ESSAYS ON ECONOMIC DEVELOPMENT AND INTERNATIONAL RISK SHARING

A Dissertation
Presented to
The Faculty of the Department
of Economics
University of Houston

In Partial Fulfillment
Of the Requirements for the Degree of
Doctor of Philosophy

By
Edson Silveira Sobrinho
December 2015

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Abstract

This dissertation consists of two independent essays approaching two macroeconomic problems: development outcomes and international risk sharing.

The first essay analyzes the relationship of income inequality and economic development. I use a difference-in-differences specification with data from Brazilian municipalities to show empirical evidence that the origins of inequality matter to determine development outcomes across different economies. Inequality in sugar-producing areas in Brazil was historically associated with non-market allocation of resources, namely slavery and royal land grants. In contrast, wheat-growing places were settled under market-related mechanisms of free labor and auction acquisition of land. I add to the Engerman-Sokoloff hypothesis by showing that there is not a simple relationship of inequality and development. Instead, I find that non-market inequality was harmful compared to market inequality. There is a differential negative effect of inequality on development in sugar compared to wheat areas. Schooling and public goods provision seem to be two important channels for those different paths of development.

The second essay explores pairwise determinants of international risk sharing. The low levels of income and consumption risk sharing found in empirical research are still not well understood in the literature. I first estimate the amount of risk sharing and find averages of zero for income and of 37% for consumption. Then I test potential direct determinants and find that equity assets seem to be contributing to income risk sharing. For consumption, international deposits seem to be helpful. Finally I look for indirect determinants, among which WTO membership, common language, migration and the share of companies listed in the stock market play a role for income risk sharing. For consumption, the size of the economies, WTO and regional trade agreements, geographic distance, migration, ease of doing business and a legal rights index seem to be important.

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Chapter 1

Inequality and Development: The Case of Brazilian Municipalities

1.1 Introduction

The role inequality plays in economic development has been extensively debated for over 60 years and yet many questions remain unresolved. Researchers have explored several different approaches and found contradictory results on the sign of the correlation of inequality and development, the direction of causality, and if there is any significant relation at all. Some argue that inequality is helpful by providing an efficient allocation of resources and by giving the right incentives for people to work hard. Others emphasize that it is harmful because it contributes to poorer institutions and inefficient political choices.

In a series of papers, Engerman and Sokoloff (1997, 2000, 2005) propose that, due to technological features, sugarcane crops were historically associated with larger farms, the formation of a political oligarchy and intensive presence of slavery, whereas wheat crops favored family farms and a stronger middle class. These factors led sugarcane economies to have more inequality. According to their hypothesis, inequality affects the quality of institutions, educational attainment and public goods provision, being negatively related to development. As a corollary, economic development may have been hindered in those economies.

However, I examine the case of Brazilian municipalities to show that there is not a simple relationship of inequality and development. Rather, the influence of inequality on development differs by crop. I find that the Engerman-Sokoloff hypothesis may be not necessarily about sugarcane crops leading to more inequality and consequently lower development levels. Instead, inequality in sugarcane places was originally associated with harmful non-market mechanisms of allocation of resources.

I build the institutional argument based on the different settlement strategies followed for wheat and sugarcane crops within Brazil, which led to differences in the origins of inequality. During the colonial period, sugarcane farms were associated with slavery and royal land grants, whereas wheat places were settled under a more market-related framework, where the use of free immigrant labor and the auction acquisition of land prevailed. These settlement schemes lasted for centuries shaping the allocation of economic resources and the formation of the Brazilian society.

Therefore, the persistence of an inefficient distribution of wealth and income over time tended to be more harmful in sugar areas, where the allocation of resources followed non-market mechanisms. Societies with strong concentration of wealth and income determined by inefficient non-market mechanisms have lower development outcomes, i.e., sugar municipalities lose more from inequality. This is verified in the descriptive data and in a variety of regressions.

I first show that there is not a clear relationship of inequality and development in OLS estimations with basic control variables. Then, by using a difference-in-differences specification, I show that this relationship becomes significant and robust when allowing it to differ by crop. The empirical results indicate that higher levels of inequality in sugar places provide a differential harmful effect on output per capita and poverty rate, when compared to higher levels of inequality in wheat places. An increase of one standard deviation in the Gini index is associated with a differential 9.7% average decrease in income per capita and 8.9% average increase in poverty rate in sugar municipalities with respect to wheat municipalities.

Finally I explore the channels that might explain why the effects of inequality on development outcomes differ by crop. The evidence points to schooling and public goods provision. Having these two as dependent variables, the results are consistent with a harmful non-market inequality in sugar places. Having them as controls, when income per capita is the dependent variable, makes the coefficients of the inequality-sugar term insignificant, as the point estimates drop by half. When poverty rate is the dependent variable, the point estimates drop to nearly zero.

Regarding the validity of the specification, it is possible, and even likely, that inequality is endogenous to development levels. Moreover, as natural resources are an input to the production function, it is also possible that agricultural endowments affected income through other channels, and income affected institutional quality, educational attainment, public goods provision, etc. This creates an identification challenge for any empirical study testing the Engerman-Sokoloff hypothesis: how to isolate these alternative channels.

The main contribution of this essay is to approach this identification challenge by using a difference-in-differences specification with an interaction term of inequality levels, as measured by the Gini index of income, and a dummy variable indicating to which crop the municipality is more suitable. The suitability variables are based purely on technical geographic factors to avoid endogeneity problems. The interaction term allows for having the crop dummy alone, inequality alone, and also the suitability measure itself as control variables. This will isolate any alternative channel for the relation of agricultural endowments and development levels, as long as it is not simultaneously correlated with inequality. In particular, it will isolate a plausible effect of reverse causality that output might have on inequality.

Yet I pay special attention to two alternative channels for the relation of agricultural endowments and development levels that could possibly be simultaneously correlated with inequality: i) the natural resource curse — high agricultural productivity in sugar economies purportedly created a comparative advantage in agricultural instead of industrial activities, leading wheat, and not sugar economies, to industrialization and high development levels; and ii) wheat as a more valuable endowment — it might be the case that wheat became a more valuable endowment yielding wheat places higher agricultural productivity and impacting several development outcomes. I test and fail to confirm both alternative hypotheses. I show that, if existent, they are not correlated with the interaction term of inequality and crop suitability.

Besides the finding that it is not simply the level, but the origins of inequality that matter, this paper has other contrasts to the Engerman-Sokoloff hypothesis. I do not argue that technological characteristics of agricultural endowments were determinant for sugar places having more slavery. It might have been a mere correlation between sugarcane and the use of slavery and land grants. Moreover, I do not need that sugar areas were more unequal than wheat areas. Instead I document that their inequality had different origins, which harmed development paths of sugar economies.

1.2 Literature Review

A first wave of the growth literature proposed that inequality benefits development by directing more income to high saving capitalists (Lewis, 1954; Kaldor, 1955, 1961). By emphasizing the reward system of free markets, the argument can also be expressed in different words, i.e., completely eliminating inequality would have obvious negative effects on labor supply and savings; therefore inequality is positive for growth.

In contrast, a second wave of the literature argued that inequality could be harmful to growth in many ways. From a political economy perspective, Alesina and Rodrik (1994) asserted that "policies that maximize growth are optimal only for a government that cares solely about pure capitalists. The greater the inequality of wealth and income, the higher the rate of taxation, and the lower growth." Other papers to explore this line are Persson and Tabellini (1994)[1] and Galor et al. (2009)[2].

A second channel through which inequality may harm growth is through institutions. Acemoglu et al. (2011) refer to the emergence and persistence of inefficient states based on patronage politics. "By choosing an inefficient state structure, the rich elite may be able to use patronage and capture democratic politics, so reducing the amount of redistribution in democracy. The inefficient state creates its own constituency and tends to persist over time. Moreover, an inefficient state is more likely to arise when there is greater income inequality." Another reference in a similar line is Banerjee and Iyer (2005).[3]

[1] Persson and Tabellini (1994) suggest that inequality is harmful for growth because "in a society where distributional conflict is important, political decisions produce economic policies that tax investment and growth-promoting activities in order to redistribute income."

[2] Galor et al. (2009) suggests that "inequality in the distribution of landownership adversely affected the emergence of human-capital promoting institutions (e.g., public schooling), and thus the pace and the nature of the transition from an agricultural to an industrial economy, contributing to the emergence of the great divergence in income per capita across countries."

[3] Banerjee and Iyer (2005) analyze "the colonial land revenue institutions set up by the British in India, and show that differences in historical property rights institutions lead to sustained differences

As inequality is associated with political instability, again it can harm institutions and lower growth. Alesina et al. (1996) define political instability as the propensity of a government collapse, and find that "in countries and time periods with a high propensity of government collapse, growth is significantly lower than otherwise."

A third channel is related to human capital. If there are imperfect capital markets then inequality will limit human capital accumulation, which also links inequality to underdevelopment (Galor and Zeira, 1993; Perotti, 1996; Galor and Moav, 2006; Bourguignon and Verdier, 2000).[4]

Challenging these perspectives, Forbes (2000); Barro (2000); Banerjee and Duflo (2003) found a zero, nonlinear, or even positive relationship for inequality and growth.[5] [6] The positive relationship of Forbes (2000) refers back to the thought of beneficent inequality of Lewis (1954) and Kaldor (1955, 1961).

Criticism of this result was made on the grounds of poor quality of the data (Deininger and Squire, 1996, 1998). Later, Deininger and Squire themselves were questioned due to the fact that their inequality data were derived from several different methodologies; individual vs. household surveys, income vs. expenditure data, and

in economic outcomes. Areas in which proprietary rights in land were historically given to landlords have significantly lower agricultural investments and productivity in the post-independence period than areas in which these rights were given to the cultivators. These areas also have significantly lower investments in health and education."

[4]Perotti (1996) investigates the relationship of income distribution, democratic institutions, and growth. He concludes that "there is strong empirical support for two types of explanations, linking income distribution to sociopolitical instability and to the education/fertility decision. A third channel, based on the interplay of borrowing constraints and investment in human capital, also seems to receive some support by the data, although it is probably the hardest to test with the existing data."

[5]Banerjee and Duflo (2003) show that "the growth rate is an inverted U-shaped function of net changes in inequality: changes in inequality (in any direction) are associated with reduced growth in the next period."

[6]Barro (2000) uses "evidence from a broad panel of countries showing little overall relation between income inequality and rates of growth and investment. For growth, higher inequality tends to retard growth in poor countries and encourage growth in richer places. The Kuznets curve - whereby inequality first increases and later decreases during the process of economic development - emerges as a clear empirical regularity."

pretax vs. post-tax measures of income (Atkinson and Brandolini, 2001).

At the microeconomic level, Marrero and Rodriguez (2013) used household data from the Panel Study of Income Dynamics (PSID) to show that "one reason for this ambiguity is that income inequality is actually a composite measure of inequality of opportunity and inequality of effort. They may affect growth through opposite channels, thus the relationship between inequality and growth depends on which component is larger." They find empirical evidence of a negative relation for inequality of opportunity and a positive one for inequality of effort.

1.2.1 The Engerman-Sokoloff Hypothesis: Agricultural Endowments as Determinants of Development Paths

Engerman and Sokoloff (1997, 2000, 2005) argue that factor endowments are a central determinant of inequality and consequently bad institutions, low human capital investment and underdevelopment. Commodities featuring economies of scale and the use of slave labor (sugarcane being the example of interest) were historically associated with high inequality. In contrast, other types of commodities (namely wheat) allowed for family farms, attracted less slave labor and promoted the growth of the middle class; thus they are often associated with more developed economies.

Easterly (2007) endorses Engerman and Sokoloff's propositions arguing that the correlation between inequality and growth is negative and the direction of causality is from the former to the latter – inequality does cause underdevelopment.

Easterly's approach refers to structural inequality as due to geographic and historical factors, such as colonization, slavery and land distribution. This requires the exclusion of the effect of inequality due to market channels, which comes from the fact that success in free markets is uneven across different individuals, firms, regions, etc. With structural inequality isolated by the use of instrumental variables, the theoretical prediction is that this type of inequality has unambiguous negative effects on growth, resulting in bad institutions, low human capital investment and underdevelopment.

