy and the growth rates for a group of countries. In their analysis, the unit of measure is called an "episode" and it is defined as a period of liberalization where "significant policy changes toward liberalization are implemented". Countries are classified into three categories: those with a persistent liberalization reform, those that kept wavering but sustain the liberalization processes, and those which trade liberalization policies collapsed. Although the measures of timing and gradualism in this study are subjective to a great extent, the methodology is consistent with other studies (Edwards, 1990).

Sachs and Warner's (1995) *Composite Openness Index* has been widely used by other authors as a proxy for openness (Sala-i-Martin, 1997; Hall and Jones, 1999; Burnside and Dollar, 2000; Greenaway et al, 2002). This is a binary index that comprises

[14] For a complete literature review on trade liberalization policy, investment, and growth see Edwards (1993), Krueger (1997) and Rodriguez and Rodrik (1999).

five different indicators: (1) Non-tariff barriers; (2) tariff rates; (3) A black market premium; (4) type of economic system; and (5) a state monopoly condition on exports. It takes the value of one if the economy is open and zero otherwise. Using the index as an independent variable, Sachs and Warner find that open economies outperformed closed economies. Also, their results show that the lack of convergence in growth rates among developing nations is related to trade regimes: closed economies do not converge. The importance of trade policy is demonstrated in several cross-country growth equations from the period 1970 to 1989 and for 135 countries. The limitation of Sachs and Warner's binary index is the poor capacity of capturing intensity of the trade reform. As long as the policy indicator surpasses the benchmark, the index shifts from zero to one, and countries falling right above the benchmark show the same value as those that far exceeded the boundary. In overcoming this limitation, Hall and Jones (1999) and Porter, Sachs, Cornelious, McArthur, and Schwab (2001) constructed indexes that allow countries to be arranged according to a broader array of categories than the zero-one scale.

Hall and Jones (1999) devise a composite variable called "social infrastructure". This is constructed by combining the Index of Government Antidiversion Policies (GADP) from the Political Risk Services in its *International Country Risk Guide;* and the *Composite Openness Index* of Sachs and Warner. They show that differences on institutions and trade policies are important determinants of disparities among countries. To examine the robustness of the model, they select distance from the equator, ethnolinguistic fractionalization, and religious affiliation among others, as control

variables. The estimates indicate that an improvement of the composite index is associated with positive effect on output per worker.

The Global Competitiveness Report edited by Porter et al. (2001) is one of the latest sources of index construction. More than seven indexes and more than 10 sub-indexes aiming to measure productivity, technology and innovation are constructed. Each one is a combination of quantitative data and information from a survey to senior business leaders[15]. For example, the macroeconomic environment index is based on hard data like government expenditure, interest rate spreads, government budget balance, and real exchange rates. The variables are scored 1-to-7. Once the index is constructed, they test the relationship between the indexes and economic growth for 75 countries with statistically strong results in the relationship. The Current Competitiveness Index or CCI (Michael Porter) is related to trade policies and it is constructed with The Survey data[16]. The CCI focuses on the detailed conditions that support a high level of productivity including liberalization policies. The statistical relationship between the index and the GDP per capita is validated using Common Factor Analysis.

Finally, Edwards (1997a) offers an interesting review of different trade policy indexes: (1) the *Leamer's Openness Index (1988)* described in Section 4.1; (2) the *Outward Orientation Index* constructed by the World Bank for 41 countries for two periods in time (1987 World Development Report); (3) Papageorgiou et al, (1991) *Subjective Index* explained in Section 2; (4) the *Wolf's (1993) Index of Import Distortion*, which is an extension of Leamer's index with a more disaggregate set of commodities and three more base years of comparison; (5) the *Average Import Tariff on*

[15] The survey is managed by the Center for International Development at Harvard University.
[16] Some quantitative data is applied; however, Porter considers that ranking countries based on such information may lead to bias in the results due to different domestic measures and methodologies.

Manufacturing (Barro and Lee, 1994); (6) The *Composite Openness Index* by Sachs and Warner (1995) described above; (7) The Heritage Foundation index of trade policy; and (8) the Average Black Market Premium. He found a positive and robust relationship between openness and productivity growth for a set of 93 countries over the period 1960-1990. The results are robust to the use of different trade indexes and time periods.

The above chronology shows a progress of index construction as indicators of trade policy measurement. Most of the current results are based on analyzing the *level* of trade policy over particular periods of time; however, the *stability* of these measures has been poorly studied under the index construction approach. Also, the review of the literature reveals that most of the work is based on cross-sectional analysis which leaves the evidence somewhat open to interpretation since the analysis shows only the results for particular periods in time. In the following sections, the construction of an index that measures trade policy instability under a panel data framework aims to build a more dynamic setting in the study of trade policy and growth.

Section 4: Setting up the Trade Policy Instability Index (TPI)

Various trade policy indexes tend to classify countries into one of two categories: those that do have open economies and those that do not. This method limits the explanatory power of the index mainly for its poor capacity of capturing intensity of trade policy changes. As long as the policy indicator surpasses a certain maximum value, the index shifts from zero to one, and countries falling right above the benchmark show the same value as those that far exceeded the boundary. Following Porter, et al (2001) methodology, the Trade Policy Instability Index or TPI can be constructed to allow more variation within countries. Instability of both policies under study, Tariff and BMP, is measured applying the concepts of *Commitment, Consistency, and Volatility* described in Section 1 and they are combined into the TPI.

The TPI allows a comparison of two trade policies (tariffs and BPM) in three dimensions: volatility of the policy, reversals or changes in the direction of the policy, and consistency among trade policies. Data is transformed into points and added together as follows:

1. Volatility. For each year, if the observation (first-difference of Tariffs and BMP) is above one standard deviation from its mean, it indicates "high volatility" and one point is added to the TPI.
2. Commitment. For each year, if the observation lies outside the one standard deviation band and the subsequent observation crosses the zero line, it indicates a reversal and one point is added to the TPI.

3. Consistency. If at least one policy indicator is positive (average 5-year sub-period), indicating trade closeness and inconsistency, the TPI takes the value of one[17].

All three instability factors are transformed into the same dimension: single points that are scored[18]. Appendix 3 presents tables of countries with their corresponding total TPI values and components' values.

4.1. The Volatility Component

Modeling the volatility component of the trade policy instability definition requires the calculation of the standard deviation of levels and the standard deviation of the first-difference for Tariffs and BMP. A move toward stability would require lower dispersion in both *level* and *changes*. If the standard deviation of the policy in a particular sub-period is above the 30-year average, it is interpreted as "highly volatile" and the binary variable takes the value of one. Otherwise it is zero[19].

4.2. The Commitment component

Commitment to the trade policy is measured by the number of reversals in the policy. As indicated in Section 1, liberalization episodes that have been reversed indicate lack of

[17] Volatility and commitment indicators are analyzed yearly but it was found consistency (both policies following the same trend toward liberalization) to be better analyzed every 5 years. The reason is that some policy adjustment does exist during the reform that could create policy discrepancies in a particular year, but such discrepancy may not last more than five years if it just represents a policy "tuning".

[18] Each point added up to the TPI is equally weighted. Some rule may be applied to weight differently each component, but no formal rule does exist.

[19] In order to add *intensity* to the index, a three-tier measurement scale for volatility is adopted. The value of two is added when policy indicators fluctuate higher than two-standard deviations. This new index is described in more details in Section 6.2 as part of the robustness measures.

commitment by the authorities, signaling instability in the trade policy. A reversal is identified when the observation lies outside one standard deviation of its mean and the subsequent observation crosses the zero line. This condition adds the value of one to the TPI. Higher number of points indicates lack of commitment and higher policy instability.

Since the Index is applied under a panel setting where the 30-year time series is split into 5-year sub-periods, the maximum number of volatility and reversal points in each sub-period is five. Appendix 3 submits tables of the countries under study with the corresponding volatility and commitment values for both Tariffs and BMP for a total of thirty years.

4.3. The Consistency Component

The third component of the Trade Policy Instability Index is the *consistency* among trade policies. The criteria require that Tariffs and BMP show the same direction toward openness. If the average value of both policies is negative, it indicates policy coherence and the index takes the value of zero (negative value in the first difference implies lower tariffs and lower black market premium). If the signs are different, the index takes the value of one since at least one policy is moving toward closeness. Figure 24 shows some examples of countries and their corresponding consistency indicator. For example, Bolivia shows a negative sign of the Tariffs Rates for the period 1986-90 (-0.98) but a positive sign in the BMP (13.91), thus, the TPI takes the value of one, indicating inconsistency among policies during the corresponding period. Botswana shows the same sign in both policies over the period 1991-95 with 0.57 in Tariff, and 4.10 in BMP,

indicating that both policies follow the same direction toward closeness. This adds up a point to the TPI.

Figure 24
Coherence among Trade Policy for five countries

	Average first-difference TARIFF			Average first-difference BMP			TPI		
	1986-90	1991-95	1996-00	1986-90	1991-95	1996-00	1986-90	1991-95	1996-00
Argentina	-0.92	-4.92	-0.25	-0.28	-7.00	-3.65	0	0	0
Bolivia	-0.98	0.01	-0.05	13.91	0.03	-0.29	0	1	0
Botswana	-0.03	0.57	-1.48	-5.14	4.10	-5.07	0	1	0
Brazil	-0.37	-0.77	0.38	-1.71	-4.47	-6.04	0	0	1
Burundi	-1.67	0.33	-1.23	-5.06	14.67	-9.23	0	1	0

Figure 25
Table 25-1: Correlation Matrix

	Volatility	Commitment	Consistency	Total (TPI)
Volatility	1.00			
Commitment	0.63	1.00		
Consistency	0.74	0.54	1.00	
Total (TPI)	0.94	0.76	0.89	1.00

Table 25-2: Value of the TPI and its Components (Regressions Values)

	Parameter value	t-value	P-value	R^2
1 GDP growth rate vs TPI	-0.0006	-2.42	0.02	0.10
2 GDP growth rate vs Consistency	-0.0021	-3.32	0.00	0.16
3 GDP growth rate vs Commitment	-0.0020	-1.68	0.10	0.05
4 GDP growth rate vs Volatility	-0.0008	-1.47	0.15	0.04
5 GDP growth model[1] vs TPI	-0.0006	-1.94	0.06	0.57
6 GDP growth model vs Consistency	-0.0019	-2.65	0.01	0.59
7 GDP growth model vs Commitment	-0.0006	-0.61	0.55	0.54
8 GDP growth model vs Volatiltiy	-0.0007	-1.23	0.23	0.55
9 GDP growth model vs TPI and all components				0.59
TPI	-0.0019	-2.27	0.03	
Volatility	0.0018	1.47	0.15	
Commitment	0.0019	1.39	0.17	

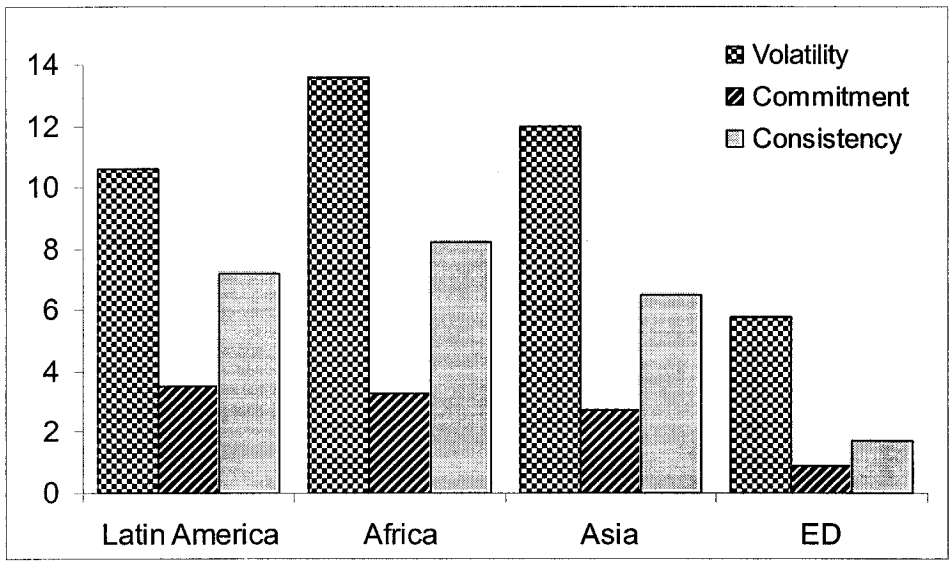
[1] GDP growth model is: GDP growth = a + b_1Y70 + $b_2$ln_investment + $b_3$ln_education(2nd year enrollment)

Figure 25 presents evidence of the importance of the three components. From table 25-1, it is evident that the three components are fairly correlated –all values are greater than 0.5–, indicating that they represent partial measures of the same event: trade policy instability. Also, each of the components is highly correlated with the TPI –all values are

greater than 0.75–, indicating that the TPI represents a measure of each of the components. Table 25-2 shows the parameter value of each component and the TPI in a regression against growth rates. All three components and the TPI exhibit negative signs, but the volatility measure is the only nonsignificant factor (*t=-1.47*). The TPI is statistically important on its own and combined with Volatility and Commitment.

Figure 26 shows the 30-years average TPI components by region. While the volatility indicator shows that Asia exhibits higher volatility than Latin America, the commitment and consistency indicators are the lowest in Asia than Latin America and Africa.

Figure 26
Average TPI Components by Region



Revealing policy volatility, commitment, and consistency requires some form of subjectivity. Particular decisions on benchmarks to determine shifts in policies are inherent factors of the index; thus, different robustness techniques are analyzed in Section 6 in order to confirm the explanatory power of the TPI. Also, the TPI may show a causal relationship with other domestic policies and with economic growth; however, if the TPI

is a satisfactory measure, the value and sign of its parameter in the regressions should be fairly invariant to changes in model specifications. Section 6 confirms that this condition is met.

4.4. The Trade Policy Instability Index and the Economy

If the Trade Policy Instability Index is an approximate measurement of policy instability, it should be related to different economic and political factors. For instance, if there is high probability that an opposition regime will take over in the next elections, firms would expect changes or reversals in various economic policies including trade. Therefore, the higher is the number of instability in the political regime, the higher should be the trade policy instability. Figure 27 shows the relationship between the TPI and the regime durability based on the number of years since the last change in authority characteristics (Polity IV dataset). It is evident that higher political regime instability (the lower values of the index) is associated with higher TPI. Feng (2003 p.180) applied this variable of regime durability in his analysis on growth and investment.

The security of property rights and enforcement laws are key factors for investors to make long-term economic decisions (Barro, 1996). The fragility or nonexistence of property right institutions could deter investment and growth. Figure 28 exhibits the relationship between the Trade Policy Instability Index and a Property Right Index (from the International Country Risk Guide dataset). Preliminary evidence from the graph suggests that trade policy instability is strongly associated with weak property right environment.

Figure 27
Trade Policy Instability Index and Regime Stability for 60 countries

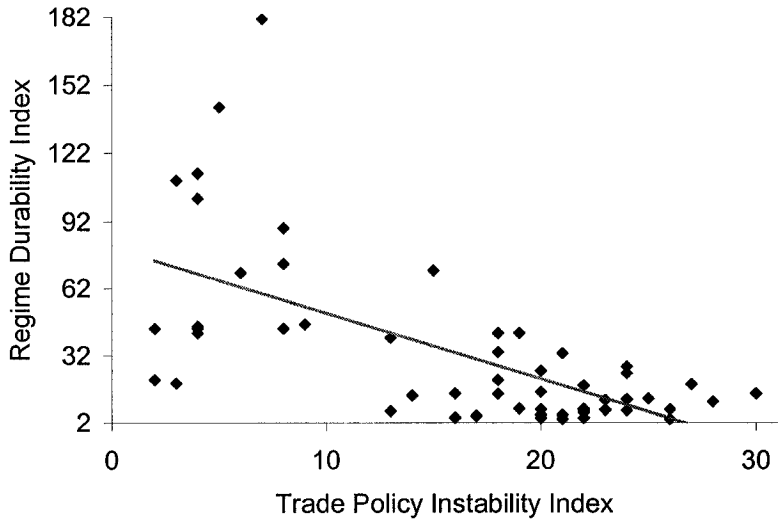
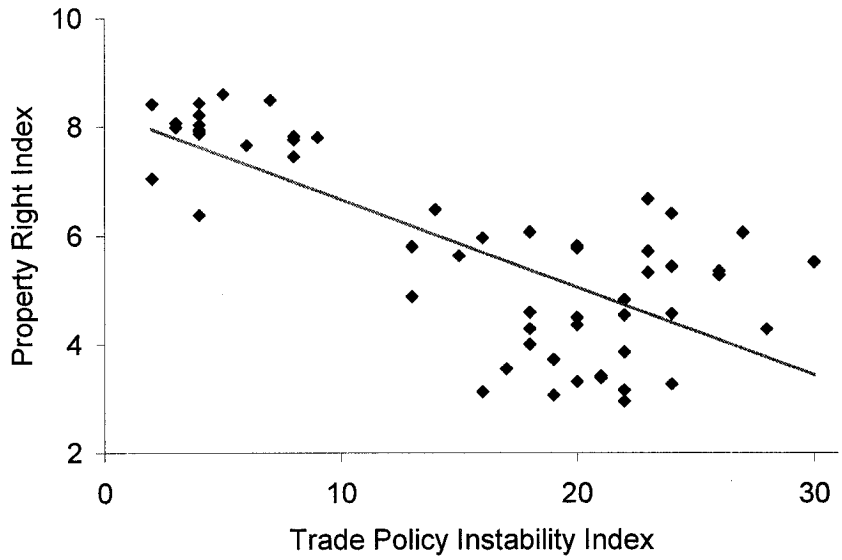


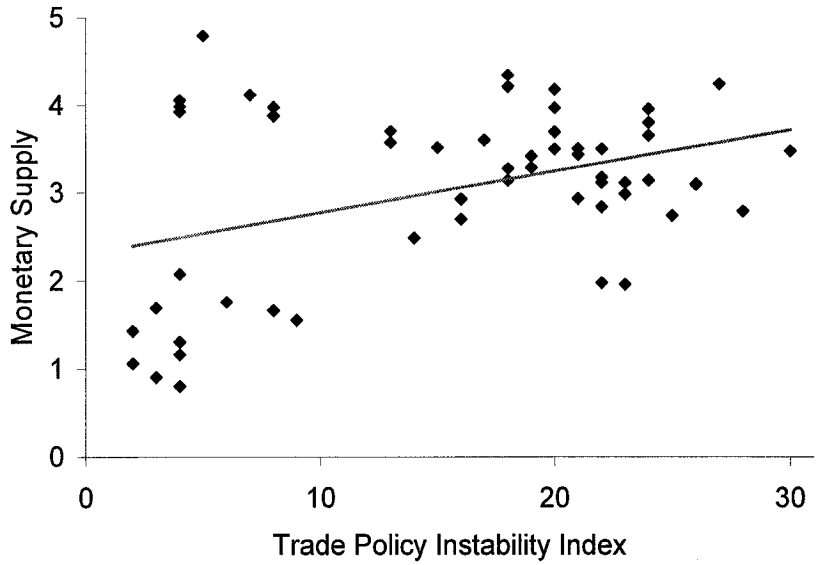
Figure 28
Trade Policy Instability Index and Property Rights for 60 countries



Trade reform is not the only economic policy where the authorities should promote stability in order to achieve economic growth; monetary and fiscal stability is also important. Section 1 describes various cases of counties that followed new trade strategies without macroeconomic stability, forcing the economy to reverse trade policies

(Peru). It also presents successful examples, where trade reform was accompanied by well-managed fiscal expenditure and effective reduction of inflation (Korea and Chile). Figure 29 confirms the positive relationship between monetary policy and the TPI; monetary expansion is related to higher trade policy instability.