Using data collected from the FAO, 2000, for 128 countries, Easterly shows evidence that the ratio of land suitable for wheat to that for sugarcane is negatively correlated with inequality. Therefore, the exogenous suitability of land for wheat versus sugarcane is used as an instrument for structural inequality. Using current income per capita as a measure of development, he finds a negative and significant relation between development and structural inequality. Moreover, he also finds similar results using institutional quality and educational enrollment as measures of development.

More recently, Naritomi and Assuno (2012) used Brazilian historic data during the sugarcane boom from the 1500's until 1700's and found that sugarcane was associated with more land inequality today. Following the path of the slavery argument, they found negative effects for gold economies on governance and access to justice. One advantage of their approach is to use an interaction term between historical sugar production and distance to Portugal.

Still regarding the Brazilian case, Musacchio et al. (2014) find some evidence that the initial colonial institutions altered the trajectories of investments in education in Brazilian states between 1889 and 1930. With US and cross-country data, Nunn (2007) finds a positive association between slavery and land inequality.

However, explanations for the effect of agricultural endowments on development outcomes are often subject to the criticism of alternative channels other than the inequality-institutional channel, e.g., the natural resource curse leading to comparative advantages in non-industrial activities or the possibility that some endowments (perhaps wheat) turned out to be more valuable than others (sugarcane) in the past centuries. Moreover, the literature has been cautious with cross-country data due to potential unobserved country heterogeneity, and because comparing inequality measures from different sources may be inappropriate.

Literature like Easterly (2007) makes use of instrument variables in an attempt to focus on the effects of non-market inequality (or structural inequality, as the author names it). This strategy is similar to the one in this paper in the sense that he also allows for a possibly positive relation of market inequality and isolates it by using agricultural endowments as instruments for inequality.

However, Easterly (2007) differs from this paper in the sense that, as a contribution to the literature, I use an interaction term to address the challenge of potential alternative channels for the effects of agricultural endowments on development levels. The identification strategy of this paper allows to gauge the differential effect of inequality in sugar places compared to wheat places. The specification includes the crop dummies and suitability indices as controls, which isolate the effects of alternative channels for the relation between crop suitability and development outcomes, as long as they are not simultaneously correlated with inequality.

1.2.2 Methodology and Contrasts to the Engerman-Sokoloff Hypothesis

I start by showing that the relation of inequality and development is insignificant in the presence of regional fixed effects and some demographic controls. This suggests that country heterogeneity may be a problem to country-level approaches.

Then I make use of some historical facts. Sugarcane plantations were the leading economic activity in Brazil in the period of 1530 - 1760, when the allocation of resources followed primarily non-market mechanisms. Labor was based on slavery and land was granted to families chosen by the Portuguese royalty. On the other hand, wheat places made a stronger use of market mechanisms in the initial allocation of resources. In those places, settlement became important after 1820, when slave trade was declining and labor force was mainly provided by free immigrants. At that time the royal land grants system was over (1822) and the Land Bill (1850 - 1964) determined that land would have to be purchased from the government in auctions.

I show that the relation of inequality level and development becomes significant and robust when allowing it to differ by crop. For that I use a dummy variable for technical crop suitability at the municipality level to compare wheat and sugar locations, as indicators of places that made a more intense use of market vs. non-market mechanisms in the initial allocation of resources. I test if inequality in sugar municipalities is associated with lower development levels compared to wheat municipalities.

Last I explore the channels that might explain why the effects of inequality on development differ by crop. I use schooling and public goods provision as dependent variables to show that their correlation with the inequality-crop interaction is consistent with the theoretical prediction, even in the presence of a control for income per capita. Then I use them as control variables to show that they seem to explain why the inequality-crop term is associated with development levels.

Engerman-Sokoloff propose that sugarcane economies, as opposed to wheat places, favored inequality, which was harmful to development outcomes. This is the most evident contrast of this paper to their hypothesis. I find that the relation of inequality and current development levels is subtle and depends on the origins of inequality.

This paper does not necessarily rely on the assertion that sugar places are or were more unequal, but it is the origins of their inequality that matter. Sugar, as opposed to wheat, was historically associated with inequality originated during a period of strong non-market allocation of labor and land resources. Then I test if this association is correlated with harmful lingering effects on development outcomes of present days.

Furthermore, this paper does not rely on the proposition that it is necessarily some feature of wheat and sugar endowments that determined harmful choices of slavery and land allocation. This may have been an occasional fact and what is important here is the mere correlation between crop suitability and a harmful type of inequality.

Finally, this paper allows for an empirical way to reconcile the apparently contradictory waves of the literature. The negative relation of non-market inequality and development is not inconsistent with a possibly positive relation of market inequality and development. It could be that both affect economic development simultaneously.

This framework shows that the Engerman-Sokoloff hypothesis appears to be somewhat simplistic, yet the essence is the same: slavery and royal land grants contributed to the formation of a political and economic oligarchy, delivering inefficient institutions and lower levels of human capital.

1.3 Empirical Approach

1.3.1 Allocation of Resources in the Settlement of Brazil

The use of two inefficient non-market mechanisms in the allocation of labor and land resources was a strong characteristic of sugarcane production. Brazilian colonization took off with the sugar boom (1530-1760) based on a "plantation" system with three core elements: "latifundio" (a large estate with a single owner), sugarcane monoculture and slave labor. For over 300 years the workforce in the sugar economy was based on slavery. Slave trade was abolished only in 1850 and slavery officially ended in 1888.

Since 1530 land use was determined by a designation system named "sesmarias." The Portuguese royalty granted the use of land to members of the Portuguese nobility and their Brazilian nominees who where in charge of implementing the sugarcane "plantations." This system lasted until 1822 with the Brazilian independence.

Wheat production was not part of the Portuguese plans during the colonial period. Wheat suitability is concentrated in the south, where intensive settlement took place only in the mid 1800's with free immigrants coming from other parts of the country (1850-), Germany (1820-) and Italy (1870-). This made the workforce in the wheat regions consisted mainly of free men.

The Land Bill (1850-1964)[7] determined that unoccupied land would have to be purchased from government in auctions. Those who already possessed land were allowed to keep it, but new allocation would follow competitive processes. The timing coincides with the settlement of the southern Brazilian territory such that the effects of the Land Bill were more pronounced in the wheat regions.

[7] BRASIL, Lei n. 601, de 18 de setembro 1850.

Both free labor and auction acquisition of land are market-related mechanisms in the sense that supply and demand were freely determined by agents, as opposed to supply and demand under slavery and royal land grants schemes. In contrast, the institutional arrangement in the sugar economy shaped a certain initial allocation of resources that diverged from efficiency. Slavery did not reward productivity or human capital accumulation, and land was not acquired by the most productive farmers.[8]

Therefore, the persistence of an inefficient distribution of wealth and income over time tended to be more harmful in sugar areas, where the allocation of resources followed non-market mechanisms. Societies with strong concentration of wealth and income determined by inefficient non-market mechanisms should have lower development outcomes, i.e., sugar municipalities lose more from inequality.

This is precisely consistent with the data. Figure 1.1 depicts the relation of output per capita and inequality separately for sugarcane and wheat places. For sugar, the relation is significantly negative, meaning that higher levels of inequality are associated with lower levels of output. The opposite holds for wheat places. Inferences for the differences between those descriptive plots are presented throughout this paper.

1.3.2 The Dataset

In addition to the main contribution, there are some advantages of this paper over cross-country studies. For each variable, all the data are provided by one unique source. This prevents difficulties that commonly arise when comparing variables from different statistical methodologies across countries. A rich collection of statistics is provided by the Brazilian Agency for Geography and Statistics (Instituto Brasileiro de Geografia e Estatistica – IBGE), established in 1936 for the purpose of carrying

[8]For further references on Brazilian economic history, see Simonsen (2005).

out most official population and economic statistics, including the census surveys and the GDP releases.

By focusing on Brazil alone I eliminate issues with unobserved country heterogeneity. Instead, to control for within country heterogeneity, I use regional fixed effects and other municipality-level controls. This provides a stronger argument against the possibility that important variables may have been omitted, such as language, religion, the origin of the legal system, etc.

Brazil is very large, with nearly 5,570 municipalities, having both tropical regions appropriate for sugarcane crops, and non-tropical regions suitable to wheat crops. It is the number one producer of sugarcane in the world and is ranked among the top 20 producers of wheat. It presents extreme regional variations in development levels as income per capita can be as much as four times higher in the richer southern compared to the poorer northern states. Using data of nearly 5,570 cross-sectional observations gives a great variability and high power tests.

The dataset on agricultural suitability comes from the FAO Global Agro-Ecological Zones (GAEZ), which provides an index on the technical potential for cultivation of wheat and sugarcane based on water-balance, soil moisture conditions, radiation and temperature. Actual production is not considered to avoid endogeneity problems. The index is presented in two forms: a value number (a continuous variable increasing in suitability) and classes (1 indicating high suitability and 8 indicating not suitable, 9 is water). Figure 3 illustrates the dataset.

The FAO GAEZ provides the information in the form of georeferenced grid cells. I use a Geographic Information System (GIS) to assign to each municipality average indices (for both class and value indices) based on an average weighted by the approximate area of the municipality covered by each grid cell.[9]

I build two dummy variables indicating the predominance in crop suitability using the class index. Since the class index of a municipality is calculated as an average of its grid cells, then it becomes a continuous variable. Whenever the difference between the classes of wheat and sugar is greater than one, either the "Wheat Dummy" or the "Sugar Dummy" is assigned. If the difference between the classes is less than one, then the "Similar Dummy" is assigned. "Similar" is omitted from the regressions due to colinearity, except when interacted with another variable.

Information on GDP, population, inequality, institutions, etc. refers to 2010 (or the most approximate year available) and is provided by the Brazilian Agency for Geography and Statistics (IBGE). The public goods and schooling datasets are provided by the United Nations Development Programme (UNDP) in contribution with the IBGE. Data on municipal governmental budget come from the National Treasury Secretariat.

1.3.3 Regression Specification

I consider municipal output per capita and poverty rate as measures of current development levels. For municipality i in region j the basic specification is as follows:

$$\begin{aligned} Y_{ij} = \beta_0 + \beta_1 \textit{Inequality * Sugar Dummy}_{ij} + \beta_2 \textit{Inequality}_{ij} + \\ + \beta_3 \textit{Sugar Dummy}_{ij} + \beta_4 \textit{Wheat Dummy}_{ij} + \\ \beta_5 \textit{Sugar Suitability}_{ij} + \beta_6 \textit{Wheat Suitability}_{ij} + X_{ij}\Gamma + S_j + \epsilon_{ij} \end{aligned} \quad (1.1)$$

[9] The median municipality contains five grid cells and the mean is 18.

where X_{ij} is a vector of control variables and S_j is regional or state fixed effects. Inequality is measured as the Gini Index in 2010. The coefficient of interest β_1 gauges how development level responds to changes in inequality differently in wheat and sugar places. If the theoretical prediction is correct, β_1 should be negative, meaning that increases in inequality in sugar places, compared to wheat places, are associated with smaller gains or larger losses in development levels.

Because the dummy variables indicate three groups of municipalities, one must be omitted. For the interaction terms I choose to omit the wheat group because that facilitates the interpretation. The t-test of the coefficient β_1 on the interaction term "Inequality * Sugar Dummy" gives the differential effect of inequality in places with sugar as opposed to wheat predominance.

Having inequality on the right-hand side allows to control for candidate explanations for the relation with development outcomes, as long as not correlated with the crop dummies. In particular, it allows to control for a likely effect of reverse causality of development on inequality. Similarly, the crop dummies will capture effects of agricultural endowments on development, as long as not correlated with inequality. The suitability indices, from which the dummies are derived, are additional controls aiming at the direct endowment-output relationship.

A requirement of this empirical approach is that current levels of inequality in sugar places reflect past non-market allocation of resources, possibly through slavery, royal land grants or both. Naritomi and Assuno (2012) present evidence in this line for Brazil. Therefore the predominance of sugar suitability over wheat suitability interacted with current inequality levels becomes a proxy for the intensity of the use of those non-market mechanisms.

The lingering effects of historical non-market inequality on output per capita, poverty rate and other outcomes is the main proposition of Engerman-Sokoloff, and it is the object of the empirical tests in this paper. Leaving aside the two alternative channels for which I run explicit tests, the underlying assumption of the specification is that, without slavery and land grants, the second derivative of the outcome variables with respect to the crop dummy and inequality would have been the same in wheat and sugar places. As a counter-factual argument, it cannot be shown directly. But I show that, controlling for schooling and public goods provision, that second derivative of output and poverty rate with respect to the crop dummy and inequality is indeed statistically the same in wheat and sugar places.

1.4 The Outcomes of the Wheat-Sugar Indicator

Table 1.2 shows the overall relation of wheat and sugar endowments and output per capita. It follows typical cross-country evidence that sugarcane economies are usually poorer than wheat economies. However, this relation becomes statistically insignificant when regional fixed effects and other control variables such as population and latitude are introduced. Table 1.3 provides similar results for poverty rate as the dependent variable.

Interestingly it is possible that having higher suitability is beneficial to output per capita and poverty rate for both crops. The theoretical prediction is that the harmful effects of those endowments come from the switch from wheat to sugar, and not from the endowments themselves. This reflects the idea that both wheat and sugar, as natural resources, serve as inputs to the production function, reassuring the importance of isolating this effect from the coefficient of interest in the main specification.

Table 1.4 points to the same direction as Table 1.2, when regressing output per capita on inequality. The apparently negative relation fades away when regional fixed effects and other control variables are added. This finding illustrates the ambiguous results for the effects of inequality on development established in the literature, which is the motivation for the empirical strategy of this paper.

Table 1.5 shows the results with poverty rate as the outcome variable. As one should expect, as inequality increases and income is more concentrated, the percentage of population below poverty line also increases. This does not come as surprise, since inequality and poverty rate are related by construction, regardless the Engerman-Sokoloff hypothesis.

1.4.1 The Effect of Farm Size and Wheat-Sugar Interaction on Inequality

Table 1.6 shows that there is a positive differential effect of farm size on inequality in sugar places compared to wheat places. This is inspired by the first part of the proposition of the Engermann-Sokoloff hypothesis, but their hypothesis implies that wheat and sugar endowments have a lingering effect on inequality and institutions, not necessarily on farm size.

I find that the effect of the interaction of current farm size and sugar crops is significantly greater than that of wheat crops. This can be interpreted as the combination of sugar and larger farms giving those municipalities a higher level of inequality. This is consistent with the setup of Engerman-Sokoloff, but it does not imply that sugar places are more unequal. As column (5) shows, they might be less unequal, given the set of controls. What is important here is that larger farms in sugar places are associated with more inequality, when compared to wheat places. Thus the sign of the coefficient of the interaction term satisfies the theoretical proposition as it provides evidence that there is some additional effect in the combination of farm size and sugar places. This is aligned with the findings of Naritomi and Assuno (2012) that sugarcane colonial heritage had an effect on current land inequality.

1.4.2 The Effect of Inequality and Wheat-Sugar Interaction on Development Outcomes

The results of the main estimating equation are reported next. Table 1.7 shows that inequality in sugar places has a negative differential effect compared to wheat places. Controlling for the dummy variables wheat and similar (the wheat dummy is omitted due to collinearity) ensures that it is not the switch from sugar to wheat itself that makes output levels higher. It is the combination of high inequality in sugar places that provides lower levels of output per capita. The results are robust to the introduction of measures of crop suitability, latitude, demographic variables and regional fixed effects.

The magnitude of the effects is meaningful. Considering the average estimated coefficient of the four reported regressions, an increase of one standard deviation in the Gini index is associated with a differential 9.7% decrease in income per capita in sugar municipalities with respect to wheat municipalities.[10]

The hypotheses of an agricultural endowment curse working against sugar municipalities or of wheat as a more valuable endowment, if not correlated with inequality,

[10] Income per capita is measured in logs such that the estimated coefficient measures the percentage change in income.

would be reflected on the coefficient of the sugar dummy or possibly on the coefficients of the suitability indices. This is irrelevant to the Engerman-Sokoloff hypothesis. What is important is that those effects are not biasing the coefficient on the interaction term.

Table 1.8 reports similar results for poverty rate as the outcome variable. Highly unequal sugar places have higher levels of poverty rate when compared to wheat places. The average estimate suggests that for an increase of one standard deviation in the Gini index there is a differential 8.9% increase in poverty rate in sugar municipalities with respect to wheat municipalities.[11]

1.5 Potential Channels for the Effects of Inequality and Wheat-Sugar Interaction

The literature defending that inequality is harmful to development refers to several potential channels, among which education attainment and public goods provision are often cited. It is argued that, under imperfect capital markets, inequality limits human capital accumulation[12]. Inefficient states arise[13] and investments in public goods and infrastructure are more limited[14] where state is governed by a rich elite. Using these potential channels as dependent variables, I test if the inequality-crop interaction term is a plausible determinant for them, with signs and significance levels consistent with the theoretical prediction that inequality lowers schooling and public goods provision.

[11] Poverty rate is measured in percentage terms and the estimate of 8.9% refers to an increase of 2.1 percentage points to an average rate of 23%.

[12] Galor and Zeira (1993); Perotti (1996); Galor and Moav (2006); Bourguignon and Verdier (2000).

[13] Banerjee and Iyer (2005); Acemoglu et al. (2011).

[14] Engerman and Sokoloff (1997, 2000, 2005).

1.5.1 Schooling

I test average years of schooling as a potential channel for the effect of wheat and sugar endowments, as indicators of market and non-market allocation of resources on development levels. Table 1.9 shows that high inequality in sugar places seems to be associated with lower schooling levels, compared to wheat places. This is robust to the introduction of the same control variables as before.

Table 1.10 shows that this effect is still significant when controlling for output per capita, suggesting that the association between high inequality in sugar places and low schooling is stronger than what could be solely an indirect effect through output level. This is a strong argument in favor of the Engerman-Sokoloff hypothesis acting through education attainment.

1.5.2 Public Goods

Tables 11 and 12 report similar tests for another potential channel: public goods provision — an index built on access to water, sanitation, illumination and garbage collection. Again, highly unequal sugar places seem to provide lower levels of public goods, even when controlling for output. This is evidence that for public goods, too, the association with inequality in sugar places is not completely explained by higher levels of output. This is a strong argument in favor of the Engerman-Sokoloff hypothesis acting through public goods provision as well.

1.5.3 Municipal Budget as a Potential Explanation for Schooling and Public Goods Provision

Table 1.13 tests if municipal budgets could explain the lower levels of schooling and public goods provision for highly unequal sugar municipalities. I find that these municipalities do not have lower total budgetary allowances as a fraction of output, as the coefficients are positive but insignificant. This result fails to provide support to the hypothesis that those places have lower levels of schooling and public goods because of a choice of smaller governments.

Table 1.14 sheds light on one of the municipal budget items: payments to corporations for the provision of services as a fraction of total budget (20% of municipal expenses on average). These payments combine three features that increase the potential for fraud and corruption: a) they are the largest budget item after payroll; b) being provided by corporations makes it easier for large-scale corruption; c) the delivery of services is more difficult than goods to be checked by monitoring authorities. The evidence indicates that highly unequal sugar places tend to spend a larger fraction of their budget on expenses that are more susceptible to fraud and corruption.

1.5.4 The Effect of Inequality and Wheat-Sugar Interaction on Development Outcomes Controlling for Potential Channels

Theory predicts that human capital and institutional quality were two important channels through which non-market inequality affected economic development. Tables 15 and 16 test these channels. They show that the effects of inequality interacted with crop endowment previously found seem to fade away when controlling for schooling and public goods provision. They become mostly insignificant for both output per capita and poverty rate. The point estimates drop by half for output per capita and to nearly zero for poverty rate.

As previously discussed, Tables 10 and 12 showed that income does not explain higher levels of schooling and public goods provision in highly unequal sugar places. Tables 15 and 16 show that the converse holds. Schooling and public goods provision do explain higher levels of output per capita and lower levels of poverty rate in highly unequal sugar places. This is consistent with the proposition that human capital and institutional quality were two important channels through which non-market inequality affected economic development.

1.6 Alternative Hypotheses for the Effects of Wheat-Sugar Endowments

Next I test alternative hypotheses for the relations of inequality, crop suitability and development levels. The natural resource curse proposes that high agricultural productivity in sugar economies purportedly created a comparative advantage in agricultural instead of industrial activities, leading wheat, and not sugar economies, to industrialization and higher development levels.

As long as agricultural productivity is not simultaneously correlated with inequality, this hypothesis is not a problem to the main specification, since there are control dummies for crop suitability that would capture that effect. However, if correlated with inequality, then the alternative hypothesis could be biasing the coefficient of interest. For this reason, I explicitly test if highly unequal sugar economies are more agricultural then wheat economies.

Table 1.17 shows no evidence in favor of this hypothesis. The dependent variable is the fraction of the value added by the agricultural sector. The results do not show any significant coefficients for the interaction term, i.e., the natural resource curse, if existent, is not correlated with the inequality-sugar term.

Another hypothesis is that wheat, supposedly a more valuable endowment, made some economies richer through higher agricultural productivity, and this might be correlated with less inequality. Again, this is not a problem to the main specification, unless if simultaneously correlated with inequality. So I test if agricultural activity in highly unequal sugar municipalities is more productive than in wheat municipalities.

Table 1.18 has as dependent variable agricultural productivity, defined as total value of agricultural production divided by the area harvested. Results show that the coefficients are highly insignificant for the interaction of sugar and inequality on agricultural productivity, suggesting that this effect, if existent, is not driving the results for the coefficient of interest.

1.7 Conclusion

This chapter approaches the relation of agricultural endowments, inequality and development to propose a new interpretation of Brazil's experience. In contrast to Engerman-Sokoloff, I do not assert that sugar economies turned out to be more unequal or that inequality is necessarily harmful. Neither I argue that sugar activities favored slavery, nor that sugar places became poorer than wheat places. Instead, I propose that it is not just the level, but most importantly the origins of inequality that matter. And it is not about the agricultural endowments themselves, it is about the manner of settlement.

During the colonial period, sugarcane municipalities in Brazil were associated with malefic non-market mechanisms of allocation of resources, e.g., slavery and royal land grants; whereas wheat places were settled later, under free labor and auction acquisition of land. These non-market mechanisms led sugar economies to have a type of inequality that was harmful to development.

The main contribution is to apply a difference-in-differences specification with an interaction term that separates the effects of inequality in municipalities with a history of strong use of non-market mechanisms from those with a strong use of market-related mechanisms of allocation of resources. This allows to isolate a potential effect of reverse causality and also any alternative channel for the relation of agricultural endowments and development levels that is not simultaneously correlated with inequality. Moreover, the choice of dataset avoids capturing unobserved heterogeneity across countries and prevents problems with the use of inequality measures from different methodologies.

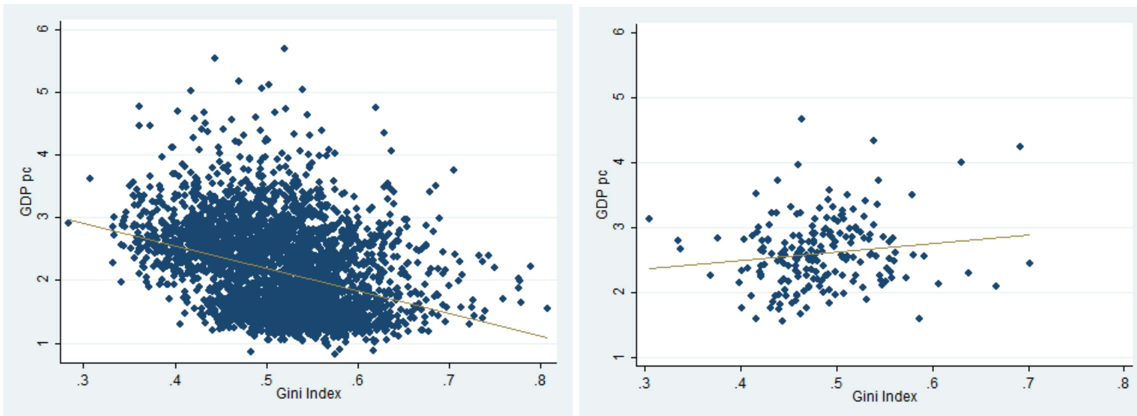
I find that highly unequal sugar places have a differential harmful effect on output per capita and poverty rate, when compared to wheat places. The results are robust to a variety of control variables, including regional fixed effects, latitude and demographics. On average, an increase of one standard deviation in the Gini Index is associated with a differential decrease of 9.7% in income per capita and an increase of 8.9% in poverty rate in sugar municipalities with respect to wheat municipalities.