Figure 29
Trade Policy Instability Index and Monetary Supply for 60 countries



In order to confirm the reliability of the TPI as a measure of policy instability, figure 30 shows the correlation between the TPI and various policy and political stability indicators. The high correlation between the TPI and Corruption, Property Right, Education, and Tariffs suggest that the Trade Policy Instability Index is also a good proxy of policy instability indicator.

Figure 30
Correlation of the Index against other Policy and Political Indicators

	Investment	*Initial Income*	*Education*	*Tariff*	*GOVSTA*	*DURABLE*	*Corruption*	*Property Right*	*Law&Order*	*Gov. Consumpt*
Index	-0.52	-0.83	-0.82	0.62	-0.60	-0.65	-0.74	-0.75	-0.71	0.47

4.5. Strengths and Limitations of Policy Instability Measurements

Section 2 along with previous empirical evidence reveal the existence of a connection between the three components of the trade policy instability index and economic growth. Poor commitment and consistency with high volatility in trade policy deteriorate economic performance. For instance, coherence of the policy reinforces any reform since credibility is associated to the number of policies that follow the same direction toward liberalization. Authorities find it more difficult to go back to the old state of affairs as they would have to reverse more policies simultaneously.

Papageorgiou et al, (1991) classified countries as: those with a stable liberalization reform, those that kept wavering but sustain the liberalization processes, and those that trade liberalization policies collapsed. Chile, Indonesia, and Sri Lanka belong to the first category, while Colombia and Pakistan fit in the second category. Brazil is considered as a collapsed state. TPI also classified these countries in the similar order.

Nonetheless, revealing policy commitment, consistency and volatility requires some sort of subjectivity on the degree of these measures. Subjective decisions on the benchmarks where the observations shift from "low to high" are important factors of the definition. For example, a policy that has survived a long period of time and then is reversed in one period, should it be considered as a reversal? In addition, the three instability factors in the TPI are transformed into single points where each point added to the TPI is equally weighted. Some rule may be applied to weight differently each component, but no formal rule does exist. The subjectivity of thresholds and the lack of rules in weighting each component call for robustness measures. Section 6.2 copes with

different robustness tests in order to confirm the validity of the TPI in measuring trade policy stability.

Also, caution must be stressed when applying the standard deviation to measure volatility. High standard deviation may imply unsteadiness and thus rank low in any stability measure; however, it may also imply changes to improve the existing policy, thus, resulting in a positive score[20]. Harsh changes may represent high volatility in terms of the standard deviation; although, it may generate positive supply-side effects. The commitment and consistency components of the definition of trade policy instability become essential factors to overcome the impreciseness of volatility. The combination of the reversal patterns, the coherence, and the volatility of the trade reform produce a more consistent measure of stability in contrast to the single use of the standard deviation.

Finally, most trade policy measures may show causal relationship with economic growth, where the direction of the relationship is unclear; however, if the TPI is a satisfactory trade policy instability measure that negatively affects economic performance, the value and sign of the TPI parameter in most regressions should be somewhat invariant with respect to changes in model specification or methodologies. Section 6 confirms that this condition is met.

[20] One example is the case of South Korea during the 1970s where trade policy was exposed to sudden and persistent changes. However, firms regarded such frequent adjustments as part of the government's plan to keep export promotion instead of an instability factor (Jones and Sakong, 1980).

Section 5: Estimation

Finding the sources of growth disparities among countries has been the endeavor of many well-known scholars (Mankiw, Romer and Weil, 1992; Barro and Lee, 1994; Sala-i-Martin, 1997)[21]. Research in this area has its foundations on the Solow (1956), Cass (1965), and Koopmans (1965) models, where the cause of economic gap among nations is technology and population, both exogenous parameters. Subsequent theoretical models based on the neoclassical approach have added important variations. For instance, Romer (1986) incorporated the technology parameter as dependent on capital investment instead of external shock. Romer (1990) and Grossman and Helpman (1991) associated the technology parameter with R&D expenditures and other measurable variables.

Barro (1991) and Mankew, Romer and Weil (1992) pioneered the empirical implications of the Solow Model, particularly the proposition of convergence: the lower the starting level of per capita income, the higher the growth rate[22]. Most of the empirical work based on the neoclassical growth model has relied on cross-country regression analysis where other variables from human and physical capital have been incorporated. New testable variables were also available in explaining the source of economic growth. For example, Barro and Sala-i-Martin (1995) add variables related to economic and political institutions, showing that a negative "beta" value (the convergence parameter) is conditional on such variables. In these settings, governments have the potential to intervene through economic policies.

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[21] For a detailed literature survey on empirical economic growth see Durlauf and Quah (1998).

[22] There are earlier studies on empirical economic growth based on the neoclassical model; however they emphasize on the factors affecting growth and not specifically on the convergence issue. See Grier and Tullock (1989).

The Solow results have been empirically studied under different methodologies[23] and evidence of conditional convergence (after controlling for determinants of the steady state)[24] has emerged. The regression of income per capita to savings, population, and human capital in various empirical growth studies is promising in terms of the linkage between theory and the observable variations in income. However, empirical work has been under strong criticism over the past years. The lack of theoretical foundation and the dependency of the results on the number of countries, the time period, and the methodologies are the most important shortcomings (Levine and Renelt, 1992). Additionally, the non-excludability in the validation of variables (the statistical significance of one argument does not preclude the importance of others) has resulted in over sixty different variables that have been proposed as growth determinants (Levine and Renelt, 1992; Durlauf and Quah, 1998). Another limitation of growth model is the parameter heterogeneity, where parameters pertaining to countries may differ from one another by unobservable conditions. This has been addressed through panel data analysis (Evans, 1997) or regional dummies in order to reduce bias on the results. As an attempt to overcome the country and time dependency, most of the studies have incorporated as many countries and time periods as possible. These alternatives have not completely addressed the problems of empirical growth analysis; for this reason, further examination is always an important element of the research. The model developed in this section makes use of some of these techniques and dedicates Section 6.2. on robustness analysis

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[23] See Islam (2003) for a detailed survey on convergence results under different measurements and methodologies.

[24] Endogenous growth models (Romer, 1986, 1989; Lucas, 1988) predict different results from the Solow model regarding convergence. In these models there is no steady state level of income and the differences among income per capita may persist indefinitely. Observe that robustness has been on conditional convergence; absolute convergence is generally discarded. See De long (1988) and Barro (1991).

in order to reduce possible bias in the results and confirm the validity of the trade policy instability index as a determinant of economic growth.

The model specification is based on Barro (1991) with a conditional panel adjustment where the dependent variable is partially predicted from its earlier value[25]:

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \delta\, TPI_{i,t} + v_{i,t} \qquad (1)$$

In Equation (1), $\Delta y_{i,t}$ is the 5-year average[26] of the income per capita growth rate for economy i over the period 1970-2000[27]. Each of the 90 countries under study has six time-observations. The μ_i term is the country specific factor indicating a fixed-effect model. This term will account for omitted variables that are specific to individual countries. $TPI_{i,t}$ stands for the Trade Policy Instability Index; $y_{i,t-j}$ represents the initial income and γ corresponds to the convergence parameter. The matrix X_i represents control variables associated with the vector β of coefficients. These control variables have been ascertained to be robust in explaining growth. Levine and Renelt (1992) identified over sixty possible control variables, and Leamer (1983) and Sala-i-Martin (1997) studied the confidence of such variables. Their proposals have been very useful, although not definitive. Based on the range of control variables in the growth literature, the benchmark regression includes macroeconomic policies, such as money supply and government consumption, conditions on human and physical capital, indexes of political

[25] Finkel (1995) and Greenaway et al. (2002) offer various explanations in applying this methodology.
[26] The model could also be regressed on one-year period, but if the characteristic of the process to get to the steady state is invariant over time, then considering the analysis under successive shorter time periods should not change the main results (Islam, 1995).
[27] Most studies use growth per capita as dependent variable. However, there are some contributions based on income levels. See Jones (1995) and Hall and Jones (1996) to detail on the ongoing debate over this subject.

instability, and dummies for geographical regions among others. These variables attempt to control for differences among various development stages for each country[28]. The explanatory variables enter independently and linearly[29]. Finally, the $v_{i,t}$ term is the transitory error term that varies across countries and time periods. The mathematical development and details of equation (1) are presented in Appendix 4.

Following Greenaway et al, (2002) on panel data and dynamic growth models, the relationship between trade policy instability and growth in a panel framework is applied. It is recognized that cross-sectional analysis lacks dynamism on the process of modeling relationships. In the particular case of trade liberalization reforms, changes in policy are expected to lead to more neutrality in market prices and to promote better resource allocation. However, in a cross-sectional framework it is difficult to observe agents' reaction to policy changes[30]. The combination of an instability measure under a panel data approach allows for a more accurate assessment of agents expectations and their effect on growth.

The panel method allows for unobservable country-heterogeneity and reduces omitted variable bias problems. Also, panel designs can test in a more rigorous form the causal relations among variables than under a cross section.

Despite its merits, panel data analysis also presents some limitations. In order to work with panels, a large number of countries and time observations are required;

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[28]Given the lack of a theoretical framework and the difficulties in the quality of data, choosing the core control variables has been a long debate. Barro (1991) and Mankiw, Romer and Weil (1992) incorporated different variables from population growth and investment to economic institutions and political instability. See Barro and Lee (1994) and Hall and Jones (1999) for the ongoing debate on control variables.

[29] Durlauf and Quah (1998) explain the weakness of growth models under the assumption of linearity of control variables. They consider that factors like international market distortions and political regime may induce nonlinearities in the growth relation.

[30] For other limitations on cross-section regressions see Lee and Swagel (1997), Evans (1997) and Islam (2003).

however, such data may not be available or its source may be questionable. Additionally, panel method can account for omitted variables that change across countries and over time but cannot control for both at the same time. This requires additional techniques like Instrumental Variable analysis, which is described in more detail in the next section.

5.1. Instrumental Variable Analysis

In Equation (1), it is assumed that the right-side variables are exogenous from the errors; otherwise the Ordinary Least Square (OLS) estimates may be inconsistent. For instance, countries that trade more will grow faster due to increasing return to scale and spread of technology; but also evidence suggests that countries with higher income tend to trade more. Nations with better institutions grow faster than those with weak ones, but also countries with higher income invest more in institutions (Dooley, Frankel and Mathieson, 1987; Rodrik, 1995). A general solution to endogeneity is the application of Instrumental Variables or IV. These variables are correlated with the original variables but uncorrelated with the errors. Roll and Talbott (2002) transformed variables into orthogonal polynomials, while Barro and Lee (1994) use lagged values as IVs[31]. Two variables enter Equation (1) in its instrumental form: Investment and Initial Income.

5.2. The Control Variables or Elements of X_i

5.2.1. Initial per Capita Income

In the neoclassical growth models of Solow (1956) and Cass-Koopmans (1965), growth rates are inversely related to their starting level of income due to diminishing

[31] Barro and Lee (1994) used 5-years lagged values, while Easterly and Levine (2001) used one-year lag. See the appendix on Easterly and Levine for more detail on the properties and assumptions of instrumental variables. For technical details see Greene (2000) and Stock and Watson (2003).

return on capital. Thus, developing countries should grow faster than OECD countries when controlling for technology parameters. Prior GDP value keeps track of this relation defined as convergence effect[32]. Following Barro and Sala-i-Martin (1992) and Sala-i-Martin (1996) an initial per capita GDP (1970-GDP level) represents the variable that controls for convergence in income.

5.2.2. Human Capital: The Educational level debate

The model augmented by human capital investment was developed by Lucas (1988). Human capital accounts for new products and ideas that support technological progress (Romer, 1990); additionally, an educated human force facilitates the adaptation of foreign technology (Bebhabib and Spiegel, 1994). These elements imply that growth rates are more sensitive to starting levels of human capital.

In the empirical ground, the relevance of human capital is debatable. While Krueger and Lindahl (1999) did not find evidence on the relationship, Barro and Lee (1994) and Hanushek and Kimko (2000) showed positive results. The inconsistency in the findings may come from the lack of reliable data on human capital. Better dataset are still needed on variables approaching human capital. School-enrollment rates are widely used as a measure of the initial stock of human capital[33]. A possible shortfall of school-enrollment is that it may end up in a causal relationship with growth since education may also be a result of higher economic development. However, this measure is likely to be the more accurate one and has been proven to be significantly correlated to economic growth

[32] If the production function shows nonconvexity, different steady-states for different groups of countries could emerge and a unique convergence may not be present (See Azariadis and Drazen, 1990, and Bernard and Durlauf, 1993). See Barro and Sala-i-Martin (1990) for more details on convergence.

[33] Barro (1991) uses life expectancy and student-teacher ratios, and Romer (1989) applies adult literacy rates, both signal for initial stock of human capital.

(Barro and Lee, 1994). Following general consensus, secondary education enrollment is one of the control variables in this study.

5.2.3. Physical Capital

The ratio of real gross domestic investment to GDP enters into the regression as control variable (Barro and Sala-i-Martin, 1995). Investment Ratio represents one of the original parameters in the Solow model as the source of growth. Its relevance in affecting per capita income is controversial. There are potential inconsistencies in OLS estimators due to causality factors. This variable enters Equation (1) in its IV form to control for causality effects.

5.2.4. Macroeconomic Policies

Analyzing the effects of macroeconomic stability is a relevant factor when studying trade policy. Under macro instability, generally characterized by high inflation and public fiscal imbalances, any positive effect of a trade reform could easily be offset. Trade liberalization policies intend to promote a market oriented economy where prices drive resource allocation. However, such policy objective may be nullified by price distortions from high inflation episodes. High inflation does not allow markets to signal adequate prices since it is difficult to differentiate price changes caused by supply and demand forces from those fostered by inflation. Also, high inflation is commonly associated with government's inability to manage the economy and shows negative relationship with income (Bruno and Easterly, 1998). In their empirical analysis,

Brunetti and Weder (1998) consider inflation rates as a proxy for policy uncertainty; however, this approach can be inaccurate because inflation may result from external shocks that are not related to domestic policies. In order to gain robustness in the results, Money Supply is applied in Equation (1) as a more accurate measure of monetary policy (Grier and Tullock, 1989).

In addition, there is considerable empirical work relating economic growth with fiscal policy. One of Easterly and Levine's stylized facts (2001) is that macro domestic policies negatively affect long-run economic growth. Barro (1990) shows under an endogenous growth model that a large government negatively affects growth through higher taxation. It is recognized that these variables have other indirect effects and its complexity is not explored in this work[34]. Following past empirical studies (Easterly and Rebelo, 1993; Rodrik, 1998a), the fiscal policy indicator to be tested in Equation (1) is the ratio of government consumption to GDP. Different categories of fiscal policy can be applied in the regressions (e.g. government expenditure compiled by the World Bank dataset); however, government consumption dataset from WPT6.1 is by far more complete and reliable (it is adjusted for purchasing-power differences across countries and it goes back more than thirty years) and more adequate for panel data analysis than the World Bank dataset on government expenditure.

Aizenman and Marion (1993) find robustness results on the negative effect of the volatility of fiscal and monetary measures on investment and economic growth. Thus, Equation (1) includes both, the level and the volatility of the monetary and fiscal policy.

[34] For example, government expenditure may affect growth in a non-linear pattern. It tends to be positively related to aggregate demand and education, but after certain level, it may reduce investment and growth.

5.2.5. Institutional Framework: Corruption

The empirical literature suggests a negative relationship between corruption and economic growth (Mauro, 1995; Brunetti and Weder, 1998; Wei and Kauffman, 1999). One obstacle in transforming savings and investment into per capita income is the involvement of inadequate institutions. Corrupt legal and regulatory frameworks reduce investment since they impose an extortionary tax on firms (Keefer and Knack, 1997). Additionally, they affect efficiency in resource allocation since investments may tilt toward those opportunities favoring corruption (Shleifer and Vishny, 1993). Li, Xu and Zou (2000) present a list of possible distortions and economic inefficiencies that corruption may generate in an economy, from project delaying to talent misallocation.

5.2.6. Institutional Framework: Property Rights

The risk of expropriation is a factor that most likely affects investment decisions in developing countries. The security of property rights and enforcement laws are variables closely observed by both domestic as well as foreign investors. When such factors are absent or weak from the institutional environment, "firms tend to adopt less efficient production processes in order to reduce their commitment of fixed capital assets that would be vulnerable to expropriation" (Keefer and Knack, 2002).

Indicators that appraise corruption and property rights are the indexes from the International Country Risk Guide (ICRG)[35]: Rule of Law, Property Rights, and Corruption in Government. These three indexes are applied in Equation (1); however, a

[35] See Keefer and Knack (2002), Li, Xu and Zou (2000), and Lambsdorff (2003) in the application of the ICRG indexes. Also Wei (1999) provides a discussion about this and other indexes of corruption.

problem of data availability is observed in this dataset since these indexes run from 1984 to 2000. When incorporating these indexes to the regressions, data set changes from six to four observations for each country.

5.2.7. Government and Political Instability

Government and political instability are defined as unexpected transfers of political power in a country. Persistent government changes increase the uncertainty of economic policy stability since authorities are perceived as unable to carry out reforms and stay in office. Feng (2003) suggests that "when a political regime is unstable, consumers decrease savings since they may become worthless". For instance, if there is a high probability that an opposition regime will take over, firms would anticipate reversals in policies and their economic decisions will be based on such political factors (e.g. holding back on investment, capital flights, and so on). Therefore, government instability has been proven to negatively affect economic growth. The indicators of government instability to be applied in Equation (1) are: Government Stability from the ICRG political data (GOVSTA) and Regime Durability (DURABLE) from Polity IV dataset.

In general, the application of control variables helps to differentiate particular development stages among countries. For example, countries positioned lower in the development ladder will tend to show less current effective use of resources, while countries with higher development will likely be promoting technological diffusion.

Section 6: The Effect of Trade Policy Instability on Growth

This section offers a detailed description of the dataset and the econometric analysis of the relationship between the TPI constructed in Section 5 and economic growth. The results evidence that trade policy instability has a negative impact on economic performance. This relationship is robust to changes in model specifications and methodology.

The dependent variable in the regression model denotes the real GDP growth rate. The independent variables consist of the Trade Policy Instability Index (TPI) and ten control variables classified into four categories: (1) initial condition variables, (2) macroeconomic policy variables, (3) institutional framework variables, and (4) political stability variables. The control variables include the initial per capita income for testing convergence (INITIAL_Y), the investment as a share of real GDP (INV), and the secondary-enrollment school as a measure of investment in human capital (HK). Past empirical studies (Greenaway et al, 2001 and Barro, 1997) suggest a strong causality between these variables and the dependent variable which may bias the OLS estimates. *Instrumental Variables* (IV) method is applied in order to reduce estimator bias when causality is suspected among regressors. INITIAL_Y and INV are instrumented on their own 5-year lag (10-year and 1-year lag was also tested and results do not change significantly). The macroeconomic policy variables consist of the annual money supply (M2) and government consumption as a percentage of GDP. Most of the control variables and the macroeconomic policy variables enter the equation in log terms.