Lower levels of schooling and public goods provision are also associated with highly unequal sugar places, with evidence that this association is not explained by output levels, suggesting that schooling and public goods are not merely a consequence of higher income. The choice of smaller municipal budgets, if existent, does not seem to be associated with lower levels of schooling and public goods provision through the sugar-inequality interaction term, whereas fraud and corruption might be a starting point for future research.

I find no evidence of two alternative hypotheses. One, that the results are driven by a possible agricultural endowment curse that affected sugar economies. Two, that the results are driven by the supposed fact that wheat turned out to be a more valuable endowment.

Finally, the point estimates of the effect of sugar inequality on output per capita become insignificant and drop by half on average, when I introduce controls for schooling and public goods. For poverty rate, the point estimates drop by 90% on average. This suggests that schooling and public goods are two important channels for the effect of non-market inequality on economic outcomes.

Figure 1.1: Output per Capita Regressed on Gini Index by Crop



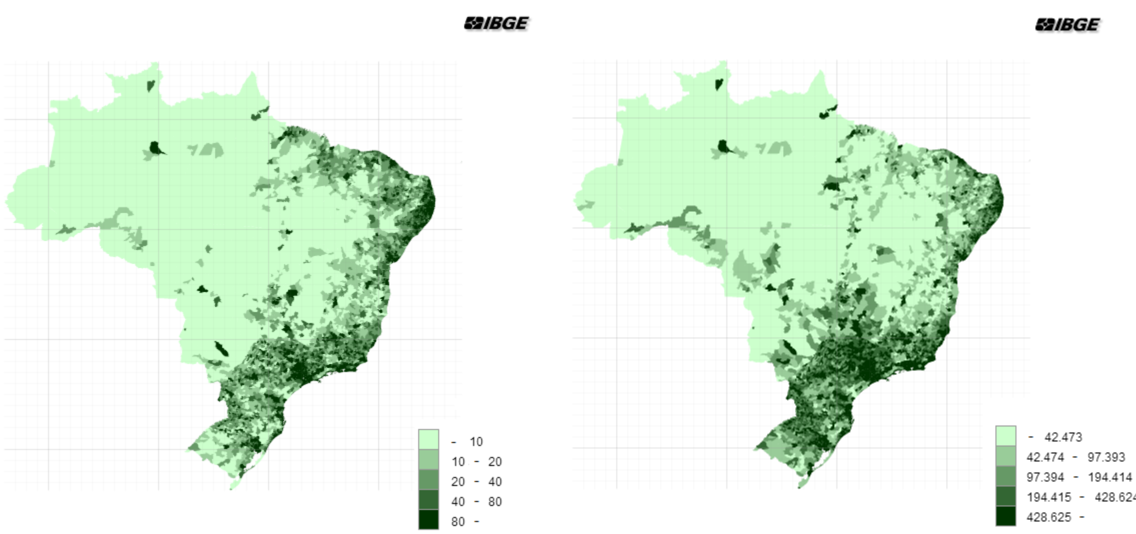
(a) Sugarcane

(b) Wheat

$$GDPpc_i = 4.00 - 3.61Gini_i + \epsilon_i$$
SE (0.09) (0.17)
Obs.: 3,348

$$GDPpc_i = 1.97 + 1.31Gini_i + \epsilon_i$$
SE (0.32) (0.66)
Obs.: 195

Figure 1.2: Brazilian Municipalities – Territorial Density of Population and GDP

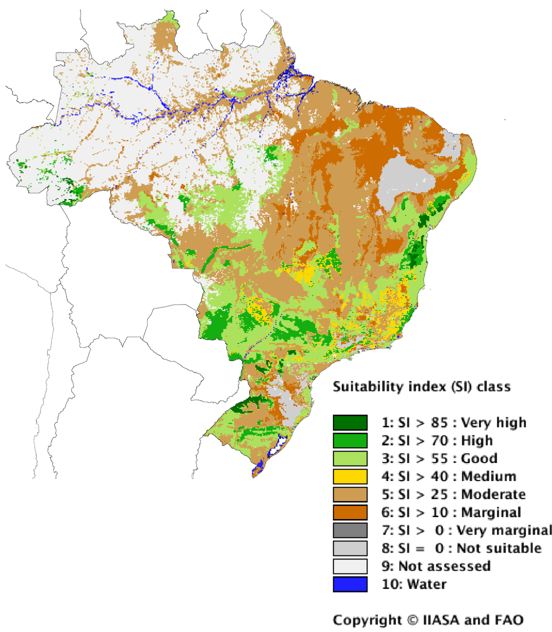


(a) Population (residents/km2)

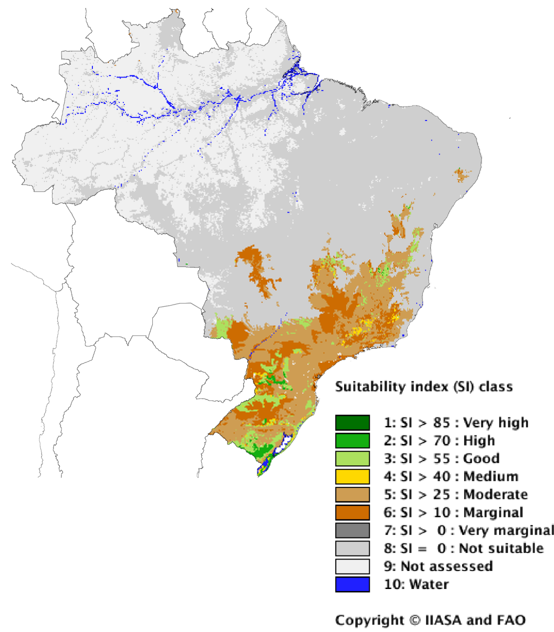
(b) GDP (US$/km2)

Note: population is as in 2010 census release. GDP is as in 2011 release at current prices converted to US$ with IMF purchase power parity implied exchange rate (1.80 BRL/US$).

Figure 1.3: Sugarcane and Wheat Suitability



(a) Sugarcane



(b) Wheat

Source: Food and Agriculture Organization of the United Nations (FAO) — Global Agro-ecological Zones (GAEZ).

Table 1.1: Summary Statistics

	GDP pc (BRL)	Poverty Rate (%)	Gini Index	Schooling (years)	Public Goods Index
Wheat Dummy					
Average	15795	13.02	48.3	9.69	0.354
Median	13078	11.04	47.7	9.71	0.390
Std. Error	11744	8.88	5.7	0.86	0.252
Obs.: 195					
Sugar Dummy					
Average	11546	28.36	51.6	9.30	-0.183
Median	7542	30.66	51.8	9.30	0.032
Std. Error	13986	18.80	6.8	1.13	0.859
Obs.: 3348					
Similar Suitability					
Average	14605	15.64	48.4	9.70	0.271
Median	12100	11.05	48.3	9.71	0.461
Std. Error	15070	13.38	6.0	1.01	0.565
Obs.: 2019					

Notes: the sugar and wheat dummies indicate to which crop the municipality is more suitable. Similar indicates that wheat and sugar suitability indices fall within the range of the same class.

Table 1.2: Output per Capita Regressed on the Wheat-Sugar Indicator

	(1)	(2)	(3)	(4)	(5)
Sugar Dummy	-0.320**	-0.246**	-0.052	0.016	-0.015
	(0.125)	(0.097)	(0.058)	(0.055)	(0.047)
Wheat Dummy	0.142	0.197*	0.058	0.007	-0.009
	(0.100)	(0.109)	(0.069)	(0.047)	(0.033)
Sugar Suitability		1.113**	0.883***	0.357*	0.326*
		(0.439)	(0.257)	(0.184)	(0.166)
Wheat Suitability		1.932***	-0.198	-0.400	-0.495**
		(0.513)	(0.315)	(0.275)	(0.192)
Population				0.037***	0.049***
				(0.013)	(0.013)
Urban Population				0.671***	0.566***
				(0.130)	(0.100)
Latitude				-0.043***	-0.047***
				(0.01)	(0.01)
Constant	2.459	1.925	2.415	1.005	0.987
	(0.12)	(0.12)	(0.12)	(0.33)	(0.27)
Regional FE	No	No	Yes	Yes	No
State FE	No	No	No	No	Yes
R-squared	0.056	0.262	0.476	0.557	0.608
Obs.	5562	5562	5562	5562	5562
F-stat of the Model	3.3	23.7	57.6	199.2	.
P-Value of the test					
$\beta_1 - \beta_2 = 0$	0.026	0.008	0.317	0.910	0.917

Notes: dependent variable is output per capita. The sugar and wheat dummies indicate to which crop the municipality is more suitable. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.3: Poverty Rate Regressed on the Wheat-Sugar Indicator

	(1)	(2)	(3)	(4)	(5)
Sugar Dummy	0.127***	0.091***	0.024	0.011	0.013
	(0.034)	(0.026)	(0.015)	(0.011)	(0.009)
Wheat Dummy	-0.026	-0.032	-0.000	0.008	0.014
	(0.020)	(0.029)	(0.013)	(0.012)	(0.014)
Sugar Suitability		-0.282**	-0.194***	-0.049	-0.065
		(0.113)	(0.056)	(0.036)	(0.039)
Wheat Suitability		-0.657***	-0.008	0.054	0.081*
		(0.135)	(0.054)	(0.051)	(0.046)
Population				0.005	0.001
				(0.003)	(0.004)
Urban Population				-0.289***	-0.259***
				(0.030)	(0.028)
Latitude				0.010***	0.013**
				(0.00)	(0.01)
Constant	0.156	0.319	0.171	0.461	0.701
	(0.02)	(0.03)	(0.02)	(0.06)	(0.08)
Regional FE	No	No	Yes	Yes	No
State FE	No	No	No	No	Yes
R-squared	0.126	0.413	0.683	0.804	0.834
Obs.	5560	5560	5560	5560	5560
F-stat of the Model	7.0	22.2	161.1	184.8	.
P-Value of the test					
$\beta_1 - \beta_2 = 0$	0.002	0.010	0.281	0.827	0.928

Notes: dependent variable is poverty rate. The sugar and wheat dummies indicate to which crop the municipality is more suitable. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are displayed in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.4: Output per Capita Regressed on Inequality

	(1)	(2)	(3)	(4)
Gini	-3.333***	-0.421	-0.271	-0.132
	(0.599)	(0.251)	(0.216)	(0.143)
Population			0.041***	0.049***
			(0.015)	(0.013)
Urban Population			0.695***	0.594***
			(0.152)	(0.117)
Latitude			-0.044***	-0.041**
			(0.012)	(0.015)
Constant	3.948	2.852	1.173	1.253
	(0.310)	(0.164)	(0.317)	(0.281)
Regional FE	No	Yes	Yes	No
State FE	No	No	No	Yes
R-squared	0.101	0.454	0.552	0.605
Obs.	5562	5562	5562	5562
F-stat of the Model	31.0	44.5	76.8	.

Notes: dependent variable is output per capita. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.5: Poverty Rate Regressed on Inequality

	(1)	(2)	(3)	(4)
Gini	1.584***	0.740***	0.679***	0.614***
	(0.149)	(0.073)	(0.055)	(0.046)
Population			-0.009**	-0.011**
			(0.003)	(0.005)
Urban Population			-0.243***	-0.226***
			(0.030)	(0.028)
Latitude			0.010***	0.012**
			(0.002)	(0.005)
Constant	-0.565	-0.244	0.196	0.395
	(0.065)	(0.037)	(0.059)	(0.070)
Regional FE	No	Yes	Yes	No
State FE	No	No	No	Yes
R-squared	0.343	0.719	0.842	0.862
Obs.	5560	5560	5560	5560
F-stat of the Model	113.7	133.7	369.9	.

Notes: dependent variable is poverty rate. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are displayed in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.6: Inequality Regressed on Farm Size and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Farm Size * Sug. Dummy	0.592***	0.604***	0.761***	0.898***	
	(0.106)	(0.104)	(0.157)	(0.163)	
Farm Size * Sim. Dummy	0.522***	0.543***	0.727***	0.856***	
	(0.099)	(0.100)	(0.156)	(0.161)	
Farm Size	-0.565***	-0.581***	-0.787***	-0.916***	
	(0.100)	(0.103)	(0.152)	(0.157)	
Sugar Dummy	-0.041***	-0.041**	-0.039***	-0.054***	-0.025**
	(0.014)	(0.016)	(0.013)	(0.014)	(0.011)
Similar Dummy	-0.029***	-0.034***	-0.034***	-0.047***	-0.019**
	(0.006)	(0.009)	(0.008)	(0.010)	(0.009)
Sugar Suitability		0.090	0.050	0.064	0.065
		(0.057)	(0.055)	(0.061)	(0.060)
Sugar Suitability Sqd.		-0.190**	-0.117	-0.136*	-0.138*
		(0.08)	(0.07)	(0.07)	(0.07)
Wheat Suitability		-0.035	-0.019	-0.040	-0.037
		(0.08)	(0.06)	(0.05)	(0.05)
Wheat Suitability Sqd.		0.014	-0.026	0.030	0.026
		(0.21)	(0.16)	(0.12)	(0.13)
Constant	0.55	0.54	0.42	0.52	0.49
	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.288	0.303	0.400	0.442	0.434
Obs.	5536	5536	5536	5536	5562
F-stat of the Model	37.9	117.8	58.8	.	.

Notes: dependent variable is the Gini Index. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.7: Output per Capita Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-1.998*	-1.685*	-0.990	-1.102**	
	(1.040)	(0.898)	(0.593)	(0.510)	
Gini * Similar Dummy	-1.242*	-1.157	-0.670	-0.869*	
	(0.719)	(0.707)	(0.474)	(0.487)	
Gini	1.304*	1.206*	0.625	0.847**	
	(0.692)	(0.669)	(0.429)	(0.393)	
Sugar Dummy	1.162*	0.686	0.483	0.493**	-0.038
	(0.568)	(0.454)	(0.295)	(0.229)	(0.068)
Similar Dummy	0.673*	0.481	0.320	0.399	-0.019
	(0.368)	(0.353)	(0.240)	(0.234)	(0.043)
Sugar Suitability		1.086*	0.372	0.648	0.624
		(0.544)	(0.343)	(0.399)	(0.393)
Sugar Suitability Sqd.		-0.321	-0.076	-0.459	-0.418
		(0.81)	(0.50)	(0.47)	(0.47)
Wheat Suitability		-0.109	-0.933	-0.264	-0.268
		(0.73)	(0.61)	(0.45)	(0.44)
Wheat Suitability Sqd.		-0.371	1.499	-0.755	-0.696
		(1.70)	(1.83)	(1.46)	(1.43)
Constant	1.84	1.89	0.69	0.59	0.99
	(0.41)	(0.42)	(0.47)	(0.40)	(0.26)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.461	0.478	0.558	0.609	0.609
Obs.	5562	5562	5562	5562	5562
F-stat of the Model	60.8	90.7	143.9	.	.

Notes: dependent variable is output per capita. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.8: Poverty Rate Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	0.499**	0.431**	0.181**	0.108	
	(0.205)	(0.187)	(0.085)	(0.071)	
Gini * Similar Dummy	0.157	0.152	-0.021	-0.007	
	(0.147)	(0.146)	(0.046)	(0.052)	
Gini	0.375**	0.387***	0.580***	0.551***	
	(0.135)	(0.137)	(0.043)	(0.041)	
Sugar Dummy	-0.271**	-0.183**	-0.089**	-0.054	-0.016
	(0.098)	(0.083)	(0.039)	(0.032)	(0.020)
Similar Dummy	-0.096	-0.070	-0.003	-0.010	-0.025
	(0.069)	(0.066)	(0.022)	(0.026)	(0.015)
Sugar Suitability		-0.140	0.064	0.024	0.072
		(0.099)	(0.053)	(0.062)	(0.083)
Sugar Suitability Sqd.		-0.040	-0.129	-0.107	-0.205**
		(0.13)	(0.08)	(0.07)	(0.10)
Wheat Suitability		-0.024	0.173	0.081	0.054
		(0.14)	(0.10)	(0.07)	(0.10)
Wheat Suitability Sqd.		0.148	-0.269	0.049	0.064
		(0.29)	(0.28)	(0.24)	(0.31)
Constant	-0.04	-0.05	0.24	0.45	0.72
	(0.07)	(0.07)	(0.05)	(0.07)	(0.07)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.723	0.733	0.845	0.864	0.835
Obs.	5560	5560	5560	5560	5560
F-stat of the Model	269.7	1182.4	849.8	.	.

Notes: dependent variable is poverty rate. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.9: Average Years of Schooling Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-5.867***	-5.206***	-3.967***	-2.644***	
	(1.018)	(0.842)	(0.673)	(0.753)	
Gini * Similar Dummy	-2.166***	-2.239***	-1.391*	-1.340	
	(0.626)	(0.573)	(0.707)	(0.930)	
Gini	1.106**	0.964**	0.545	0.432	
	(0.440)	(0.428)	(0.417)	(0.640)	
Sugar Dummy	3.479***	3.322***	2.658***	1.665***	0.418**
	(0.493)	(0.384)	(0.343)	(0.366)	(0.159)
Similar Dummy	1.414***	1.587***	1.147***	1.038**	0.422**
	(0.246)	(0.255)	(0.373)	(0.434)	(0.153)
Sugar Suitability		-1.385**	-1.590**	-0.530	-0.729*
		(0.616)	(0.582)	(0.339)	(0.360)
Sugar Suitability Sqd.		1.944**	2.076**	0.715	1.090**
		(0.81)	(0.79)	(0.45)	(0.47)
Wheat Suitability		0.216	0.236	-0.181	-0.098
		(1.10)	(0.84)	(0.86)	(0.91)
Wheat Suitability Sqd.		2.794	2.515	-0.388	-0.310
		(4.01)	(3.06)	(2.18)	(2.25)
Constant	8.47	8.55	8.88	7.94	8.10
	(0.26)	(0.29)	(0.64)	(0.22)	(0.32)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.330	0.339	0.366	0.512	0.506
Obs.	5562	5562	5562	5562	5562
F-stat of the Model	234.1	230.8	1591.1	.	.

Notes: dependent variable is expected number of years of schooling. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.10: Average Years of Schooling Regressed on Inequality and Wheat-Sugar Interaction Controlling for Output

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-5.306***	-4.729***	-3.733***	-2.537***	
	(0.772)	(0.692)	(0.629)	(0.725)	
Gini * Similar Dummy	-1.817***	-1.911***	-1.233*	-1.256	
	(0.582)	(0.477)	(0.669)	(0.882)	
Gini	0.740**	0.622*	0.398	0.350	
	(0.350)	(0.340)	(0.444)	(0.634)	
Sugar Dummy	3.153***	3.127***	2.544***	1.617***	0.422**
	(0.359)	(0.345)	(0.337)	(0.359)	(0.160)
Similar Dummy	1.225***	1.451***	1.072***	0.999**	0.424**
	(0.266)	(0.243)	(0.365)	(0.416)	(0.155)
Sugar Suitability		-1.693**	-1.678***	-0.592*	-0.793**
		(0.610)	(0.601)	(0.339)	(0.360)
Sugar Suitability Sqd.		2.035**	2.094**	0.760	1.132**
		(0.78)	(0.80)	(0.45)	(0.47)
Wheat Suitability		0.247	0.456	-0.156	-0.071
		(1.03)	(0.84)	(0.87)	(0.92)
Wheat Suitability Sqd.		2.899	2.162	-0.315	-0.240
		(3.69)	(2.82)	(2.08)	(2.14)
GDP pc	0.28***	0.28***	0.24***	0.10**	0.10**
	(0.07)	(0.06)	(0.06)	(0.05)	(0.05)
Constant	7.95	8.02	8.72	7.88	8.00
	(0.31)	(0.33)	(0.60)	(0.22)	(0.29)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.347	0.356	0.376	0.514	0.508
Obs.	5562	5562	5562	5562	5562
F-stat of the Model	403.8	454.6	724.8	.	.

Notes: dependent variable is expected number of years of schooling. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.11: Public Goods Index Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-3.508***	-3.373***	-1.931**	-0.868*	
	(1.004)	(1.008)	(0.695)	(0.470)	
Gini * Similar Dummy	-1.162*	-0.992	0.011	-0.025	
	(0.672)	(0.633)	(0.301)	(0.257)	
Gini	-0.184	-0.289	-1.082***	-1.069***	
	(0.359)	(0.424)	(0.210)	(0.204)	
Sugar Dummy	1.796***	1.282**	0.690*	0.261	-0.124*
	(0.473)	(0.479)	(0.339)	(0.245)	(0.070)
Similar Dummy	0.605*	0.280	-0.143	-0.078	-0.060
	(0.324)	(0.304)	(0.127)	(0.141)	(0.041)
Sugar Suitability		2.069***	1.237**	0.634**	0.469*
		(0.678)	(0.486)	(0.239)	(0.267)
Sugar Suitability Sqd.		-1.605*	-1.323**	-0.470*	-0.152
		(0.79)	(0.60)	(0.25)	(0.27)
Wheat Suitability		-0.008	-0.887*	-0.060	0.030
		(0.55)	(0.46)	(0.31)	(0.35)
Wheat Suitability Sqd.		-1.475	0.421	-0.987	-1.006
		(1.36)	(1.22)	(0.88)	(1.02)
Constant	0.43	0.45	-0.58	-1.62	-2.16
	(0.19)	(0.24)	(0.28)	(0.27)	(0.29)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.497	0.517	0.638	0.713	0.703
Obs.	5557	5557	5557	5557	5557
F-stat of the Model	19.4	139.7	173.9	.	.

Notes: dependent variable is a public goods index, calculated as the fraction of population with access to: public illumination, piped water, piped water and bathrooms and garbage collection. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.12: Public Goods Index Regressed on Inequality and Wheat-Sugar Interaction Controlling for Output

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-2.702***	-2.733***	-1.721**	-0.677	
	(0.734)	(0.771)	(0.658)	(0.428)	
Gini * Similar Dummy	-0.659	-0.550	0.153	0.125	
	(0.471)	(0.443)	(0.273)	(0.224)	
Gini	-0.712***	-0.749***	-1.215***	-1.215***	
	(0.189)	(0.259)	(0.221)	(0.203)	
Sugar Dummy	1.327***	1.021***	0.588*	0.176	-0.118*
	(0.336)	(0.366)	(0.322)	(0.223)	(0.068)
Similar Dummy	0.332	0.096	-0.211*	-0.147	-0.056
	(0.214)	(0.204)	(0.108)	(0.121)	(0.040)
Sugar Suitability		1.654***	1.159**	0.522**	0.359
		(0.565)	(0.479)	(0.245)	(0.265)
Sugar Suitability Sqd.		-1.482**	-1.307**	-0.390	-0.078
		(0.68)	(0.60)	(0.27)	(0.26)
Wheat Suitability		0.034	-0.689*	-0.015	0.077
		(0.39)	(0.40)	(0.30)	(0.34)
Wheat Suitability Sqd.		-1.336	0.104	-0.857	-0.884
		(1.23)	(1.14)	(0.77)	(0.90)
GDP pc	0.40***	0.38***	0.21***	0.17***	0.18***
	(0.07)	(0.06)	(0.05)	(0.03)	(0.03)
Constant	-0.32	-0.28	-0.72	-1.72	-2.34
	(0.17)	(0.19)	(0.26)	(0.22)	(0.25)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.567	0.577	0.654	0.723	0.712
Obs.	5557	5557	5557	5557	5557
F-stat of the Model	35.8	307.0	210.2	.	.