The institutional framework variables are defined as PROPERTY, which represents the Property Right index from *Economic Freedom*; Law and Order (LAW&ORDER);

and Corruption (CORRUPTION). The political stability variables correspond to Political Stability Index (GOVSTA) and Regime Durability (DURABLE). The source and description of the data on all variables is presented in Appendix 1.

Table 1 exhibits the summary statistics for all variables. The initial income per capita (Y70) ranges from a minimum of $179 (Uganda, 1971-75) to a maximum of $41,812 (Luxembourg, 1996-00). Average investment as a percentage of GDP (INV) also shows large ranges: from 1.03 percent (Uganda, 1976-80) to almost 50 percent (Singapore, 1981-85). The total number of observations is 540 (6 observations per country for 90 countries) except for M2 with 510 (85 countries). The number of observations for BMP and Tariff is 426 and 366 respectively. CORRUPTION, GOVSTA and LAW&ORDER have considerable less data points, totaling 328 (4 observations per country for 82 countries). The institutional and political variables are indexes where higher values denote a better situation in terms of policy and political stability.

Table 1
Summary Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum	Count
GDP	0.06	0.04	-0.05	0.22	540
INV	16.52	8.66	1.03	49.95	540
HK	20.35	16.26	0.30	69.60	540
Y70	5044.58	5977.70	179.25	41812.03	540
M2	44.06	250.34	-4.78	4733.98	510
GOVCON	19.37	10.28	4.27	58.80	540
BMP	93.24	1187.14	0.00	21881.50	426
Tariff	0.11	0.11	0.00	0.60	366

	Mean	Std.Dev.	Minimum	Maximum	Count
CORRUPTION	3.59	1.45	0	6	328
GOVSTA	7.00	1.98	2	11	328
DURABLE	25.89	31.17	0	189	528
PROPERTY	5.44	1.96	1.15	9.6	498
LAW_ORDER	3.76	1.64	0.6	6	328

Table 2 reports the correlation matrix for the ten independent variables. As it was anticipated, GDP negatively correlates with INITIAL_Y, M2, and COVCON and positively correlates with INV and HK. A high correlation among the institutional and political variables is observed. For example, PROPERTY and CORRUPTION exhibit 0.77 correlation factor and LAW&ORDER with CORRUPTION and PROPERTY shows a 0.90 and 0.75 correlation factor respectively.

Table 2
Correlation Matrix

	GDP	*INV*	*HK*	*Y70*	*M2*	*GOVCON*
GDP	1.00					
INV	0.32	1.00				
HK	0.04	0.53	1.00			
Y70	-0.14	0.46	0.74	1.00		
M2	-0.16	-0.06	-0.07	-0.05	1.00	
GOVCON	-0.10	-0.28	-0.36	-0.42	0.16	1.00

	CORRUPTION	*GOVSTA*	*DURABLE*	*PROPERTY*	*LAW_ORDER*
CORRUPTION	1.00				
GOVSTA	0.45	1.00			
DURABLE	0.56	0.33	1.00		
PROPERTY	0.77	0.51	0.56	1.00	
LAW_ORDER	0.75	0.61	0.56	0.90	1.00

High correlation among variables has an impact on the variance of parameters causing changes in the signs of the regression coefficients[36]. Appendix 4 describes a test for assessing multicollinearity among institutional and political variables. The results suggest that a better alternative is to calibrate each variable sequentially[37].

[36] The extreme case is when two variables are perfectly correlated and the variance is infinite. This can be observed in the estimated variance of the b_k regressor. The value r^2_{12} stands for the correlation between variable 1 and 2: $\text{var}[b_k] = \sigma^2 / (1 - r_{12}^2) S_{kk}$

[37] Dropping variables that are highly correlated is generally applied to reduce multicollinearity; although, if the dropped variable actually belongs in the model, the coefficients may be biased. Nonetheless, Aizenman and Marion (1995) considered that high correlation among indicators should enter the regression sequentially.

The first relationship to be tested is the level and volatility of tariff rates and black market premium against economic growth in order to confirm that trade policy indicators have a negative impact on economic performance. Afterward, the *Trade Policy Instability Index* enters the regression to confirm its statistic relevance. The TPI and Tariffs are combined into an interaction term (TPI_TARIFF) to verify that any positive effect of a reduction in tariffs on growth is enhanced if accompanied by a decline in the policy instability. The TPI remains an improved measure of trade policy instability rather than the volatility of individual trade policy indicators since the latter may not indicate policy instability as suggested by the examples of South Korea and Malaysia from Section 1. South Korea's frequent adjustments in the trade policy during the 1970s were regarded as a trade strategy rather than an instability factor (Jones and Sakong, 1980). The commitment and consistency components of the TPI turn out to be essential to overcome the impreciseness of volatility.

Equation (1) and its different specifications are estimated both with and without *IV* method. Lagged values as instruments have their limitations[38]; however, the similarity between *IV* and (Ordinary Least Square) *OLS* estimates resulted from the regressions may be indicative of unbiased parameters. One important exception is the Investment Ratio (INV). Although INV shows no statistical significance under the *IV* model, the parameter becomes important under *OLS* model[39]. All panel data regressions apply the *fixed effect* method, which controls for omitted variables that may differ across countries.

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[38] The main problem is the lack of statistical tests confirming instrument variable validity: instrument relevance and exogeneity. See Stock and Watson (2003) for more details.

[39] Barro (1995) and Greenaway et al, (1997) present the same results. There is a significant difference in the investment parameter when comparing the IV and OLS methods.

6.1. The negative impact of trade policy instability on growth

The key question to be considered is: *do countries that lower tariffs experience significantly higher rates of growth when accompanied by lower trade policy instability?* Column (1) and (2) from Table 3 shows the effect of the two trade policies (LN_BMP, LN_TARIFF) on economic growth. In line with Barro and Lee (1994) and Sala-i-Martin (1997), BMP and Tariffs negatively affect growth rates (*-0.005, t=-3.95 and -0.075, t=-2.73 respectively*). The standard deviation of Tariffs and Black Market Premium (TARIFF_SD, BMP_SD) are considered policy instability indicators and they show a negative and important impact on growth (column 3 and 4). Results do not change when applying the first-difference of the standard deviation of the trade policies (not shown in the table)[40].

Column (5) shows the impact of tariffs and volatility of tariffs on economic growth under the same regression. Tariffs volatility becomes a key factor at explaining economic performance and tariffs becomes statistically irrelevant. This result is also supported by a higher R^2 (from 0.54 to 0.56). Column (6) shows similar results for the case of BMP.

Investment shows no statistical importance under IV –and in some regressions it exhibits negative values–; however, it becomes relevant under OLS, indicating some causality between investment and growth. The value of Y70 is negative (-0.05), representing convergence in the system (Barro, 1991; Finkel, 1995). Human Capital (LN_HK) shows no statistical significance under any model specification. Earlier work shows similar results regarding human capital (De Gregorio, 1992; Benhabib and Spiegel, 1994; and Islam, 1995). This indetermination may be due to data limitations,

[40] Rodrik (1998a) applies the first difference of the standard deviation as an indicator of instability for the case of fiscal policy.

where schooling figures are yet to be adjusted for quality differences. Fiscal policy (LN_GOVCON) and monetary policy (LN_M2) show the expected sign in most cases but their statistical importance varies among regression specifications[41]. It is recognized that these variables have indirect effects on growth and their complexity is not explored in this work. For example, government expenditure may affect the economy in a non-linear pattern: it tends to be positively related to aggregate demand and education, but after a certain level it may reduce investment and growth[42].

Table 3
Panel Data Regression of trade policies and Economic Growth
Column 1-6: IV - Two-Stage Least-Squares (2SLS)

Regression No.	(1)	(2)	(3)	(4)	(5)	(6)
LN_Y	-0.051 *	-0.043 *	-0.049 *	-0.043 *	-0.049 *	-0.042 *
	(-12.72)	(-11.37)	(-13.23)	(-11.25)	(-12.15)	(-11.14)
LN_INV	-0.002	-0.004	-0.003	-0.007	-0.003	-0.004
	(-0.14)	(-0.32)	(-0.26)	(-0.51)	(-0.25)	(-0.30)
LN_HK	-0.002	-0.013	-0.004	-0.010	-0.004	-0.013
	(-0.39)	(-2.40)	(-0.69)	(-1.99)	(-0.71)	(-2.45)
LN_M2	-0.004 *	-0.003	-0.003	-0.002	-0.003	0.001
	(-1.93)	(-0.02)	(-1.52)	(-0.86)	(-1.46)	(0.3)
LN_GOVCON	-0.012 *	-0.002	-0.010 **	-0.003	-0.010 **	-0.002
	(-1.940)	(-0.43)	(-1.71)	(-0.57)	(-1.64)	(-0.28)
PROPERTY	0.004 *	0.004 *	0.004 *	0.004 *	0.004 *	0.004 *
	(2.22)	(2.40)	(2.33)	(2.62)	(2.33)	(2.46)
LN_TARIFF	-0.002 *				0.007	
	(-2.73)				(0.19)	
LN_BMP		-0.005 *				-0.005 *
		(-3.95)				(-3.68)
TARIFF_SD			-0.226 *		-0.237 *	
			(-3.93)		(-2.96)	
BMP_SD				-0.002 *		-0.001 **
				(-2.11)		(-1.5)
C	0.529 *	0.443 *	0.512 *	0.446 *	0.508	0.433
	(8.52)	(9.32)	(9.1)	(8.86)	(8.37)	(9.06)
R2	0.5525	0.5422	0.5638	0.5146	0.5644	0.5465
No. Observations	348	385	348	385	348	385

* = significance at 5%; ** = significance at 10%; Values in parenthesis are t statistics

[41] Individual macroeconomic policies were also included in the regression in order to control for high correlation between monetary and fiscal policy, and the results remain similar to those from table 3.

[42] For more details on the effect of Fiscal Policy volatility on growth see Fatas and Mihov (2003). They consider that fiscal policy may promote macroeconomic instability but it also may smooth business cycles by using expansionary public spending in recessions and contractionary spending in expansions.

A property right institutions index is incorporated in all regressions from Table 3 and the value of this parameter shows a positive and statistically important effect on economic growth. This is in line with the findings on Barro (1997).

Trade policy plays a central role in explaining poor performance in economic growth. The parameters are robust to changes in model specification and changes in methodology (e.g. from IV method to OLS method). Finally, the R^2's from the different model specifications are between 0.50 and 0.60.

Table 4 exhibits the effect of the Trade Policy Instability Index (TPI) on economic growth. It also presents the results when combining TPI and tariffs and BMP in order to confirm the relevance of the policy instability factor on the effectiveness of trade policy on growth. The TPI exhibits a negative impact on economic growth and it is statistically important (Column 1). When the model includes tariffs and TPI (column 2), the TPI is the relevant factor at explaining growth and Tariffs becomes non-significant. Column (3) shows the results of the effect of BMP. TPI and BMP are important at explaining economic growth; however BMP's value falls when combined with the TPI (from *BMP=-0.005* from Table 3, column 2, *to BMP=-0.003*) indicating that the TPI emerges as the driven factor at explaining growth. Results do not change under OLS (not shown in table 4).

Column (4) and (5) exhibit two interacted regressors. The tariff interaction term (TPI*TARIFF) in equation (4) allows the examination of the positive effects of lower tariffs and lower trade policy instability simultaneously on economic growth. The effect of lower tariffs on growth is approximately 0.002 percent, but if lower tariffs are combined with lower trade policy instability, the effect on growth is 0.009 percent.

The results confirm that trade policy instability is a factor that negatively affects economic performance. On average, a fall of one unit in the TPI could increase annual growth by about one fifth of a percentage point; thus, countries capable of reducing the reversals and inconsistencies among trade policies could experience an additional 0.2 percent in their growth rates. The effect on growth becomes even more important if governments follow more open-oriented policies (e.g. tariff reductions) and a more trade policy stability environment simultaneously.

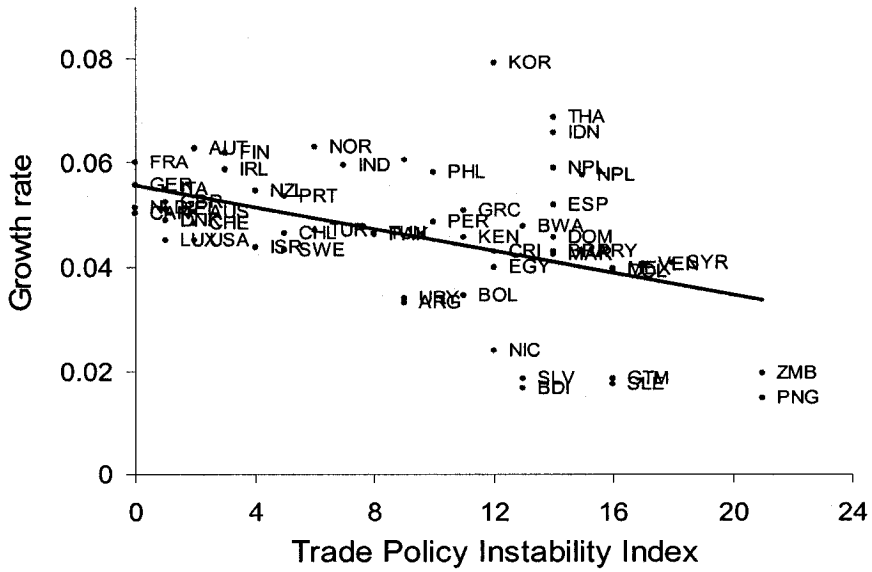
Table 4
Panel Data Regression of TPI and Economic Growth
Column 1-5: IV - Two-Stage Least-Squares (2SLS)

Regression No.	(1)	(2)	(3)	(4)	(5)
LN_Y	-0.050 *	-0.050 *	-0.049 *	-0.049 *	-0.046 *
	(-12.15)	(-12.16)	(-12.24)	(-11.96)	(-11.33)
LN_INV	-0.002	-0.002	-0.002	-0.007	-0.002
	(-0.17)	(-0.13)	(-0.13)	(-0.48)	(-0.12)
LN_HK	-0.004	-0.004	-0.005	-0.006	-0.004
	(-0.62)	(-0.61)	(-0.74)	(-0.91)	(-0.56)
LN_M2	-0.002	-0.211	-0.001	-0.004 **	-0.003
	(-1.05)	(-0.95)	(-0.40)	(-1.7)	(-1.34)
LN_GOVCON	-0.011 **	-0.012 *	-0.010 **	-0.012 **	-0.007
	(-1.840)	(-1.98)	(-1.79)	(-1.87)	(-1.18)
PROPERTY	0.003 *	0.003 **	0.003 *	0.003 *	0.004 *
	(1.86)	(1.81)	(1.90)	(2.05)	(2.47)
TPI	-0.002 *	-0.002 *	-0.003 *		
	(-3.22)	(-3.06)	(-3.83)		
TARIFF		-0.001			
		(-1.11)			
BMP			-0.003 *		
			(-2.15)		
TPI*TARIFF				-0.009 *	
				(-2.86)	
TPI*BMP					-0.001 **
					(-1.88)
C	0.516 *	0.519 *	0.513 *	0.532 *	0.464
	(8.75)	(8.79)	(9.04)	(8.45)	(8.7)
R2	0.5451	0.5482	0.5743	0.5287	0.5499
No. Observations	336	336	324	336	324

* = significance at 5%; ** = significance at 10%; Values in parenthesis are t statistics

Figure 31 displays the relationship between the TPI and economic growth adjusted by the control variables. The negative relationship between trade policy instability and growth is noticeable. Most developed countries fall into the category of high growth versus low TPI values and most developing countries show the expected relationship: the higher the TPI, the lower the growth rate. However, there are some evident exceptions. Some East Asian countries exhibit high growth along with relatively high trade policy instability. Also, Botswana emerges as an exception with growth rates exceeding 8 percent during the last decade[43]. This indicates that isolation of the impact of trade policy stability on growth must control for other factors in the regression model.

Figure 31
Trade Policy Instability Index and Economic Growth



[43] In 1966, after achieving independence from Britain, Botswana's GDP per capita was 80 dollars. By the 1980's, the average GDP growth rate was 9 percent. The discovery of Diamonds in 1967 may account for the main source of economic growth, representing almost 80 percent of export incomes.

6.2. Standarized Coefficients

The relevance of trade policy instability on economic growth is confirmed in Table 5 where the parameters of tariffs, the standard deviation of tariffs, and the TPI are standarized in order to compare the parameters' values. Values of all control variables are excluded from the table and only the trade policy variable, the standard deviation of the policy, and the TPI are shown. The standarized coefficient formula is given by,

$$b_k^{'} = b_k * \frac{\sigma_{x_k}}{\sigma_y}$$

where, $b_k^{'}$ is the standarized coefficient, b_k is the coefficient k from the 2SLS regression, σ_{x_k} is the standard deviation of the coefficient k, and σ_y is the standard deviation of the dependent variable.

Table 5
Standarized Coefficients: Tariffs and TPI effect on Economic Growth
IV - Two-Stage Least-Squares (2SLS)

ln_tariff	-0.09 **	-0.07	-0.09		-0.04	-0.07
	-1.78	*-1.20*	*-1.51*		*-1.23*	*-1.42*
sd_tariff		-0.09 *				
		-3.79				
fdsd_tariff			-0.11 *			
			-2.29			
TPI				-0.14 *	-0.14 *	
				-3.33	*-3.13*	
TPI*Tariff						-0.12 *
						-2.86
R^2	0.55	0.56	0.56	0.55	0.55	0.54

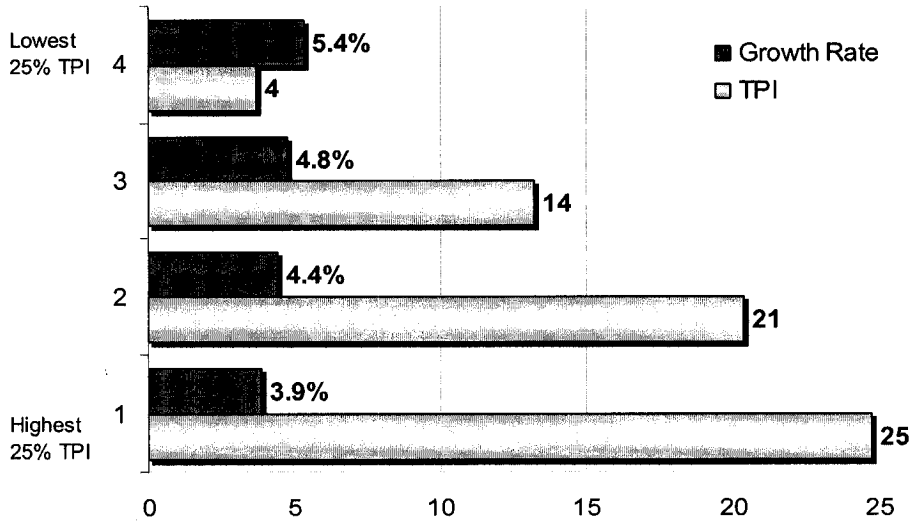
The effect of a reduction in tariffs on economic growth is 0.09. The effect of the TPI is almost twice as the tariffs (0.14), and the effect of the TPI and the tariffs is 0.12. This indicates that a country that reduces tariffs by 1 percent can experience an increase in

growth rates of 0.09 standarized points, but if the country reduces both tariffs and trade policy instability, the positive effect on growth increases by 0.12 standarized points. The results confirm the effectiveness of trade policy instability on economic growth.