Notes: dependent variable is a public goods index, calculated as the fraction of population with access to: public illumination, piped water, piped water and bathrooms and garbage collection. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.13: Municipal Budget Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	1.098	0.452	0.968	0.886	
	(1.453)	(1.344)	(0.773)	(0.767)	
Gini	-2.104*	-1.830	0.012	-0.038	
	(1.104)	(1.143)	(0.483)	(0.513)	
Gini * Similar Dummy	0.953	0.703	0.970**	1.126**	
	(1.057)	(0.964)	(0.453)	(0.508)	
Sugar Dummy	-0.809	0.235	-0.265	-0.310	0.096
	(0.759)	(0.675)	(0.394)	(0.406)	(0.096)
Similar Dummy	-0.577	-0.072	-0.359	-0.468	0.059
	(0.552)	(0.483)	(0.262)	(0.294)	(0.076)
Sugar Suitability		-3.275***	-1.367**	-1.279**	-1.241**
		(0.742)	(0.592)	(0.559)	(0.570)
Sugar Suitability Sqd.		2.269**	0.813	0.697	0.605
		(1.03)	(0.81)	(0.68)	(0.72)
Wheat Suitability		-1.008	0.026	-0.332	-0.332
		(1.22)	(0.85)	(0.67)	(0.66)
Wheat Suitability Sqd.		2.561	0.793	1.724	1.679
		(2.42)	(2.32)	(2.04)	(2.06)
Constant	2.88	2.86	6.65	6.87	6.86
	(0.61)	(0.67)	(0.66)	(0.88)	(0.77)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.294	0.331	0.556	0.596	0.594
Obs.	5492	5492	5492	5492	5492
F-stat of the Model	35.9	71.8	103.8	.	.

Notes: dependent variable is total municipal budget as a fraction of GDP. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.14: Municipal Payments to Corporations for the Provision of Services Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	0.096*	0.105**	0.061	0.083**	
	(0.051)	(0.043)	(0.039)	(0.034)	
Gini * Similar Dummy	0.041	0.036	0.009	0.018	
	(0.033)	(0.044)	(0.056)	(0.048)	
Gini	0.028	0.031	-0.024	-0.041	
	(0.041)	(0.036)	(0.033)	(0.032)	
Sugar Dummy	-0.028	-0.049*	-0.012	-0.030	0.010
	(0.028)	(0.026)	(0.024)	(0.021)	(0.008)
Similar Dummy	-0.008	-0.015	0.008	0.002	0.010
	(0.020)	(0.029)	(0.033)	(0.028)	(0.007)
Sugar Suitability		0.057	-0.017	-0.046	-0.040
		(0.058)	(0.040)	(0.031)	(0.030)
Sugar Suitability Sqd.		-0.004	0.039	0.059	0.049
		(0.07)	(0.05)	(0.04)	(0.04)
Wheat Suitability		0.079	0.012	0.038	0.035
		(0.07)	(0.05)	(0.04)	(0.03)
Wheat Suitability Sqd.		-0.252*	-0.104	-0.181	-0.183*
		(0.14)	(0.12)	(0.11)	(0.11)
Constant	0.10	0.09	-0.08	-0.07	-0.09
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.084	0.092	0.182	0.235	0.235
Obs.	5492	5492	5492	5492	5492
F-stat of the Model	11.7	10.2	49.2	.	.

Notes: dependent variable is municipal payments to corporations for the provision of services, as a fraction of total budget. These payments combine three features that increase the potential for fraud and corruption: a) they are the largest budget item after payroll; b) being provided by corporations makes it easier for large-scale corruption; c) the delivery of services is more difficult than goods to be checked by monitoring authorities. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.15: Output per Capita Regressed on Inequality and Wheat-Sugar Interaction Controlling for Schooling and Public Goods

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-0.655	-0.465	-0.478	-0.927*	
	(0.661)	(0.594)	(0.550)	(0.471)	
Gini	1.329**	1.264**	0.803*	1.040**	
	(0.573)	(0.552)	(0.437)	(0.397)	
Gini * Similar Dummy	-0.793	-0.777	-0.617	-0.855*	
	(0.515)	(0.519)	(0.447)	(0.455)	
Sugar Dummy	0.460	0.178	0.251	0.434**	-0.019
	(0.374)	(0.305)	(0.273)	(0.209)	(0.068)
Similar Dummy	0.430	0.343	0.301	0.406*	-0.011
	(0.260)	(0.260)	(0.225)	(0.213)	(0.044)
Schooling	0.032	0.033	0.040**	0.007	0.007
	(0.024)	(0.020)	(0.017)	(0.012)	(0.012)
Public Goods	0.328***	0.309***	0.185***	0.183***	0.180***
	(0.06)	(0.05)	(0.04)	(0.03)	(0.03)
Constant	1.427	1.473	0.444	0.823	1.319
	(0.52)	(0.49)	(0.52)	(0.40)	(0.25)
Crop Suitability	No	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.536	0.544	0.579	0.621	0.621
Obs.	5557	5557	5557	5557	5557
F-stat of the Model	177.9	141.3	104.8	.	.

Notes: dependent variable is output per capita. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Crop Suitability refers to a quadratic function of wheat and sugar suitability. Schooling is in years. Public Goods is the index previously described. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.16: Poverty Rate Regressed on Inequality and Wheat-Sugar Interaction Controlling for Schooling and Public Goods

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	0.042	0.004	-0.011	0.010	
	(0.097)	(0.089)	(0.053)	(0.046)	
Gini * Similar Dummy	0.005	0.019	-0.040	-0.026	
	(0.077)	(0.076)	(0.032)	(0.030)	
Gini	0.371***	0.371***	0.513***	0.480***	
	(0.092)	(0.091)	(0.043)	(0.037)	
Sugar Dummy	-0.030	-0.002	-0.003	-0.013	-0.020
	(0.044)	(0.035)	(0.023)	(0.017)	(0.017)
Similar Dummy	-0.013	-0.020	0.004	-0.002	-0.023*
	(0.035)	(0.032)	(0.013)	(0.014)	(0.012)
Schooling	-0.014***	-0.014***	-0.014***	-0.013***	-0.015***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
Public Goods	-0.105***	-0.104***	-0.069***	-0.071***	-0.081***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.124	0.112	0.328	0.433	0.664
	(0.07)	(0.07)	(0.05)	(0.07)	(0.08)
Crop Suitability	No	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.848	0.851	0.889	0.900	0.883
Obs.	5555	5555	5555	5555	5555
F-stat of the Model	432.1	864.8	1000.8	.	.

Notes: dependent variable is poverty rate. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Crop Suitability refers to a quadratic function of wheat and sugar suitability. Schooling is in years. Public Goods is the index previously described. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.17: Fraction of the Value Added by the Agricultural Sector Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	0.080	0.026	-0.034	-0.090	
	(0.329)	(0.322)	(0.208)	(0.125)	
Gini * Similar Dummy	0.070	0.094	0.039	0.115	
	(0.237)	(0.236)	(0.122)	(0.114)	
Gini	-0.101	-0.102	0.213	0.156	
	(0.288)	(0.294)	(0.166)	(0.137)	
Sugar Dummy	-0.049	-0.045	-0.030	0.002	-0.046
	(0.171)	(0.175)	(0.108)	(0.070)	(0.029)
Similar Dummy	-0.048	-0.076	-0.061	-0.088	-0.035
	(0.135)	(0.138)	(0.071)	(0.071)	(0.029)
Sugar Suitability		0.175	0.445***	0.325**	0.319**
		(0.134)	(0.130)	(0.125)	(0.131)
Sugar Suitability Sqd.		-0.249	-0.485***	-0.286*	-0.281
		(0.19)	(0.17)	(0.16)	(0.17)
Wheat Suitability		-0.148	-0.073	-0.149*	-0.144*
		(0.21)	(0.10)	(0.07)	(0.08)
Wheat Suitability Sqd.		0.049	0.018	0.189	0.191
		(0.49)	(0.22)	(0.19)	(0.19)
Constant	0.41	0.41	0.84	0.77	0.85
	(0.16)	(0.16)	(0.10)	(0.05)	(0.07)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.157	0.162	0.448	0.542	0.538
Obs.	5562	5562	5562	5562	5562
F-stat of the Model	14.6	123.2	226.5	.	.

Notes: dependent variable is the fraction of the value added by the agricultural sector. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table 1.18: Agricultural Productivity Regressed on Inequality and Wheat-Sugar Interaction

	(1)	(2)	(3)	(4)	(5)
Gini * Sugar Dummy	-2.305	-0.620	0.259	-1.096	
	(2.922)	(2.843)	(2.358)	(2.331)	
Gini * Similar Dummy	-0.605	-0.015	0.621	0.344	
	(3.327)	(3.250)	(2.903)	(2.761)	
Gini	-1.517	-2.279	-3.030	-1.992	
	(3.449)	(3.317)	(3.147)	(3.148)	
Sugar Dummy	1.346	-0.274	-0.643	0.079	-0.397
	(1.483)	(1.403)	(1.221)	(1.258)	(0.303)
Similar Dummy	0.193	-0.380	-0.646	-0.375	-0.160
	(1.715)	(1.705)	(1.572)	(1.500)	(0.287)
Sugar Suitability		2.124**	1.360	1.596**	1.322
		(0.984)	(0.845)	(0.757)	(0.819)
Sugar Suitability Sqd.		-0.027	0.432	-0.343	0.176
		(1.42)	(1.29)	(0.97)	(1.13)
Wheat Suitability		-3.598*	-4.116**	-4.665**	-4.505**
		(1.83)	(1.88)	(1.69)	(1.69)
Wheat Suitability Sqd.		10.214*	11.086**	10.230**	10.166**
		(5.52)	(5.35)	(4.70)	(4.63)
Constant	2.33	2.85	1.84	2.35	1.33
	(1.73)	(1.66)	(1.78)	(2.09)	(0.72)
Regional FE	Yes	Yes	Yes	No	No
State FE	No	No	No	Yes	Yes
Latitude	No	No	Yes	Yes	Yes
Population	No	No	Yes	Yes	Yes
Urban Pop.	No	No	Yes	Yes	Yes
R-squared	0.066	0.076	0.085	0.106	0.104
Obs.	5501	5501	5501	5501	5501
F-stat of the Model	23.1	719.4	573.2	.	.

Notes: dependent variable is agricultural productivity, as total production value divided by harvested area. The sugar dummy indicates that suitability is higher for sugar than for wheat, whereas the similar dummy indicates the same suitability class for wheat and sugar. Sugar Suitability and Wheat Suitability are continuous variables increasing in suitability. Sqd. stands for squared variables. Population is in logs and urban population is in percent terms. Regional FE and State FE indicate fixed effects. Standard errors are in parenthesis and clustered at the state level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Chapter 2

Pairwise Determinants of Risk Sharing

2.1 Introduction

In the absence of frictions, theory predicts that a country will trade securities with others until it achieves full risk sharing. This implies that idiosyncratic output fluctuations would be pooled, making income and consumption growth less volatile. However, there is a vast economic literature showing the empirical disconnection of consumption and income growth from full insurance and the causes of that have been under investigation. Using a pairwise approach, this chapter provides empirical evidence of the determinants of international risk sharing.[1]

The motivation is to shed light on an important macroeconomic problem. Literature points to large potential welfare gains in international risk sharing. Obstfeld and Rogoff (2001) describe the low levels of risk sharing among "The Six Major Puzzles in International Macroeconomics." Hence understanding the factors driving international risk sharing is a relevant effort to the literature.

I approach the problem by testing direct and indirect factors that are candidate determinants of risk sharing. Identifying those that do help and the ones that fail to help seems to be a starting point for clarifying the puzzle. The main contribution is that I use bilateral relations, first to estimate risk sharing levels of pairs of countries, then to look for their determinants. For instance, instead of seeking the determinants of risk sharing between the U.S. and the rest of the world, I seek the determinants of risk sharing between the U.S. and Germany, Canada and France, etc. The risk sharing estimate of a pair of countries may vary with characteristics of that pair, like distance and language, that are not captured in country-world approach. Indeed countries trade securities with partner countries, not with the world as an entity,

[1] Throughout this chapter, I use the terms risk sharing, insurance and smoothing interchangeably.

which makes this a more realistic assessment.[2]

Output is considered to be exogenous and subject to stochastic shocks. Under a stylized Arrow-Debreu model, markets are complete and countries can pool risk by signing contingent contracts with each other at no cost, compensating any idiosyncratic output shocks. The implication is that each country should have the same income and consumption growth rates as the whole world and country-specific output shocks would not affect welfare. If that is true for all countries, then it should be true for each pair of countries.

The first step is to estimate the amount of insurance for all pairs of countries. I adapt the approaches of Obstfeld (1994b) and Sørensen and Yosha (1998) to build specifications to estimate pairwise coefficients for income and consumption risk sharing. The empirical results show nearly zero levels of income smoothing, which is consistent with other literature that points to low degrees of insurance, specially for income. For consumption, I find significant positive estimates, which indicate that countries share risk mostly through borrowing and lending as opposed to diversifying income sources.[3]

The second step is to look for the pairwise determinants. I test direct and indirect candidate determinants of income and consumption risk sharing. The direct determinants are closely related to macroeconomic identities. Using the IMF SNA 2008 standard,[4] income from foreign direct investment, portfolio equity and compensation

[2]Canova and Ravn (1996) use a pairwise approach with a different setting under the null hypothesis of full insurance. They "find that aggregate domestic consumption is almost completely insured against idiosyncratic real, demographic, fiscal and monetary shocks over short cycles, but that it covaries with these variables over medium and long cycles."

[3]Sørensen and Yosha (1998) find no international income insurance among OECD countries, whereas about 40% of shocks to GDP are smoothed by budget deficits and corporate savings. Volosovych (2013) estimates the mean estimate of income risk sharing to be 1.94%. Kose et al. (2009) find a modest degree of international consumption risk sharing.

[4]International Monetary Fund System of National Accounts, 2008.

of employees are the three most important factors that distinguish domestic product from national income. Because FDI flows should be determinant to FDI income, FDI flows are used as an explanatory variable to income risk sharing. Similarly, I use portfolio equity investment and migration as direct determinants of income from portfolio equity and compensation of employees. I find that holding portfolio equity assets is positively and significantly correlated with income risk sharing. FDI flows do not have the expected sign and migration is insignificant.

For the direct determinants of consumption risk sharing, the variables of interest must be directly associated with international borrowing and lending. Thus international assets and liabilities are used as explanatory variables. The empirical results show that deposits and multilateral loans are positive determinants. Bank loans, IMF loans and reserves have a negative sign.

The indirect determinants are factors that are commonly cited in the economic literature as important to the direct determinants, e.g., having a common language and being part of the World Trade Organization (WTO) may be important for two countries to share risks through foreign direct investment or through borrowing and lending. The same set of regressors is used as indirect determinants for both income and consumption. For income, I find that countries tend to smooth fluctuations when they are members of the WTO, share a common language, have strong migration and a large share of companies in the stock market. For consumption, the size of their economy, WTO and regional trade agreements, geographic distance, migration, ease of doing business and strength of legal rights seem to help.

2.2 Theory and Literature

Considering a standard risk averse agent, a smooth consumption flow is preferred to a volatile one. Output fluctuations may lead to undesirable volatility of income and consumption. Hence agents will prefer to smooth output shocks possibly through income or consumption means. By sharing risks with each other they can achieve smoother income and consumption paths rendering them welfare gains.

Based on classic models of complete contingent claims markets proposed by Arrow and Debreu (1954), Obstfeld and Rogoff (1996) provide a textbook model of consumption risk sharing. By trading securities, a country's choice of consumption in different states of the world becomes similar to the choice of consumption in different periods of time. As a corollary of the model, the marginal rates of substitution must be equalized, hence all countries should have the same consumption growth rate.

However the degree of risk sharing found in the data does not match the model predictions. Backus et al. (1992) find that international output growth rates are more highly correlated than consumption growth rates. Lewis (1996) investigated the reasons why empirical consumption correlations are not as predicted. She allowed utility not to be separable in tradables and nontradables and also allowed for incomplete markets. She found evidence that a combination of those two factors together may explain a low degree of consumption risk sharing.[5] [6]

[5]Other empirical studies have been more successful in finding significant risk sharing levels at the intranational level. Asdrubali et al. (1996) "decompose the cross-sectional variance in gross state product into several components which they refer to as levels of smoothing. They find that 39 percent of shocks to gross state product are smoothed by capital markets, 13 percent are smoothed by the federal government, and 23 percent are smoothed by credit markets. The remaining 25 percent are not smoothed."

[6]Crucini (1999) compared the provinces of Canada, the states of the United States, and the G-7 countries, and found similar degrees of risk sharing within regions of Canada and the U.S. that exceed the risk sharing that occurs across countries.

One potential explanation for this macroeconomic puzzle is the existence of frictions when trading international securities. Nonetheless, several papers have suggested relatively large potential welfare gains from risk sharing.[7] [8] The general conclusion is that the welfare benefits more than compensate the costs. This reinforces the question why the empirical evidence points to such low levels of insurance.

Becker and Hoffmann (2006) investigate empirically how industrialized countries and U.S. states share consumption risk. U.S. federal states share about 50 percent of their permanent idiosyncratic risk through cross-state capital income flows. While insurance against transitory fluctuations in output is virtually complete, OECD countries do not share any of their permanent idiosyncratic risk. Transaction costs cannot explain the home bias, since the potential welfare gains from insurance would by far outweigh that of insuring against transitory variation. They conclude that market incompleteness may be preventing insurance of permanent shocks, in particular at the international level.

Asdrubali and Kim (2008) model incomplete risk sharing as well as incomplete intertemporal smoothing, distinguishing between the effects of temporary vs. permanent shocks. They find negligible international risk sharing and show that "industrial countries have tended to absorb output shocks mostly through intertemporal smoothing. About 25% of all temporary shocks are smoothed this way, while a comparable fraction of permanent shocks determine consumption growth."

Sørensen and Yosha (1998) sought risk sharing patterns among European Comunity and OCDE countries and found that factor income flows do not play an important role in smoothing income across countries. Around 40 percent of the consumption

[7]For example: Wincoop (1994), Wincoop (1996), Lewis (1996), Shiller and Athanasoulis (1995), Obstfeld (1994a) and Obstfeld (1996).

[8]Kalemli-Ozcan et al. (2001) provide an expression to measure the welfare gains.

smoothing comes from savings, this being the most important channel.

Wincoop (1999) attempts to explain the deviation from risk sharing by questioning to what extent the results are sensitive to the parameterization of preferences, and assumptions about the stochastic process and measurement of the endowment. He finds that the welfare gains are quite sizable for realistic assumptions about the underlying factors.

Kalemli-Ozcan et al. (2001) provide a closed form expression for the gains from risk sharing for CRRA utility. The more a country can gain from sharing country specific risk with other countries in a group, the more asymmetric are its GDP fluctuations relative to the group. Balli and Balli (2011) applied this model to Pacific island countries and found that, under full risk sharing, overall welfare gains are at desirable levels.

Sørensen et al. (2007) relate the home bias and the risk sharing puzzles showing that "international home bias in bond and equity holdings declined during the late 1990s at the same time as international risk sharing increased. Also, countries with less home bias, on average, tended to obtain more risk sharing in international markets. Using panel data estimations, we demonstrate that less home bias is associated with more international risk sharing when both cross-sectional and time-series dimensions are taken into account."

Kose et al. (2009) extend the analysis to a larger group of developing countries, allowing for changes over time in the degree of risk sharing and different measures of risk sharing. They find that there is a modest degree of risk sharing for industrial countries, possibly fostered by finacial globalization, whereas for developing economies they find no evidence of improved risk sharing. They also conclude that portfolio debt, more important to emerging economies, is not conducive to risk sharing.

Volosovych (2013) searches for factors that explain cross-country differences in the extent of risk sharing restricting attention to one of the channels: asset diversification and income flows. He finds little evidence of risk sharing, mostly related to investor protection.

Kalemli-Ozcan and Sørensen (2008) group the barriers to financial integration as: a) transaction costs, i.e., higher costs associated with international assets trade; b) lower information transparency for foreign investors, given that investors will generally know better the assets in the home country; c) moral hazard and sovereign risks, referring to the limits to enforcement of international contracts; and d) currency risk, which will step in if purchase power parity fails to hold.

Fratzscher and Imbs (2009) use a bilateral approach with interaction terms that allow for differential risk sharing measures depending on financial openness and quality of institutions. These are interpreted as two substitute determinants of risk sharing. In this paper I also take advantage of the bilateral approach and add other determinants, like language, migration, WTO membership, geographic distance, etc.

2.3 Empirical Strategy

I use a two-step identification strategy. First I estimate the pairwise level of risk sharing with the regression equation:

$$\widetilde{gdp}_{ijt} - \widetilde{gni}_{ijt} = \alpha^I_{ij} + \beta^I_{ij}\widetilde{gdp}_{ijt} + \epsilon_{ijt}, \tag{2.1}$$

where $\widetilde{gdp}_{ijt} = \Delta \ln gdp_{it} - \Delta \ln gdp_{jt}$ is the output growth differential between the pair of countries i and j. Similarly, $\widetilde{gni}_{ijt}$ is the national income growth differential for i and j.

With perfect income risk sharing, all countries should have the same income growth and the left-hand side of Eq. 1 should equal $\widetilde{gdp}_{ijt}$, thus β^I_{ij} would be one.

In the complete absence of risk sharing, the left-hand side of Eq. 1 is uncorrelated with $\widetilde{gdp}_{ijt}$, such that the estimated coefficient should be zero. Thus β^I_{ij} can be interpreted as a measure of income risk sharing between countries i and j.

For consumption risk sharing, I have:

$$\widetilde{gni}_{ijt} - \widetilde{c}_{ijt} = \alpha^C_{ij} + \beta^C_{ij}\widetilde{gni}_{ijt} + \omega_{ijt}, \tag{2.2}$$

and $\widetilde{c}_{ijt}$ is the consumption growth differential between the pair of countries i and j. The same reasoning applies to the consumption risk sharing measure represented by β^C_{ij} in Eq. 2.

The second step is to look for direct and indirect determinants of income and consumption risk sharing. For direct determinants of income risk sharing, I use the definition of the IMF-SNA 2008 that $GNI_{it} = GDP_{it} + Primary\,Income_{it}$. Some of the most important components of primary income are direct investment income, portfolio equity income and compensation of employees. For the first two I have data on two straightforward determinants: foreign direct investment and investments in portfolio equity. For compensation of employees I use migration as an approximate direct determinant.

The identification is given by the following equation:

$$\hat{\beta}^I_{ij} = \gamma_0 + \gamma_1 FDI_{ij} + \gamma_2 Portfolio\ Equity_{ij} + \gamma_3 Migration_{ij} + \nu_{ij}. \tag{2.3}$$

$\hat{\beta}^I_{ij}$ is not time-varying. I have a cross sectional measure of income risk sharing over the period of 1978 - 2013. So for the regressors, too, I need a measure of overall performance during that period. Then I use average measures spanning the same period as much as the dataset is available.

If not through income, a country can still share risks through international borrowing and lending. This will reflect on the measure of consumption risk sharing. Thus I use amounts of international assets and liabilities as direct determinants of the flows of borrowing and lending. The estimating equation is:

$$\hat{\beta}_{ij}^{C} = \theta_0 + \theta_1 BIS\ Deposits_{ij} + \theta_2 BIS\ Loans_{ij} + \theta_3 IMF\ Loans_{ij} + \theta_4 Multilateral\ Loans_{ij} + \theta_5 Reserves_{ij} + \theta_6 SDR_{ij} + \theta_6 Securities_{ij} + \iota_{ij}, \quad (2.4)$$

where BIS deposits and loans refer to operations with the Bank for International Settlements reporting banks and SDR are the Special Drawing Rights on the IMF. Again I use average measures spanning the period of 1978-2013 as much as the dataset is available.