6.3. How does the TPI affect growth?

It is evident that economic agents are concerned not only with the potential benefits that trade policy may offer them, but also with the stability of the policy. Figure 32 shows the distribution of the countries into four groups from the lowest to the highest TPI. The more stable countries in terms of the policy instability index exhibit an average growth rate of 5.4 percent, while those with high policy instability only show 3.9 percent. This represents a difference of 38 percent in terms of economic performance.

Figure 32
Country distribution according to the TPI



Policy instability –which consists of high volatility, constant reversals, and inconsistencies among policies– fosters an environment of uncertainty where firms and

consumers would prefer to delay economic decisions and thus, harm economic growth. Therefore, governments should promote an environment that moderates policy instability (e.g. reduction of the TPI). Regional trade agreements may promote policy commitment; also, the political regime (Lijphart, 1992), the number of Veto players (Tsebelis, 1999), or the accountability of leaders (Dahl, 1985) could moderate policy stability.

Which countries benefit the most from a reduction in the policy instability? Figure 33 exhibits a possible scenario of a reduction of the TPI by 10 percent. Countries in the rank of the highest policy instability would reach an average growth of 4.2 percent, representing 0.2 percent more in terms of long term economic performance.

Figure 33
Simulation of the effect of 10 percent reduction in the TPI on growth

Country	GDP growth (Yhat)	Growth with 10% TPI fall	Increase on Growth	TPI	TPI - 10%
Highest 25% TPI - Q1	4.03%	4.21%	0.18%	25	22
Q2	4.22%	4.34%	0.13%	21	19
Q3	4.96%	5.05%	0.09%	14	13
Lowest 25% TPI -Q3	5.26%	5.29%	0.03%	4	4

6.4. Macroeconomic policy stability

Table 6 exhibits the model from equation (1) where two new variables are introduced: SD_M2, and SD_GOVCON representing the standard deviation of the money supply and government consumption respectively. These parameters account for better proxies of macroeconomic stability. Volatility of government consumption does not present robust results in any model specifications (*IV* and *OLS*). In contrast, volatility of M2 negatively affects growth. TPI and PROPERTY maintain their statistical significance under both IV

and OLS, which confirms the relevance of the institutional and policy stability framework as determinants of economic growth.

Table 6
Panel Regressions: TPI and the stability of Macroeconomic Policy

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \pi_1 M2\_SD + \pi_2 GOVCON\_SD + \lambda TPI + v_{i,t}$$

Dependent Variable: GDP per capita growth rate
Regression Method: Column (1): IV - Two-Stage Least-Squares. Column (2): OLS

Regression No.	(1)	(2)
LN_INITIAL_Y	-0.045 *	-0.045 *
	(-11.75)	(-12.88)
LN_INV	0.0013	0.035 *
	(0.10)	(5.16)
LN_HK	-0.006	-0.001
	(-0.93)	(-0.18)
SD_M2	-0.00002 *	-0.00001 *
	(-3.79)	(-3.51)
SD_GOVCON	0.001	0.001 **
	(0.17)	(1.80)
PROPERTY	0.004 *	0.004 *
	(2.43)	(2.51)
TPI	-0.0024 *	-0.0018 *
	(-3.13)	(-2.54)
C	0.433 *	0.318 *
	(8.78)	(10.97)
R^2	0.5718	0.6078
No. Observations	336	336

* = significance at 5%
** = significance at 10%
Values under parameter are *t* statistics

Volatility of the first-difference of money supply and government consumption (LSD_M2 and LSD_GOVCON) were also tested under the IV and OLS method (not shown in table). The parameters and general results are similar to those from Table 6.

Finally, Table 7 incorporates two political stability variables: Regime Durability (column 1) and Government Stability (column 2). Law and Order is shown in column (3) as another indicator of institutional framework. The TPI exhibits the negative sign and the stability of its value is evident; although, it becomes non-significant in column (2). It must be noted that the R^2 in column (2) is considerably low ($R^2 = 0.11$). The modest fitness of the model may be due to the lower number of observations (from 336 to 220).

Table 7
The Growth Model with Different Political Stability Variables

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \pi(Political_n) + \lambda TPI + v_{i,t};$$

Where $n = DURABLE$ *and* $GOVSTA$

Dependent Variable: GDP per capita growth rate
Regression Method: Column (1) to (3): IV - Two-Stage Least-Squares.
Column (4): OLS

Regression No.	(1)	(2)	(3)	(4)
LN_Y70	-0.049 *	-0.043 *	-0.044 *	-0.048 *
	(-11.04)	(-5.40)	(-5.36)	(-12.22)
LN_INV	0.003	-0.068 **	-0.067 **	0.035 *
	(0.25)	(-1.840)	(-1.79)	(5.28)
LN_HK	-0.004	-0.0138	-0.0080	0.0009
	(-0.55)	(-1.11)	(-0.66)	(0.16)
SD_M2	-0.00001 *	-0.00002 *	-0.00002 *	-0.00001 *
	(-3.47)	(-3.14)	(-3.18)	(-3.21)
SD_GOVCON	0.001	0.001	0.001	0.002 **
	(1.5)	(0.72)	(0.48)	(1.92)
PROPERTY	0.0038 *	0.0046 **	0.0055 **	0.0037 *
	(2.41)	(1.66)	(1.87)	(2.47)
DURABLE	0.0004 **			0.0004 **
	(1.82)			(1.83)
GOVSTA		0.0035 *		
		(2.42)		
LAW_ORDER			0.0002	
			(0.07)	
TPI	-0.0024 *	-0.0020	-0.0029 *	-0.0018 *
	(-3.15)	(-1.57)	(-2.14)	(-2.58)
C	0.4384 *	0.6019 *	0.6173 *	0.3279 *
	(8.93)	(4.94)	(4.82)	(11.16)
R^2	0.5795	0.1124	0.0739	0.6125
No. Observations	336	220	220	348

* = significance at 5%; ** = significance at 10%; Values in parenthesis are *t statistics*

Overall, the TPI parameter and the parameter value from each individual trade policy indicator in its level and volatility form are statistically significant in most regressions tested in this study. One important characteristic of the TPI is the steadiness of its value in all regressions, which confirms that the Index is an improved measure of trade policy instability.

6.5. Robustness Analysis

Several changes in the model specification and in the methodology are developed in this section in TPI) confirm the robustness of the results. Although numerous estimations were completed, not all are reported. For example, different indicators of human capital were tested based on Barro and Lee (1994) dataset: primary and secondary school enrollment, female and male school enrollment, and number of pupils per teacher. The secondary school enrollment variable (HK) is shown in most of the results since it has been frequently applied by other authors. Population growth was introduced as another control variable; however, similar to Levine and Renelt (1992)'s findings, this variable shows to be not significantly different from zero. Finally, the growth model is analyzed under different methodological approaches. For example, cross-sectional and panel data results are evaluated. The findings relating to the relationship between trade policy instability and growth are significantly robust to changes in such model specifications.

6.5.1. Change in Methodology 1: From Panel Data to Cross-Section

The growth model under cross-sectional analysis is analogous to the work of Barro (1991) and is as follows:

$$\Delta y_i = \alpha + \gamma Y70_i + \beta X_i + \delta\, TPI_i + v_i \qquad (2)$$

The difference between equation (2) and equation (1) from Section 6.1. is the exclusion of the subscript t of the time series component and the specific-country effect component. The matrix X considers the same variables defined in Section 5.

Table 8 reports cross-section regression results where the dependent variable is the GDP per capita growth rate for the period 1980-2000. Each column represents a variation in the growth model: the first column shows the model including the convergence parameter (LN_Y70) as derived from the GDP per capita of 1970 (also the GDP per capita of 1960 was applied and the results are similar to those from Table 8). The second column adds the macroeconomic variables, M2 and GOVCON, as their 1980-2000 average values. Column (3) exhibits the complete model that includes PROPERTY represented by the average value of the Property Right Index for the period 1980-2000. In column (1) to (3), the *IV* method is applied (LN_Y70 and LN_INV are in their instrumental form). Finally, column (4) exhibits the complete model under *OLS* method.

As indicated by the negative beta-value, the convergence parameter holds with a value of -0.02, which is close to Barro's (1997) results. Investment has become statistically relevant in explaining economic growth and its value is also similar to that shown in Barro. The trade instability factor (TPI) shows the expected negative sign

indicating its robustness; nonetheless, the parameter value is lower than the panel data results (-0.001 vs. -0.002).

In evaluating Panel and Cross-country analysis, two important observations are made: First, results are similar in terms of the relevance of the trade policy instability index in affecting economic growth, although, with less intensity in cross-country models; and second, INV, HK, and GOVCON parameters are statistically important under cross-country analysis, while they show unstable significance under panel data framework.

Table 8
Growth Model and the TPI under Cross-Section Analysis

$$\Delta y_i = \alpha + \gamma LN\_Y70_i + \beta X_i + \delta\, TPI_i + v_i$$

Regression Method: Column (1) to (3): IV - Two-Stage Least-Squares.
Column (4): OLS

Regression No.	(1)	(2)	(3)	(4)
LN_Y70	-0.018 *	-0.019 *	-0.024 *	-0.022 *
	(-5.52)	(-5.81)	(-6.17)	(-6.29)
LN_INV	0.023 *	0.022 *	0.013 **	0.016 *
	(4.67)	(4.510)	(1.920)	(2.53)
LN_HK	0.010 *	0.009 *	0.012 *	0.011 *
	(2.60)	(2.53)	(3.18)	(2.96)
LN_M2		-0.00003	0.0002	0.0002
		(-0.02)	(0.12)	(0.10)
LN_GOVCON		-0.001 *	-0.009 *	-0.009 *
		(-3.21)	(0.03)	(-2.08)
PROPERTY			0.004 *	0.004 *
			(2.39)	(2.12)
TPI	-0.0013 *	-0.0012 *	-0.0009 *	-0.0009 *
	(-3.36)	(-3.21)	(-2.13)	(-2.19)
C	0.088 *	0.125 *	0.149 *	0.138 *
	(4.12)	(4.590)	(4.86)	(4.72)
R^2	0.6094	0.6439	0.6556	0.6579
No. Observations	57	57	57	57

* = significance at 5%;
** = significance at 10%
Values under parameter are *t* statistics

Cross-country analysis was also examined with the other institutional framework variable (LAW&ORDER) and the political stability variables (GOVSTA and DURABLE). The TPI parameter is negative and relevant in most of the cases[44].

6.5.2. Change in Methodology 2: The Growth model without Fixed Effects

Table 9
Growth Model and the TPI without fixed Effects

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \lambda TPI + v_{i,t}$$

Regression Method: Eq. (1): G2SLS random-effects IV regression; Eq. (2): Maximum Likelihood – Random Effect

Regression No.	(1)		(2)	
LN_Y70	-0.043	*	-0.043	*
	(-13.25)		(-13.05)	
LN_INV	0.039	*	0.050	*
	(6.05)		(9.84)	
LN_HK	0.013	*	0.009	*
	(3.33)		(2.31)	
SD_M2	-0.001		-0.0008	
	(-0.61)		(-0.45)	
SD_GOVCON	-0.009	*	-0.009	*
	(0.02)		(-2.12)	
PROPERTY	0.005	*	0.004	*
	(3.71)		(3.08)	
TPI	-0.0013	**	-0.0013	**
	(-1.68)		(-1.78)	
C	0.277	*	0.261	*
	(9.57)		(8.62)	
R^2	0.5792		0.6078	
No. Observations	336		336	

* = significance at 5%
** = significance at 10%
Values under parameter are *t* statistics

[44] Regional dummies for Africa, Latina America and Asia were included in these specifications, but none of them turn out to be significant. The values of these parameters are not shown in any table.

Panel Data can be analyzed under fixed or random effects. Considering fixed effects is especially convenient since the possibility of country specifics may be relevant in growth models; however, there is no guidance to determine between both effects. Table 9 shows equation (1) under random-effects. The TPI coefficient is -0.0013, which is rather lower than -0.0018/-0.0028 from the fixed-effects results. The relevant disparity is on INV and HK. Both parameters are statistically significant under random effects but not under fixed effects (under *IV* method).

6.5.3. Adding Intensity (TPI-2)

In order to add *intensity* to the index, a three-tier measurement scale for volatility is adopted. The value of two is added to the original binary scale and it applies to the case when policy indicators fluctuate higher than two-standard deviations. For example, Figure 34 shows the volatility of BMP for the case of Argentina. The new index (TPI-2) would show value of one in 1971, 1981 and 1989, where the volatility of the BMP surpasses one-standard deviation and value of two in 1974 and 1976 where it surpasses two-standard deviations. This procedure adds robustness to the stability measure and allows for more accuracy of the index.

Figure 35 plots the new TPI-2 against Growth adjusted by the control variables (Yhat). Similar to Figure 31, it shows evidence on the robustness of the trade instability measure and its negative effect on economic growth.

Figure 34
Argentina: BMP Volatility and TPI2

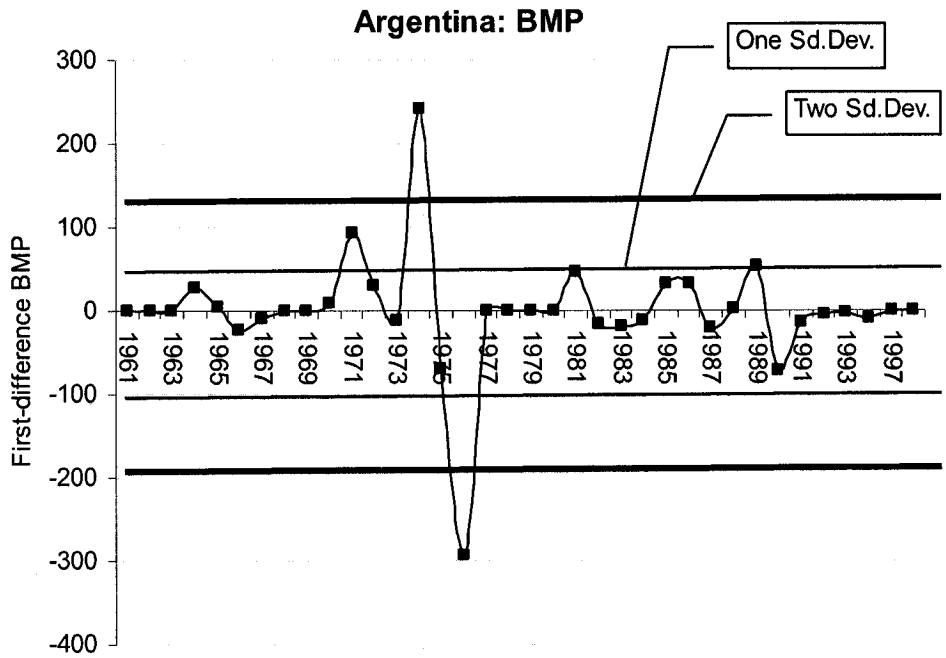


Figure 35
TPI2 Vs GDP growth

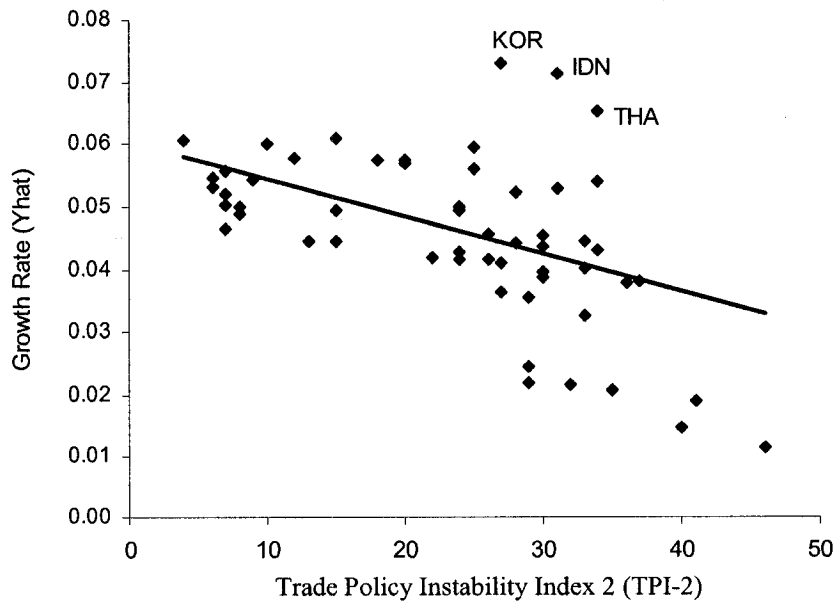


Table 10 shows the growth model under IV method (column 1) and OLS (column 2) applying the TPI-2. As expected, adding intensity to the index does not change the main results: trade policy instability deteriorates economic growth. The TPI-2 parameter value is -0.0014/-0.0019 whereas TPI is -0.0018/-0.0028, representing a slightly lower value. The rest of the variables show similar results as those from Table 4. For instance, investment is relevant under OLS but not under IV method, and property right as a characteristic of institutional environment is important at explaining economic growth. The R^2 values are relatively higher than those from Column 1, Table 4 (R^2 = 0.58 vs. R^2 = 0.54).

Table 10
Adding Intensity to the TPI or TP2

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \lambda TPI - 2 + v_{i,t}$$

Regression Method: Eq. (1): G2SLS fixed-effects IV regression; Eq. (2): OLS

Regression No.	(1)	(2)
LN_Y70	-0.047 *	-0.046 *
	(-11.96)	(-13.03)
LN_INV	0.0016	0.034 *
	(0.12)	(5.12)
LN_HK	-0.005	-0.001
	(-0.84)*	(-0.11)
SD_M2	-0.00002	-0.00001 *
	(-3.60)	(-3.35)
SD_GOVCON	0.001	0.002 **
	(0.12)	(1.95)
PROPERTY	0.004 *	0.004 *
	(2.32)	(2.41)
TPI-2	-0.0019 *	-0.0014 *
	(-3.62)	(-3.04)
C	0.444 *	0.330 *
	(8.89)	(11.1)
R^2	0.5773	0.6117
No. Observations	336	336

* = significance at 5%
** = significance at 10%
Values under parameter are *t* statistics

6.5.4. Commitment to Openness (TPI-3)

The robustness of the TPI is also tested by creating another version of this indicator. Recall that a reversal of a trade policy indicator is characterized when "the observation (in first-difference) lies outside the one standard deviation band and the subsequent observation crosses the zero line, indicating a change in the direction of the policy".

Table 11
TPI3: Alternative measure of commitment

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \lambda TPI - 3 + v_{i,t}$$

Regression Method: Eq. (1): G2SLS fixed-effects IV regression; Eq. (2): OLS

Regression No.	(1)		(2)	
LN_Y70	-0.045	*	-0.045	*
	(-11.58)		(-12.75)	
LN_INV	0.000		0.035	*
	(0.03)		(5.24)	
LN_HK	-0.007		-0.001	
	(-1.02)		(-0.22)	
SD_M2	-0.002	*	-0.001	*
	(-3.78)		(-3.49)	
SD_GOVCON	0.001		0.001	**
	(1.43)		(1.85)	
PROPERTY	0.004	*	0.004	*
	(2.31)		(2.43)	
TPI-3	-0.002	*	-0.002	*
	(-2.80)		(-2.22)	
C	0.437	*	0.318	*
	(8.69)		(10.71)	
R^2	0.5660		0.6056	
No. Observations	336		336	

* = significance at 5%
** = significance at 10%
Values under parameter are *t* statistics

Instead of considering as a reversal of trade policy all the observations that cross the zero line, only the observations that are outside the negative side of the band that cross the zero line are taken into consideration. This represents a move from a negative to a positive value in the first-difference, indicating a change of direction toward a more

closed economy. On the contrary, observations that move from positive to negative denote a movement toward openness and these changes are not considered reversals. The Index with this characteristic is defined as TPI-3. Table 11 exhibits the results from the regressions when TPI-3 is applied. The effects are similar to those observed in Table 10: The value of the TPI-3 is negative and statistically relevant under IV and OLS method.

6.5.5. Random exclusion of countries

Table 12
Country and Periods Random Exclusion

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \lambda INDEX + v_{i,t}$$

Regression Method: Eq. (1)-(2): G2SLS fixed-effects IV regression; Eq. (3): OLS fixed effects; Eq. (4): OLS random effects

Regression No.	(1)	(2)	(3)	(4)
LN_Y70	-0.043 *	-0.046 *	-0.049 *	-0.048 *
	(-11.97)	(-12.34)	(-11.89)	(-12.98)
LN_INV	-0.011	-0.008	0.002	0.038 *
	(-0.87)	(-0.650)	(0.120)	(5.43)
LN_HK	-0.0004	0.002	0.002	0.007
	(-0.07)	(0.360)	(0.31)	(1.17)
LN_M2		-0.003	-0.003	-0.0016
		(-1.840)	(-1.37)	(-0.77)
LN_GOVCON		-0.012 **	-0.011 **	-0.011 **
		(-1.84)	(-1.70)	(-1.84)
PROPERTY			0.004 *	0.004 *
			(2.35)	(2.42)
TPI	-0.0025 *	-0.0024 *	-0.0021 *	-0.0014 **
	(-3.13)	(-2.97)	(-2.57)	(-1.91)
C	0.450 *	0.507 *	0.477 *	0.348 *
	(10.05)	(9.820)	(8.42)	(9.15)
R^2	0.4593	0.4804	0.5251	0.5712
No. Observations	330	324	312	312

* = significance at 5%;
** = significance at 10%
Values under parameter are *t* statistics

McArthur and Sachs (2001) used the random exclusion of countries or periods to test the robustness of their findings. If the Trade Policy Instability Index does affect economic growth, then, exclusion of countries should not alter the main results. Table 12 shows regressions in which a number countries where randomly eliminated from the dataset (the number of observations is in the range of 312-330, compared to 354-336 from previous tables).

Results from Table 12 confirm once more the relevance of trade policy stability in economic growth. The index parameter maintains its sign and statistical significance under different model specifications.

Section 7: Conclusions and Policy Implications

Evidence from Section 7 suggests that a relationship between trade policy instability and economic growth does exist. Agents respond to the instability of trade policy when making economic decisions. The relationship is robust to the inclusion of different control variables and changes in methodology.

Finding evidence of the relationship between trade policy instability and economic growth required considering two important aspects: First, choosing an accurate measure of trade policy instability and second, assessing agent's responses to trade policy instability.

Previous empirical analysis measured instability by applying the standard deviation of single trade policy indicators. However, single policy indicators offer partial information on overall liberalization reform since other anti-liberalization policies may invalidate the effect of the policy under analysis. Therefore, any measure of trade reform should contemplate more than one policy indicator to improve accuracy of the measure.

In addition, the standard deviation of a policy indicator offers partial information on instability. High standard deviation can be interpreted as instability but also as government's strategy of frequent adjustments in trade policy in order to find optimal protection levels. The ability to separate these two states of affairs requires more information related to policy instability than the standard deviation itself. After a comparative analysis of different alternatives, the most suitable approach to include different trade policies and different instability measures into one single value was the design of the *Trade Policy Instability Index or TPI.*

The components of the TPI are essential in overcoming the impreciseness of the standard deviation as instability indicators. Combining *Commitment, Consistency,* and *Volatility* into a single measure was found to be a more effective approach in assessing policy instability, which was confirmed by the steadiness of the value and sign of the parameter of the TPI in most of the regressions.

Most of the influential empirical studies on growth and trade policy are based on cross-section analysis. Cross-section designs are unable to effectively study agents' responses to changes in policy over time because only the average of one specific period is analyzed. Panel data frameworks allow for inter-country and inter-temporal variations, enabling a more dynamic and accurate assessment of the economic responses of individuals.

In line with past empirical studies (Barro, 1991 and Finkel, 1995), results from regressions show that the convergence factor exhibits the expected negative sign and is statistically significant in all regressions. Macroeconomic and political stability are factors that contribute to economic growth; however, these parameter values are statistically unstable and the conclusions about their effect on growth must be taken with caution. Among the institutional variables the importance of property rights is evident in most of the model specifications.

Two main contributions of the model developed in this dissertation consist of: First, by creating a more stable trade policy environment (e.g. consistency among trade policies and reduction of policy reversals) authorities could increase long term economic growth by one fifth percentage point (0.2 percent). Second, by applying interacted regressors between TPI and Tariffs, the positive effects of lower tariffs on growth is enhanced if

accompanied by lower trade policy instability simultaneously. The effect of lower tariffs on growth is approximately 0.09 percent, but if lower tariffs are combined with lower trade policy instability, the effect on growth is 0.12 percent.

Policy instability –which consists in constant reversals of the policy, inconsistencies among policies, and high volatility in policy indicators– fosters an environment of uncertainty where firms and consumers would prefer to delay economic decisions, adversely affecting growth. Therefore, governments should promote an environment of policy stability. Political structures such as voting procedures (Lijphart, 1992), the number of veto players (Tsebelis, 1999), and the accountability of leaders, (Dahl, 1985) are in the table of alternatives at moderating policy stability. This dissertation verifies that trade policy instability is a factor partially responsible for the poor results of trade liberalization on economic performance observed among developing countries.

Robustness of the results is a crucial segment of the current empirical analysis due to the following limitations:

- Policy measures are hard to disentangle from the influence of other factors (i.e. macroeconomic policies, external shocks, political factors).
- Data from developing countries tends to be particularly unreliable and incomplete.
- The possible endogeneity of some independent variables may bias the parameter values.

To complete the robustness analysis, the TPI was tested under different model specifications and methodologies. For instance, regressions were analyzed under Two Stage Least Square (2SLS) and Ordinary Least Square (OLS); data was studied under Panel Data as well as Cross-Section; and the regressions were re-examined with random exclusion of countries. Additionally, components of the TPI were modified in order to construct two new indexes: the TPI-2, where the volatility indicator was transformed into a three-tier measure, and TPI-3 which restricted the commitment component by considering as reversal of trade policy only the observations that are outside the negative side of the band that cross the zero line. Conclusions from the robustness tests are:

- The TPI is statistically significant under most of the model transformations and methodologies (e.g. panel data or cross sectional and IV or OLS).
- The existence of property rights institutions enhances economic growth. In most of the specifications, the PROPERTY parameter shows a positive sign and is statistically significant.
- The analysis under cross-country dimension does not change the conclusion that trade policy instability harms economic growth.
- Adding intensity to the index through the TPI-2 does not change the main results; trade policy instability deteriorates economic growth.

Results confirm that trade policy instability negatively affects economic performance by creating an environment of uncertainty among market participants. Under conditions of policy uncertainty, firms and consumers would prefer to hold off economic decisions until authorities show commitment to the new reform. This delay in economic decisions

will adversely effect economic growth. In particular, less developed countries have experienced instability episodes causing agents to become especially concerned with the instability of policies. As a consequence, policymakers may find themselves with the intention of setting up effective trade policies and sound liberalization reforms but are unable to implement them when a private sector is reluctant to invest or opposes the reform in anticipation of an unstable policy climate. Governments should concern not only about the merits of the new trade policy but also in creating the environment to reduce policy instability.

Chapter 2

Distrust and Gender: Neurophysiological differences between men and women when giving and receiving

> "Hormones can modify brain functions and therefore behavior by altering the brain cells, the electrical mechanism of the neuronal elements, or the neurotransmitter system."
> (Pfaff, et al., 2002)

Introduction

Trust is recognized as an important component of economic growth (Knack and Keefer, 1997; Fukuyama, 1995). Countries with high levels of trust among individuals grow faster since this attribute facilitates economic transactions by reducing the costs of investigating trading partners (Zak and Knack, 2001). The relevance of trust as a desirable component for economic performance has led economists to search for the sources of trust. According to Guerra and Zizzo (2004), individuals trust because it is self-fulfilling. Individuals are inclined to believe that when trust has been placed in them they must act accordingly. Case studies have shown that people act on the expectation of trustworthiness (Barr, 2003). Zak, Kurzban, and Matzner (forthcoming, 2005) found that receiving signals of trust are associated with an increase in the neuroactive hormone oxytocin (OT) and subsequent trustworthy behavior.

Nonetheless, what could we say about distrust? Distrust may restrain optimal economic and political outcomes in our society. It may reduce transactions among nations and citizens, and it may incite political instability (Rose and Munro, 2003). Distrust may become an important barrier for reaching governments' policy objectives (Rodrik, 1989), and for arriving at optimal outcomes in negotiations among firms. For instance, Falk and Kosfeld (2004) showed under an experimental setting of principal-

agent model, that distrust signals from the principal to the agent in the form of restrictions on agent's choice set, reduces performance among agents. Therefore, on average, they observed lower payoffs among principals who practice distrust signals. Because of its several effects, this dissertation aims to investigate the physiological nature of distrust among individuals during social interactions.

Distrust is observed when individuals do not allow others to participate in decisions related to their welfare because of the expectation that intentions and behaviors are harmful to their interests. Although, some studies argue that distrust has its origin in group differences, lack of information, and weak institutional settings (Fershtman and Gneezy, 1998; Kramer, 1999), it is observed that individuals who communicate and are engaged in repeated cooperation settings, with clear rules of the game, do not resolve problems of non-cooperation and distrust (Wilson and Sell, 1997). Perhaps, distrust may be part of human nature. In interdependent relationships, distrust involves a sense of fear, discomfort, or danger which entail hormonal activity in the brain to help the body to react.

This study examines the neurophysiological effects of distrust signals. In particular, it investigates if distrust has different physiological reactions among men and women. While behavioral gender differences have been studied by Bolton and Katok (1995), Jianakoplos and Bernasek (1998), Eckel and Grossman (1996, 1998, 2001), Croson and Buchan (1999), and others; neurophysiological variations under experimental conditions with monetary payoffs have just begun to be examined (Zak et al, 2005). Measuring neurophysiological changes in humans is far from a straightforward task, but previous studies have analyzed blood samples right after individuals make decisions in social

interactions. These studies have demonstrated the relationship between hormonal activity in the bloodstream and emotions/reactions. Specifically, testosterone (T) and dyhidrotestosterone (DHT) are hormones related to fear, stress, discomfort, and aggression. It has been established that such emotions/reactions are stronger in men than in women. For instance, in experiments that involve competition for assets or resources, DHT activity and a corresponding aggressive reaction is observed in men but not in women (Simon et al, 1996). Based on this literature, it is hypothesized that men experience higher changes in DHT levels when distrust signals are observed.

In a trust experiment, the premise that men show higher levels of DHT than women when receiving distrust signals is tested. The experiment consists of a one-shot interaction between two subjects: an "investor" endowed with $10, determines how much money out of the endowment he or she will allocate to a "trustee". The amount allocated represents a costly signal of trust/distrust that the investor is sending. The trustee, who has also being endowed with $10, receives the signal of trust/distrust and then decides how much to return to the investor, including the option of returning zero dollars. After these decisions are made sequentially, a sample of blood is drawn from participants in order to measure DHT levels. A group of students play the trust game in a laboratory and differences in responses and neurophysiological changes are observed between men and women.

Two testable hypotheses are to be examined in this study: First, women tend to distrust more than men when facing anonymous partners, which can be explained by the general notion of women as custodians of scarce resources and protectors of their offspring. Second, men have stronger neurophysiological reactions than women when

facing distrust signals and monetary payoffs are involved as evidenced by elevated levels of DHT, which are not observed in women.

This paper is organized as followed. Section 1 introduces and reviews gender differences in decisions made in experimental games. It presents evidence on the relation between DHT and behavior under different social settings –e.g. contests, competitions for resources, distrustful environments, etc. Section 2 provides a description of the trust experiment based on Berg, et al. (1995). Section 3 presents the data analysis of the subjects' behavior with a focus on gender differences and attempts to answer the following question: how is DHT in men and women related to distrust signals? Finally, Section 4 provides conclusions.

Section 1: Gender, behavior, and Neurophysiology

1.1. Men, Women, and their behavior in experimental games

Men and women often behave differently when facing similar economic and social stimuli. Gilligan (1982) showed that women are more likely to prefer harmony in social interactions, while men tend to be more competitive. Solnick (2001) found that individuals tend to demand more from women than from men in ultimatum games. In dictator games, Andreoni and Vesterlund (2001) showed that women gave significantly more and were more likely to divide wealth evenly overall, compared to men who became more selfish as the value of the wealth to be divided increased. Eckel and Grossman (2001) examined gender differences in ultimatum bargaining, showing that women rejected the amount offered less often than men.

Eckel and Grossman (1996) showed that men and women may differ in their idea of fairness and this affects their economic decision making. In their experiment, subjects must allocate an amount of money between two types of individuals. One type is defined as "fair" (subjects were told that this type split their money evenly with their partner in a previous game), and the other type was represented as being "unfair" (subjects were told that this type took the entire amount previously). Their results show a significant difference between men and women in their willingness to reward or punish a partner perceived as fair or unfair. In particular, women rewarded fair partners approximately twice as frequently as did men.

In another experiment using a double-blind dictator game, Eckel and Grossman (1998) found that women were more generous to their anonymous partners than men. Subjects were divided into two groups, one group of participants acted as Dictators who chose a fraction of their $10 initial endowment to transfer by putting it in an envelope and dropping the envelope into a box. The results showed that women on average donated twice as much to their partners as men. Croson and Buchan (1999) examined gender differences under a trust game setting (double-blind) conducted in four different countries (The US, China, Japan, and Korea). They found no gender difference in the amount sent by the investors (the first-move player), but women as trustees (the second-move player) tended to return significantly more of the total wealth than men. Similar results were observed in all four countries.

The results from experimental games presented above show not only that individuals tend to deviate from the sub-game perfect Nash equilibrium, but also that economic theories that assume agents to be homogeneous subjects may be weak predictors of

behavior and the gender factor plays an important role of such heterogeneity (Eckel and Grossman, 1998).

Previous studies also have demonstrated that men and women experience different reactions toward similar stimuli and their brain activity differs when performing identical tasks (Haier, Jung, Yeo, Head, and Alkire, 2005)[45]. Thus, an explanation for the differences between men and women in the experimental games described above is that women process social signals in a different way than men. This may be measured by their hormonal activity right after their interactions under an experimental setting.

1.2. Overview on the decision process and hormonal states between men and women

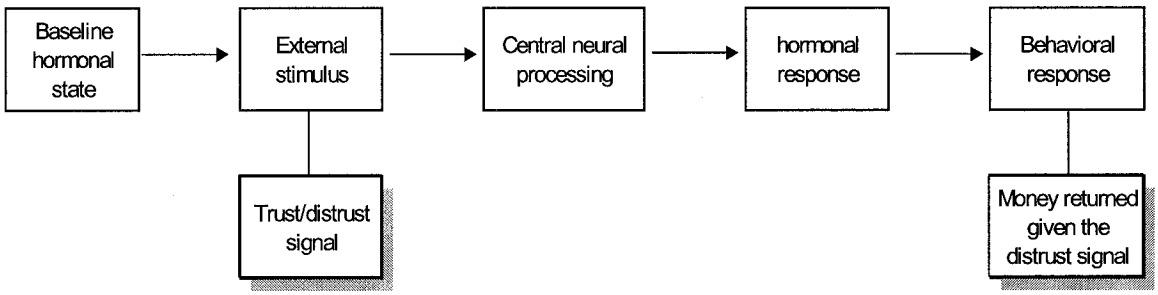
This section briefly describes the neurophysiological model that sets up the relationship between hormonal activity and distrust signals. Individuals approach decision-making processes with a "baseline hormonal state". External stimulus may alter this hormonal state. Figure 36 outlines the general hormone-behavior interaction during the distrust experiment.

Individuals operate from a baseline hormonal state when exposed to external stimuli such as a distrust signal received from a partner during a social interaction. The observation of the distrust signal involves neural activity accompanied by a release of hormones –e.g. the brain sends a message of discomfort to the body. Hormones represent the messengers or the mechanism of communication between the brain and the body and

[45] Haier et al, (2005) showed women having more white matter and men more gray matter but similar intellectual skills, indicating that different brain designs are capable of producing equivalent intellectual performance. Additionally, woman's brain has a larger corpus collusum, which means women can transfer data between the right and left hemisphere faster than men. Females have a relatively larger limbic system than males, so, women may be more emotional than men. See Baron-Cohen (2003) for more details on different brain activities between men and women when facing similar tasks.

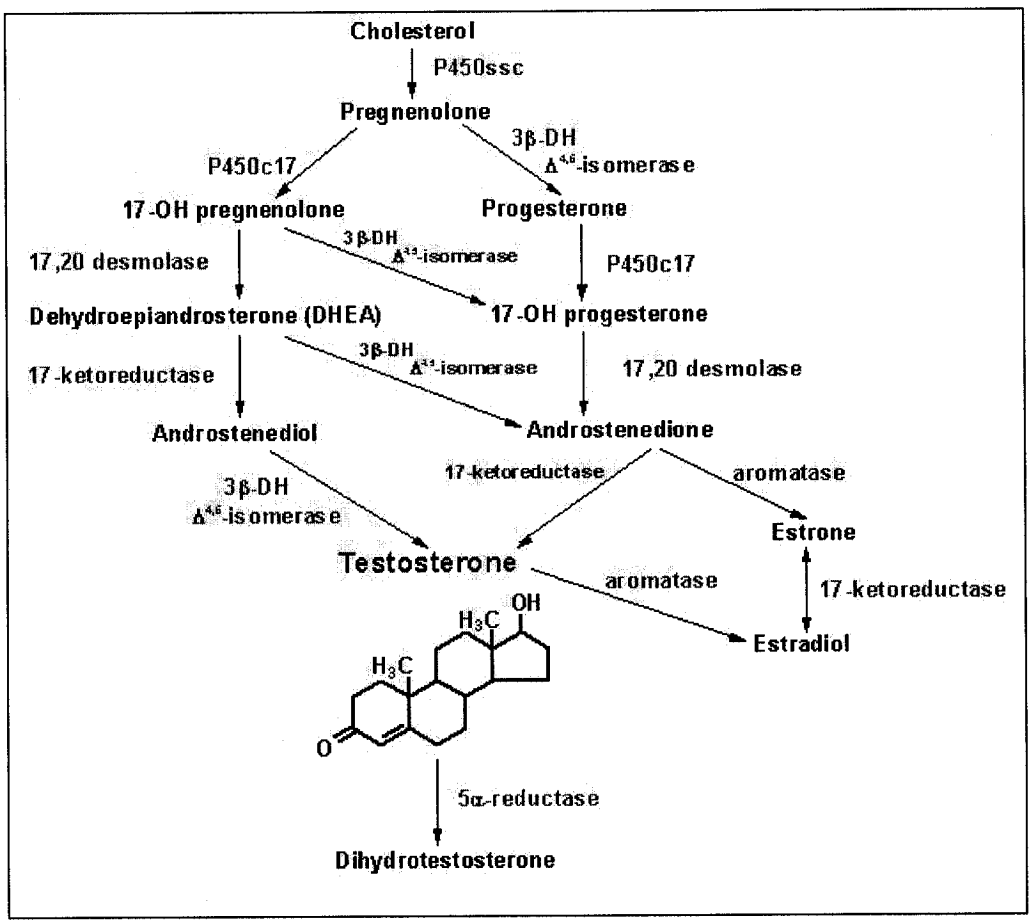
also between different regions within the brain, affecting reactions, feedback, and responses. The reaction or behavior after the distrust signal –e.g. how much money individuals return to their partners in the experiment– functions as the external response associated with the hormonal change.

Figure 36
Hormone activation in a social interaction process



Studies in animals and humans have identified regions in the amygdala, anterior hypothalamus, and other well-identified brain regions where hormones release and particular behaviors are associated. Recent animal models support the *neuromodulator hypothesis,* which posited androgen hormones as principal factors in the regulation of specific aggressive behaviors. For example, hormones like testosterone (T) and dihydrotestosterone (DHT) produced in the adrenal glands, testes, and ovaries are associated with sexual behavior, aggressiveness, survival, and stress. These hormones are produced three to four times more in men than in women. Figure 37 outlines the synthesis of the chemical structure of DHT.

Figure 37
T and DHT: Chemical construction



Wang, et al (1996) in a study comparing men with low T who received T replacement to those who did not, showed that lower T led to a decline in mood attributes –e.g. anger, irritability, and sadness. Similar correlations were found between DHT and these mood attributes. Von Der Pahlen et al, (2002a) and Eriksson et al, (2003) studied basal steroid hormones and their relationship with alcohol use/abuse and aggressive interactions in men. Basal DHT correlates positively with verbal aggression and anger. In general, studies have shown that T and DHT are associated with reactive aggression in adult males (Simon and Whalen, 1986; Dabbs, 1996). However, in humans, detection of

aggressive behavior is less evident since it involves more subtle behavioral forms (Rubinow and Schmidt, 1996; and Maras et al, 2002).

One critical difference between T and DHT is their chemical composition. T circulates in the blood in three forms: around 60 percent is bound to a protein called sex hormone-binding globulin (SHBG), about 38 percent is bound to albumin protein; and only about 2 percent circulates freely in the bloodstream. This implies that T is mostly an inactive hormone as only free T binds to T receptors. The enzyme 5-alpha reductase transforms T into DHT, which is not bound to SHBG or albumin, making it biologically active and therefore a better measure of aggressive-hormonal variation. For instance, DHT and not T is associated with male virilization (muscle enhancement, hair in chest and body, etc.)

1.3. The neurophysiological difference between men and woman

Studies of behavioral neuroendocrinology have produced interesting results related to male T levels and aggression (Ehrenkranz, Bliss, and Sheard, 1974; Kouri et al, 1995). Considerably less attention has been paid to the T or DHT processes in females and the relationship with aggressive behavior (Von der Pahlen, 2002b; Dabbs and Hargrove, 1997). Various studies of female animals found almost no display of aggression in tests related to resident-intruder type, except during lactation (Pfaff, et al. 2002). According to Simon, et al. (1985) and Simon and Gandelman (1978), the adult female brain is highly insensitive to the aggression-promoting property of androgens. In general, women do not seem to exhibit changes in androgen hormones comparable to those seen in men in

competitive settings (Monti-Bloch et al, 1998; Cashdan, 1995)[46]. Alternative studies have proposed a sociobiological model based on the nature of competition among females. Androgens are experience to be involved if competition is for material resources (food) (Mazur et al, 1997; Booth et al, 1989)[47].

Overall, findings suggest that females experience different physiological features than male during social interactive settings. (Albert et al, 1993; Stavisky et al, 2001; von Engelhardt et al, 2000; Perche et al, 2000). The following section describes the social interaction during a trust experiment where male and female subjects send and received distrust signals by making decisions with monetary payoffs. Immediately after their choices, DHT levels are measured in order to test the relationship between social signals of distrusts and neurophysiological activity.

Section 2: Experimental Design

In order to examine the behavior of individuals when facing a distrust situation, individuals participate in an experimental trust game based on Berg, et al. (1995).

The trust game consists of a one-shot interaction between two subjects. An investor or Player 1 (P1), endowed with $10, determines how much money he/she will allocate to a trustee or Player 2 (P2), who also is endowed with $10. The amount allocated to P2 is tripled and he or she must then decide how much to return to P1. When individuals cannot identify each other, the allocation of the investor represents a signal of trust since insufficient information is placed on the partner's identity. Hoffman, McCabe and Smith

[46] Other studies related to women's lack of changes in androgen hormones in competitive settings are Dougherty et al, 1997; Van Goozen et al, 1997; and Mazur and Booth, 1998

[47] Other studies relating behavior and androgen hormonal release in women under sociobiological models are: Dougherty et al, 1997; Dabbs and Hargrove, 1997; Baulieu, 1997; Robel and Baulieu, 1995; and Young et al, 1991, 1995, 1996.

(1996) tested behavior under a dictator game, varying the degree of social distance between players. The higher is the social isolation through anonymity and physical separation among players, the lower is the social norm of reciprocity and trust observed. The return from P2s to P1s represents reciprocation of trust.

Individuals who agree to take part in the trust experiment will have to make one decision sequentially after which they are immediately taken into an anteroom where a sample of 28ml of blood is drawn from an antecubital vein (a large vein in the inner elbow area). The level of DHT is measured in the blood serum. Finally, participants complete a survey of 172 questions: 132 questions of social and developmental history, and 40 questions relating to affective intensity (Larsen and Diener, 1987). The questionnaire examines whether experimental decisions are related hormonal changes or to personal experience and background conditions (e.g. educated parents, ethnicity, religion, activities with friends).

Throughout the entire process, identity is concealed and complete anonymity is maintained from the other subjects and the experimenter. Jenni and Loewenstein (1997) and Bohnet and Frey (1999) showed that physical contact or identification could activate feelings of empathy or contempt. These feelings may alter hormonal levels and decisions; thus, anonymity is important in trust experiments. To control for confidentiality individuals are assigned to separate partitions with computer stations in a large laboratory (CASSEL at UCLA, see Appendix 5 for pictures), where their only interaction is via a computer interface. Subjects are randomly paired with each player assigned one of the two roles: P1 and P2. In line with the laboratory policy, there was no deception of any kind.

The sub-game perfect Nash equilibrium of the game can be found using backward induction. In the second stage of the game, P2 returns nothing to P1 since P1 has no means to enforce punishment[48]. P1 anticipating P2's action will offer the lowest possible amount (zero dollars). The equilibrium is that P1 offers zero. However, in most trust experiments, subjects are willing to take actions that are risky and costly for both participants. For instance, Hoffman et al, (1996) showed that on average, P1s offered around 30-50 percent of the total amount and P2s returned around 20-30 percent. The results from the trust game are in line with Hoffman and presented in Section 3.

A distrust indicator is constructed based on the money sent from P1 to P2. The distrust indicator is a simple linear transformation of the original data. It ranges from 0 to 30, 30 being the maximum distrust value and is constructed along these lines:

Maximum $ that P2 *can* receive from P1 ($10*3=$30) minus $ that P2 *actually* received from P1

Example:

$30 - 0*3 = 30 \rightarrow$ maximum distrust signal sent to P2

$30 - 10*3 = 0 \rightarrow$ minimum distrust signal sent to P2

Section 3: Experimental Results

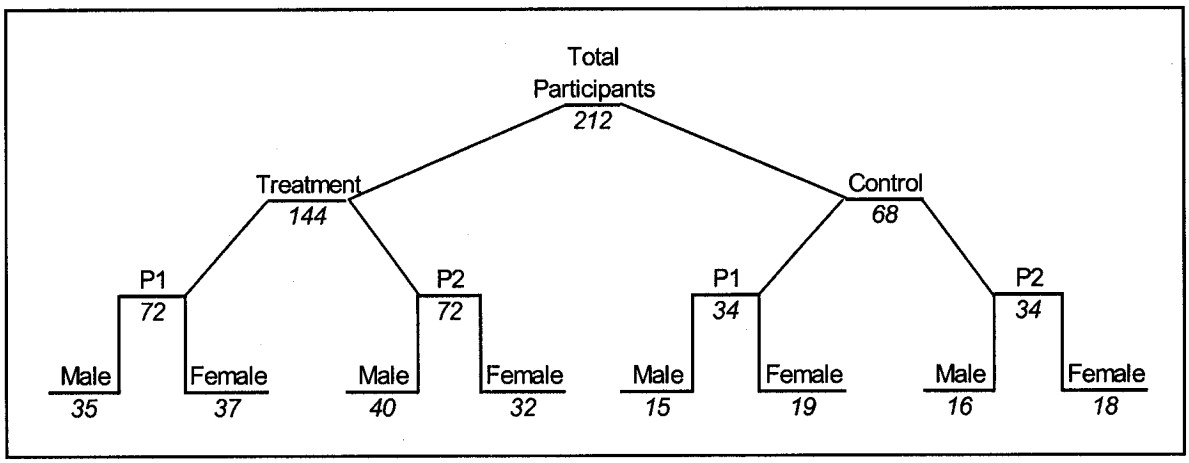
Thirteen sessions were conducted with an average of 16 subjects in each session. 50 percent of total subjects were men and 50 percent female. All experiments were run at UCLA during the 2002-2004 period, and subjects were recruited from students with a variety of majors, ages, and ethnicities (See Appendix 6). Four sessions from the thirteen were defined as "control" experiments, where the distrust signal was removed by

[48] Since the game is one-shot, P1 cannot respond after P2's decision. Also, since the game is double-blind, and the experimenter does not know the players' name, no social punishment is implicit either.

assigning the amount sent from P1 to P2 randomly. Both players were informed of the random assignment.

A total of 212 individuals participated in the experiment: 144 in the treatment and 68 in the control experiment. Half of the individuals participated as P1 and the other half as P2. More females participated as P1s (37 female vs. 35 male in the treatment and 19 female vs. 15 males in the control experiment, representing 53 percent of P1s), but more male participated as P2s (53 percent male vs. 47 percent female). P1s and P2s did not know the gender of their partner they were matched with. Figure 38 exhibits the details of participants along with their type of player and gender.

Figure 38
Number and type of participants



3.1. Distrust signals sent by the Investor

Table 13 summarizes the outcomes from the investor. Across the 72 individuals from the treatment experiment who participated as P1, 35 of the groups were male and 37 female. The mean percent sent by all P1s was 46 percent ($4.56). However, P1-men in

the treatment sent an average of 53 percent ($5.28) of their total endowment while P1-women only sent 39 percent ($3.92). The difference between money sent by men and women is statistically significant (t-test, one-tail, p=0.04). The results confirm that women sent less money than men when they perform as investors.

Table 13
Summary Statistics: Money Sent from P1 to P2

	Treatment			Control		
	No. of Obs.	P1 $Sent	% ($sent/$10)	No. of Obs.	P1 $ Sent	% ($sent/$10)
Total	72	4.56	45.6%	34	5.26	52.6%
Men	35	5.28	52.8%	15	4.93	49.3%
Women	37	3.92	39.2%	19	5.53	55.3%

In the control experiment, where the decision of P1 is removed, no differences in money sent between men and women would be expected since the decision is randomly determined. Table 14 shows the t-tests for the difference between P1-men and P1-women in the treatment versus control game. Women sent significantly less money than men in the treatment (p=0.04), and also they sent significantly less money than women in the control game (p=0.05).

Table 14
Money Sent by P1
T-tests, one-tail, Treatment Vs Control experiment

		p-value
1	Difference between men and women in the treatment experiment	**0.04**
2	Difference between men and women in the control experiment	0.25
3	Difference between men-treatment and men-control	0.30
4	Difference between women-treatment and women-control	**0.05**
5	Difference between all individuals-treatment and all individuals-control	0.19

3.2. The Trustee: Reciprocity or Nash Equilibrium?

Table 15 shows the summary statistics of the outcomes from P2s. In the treatment experiment, 40 out of the 72 individuals are men, representing 56 percent of the P2s. On average, P2s received $13.88 (which is equivalent to the averaged tripled total money sent by P1, $4.63 from Table 13). P2-men received $10.73 while P2-women received significantly more money ($17.81, p=0.002). The difference between the money received by men and women cause difficulties when formulating conclusions about P2s behavior (money returned). Although men returned significantly less money than women ($3.68 vs. $8.06; t-test, one-tail, p=0.002), it is not possible to deduce that this difference is due to gender or simply because men received significantly less money in the first place. In order to control for this difference, P2s behavior will be measured in terms of relative returns (money returned divided by money received). Column 3 from Table 15 shows the relative returns for men and women in the treatment experiment. Men returned 25 percent while women returned 42 percent (t-test, one tail, p=0.008).

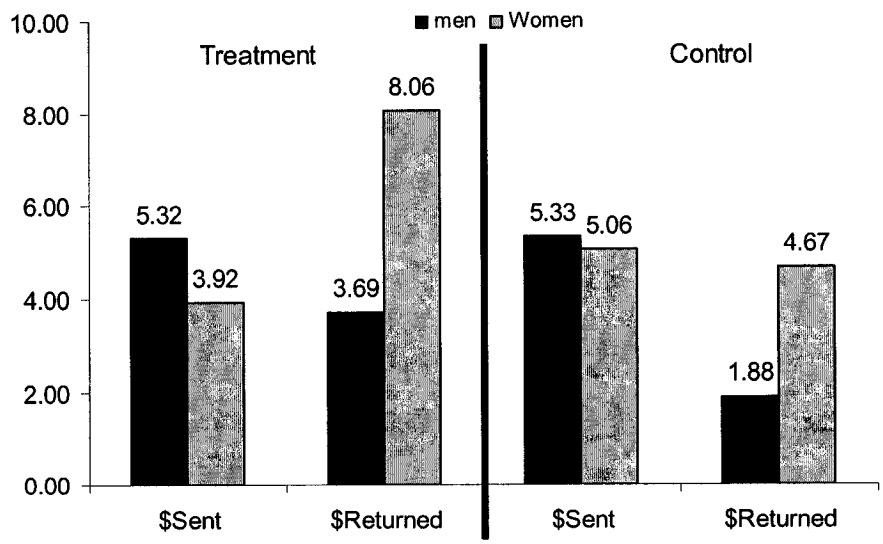
Table 15
Summary Statistics: The Trustee (P2)

	Treatment			Control		
	(1) No. of Obs.	(2) $ Received from P1	(3) %	(1) No. of Obs.	(2) $ received from P1	(3) %
Total	72	13.88	46.3%	34	15.79	52.6%
Men	40	10.73	35.8%	15	16.00	53.3%
Women	32	17.81	59.4%	18	16.00	53.3%
		$ Returned by P2	%		$ Returned by P2	%
Total		5.63	32.6%		3.35	20.4%
Men		3.68	25.1%		1.80	10.5%
Women		8.06	41.9%		4.67	28.0%

In the control experiment, men and women received similar amounts ($16), but women returned significantly more money to their partner ($4.67, 28 percent) than men ($1.80, 10.5 percent; t-test, p=0.005). Women returned more money to their partner even when the signal of distrust was removed, indicating that other factors such as generosity and sympathy may have been involved in women's decision.

Finally, it is expected that the money returned by P2 is significantly higher in the treatment versus the control game, since no incentive for reciprocation or gratitude to P1 should occur in the control game. Table 15 also shows these results. In the treatment experiment, P2s returned an average $5.63 or 33 percent and only $3.35 or 20 percent in the control experiment. This difference is statistically important (p=0.009). Therefore, individuals respond to the distrust signal when compared to the random assignment.

Figure 39
Men Vs Women: Money sent and returned



The experimental results confirm that women sent significantly less than men. This is in line with Olsen and Cox (2001) and Hartog, Ferrer-i-Carbonell, and Jonker (2002),

who deduced that women are more risk averse in investment decisions, since they tend to send less money than their male counterparts after controlling for age, education, and other demographic factors. In addition, women returned significantly more than men in both the treatment and the control game, which is in line with Eckel and Grossman (1996) who found that women tend to arrive at decisions that are fair to the people involved while men tend to make decisions on the basis of system of rules and laws. Figure 39 confirms these results.

Table 16 exhibits the distrust signal sent by P1 in the treatment game. 11 out of 72 individuals sent nothing to their partners and thus, played the sub-game perfect Nash equilibrium. However, 12 subjects sent the maximum amount of $10, offering a strong signal of trust. From those 12 subjects, only 3 women sent the full amount.

Table 16
Distrust Signals sent in the Treatment Game
$ Sent by P1

	Sent $0	Sent $10	Sent less than $5	Sent more than $5
Total (72)	11	12	46	27
Male (35)	5	9	20	15
Female (37)	6	3	26	11

Two main results on gender behavior can be inferred from the trust experiment. A t-test confirms that women sent significantly less money than men when playing the role of P1s, and women returned more money than men when acting as P2s. Regressions of the percentage sent and returned on gender are presented in Table 17. Column (1) and (2) show that gender is an important factor when sending the distrust signal and also when making a decision on how much money to return. On average, P1-men send 13 percent points more money than P1-women, but P2-women return 14 percent points more than

P2-man. As it was stated above, money returned by P2 depends not only on the money they received, but also on gender: if P1 sends less money to P2, P2 responds by returning a lower proportion of money; however, this response is stronger in men. Column (3) shows regression results adding a dummy variable for the data on the control experiment (Dummy_control=1 if subject is under treatment, dummy_control=0 if subject is under control). The significant coefficient (0.14) indicates that individuals return significantly more when the trust/distrust signal is included. Gender maintains its negative sign and it is statistically important at explaining the amount returned by P2. Results do not significantly change when applying total amounts of money instead of percentage returns as dependent variable (not shown in table).

Table 17
OLS Regressions
Percentage sent by P1 and returned P2 Vs Gender

	(1) % Sent by P1 to P2	(2) % Returned from P2 to P1	(3) % Returned from P2 to P1	(4) % Returned from P2 to P1
Gender	0.13***	-0.14*	-0.15*	-0.13*
	(1.62)[a]	(-2.79)[a]	(-3.08)	(-2.59)
Dummy_control			0.14*	0.15*
			(2.83)	(2.96)
$ received				0.13**
				(1.69)
C	0.39*	0.37*	0.28*	0.20*
	(6.95)	(10.19)	(5.77)	(3.12)
R^2	0.04	0.07	0.13	0.16
No. Obs	72[b]	109[c]	109	109

* = significance at 1%; ** = significance at 5%; *** = significance at 10%
a. Numbers in parenthesis are t-values.
b. 72 subjects from the treatment experiment = 35 male subjects and 37 female subjects.
c. 106 = 72 subjects from treatment and 34 from control game.

What might cause the difference in gender behavior under the trust experiment? The next section presents information on the relationship between DHT and distrust signals. This relationship was found to be strong in men but not in women. The results are in line

with Simon et al, (1996) and others who have found a positive relationship between androgen hormones and aggressive behavior in men but not in women.

3.3. The Decision Process and Hormonal States

From experimental economics, it is possible to observe that individuals appear to consider factors like social acceptance, altruism, and punishment when making economic decisions. For instance, in ultimatum games, those players who received small amounts of money from their partners may punish the other player; the uncooperative subject tends to reject the offers, resulting in both players walking away with zero dollars. In the following section, the hypothesis that individuals receiving a distrust signal experience a neurophysiological reaction associated with higher levels of DHT is examined.

P2s are split into two groups, those with high distrust index (Index $\geq$ 15) and those with low distrust index (Index < 15)[49]. Table 18 shows that individuals (men and women) in the treatment game who received the high mean distrust signal of 24.15 returned only $2.02 but subjects who received the low mean distrust signal of 6.18 returned $10. The difference between these two amounts is statistically important (p-value = 0.000). Thus, the distrust signal generates a reaction on P2 that is externalized in their returns.

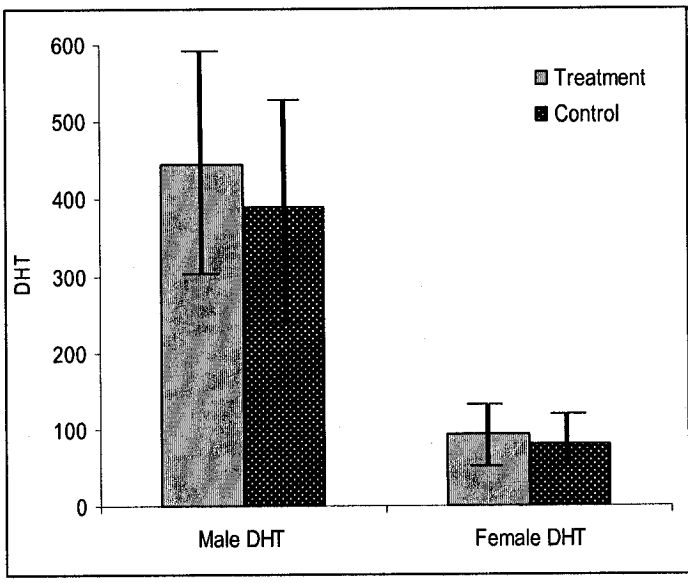
Table 18
Treatment Game - Distrust Index and $Returned

		$ Returned
High distrust index	24.15	2.02
Low distrust index	6.18	10.00
P-value (t-test) =	0.000	

[49] Another rule for the high-low distrust index was constructed. A low distrust signal was defined as the index value below its mean, and high distrust signal represents values above its mean. The results applying this rule did not significantly change from those exhibited in Table 18.

This dissertation studies the *activation* of DHT when individuals face distrust signals. The statistical summary of the DHT levels from P2 subjects of both treatment and control experiment is shown in Figure 40. The difference between DHT levels of men and women is evident. In the treatment game, men's average DHT is 445.2 pg/ml, while in women the average is 93.6. In the control game, without the trust/distrust signal, the DHT level is lower in both men (389.9) and women (79.7). T-tests (two-tails) for difference of mean were carried out between DHT men and DHT women, showing to be statistically different. However, t-test between DHT under treatment and control game is not relevant.

Figure 40
Summary Statistics for P2's DHT level (pg/ml)



Treatment Game		
	Male DHT	***Female DHT***
Mean	445.2	93.57
Standard Deviation	139.24	49.88
Minimum	214	15
Maximum	763.88	200
Count	40	32
Control Game		
	Male DHT	***Female DHT***
Mean	389.91	79.69
Standard Deviation	154.3	35.12
Minimum	69	31
Maximum	688.69	172
Count	16	18

Table 19 exhibits the average high and average low distrust indices and their corresponding average DHT levels by gender for the treatment and control game. For instance, the difference of DHT levels between men receiving high vs. low distrust index in the treatment game is 115.2 (468.2 – 353.1, p=0.04) and in women this variation is

only 17.3 (103.3 – 86, p=0.17). Changes in DHT seem to be higher in men than in women when facing distrust signals. Once the distrust signal is removed in the control game, the difference of DHT level in men is negative and in women only represents 3.2 pg/ml.

Table 19
High Vs Low Distrust Index and Male Female DHT

	Treatment Game			
	High distrust index	DHT	Low Distrust Index	DHT
Women	22.0	103.3	4.0	86.0
Men	23.1	468.2	4.1	353.1
	Control Game			
	High distrust index	DHT	Low Distrust Index	DHT
Women	22.1	81.4	5.3	78.3
Men	24.0	382.9	7.5	421.0

Table 20 shows the regression results of the distrust index against DHT levels for all participants, for only men, and for only women. The connection between the distrust index and the DHT level for men is positive and relevant in the treatment game (4.72, p=0.047) but not in the control game (-0.01, p=0.52). No link between DHT and distrust signal is observed among women in any of the experiments.

Results confirm that the higher the distrust signals received by men, the higher their DHT levels; however, when the distrust signal is removed in the control game, the DHT level is not related to the money received by P2. This is not the case for women. Women show no correlation between the distrust signal and DHT in any of the games.

In this study, DHT is the leading hormone to measuring neurophysiological changes in subjects facing distrust signals; however, T is also an aggressive-discomfort hormone highly linked to DHT (correlation = 0.42) but with the disadvantage that it is mostly inactive (See section 1.2). Since T and DHT are highly correlated, similar tests as those

presented in Table 20 were competed applying T (only for the treatment group). Table 21 shows those results. The relationship between distrust signals and T is not relevant in men or women. This suggests that it is the biologically active metabolite of T, DHT, that responds to the receipt of signals of distrust.

Table 20
OLS regression Distrust Index Vs DHT level
Dependent Variable: Distrust index

	Treatment Game		
	All obs.	Men obs.	Women obs.
DHT	7.90 *	4.72 **	0.10
	3.62	*2.05*	*0.12*
C	161.58 *	354.23 *	92.31 *
	3.87	*7.21*	*6.65*
R^2	0.16	0.10	0.00
No. Obs.	72	40	32
	Control game		
	All obs.	Men obs.	Women obs.
DHT	-1.20	-0.01	-0.01
	-0.34	*-0.66*	*-0.01*
C	243.57 *	19.83 ***	79.80 *
	4.12	*2.14*	*4.94*
R^2	0.00	0.03	0.00
No. Obs.	33	15	18

* = significance at 1%; ** = significance at 5%; *** = significance at 10%
Numbers in italics are t-values.

Table 21
OLS regression Distrust Index Vs T level
Dependent Variable: Distrust index

	Treatment Game		
	All obs.	Men obs.	Women obs.
T	0.05***	-0.01	0.00
	(1.84)	(-0.72)	(0.11)
C	1.99*	4.87*	0.72*
	(4.02)	(12.68)	(8.44)
R^2	0.06	0.02	0.00
No. Obs.	54	27	26

* = significance at 1%; ** = significance at 5%; *** = significance at 10%
Numbers in parenthesis are t-values.

Section 4: Discussion and further research

Cooperation and trust are desired attributes to observe in any negotiation; however, some form of distrust among individuals participating in teamwork, negotiations, and trade is also evident. This dissertation presents new information on the neurophysiology behind social signals of distrust among human beings, with a focus on male-female differences.

The results presented in this dissertation are the beginning toward understanding the role of hormonal activity when distrust signals are observed in social interactions. The findings suggest that dyhidrotestosterone (DHT), an active hormone in the bloodstream related to stress, discomfort and aggression, tends to respond to social signals of distrust in men. Once this social signal is removed in the control game, so is the DHT response. This is not the case for women where DHT activity is not related to the distrust signals received in any of the experiments. These results indicate a causal relationship between distrust in a monetary transfer and the level of DHT in men but not in women. At present we cannot confirm that women do not respond to any distrust signal, other forms of distrust indicators different from monetary rewards may cause DHT activity in women. In addition to DHT and T, seven additional hormones were assayed – andrenocorticotropin hormone (ACTH), prolactin, cortisol, oxytocin, estradiol, Progesterone, and vasopressin– finding no evidence for a correlation between female DHT and the levels of the other hormones. Additional work will be required before a definitive conclusion can be drawn for the case of female subjects.

The findings also confirm that women sent significantly less money than men in the trust experiment. This result is in line with Olsen and Cox (2001) and Hartog, Ferrer-i-

Carbonell, and Jonker, (2002). In both games, treatment and control, women's relative returns are higher than those from men indicating that women may consider factors of fairness and sympathy when making their decisions (Eckel and Grossman, 1996).

Perhaps the source of external responses during a trust game can be related to brain activity. For instance, a neural activation is set in place when observing unfairness or distrustful actions in individuals. This neural activation is different between men and women when facing similar situations. For example, Burnham (2000) tested the hypothesis that men with higher levels of basal testosterone (T) are more likely to use punishment strategies in ultimatum games. Mazur, et al. (1992) and Gladue, et al. (1989) showed that higher levels of T correlated to aggressive behavior in competitive environments. This dissertation intends to provide the opening for further research on behavior and neurophysiological changes when individuals face distrust signals.

It is important to note some limitations of the present study. First, defining the contribution of hormones to human aggressive behavior is not an easy task. Various factors may affect the hormonal state while individuals are involved in the experiment. For example, the type of activities carried out before their interaction in the trust game, the food digested the previous day, or feelings of discomfort with the phlebotomist represents some of these factors. The ideal experimental design would require blood drawn right before and after the decision made by subjects, but this would create additional social interactions (e.g. with phlebotomist or experimenter) which potentially affect DHT activity. The random assignments and the full anonymity of subject's responses allow for inferences about differences between men and women without requiring the additional blood draw.

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Appendixes

Appendix 1

Table A-1
Variable description, Number of observations, and Sources[1]

Code	Name-Definition	Number of Observations		Source
		Countries	Period	
LnY70	Convergence indicator: Natural log of GDP of 1970	136	1950-2000	World Penn Table 6.1
LnINV	Natural log of Investment share of the GDP	136	1950-2000	World Penn Table 6.1
LnHK	Natural log of secondary school enrolment rates	98	1955-2000	Barro and Lee, "International Data on Educational Attainment: Updates and Implications," Harvard University, 2000
LnGOVCON	Natural log of government consumptio share of the GDP	136	1950-2000	World Penn Table 6.1
LnM2	Natural log of money and quasi money (M2) as % of GDP	99	1970-2000	World Development Indicators, WB
BMP	Black Market Premium = (parallel Xrate/official Xrate-1)*100); values for industrial countries are added as 0)	60	1970-2000	Levine and Renelt; World's Currency Yearbook (for 1985, 1990-93); World Development Indicators, WB
TARIFF	Tariff = (tax int trade*current revenue) / Imports	65	1970-2000	World Development Indicators, WB
BMP_SD	Standard Deviation of BMP	60	1970-2000	
TARIFF_SD	Standard Deviation of TARIFF	65	1970-2000	

[1] Table A-1 shows the data available in the source, while Table A-2 shows the data that was actually used in the regressions. Some of the sources include data from the oil-producer countries and the emerging economies from East Europe, which where removed from the dataset.

Code	Name-Definition	Number of Observations		Source
		Countries	Period	
BMP_FDSD	Standard Deviation of First-difference TARIFF	60	1970-2000	
TARIFF_FDSD	Standard Deviation of First-difference TARIFF	65	1970-2000	
CORRUPTION	Corruption (Index)	90	1984-2000	ICRG: The PRS Group, Inc., 1979-2004
GOVSTA	Government stability	90	1984-2000	ICRG: The PRS Group, Inc., 1979-2004
LAW AND ORDER	Index of law and order	90	1984-2000	ICRG: The PRS Group, Inc., 1979-2004
DURABLE	Regime Durability: number of years since the most recent regime change	98	1970-2000	POLITY_IV: Political Regime Characteristics and Transitions, 1800-2002
PROPERTY	Legal System & Property Rights	85	1970-2000	Economic Freedom of the World / 2003 Annual Report

Table A-2
Variable description and Number of observations from regressions

Code	Name-Definition	Number of Observations	
		Countries	Period
LnY70	Convergence indicator: Natural log of GDP of 1970	84	1970-2000
LnINV	Natural log of Investment share of the GDP	84	1970-2000
LnHK	Natural log of secondary school enrolment rates	84	1970-2000
LnGOVCON	Natural log of government consumptio share of the GDP	84	1970-2000
LnM2	Natural log of money and quasi money (M2) as % of GDP	70	1970-2000
BMP	Black Market Premium = (parallel Xrate/official Xrate-1)*100); values for industrial countries are added as 0)	60	1970-2000
TARIFF	Tariff = (tax int trade*current revenue) / Imports	65	1970-2000
BMP_SD	Standard Deviation of BMP	60	1970-2000
TARIFF_SD	Standard Deviation of TARIFF	65	1970-2000

Code	Name-Definition	Number of Observations	
		Countries	Period
BMP_FDSD	Standard Deviation of First-difference TARIFF	60	1970-2000
TARIFF_FDSD	Standard Deviation of First-difference TARIFF	65	1970-2000
CORRUPTION	Corruption (Index)	77	1984-2000
LAW AND ORDER	Index of law and order	77	1984-2000
GOVSTA	Government stability	77	1984-2000
DURABLE	Regime Durability: number of years since the most recent regime change	82	1970-2000
PROPERTY	Legal System & Property Rights	77	1970-2000

Appendix 2
List of countries

	Code	Country		Code	Country		Code	Country
1	DZA	Algeria	31	GRC	Greece	63	PNG	Papua New
2	ARG	Argentina	32	GTM	Guatemala			Guinea
3	AUS	Australia	33	HTI	Haiti	64	PRY	Paraguay
4	AUT	Austria	34	HKG	Hong Kong	65	PER	Peru
5	BGD	Bangladesh	35	HND	Honduras	66	PRT	Portugal
6	BRB	Barbados	36	ISL	Iceland	67	PHL	Philippines
7	BEL	Belgium	37	IND	India	68	RWA	Rwanda
8	BEN	Benin	38	IDN	Indonesia	69	SEN	Senegal
9	BOL	Bolivia	39	IRL	Ireland	70	SLE	Sierra Leone
10	BWA	Botswana	40	ISR	Israel	71	SGP	Singapore
11	BRA	Brazil	41	ITA	Italy	72	ZAF	South Africa
12	BDI	Burundi	42	JAM	Jamaica	73	ESP	Spain
13	CMR	Cameroon	43	JPN	Japan	74	LKA	Sri Lanka
14	CAN	Canada	44	JOR	Jordan	75	SWE	Sweden
15	CAF	Central African	45	KEN	Kenya	76	CHE	Switzerland
		Republic	46	KOR	Korea,	77	SYR	Syria
16	CHL	Chile			Republic of	78	TWN	Taiwan
17	CHN	China	47	LSO	Lesotho	79	THA	Thailand
18	COL	Colombia	48	LUX	Luxemburg	80	TGO	Togo
19	COG	Congo,	49	MWI	Malawi	81	TTO	Trinidad
		Republic of	50	MYS	Malaysia			&Tobago
20	CRI	Costa Rica	51	MLI	Mali	82	TUN	Tunisia
21	DNK	Denmark	52	MEX	Mexico	83	TUR	Turkey
22	DOM	Dominican	53	MAR	Morocco	84	UGA	Uganda
		Republic	54	MOZ	Mozambique	85	URY	Uruguay
23	ECU	Ecuador	55	NPL	Nepal	86	GBR	United
24	EGY	Egypt	56	NLD	Netherlands			Kingdom
25	SLV	El Salvador	57	NZL	New Zealand	87	USA	USA
26	FJI	Fiji	58	NIC	Nicaragua	88	VEN	Venezuela
27	FIN	Finland	59	NER	Niger	89	ZMB	Zambia
28	FRA	France	60	NOR	Norway	90	ZWE	Zimbabwe
29	GMB	Gambia, The	61	PAK	Pakistan			
30	GER	Germany	62	PAN	Panama			

Appendix 3

Deriving the Dynamic Panel Data Equation

The following results represent the development of the model and derivation of the equations from the work of Mankew, Romer and Weil (1995) and Islam (1995), with minor modifications in the interpretation of the parameters. A panel data equation is derived from the examination of this version of the Solow model and it validates the economic growth model specification from Section 6.

The model follows a Cobb-Douglas production function of the form:

$$Y(t) = K(t)^{\alpha}[A(t)L(t)]^{1-\alpha} \qquad \text{when } 0 < \alpha < 1 \tag{A-1}$$

where $Y(t)$ = Output
$K(t)$ = Capital
$L(t)$ = Labor

$$\frac{Y(t)}{L(t)} = K(t)^{\alpha} A(t)^{1-\alpha} L(t)^{-\alpha} \tag{A-a}$$

Defining stock of capital and output per unit of effective labor,

$$\hat{k} = \frac{K}{AL} \qquad \text{and} \qquad \hat{y} = \frac{Y}{AL}$$

L and A are assumed to grow exogenously at rates n and g so that (Solow Model)

$$L(t) = L(0)e^{nt}$$
$$A(t) = A(0)e^{gt}$$

Rewriting K,

$$K = AL\hat{k}$$
$$= A(0)e^{gt}L\hat{k}$$

Rewriting Equation (A-a) by substituting the above yields,

$$\frac{Y(t)}{L(t)} = [A(0)e^{gt}L\hat{k}]^{\alpha} A^{1-\alpha} L^{-\alpha}$$

$$= [A(0)e^{gt}\hat{k}]^{\alpha} A^{1-\alpha}$$
$$= [A(0)e^{gt}\hat{k}]^{\alpha} [A(0)e^{gt}]^{1-\alpha}$$
$$= A(0)e^{gt}\hat{k}^{\alpha}$$

$$\ln[\frac{Y(t)}{L(t)}] = \ln[A(0)] + gt + \alpha \ln \hat{k} \qquad \text{(A-b)}$$

The dynamic equation for $\hat{k}$ is given by,

$$\dot{\hat{k}}(t) = s\hat{y}(t) - (n + g + \delta)\hat{k}(t) \qquad \text{(A-2)}$$
$$= s\hat{k}(t)^{\alpha} - (n + g + \delta)\hat{k}(t), \text{ where } \delta = \text{depreciation rate}$$

At steady state, $\hat{k}$ converges to

$$\hat{k}^{*} = (\frac{s}{n + g + \delta})^{\frac{1}{1-\alpha}}$$

To derive the expression for steady state per capita income, substitute $\hat{k}^{*}$ into Eq. (A-b),

$$\ln[\frac{Y(t)}{L(t)}] = \ln[A(0)] + gt + (\frac{\alpha}{1-\alpha}) \ln(\frac{s}{n + g + \delta})$$
$$\ln[\frac{Y(t)}{L(t)}] = \ln[A(0)] + gt + (\frac{\alpha}{1-\alpha}) \ln(s) - (\frac{\alpha}{1-\alpha}) \ln(n + g + \delta) \qquad \text{(A-3)}$$

Adding a country specific shock (See Mankew, Romer and Weil (1995) for the validation of this type of shock to the model)

$$\ln A(0) = \alpha_0 + \varepsilon$$

$$\text{let } \alpha = \alpha_0 + gt$$

$$\ln[\frac{Y(t)}{L(t)}] = \alpha + (\frac{\alpha}{1-\alpha}) \ln(s) - (\frac{\alpha}{1-\alpha}) \ln(n + g + \delta) + \varepsilon \qquad \text{(A-4)}$$

To determine the pace of convergence lets review Eq. (A-1) and the definitions of stock of capital and output per unit of effective labor,

$$Y(t) = K(t)^{\alpha}[A(t)L(t)]^{1-\alpha}$$

$$\hat{k} = \frac{K}{AL} \qquad \hat{y} = \frac{Y}{AL}$$

Substituting in $\hat{y} = \frac{Y}{AL}$ yields,

$$\hat{y}AL = \frac{(\hat{k}AL)^{\alpha} AL}{(AL)^{\alpha}}$$

$$\hat{y} = \hat{k}^{\alpha} \tag{A-c}$$

Relative growth rate is denoted by,

$$x_r = \frac{\dot{x}}{x} = \frac{d(\ln x)}{dt} \tag{A-d}$$

Accordingly,

$$\hat{y}_r = \frac{\dot{\hat{y}}}{\hat{y}} = \frac{d}{dt}(\ln \hat{k}^{\alpha})$$

$$= \alpha(\frac{1}{\hat{k}})\dot{\hat{k}}$$

$$= \frac{\alpha \dot{\hat{k}}}{\hat{k}}$$

$$\hat{y}_r = \alpha \hat{k} \tag{A-e}$$

Rearranging Eq. (A-2),

$$\dot{\hat{k}}(t) = s\hat{y}(t) - (n + g + \delta)\hat{k}(t)$$

Divide both sides by $\hat{k}$,

$$\frac{\dot{\hat{k}}}{\hat{k}} = s\frac{\hat{y}}{\hat{k}} - (n + g + \delta)$$

Substitute Eq. (A-e),

$$\frac{\hat{y}_r}{\alpha} = s\frac{\hat{y}}{\hat{k}} - (n+g+\delta)$$

Solving for $\hat{y}_r$,

$$\hat{y}_r = \alpha[s\frac{\hat{y}}{\hat{k}} - (n+g+\delta)]$$

Substituting into Eq. (A-c),

$$\hat{y}_r = \alpha[s\frac{\hat{y}}{\hat{y}^{\frac{1}{\alpha}}} - (n+g+\delta)]$$

$$\hat{y}_r = \alpha[s\hat{y}^{-(\frac{1-\alpha}{\alpha})} - (n+g+\delta)] \qquad \text{(A-f)}$$

The $\hat{y}$ variable can also be written as: $\hat{y} = e^{\ln \hat{y}}$

Substituting this into (A-f) yields,

$$\hat{y}_r = \alpha[se^{-(\frac{1-\alpha}{\alpha})\ln \hat{y}} - (n+g+\delta)]$$

Lets define $\hat{y}_r \equiv \phi(\ln \hat{y})$,

$$\phi(\ln \hat{y}) \equiv \alpha[se^{-(\frac{1-\alpha}{\alpha})\ln \hat{y}} - (n+g+\delta)]$$

Using the Taylor Approximation of

$$f(x) \approx f(a) + f'(a)(x-a) \qquad \text{for } x \text{ close } a$$

Approximating close to the steady state point such that,

$$f(x) = \phi(x)$$
$$x = \ln \hat{y}$$
$$a = \ln \hat{y}^*$$

Therefore the Taylor expression is as follows,

$$\hat{y}_r \approx \phi(\ln \hat{y}^*) + \phi'(\ln \hat{y}^*)(\ln \hat{y} - \ln \hat{y}^*) \qquad \text{(A-g)}$$

To develop the first term of the Taylor expression (A-g), lets use Equation (A-f),

$$\phi(\ln \hat{y}^*) = \alpha[s(\hat{y}^*)^{-(\frac{1-\alpha}{\alpha})} - (n+g+\delta)]$$

Recall that at steady state,

$$\hat{k}^* = (\frac{s}{n+g+\delta})^{\frac{1}{1-\alpha}} \quad \text{and} \quad \hat{y}^* = \hat{k}^{*\alpha} = (\frac{s}{n+g+\delta})^{\frac{1}{1-\alpha}}$$

$$\phi(\ln \hat{y}^*) = \alpha\{s[(\frac{s}{n+g+\delta})^{\frac{\alpha}{1-\alpha}}]^{-(\frac{1-\alpha}{\alpha})} - (n+g+\delta)\}$$

$$\phi(\ln \hat{y}^*) = \alpha[s(\frac{n+g+\delta}{s}) - (n+g+\delta)]$$

$$\phi(\ln \hat{y}^*) = 0 \qquad \text{(first term)}$$

To develop the second term of the Taylor expression (A-g), lets also use Eq. (A-f),

$$\phi'(\ln \hat{y}^*) = \frac{d}{d(\ln \hat{y}^*)}\phi(\ln \hat{y}^*)$$

$$= \frac{d}{d(\ln \hat{y}^*)}\{\alpha[s(\hat{y}^*)^{-(\frac{1-\alpha}{\alpha})} - (n+g+\delta)]\}$$

$$= (-\frac{1-\alpha}{\alpha})\alpha s\hat{y}^{*-(\frac{1-\alpha}{\alpha})}$$

$$= (-\frac{1-\alpha}{\alpha})\alpha s e^{-(\frac{1-\alpha}{\alpha})\ln \hat{y}^*}$$

$$= -(1-\alpha)s\hat{y}^{*-(\frac{1-\alpha}{\alpha})}$$

Substituting $\hat{y}^*$ for the steady state the second term of the Taylor expression becomes,

$$\phi'(\ln \hat{y}^*) = -(1-\alpha)(n+g+\delta) \qquad \text{(second term)}$$

Now applying the first and second term back into the Taylor Expression (A-g),

$$\hat{y}_r \approx 0 - (1-\alpha)(n+g+\delta)(\ln \hat{y} - \ln \hat{y}^*)$$

Using Eq. (A-d), it is known that $\hat{y}_r = \frac{d}{dt}(\ln \hat{y})$

$$\frac{d}{dt}(\ln \hat{y}) = -(1-\alpha)(n+g+\delta)(\ln \hat{y} - \ln \hat{y}^*)$$

$$\frac{d}{dt}(\ln \hat{y}) = \lambda(\ln \hat{y}^* - \ln \hat{y}) \qquad \text{(A-5)}$$

where $\lambda = (1-\alpha)(n+g+\delta)$

Equation (A-5) is known as the pace of convergence. Manipulating Eq. (A-5) further,

$$\frac{d}{dt}(\ln \hat{y}) = -\lambda \ln(\frac{\hat{y}}{\hat{y}^*}) \qquad \text{(A-h)}$$

$$\text{let } q_t = \ln(\frac{\hat{y}}{\hat{y}^*}) \qquad \text{(A-i)}$$

By substituting Equation (A-i) into (A-h) we can express the following differential equation,

$$\dot{q}_t = -\lambda q_t$$

$$\frac{dq_t}{dt} = -\lambda q_t$$

$$\frac{1}{q_t} dq_t = -\lambda dt$$

Evaluating this expression for a period of $t_2 - t_1$ yields,

$$\int_1^2 \frac{1}{q_t} dq_t = -\int_1^2 \lambda dt$$

$$\ln q_t \Big|_{t1}^{t2} = -\lambda t \Big|_{t1}^{t2}$$

$$\ln q_{t2} - \ln q_{t1} = -\lambda(t_2 - t_1)$$

$$\ln(\frac{q_{t2}}{q_{t1}}) = -\lambda(t_2 - t_1)$$

$$\frac{q_{t2}}{q_{t1}} = e^{-\lambda(t_2 - t_1)}$$

$$q_{t2} = e^{-\lambda(t_2 - t_1)} q_{t1} \qquad \text{(A-j)}$$

Substitute Eq. (A-i) into Eq. (A-j) yields,

$$\ln[\frac{\hat{y}(t_2)}{\hat{y}^*}] = e^{-\lambda(t_2-t_1)} \ln[\frac{\hat{y}(t_1)}{\hat{y}^*}]$$
$$\ln[\hat{y}(t_2)] - \ln(\hat{y}^*) = e^{-\lambda(t_2-t_1)} \{\ln[\hat{y}(t_1)] - \ln(\hat{y}^*)\}$$
$$\ln[\hat{y}(t_2)] = (1-e^{-\lambda\tau}) \ln(\hat{y}^*) + e^{-\lambda\tau} \ln[\hat{y}(t_1)] \qquad \text{(A-6)}$$

where $\tau = t_2 - t_1$

Subtracting $\ln[\hat{y}(t_1)]$ from both sides,

$$\ln[\hat{y}(t_2)] - \ln[\hat{y}(t_1)] = (1-e^{-\lambda\tau}) \ln(\hat{y}^*) - (1-e^{-\lambda\tau}) \ln[\hat{y}(t_1)] \qquad \text{(A-7)}$$
$$\ln[\hat{y}(t_2)] - \ln[\hat{y}(t_1)] = (1-e^{-\lambda\tau}) \{\ln(\hat{y}^*) - \ln[\hat{y}(t_1)]\} \qquad \text{(A-8)}$$

Recall that at steady state $\hat{y}^* = (\frac{s}{n+g+\delta})^{\frac{1}{1-\alpha}}$ and substituting into Eq.(A-8) will yield,

$$\ln[\hat{y}(t_2)] - \ln[\hat{y}(t_1)] = (1-e^{-\lambda\tau}) \frac{\alpha}{1-\alpha} \ln(s) - (1-e^{-\lambda\tau}) \frac{\alpha}{1-\alpha} \ln(n+g+\delta) - (1-e^{-\lambda\tau}) \ln[\hat{y}(t_1)] \qquad \text{(A-9)}$$

Note that the income per effective labor is,

$$\hat{y}(t) = \frac{Y(t)}{A(t)L(t)} = \frac{Y(t)}{L(t)A(0)e^{gt}}$$
$$\ln[\hat{y}(t)] = \ln[\frac{Y(t)}{L(t)}] - \ln A(0) - gt$$
$$= \ln[y(t)] - \ln A(0) - gt \qquad \text{(A-k)}$$
$$\text{where } y(t) = \frac{Y(t)}{L(t)} \quad \text{(per capita income)}$$

Therefore,

$$\ln \hat{y}(t_1) = \ln[y(t_1)] - \ln A(0) - gt_1$$
$$\ln \hat{y}(t_2) = \ln[y(t_2)] - \ln A(0) - gt_2$$

Substituting these two into Equation (A-9) yields,

$$\ln[y(t_2)] - \ln[y(t_1)] = (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}\ln(s) - (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}\ln(n+g+\delta) \qquad \text{(A-10)}$$
$$-(1-e^{-\lambda\tau})\ln[y(t_1)] + (1-e^{-\lambda\tau})\ln A(0) + g(t_2 - e^{-\lambda\tau}t_1)$$

By collecting the terms with $\ln[y(t_1)]$ and placing them on the right side of the equation,

$$\ln[y(t_2)] = (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}\ln(s) - (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}\ln(n+g+\delta) + e^{-\lambda\tau}\ln y(t_1) \qquad \text{(A-11)}$$
$$+(1-e^{-\lambda\tau})\ln A(0) + g(t_2 - e^{-\lambda\tau}t_1)$$

The equation above is representative of the dynamic panel data model where $(1-e^{-\lambda\tau})\ln A(0)$ is the time-invariant individual country-effect term.

$$y_{i,t} = \gamma y_{i,t-1} + \beta_1 x_{it}^1 + \beta_2 x_{it}^2 + \eta_t + \mu_i + \nu_{it} \qquad \text{(A-12)}$$

where, $y_{i,t} = \ln y(t_2)$

$y_{i,t-1} = \ln y(t_1)$

$\gamma = e^{-\lambda\tau}$

$\beta_1 = (1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}$

$\beta_2 = -(1-e^{-\lambda\tau})\frac{\alpha}{1-\alpha}$

$x_{it}^1 = \ln(s)$

$x_{it}^2 = \ln(n+g+\delta)$

$\mu_i = (1-e^{-\lambda\tau})\ln A(0)$

$\eta_t = g(t_2 - e^{-\lambda\tau}t_1)$

The variable $y_{i,t-1} = \ln y(t_1)$ represents initial GDP per capita for testing convergence. The original determinants of economic growth in the Solow model are the rate of savings (s) and population growth (n). Further development of the empirical implications of the

Solow model (Barro, 1991) suggests additional control variables, which were included in the regression analysis in Section 7. These regressors are represented by the matrix X. Finally, μ_i and η_t describe the country-specific and time effects. In all tables from Section 6, model specifications were adjusted to country-specific effects (fixed effects). The construction of the panel data for this particular work consists on 5-year clusters. The v_{it} represents the error term that varies across countries and time periods. This has a mean value of zero. Equation (A-12) is transformed into Equation (1) from Section 5:

$$\Delta y_{i,t} = \mu_i + \gamma y_{i,t-j} + \beta X_{i,t} + \delta\, TPI_{i,t} + v_{i,t} \qquad (1)$$

Appendix 4

Statistical Test for Multicollinearity among political variables

From table 3, there is evidence of high multicollinearity among the three political stability variables and the institutional framework indicator. Multicollinearity may substantially increase the standard errors and lower the t-statistics of the parameters in the regression. If variables are closely related, it is difficult to separate their effects on the dependent variables and it is a better option to ascertain the effect of each predictor alone.

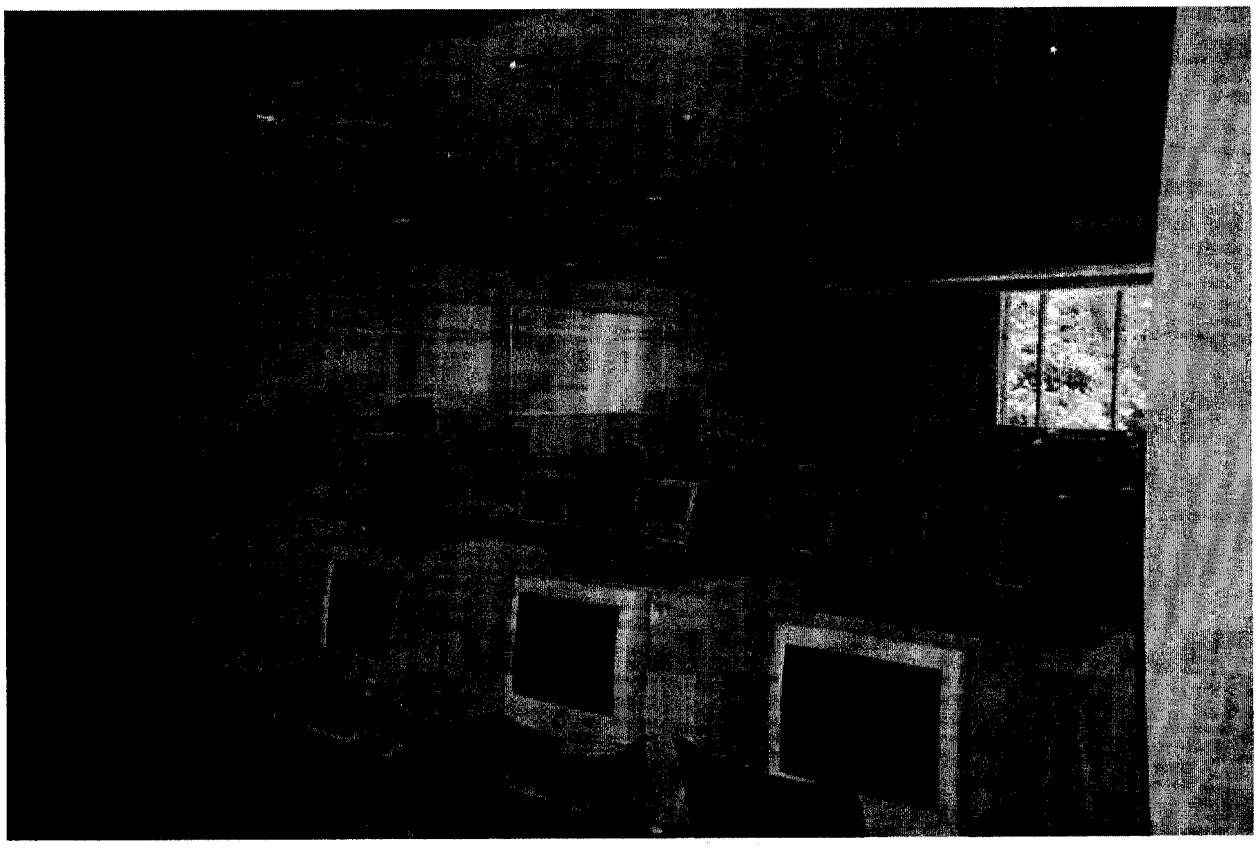
Table A-4
Variance Independence

Dependent Variable (# of Obs)	Independent Variables	1-R^2 (%)
Corruption	law_order	**0.15**
(328)	property	**0.17**
	govsta	0.61
	durable	0.65
	Overall	0.36
Govsta	property	**0.16**
(328)	law_order	**0.18**
	corruption	**0.36**
	durable	0.63
	Overall	0.60
Durable	law_order	**0.15**
(528)	property	**0.16**
	corruption	**0.38**
	govsta	0.60
	Overall	0.63
Property	law_order	**0.33**
(498)	corruption	0.40
	govsta	0.61
	durable	0.64
	Overall	0.16
law_order	property	**0.34**
(304)	corruption	**0.37**
	durable	0.63
	govsta	0.70
	Overall	0.15

One alternative to detect multicollinearity is to regress each variable on all the rest of other variables. Subsequently, $1-R^2$ is calculated from the regressions to observe the percentage of variance independence from the rest of the indicators. Table 4-A shows the results for the variables mentioned above. For example, the table discloses that only 15% of CORRUPTION's variance is independent of LAW&ORDER variable, and GOVSTA's variance is only 16% independent from PROPERTY. Overall, PROPERTY's variance is barely 16% independent of all the other variables. The high dependency among political variables may generate statistical instability in the value of the parameters.

Appendix 5

CASSEL LABORATORY, UCLA



Appendix 6

General Information on Subjects from the trust experiment

Gender	Female	106
	Male	106
Ethnicity	Black (not of Hispanic Origin)	6
	Hispanic	28
	Filipino	6
	White	59
	American Indian/Alaskan Native	0
	Pacific Islander	21
	Asian	86
	Middle East	7
	Other	3
Age, average		22
Year at UCLA	Freshman	20
	Sophomore	16
	Junior	62
	Senior	84
	Graduate Student	34
Major t UCLA	Econ and Business	30
	Communications	6
	Med School	1
	Psychology	22
	Computer Science	8
	Philosophy	2
	Sociology	9
	History	11
	Science	12
	Engineering	20
	Physiology	1
	Language	4
	Accounting	2
	Math	14
	Political Science	19
	Chemistry	12
	English	7
	Other	29
	Undeclared	7