Finally I look for indirect determinants of risk sharing. The same regressors are potential determinants of both income and consumption risk sharing. I borrow from Bekaert and Wang (2009) several of them.[9] The estimating equation is:

$$\hat{\beta}_{ij}^{I,C} = \phi_0 + \phi_1 GDP_i\ x\ GDP_j + \phi_2 GDP\ Difference_{ij} + \phi_3 WTO_{ij} + \phi_4 RTA_{ij} + \phi_5 Common\ Language_{ij} + \phi_6 Geographic\ Distance_{ij} + \phi_7 Migration_{ij} + \phi_8 Ease\text{-}of\text{-}Business_{ij} + \phi_9 Credit\ Info_{ij} + \phi_{10} Legal\ Rights_{ij} + \phi_{11} Listed\ Companies_{ij} + \tau_{ij}. \quad (2.5)$$

For convenience I suppress the indicators I and C on the ϕ coefficients and the τ_{ij} error term. The term "GDPi x GDPj" is the product of the logs of output for countries i and j. It is commonly used in trade models that include trade volume that increases with output and trade costs that increase with distance. Thus I use it together with geographic distance as potential determinants of international asset trading, i.e., primary income and borrowing and lending instruments.

[9] In Bekaert and Wang (2009) they are looking for the determinants of home bias.

The term "GDP Difference" is the log of the difference of output between the two countries in the pair. A negative (positive) sign could be reflecting that countries choose to share more risks with partners that are similar (different) with respect to the size of the economy.

The presence of WTO and regional trade agreements memberships as regressors may have different theoretical explanations. For instance, a positive sign could be reflecting that trade and foreign direct investments are complements at the firm level. Or it could be reflecting that trade helps foreign portfolio investments due to an improved informational environment that partner countries have of each other.

The effect of migration can also have different potential explanations. For instance, it may have an impact on compensation of employees, one of the components of primary income sent and received from abroad. This would relate migration to income risk sharing. Or it may be related to consumption risk sharing if it helps the information available to agents for the purpose of borrowing and lending abroad.

Ease-of-Business, Credit Info, Legal Rights and Listed Companies are indices provided by the World Bank. They relate to transaction costs and risks as determinants of foreign investment. Further references on these topics can be found in Domowitz et al. (2001) and Ahearne et al. (2004).

2.4 Dataset

For most of the variables I get the data from the World Bank Development Indicators between 1978 and 2013 for 41 of the the world's largest economies. They are not available as bilateral relations. Thus for FDI, portfolio equity, migration and others, I build the pairwise measures as the sum of the individual measures of the two countries in each pair. They are measured as fractions of GDP (share of population in the case of migration).

The ease-of-business index ranks economies from 1 to 189. A high ranking (a low numerical rank) means that the regulatory environment is conducive to business operation. I take them with a negative sign to make the variable increasing in quality. The credit info index measures rules affecting the scope, accessibility, and quality of credit information. The index ranges from 0 to 8, with higher values indicating the availability of more credit information. Legal Rights Index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The share of listed companies refers to the market value of domestic companies incorporated on the country's stock exchanges at the end of the year. These indices are provided by the World Bank Development Indicators.

I get data from the Joint External Debt Hub on deposits and loans with the Bank for International Settlements reporting banks, loans with the IMF and other multilateral institutions, international reserves, SDR allocation and international debt securities.

Pairwise data on WTO and regional trade agreements memberships, common language and geographic distance come from the gravity dataset available in Head et al. (2010). WTO assumes the value of 2, 1 or 0, if both, one or none of the countries in the pair is a World Trade Organization (or used to be a GATT) member. Regional Trade Agreement is a dummy variable indicating a regional trade agreement in force for the pair of countries. Common language is a dummy variable indicating pairs of countries that share one official language. Geographic distance is the distance between the two countries of a pair, weighted by their major cities.

The complete lists with all the variables, their appropriate names and descriptions are available in the appendices.

2.5 Empirical Results

2.5.1 Estimates of Income Risk Sharing

I have 820 estimates for income risk sharing β^I_{ij} in Eq. 1, which correspond to the bilateral relations amongst 41 countries. The summary statistics are reported in Table 2.1 and the distribution is illustrated in Figure 2.1. The median is -0.010, meaning that the median pair of countries shares no risk through income. This is consistent with nearly zero levels of international income smoothing found in other empirical literature. Each $\widehat{\beta}^I_{ij}$ has its own standard deviation and confidence interval, and statistics on the lower and upper bounds are reported in Table 2.1 as well. Both the lower and upper bounds have their mean values farther from zero compared to their median values. Figure 2.1 shows that the their distributions are skewed to the left and right, respectively. This indicates that the coefficients $\widehat{\beta}^I_{ij}$ that are farther from zero tend to have larger variances, i.e., estimates around zero tend to be more precise.

For each country i, I calculate the mean values of the coefficients $\widehat{\beta}^I_{ij}$ over all j countries. Table 2.2 reports these $\widehat{\beta}^I_i$ means. The country with the largest income risk sharing estimate is Switzerland, whereas Argentina has the smallest.

Table 2.3 shows the ten pairs of countries with largest and the ten with smallest estimates of income risk sharing. The pair of countries with the largest estimate is Austria-Switzerland, with an estimated coefficient of .839, which implies roughly

83.9% of income risk sharing. The interpretation is that their income is highly correlated for a relatively small correlation of output. Among the low levels of risk sharing, Egypt-Turkey and Singapore-Sweden have the smallest estimates. They are negative, meaning that their income growth rates diverge more than their their output growth rates.

Table 2.4 shows the top 10 and low 10 estimates considering countries pairing with the U.S. only. Switzerland is the country that shares the most income risk with the US, for a given output growth covariance. Sweden is the one with the smallest estimate. The negative sign means that Sweden and the U.S. are actually increasing risk by having income growth rates that diverge more than their output growth rates.

2.5.2 Estimates of Consumption Risk Sharing

The consumption risk sharing estimates are economically more interesting. Table 2.5 shows that countries do have significantly positive levels of consumption risk sharing. The median observation is .371, meaning that they share about 37.1% of consumption risk through international borrowing and lending. Given their income growth fluctuations, their consumption presents less idiosyncratic fluctuations. This is consistent with the theoretical prediction that countries prefer consumption to be smoother. It is also consistent with empirical findings of some level of inter-temporal smoothing in international Macroeconomics.

Each of the 820 $\widehat{\beta}_{ij}^{C}$ has its own confidence interval. Table 2.5 shows summary statistics on the upper and lower bounds of those estimates. The median lower bound is .104, meaning the half of the consumption risk sharing estimates are above 10.4% with 95% of confidence.

Table 2.6 shows the estimates of consumption risk sharing averaged for each country. Indonesia shares the most risk, which can be interpreted as a low level of idiosyncratic consumption growth fluctuations through borrowing and lending given a relatively high level of idiosyncratic income growth fluctuations. Argentina shares the least.

The pair of countries that presents the most consumption risk sharing is Colombia-Egypt. This implies a low level of idiosyncratic consumption fluctuations given relatively high levels of idiosyncratic income fluctuations. Argentina and Denmark share the least.

Pairing with the U.S., Egypt has the highest level of consumption risk sharing whereas Turkey has the lowest.

2.5.3 Direct Determinants of Income Risk Sharing

The interpretation of the determinants of income risk sharing can be tricky because they might be correlated with output, but not with the channels through which output can be smoothed, i.e., with the components of primary income from abroad. Hence to give a better understanding of how the determinants work, I report the regressions with output correlation as the dependent variable regressed on the same set of determinants of risk sharing. This is presented in Table 2.9.

The first two columns do not have country-fixed effects. FDI is negatively correlated with income risk sharing. This result is the opposite of what was expected. This means that FDI is contributing to decrease income smoothing. Instead of using FDI to invest in places with different output cycles, countries seem to be using it to invest in places where output fluctuations are correlated, which makes their income from direct investments higher in good states and lower in bad states of nature.

Portfolio equity is more consistent with the theoretic prediction. Countries seem to be investing in places where output fluctuations are negatively associated, such that they achieve insurance when output fluctuates, making income smoother through portfolio equity income. In this setting, migration is insignificant to income risk sharing with or without country-level fixed effects.

The introduction of country-level fixed effects makes the interpretation a bit different. Instead of capturing the overall effect of the bilateral relation, in the presence of country-level fixed effects, the coefficients are only going to capture what is beyond the characteristics of each country independently of the pair. This can be interpreted as some sort of synergy within the pairs of counties such that it is not just the linear sum of their individual characteristics, it is a feature of the pair of countries that makes the potential determinants significant to risk sharing. For income risk sharing all the coefficients become insignificant in the presence of country-level fixed effects.

2.5.4 Direct Determinants of Consumption Risk Sharing

Table 2.10 presents the direct determinants of consumption risk sharing. Those determinants are focused on means of international borrowing and lending. BIS deposits are the only channel that is positive and significant to consumption risk sharing, with or without country-level fixed effects. This is consistent with the theoretical prediction that countries should use their international deposits to smooth consumption in bad states of income growth.

BIS loans, IMF loans, reserves and SDR seem to have the opposite effect. The pattern is about the same with or without fixed effects. Instead of helping countries to smooth consumption, these instruments are increasing consumption risk, such that apparently in good states of nature these instruments are plenty and in bad states theses instruments are more scarce to countries. BIS and IMF loans, reserves and SDR's seem to be working pro-cyclically with respect to consumption growth.

2.5.5 Indirect Determinants of Income Risk Sharing

Table 2.11 shows that WTO membership is positively associated with income risk sharing. Examining the direct determinants of income risk sharing, there are some potential explanations. One possibility is that WTO membership is positively associated with trade, and trade is negatively associated with foreign direct investment, assuming that its negative sign in Table 2.9 is correct. Another possibility is that WTO membership is positively associated with trade, and trade is positively associated with portfolio equity investments (debt or equity securities, other than those included in direct investment or reserve assets).

The coefficients for sharing an official language, having strong migration flows and having a large fraction of firms listed in the stock market are significantly positive. These factors should improve information for the pairs of countries, reducing transaction costs and contributing to international flows of primary income that make idiosyncratic fluctuations of income smoother than output. The coefficients remain significantly positive in the presence of fixed effects, which points to some sort of synergy in having a pair of countries with a high value of those variables.

The product of output of the pair of countries is a common term in gravity models of trade, but the findings of this paper do not indicate any significant relation for income risk sharing. One possible reason relies on a potential ambiguity. On the one hand, trading securities with larger and closer economies may present gains of scale and reduced transaction costs. On the other hand, larger and closer economies have a higher correlation of output fluctuations, making the partner country a less interesting source of income insurance.

Legal rights index is significant but with a negative sign, which makes it difficult to reconcile with the prediction that enforcement of legal rights should improve a country's capability of trading securities. All other variables are insignificant, including GDP differences and regional trade agreements.

2.5.6 Indirect Determinants of Consumption Risk Sharing

The results for the indirect determinants of consumption risk sharing are presented in Table 2.12. The product of output of the pair of countries is significantly positive. One possible interpretation might be that the gains of borrowing and lending from larger and closer economies overcome the disadvantages of borrowing and lending from economies that present a higher income correlation, thus less potential for insurance.

WTO and other trade agreements memberships also present significant positive coefficients. This can be interpreted as being part of trade agreements facilitates access to international borrowing and lending, which helps consumption smoothing. The positive sign of the coefficient of geographic distance is consistent with the idea that countries that are farther away are a better source of insurance. Migration, the ease-of-doing-business index, the legal rights index are also positive, as these factors seem to lower informational problems and transaction costs.

The coefficients on credit information index and the share of companies listed in the stock market are significantly negative. The behavior of these coefficients is rather similar with or without country fixed effects. This is counter intuitive, as these factors should also be contributing to lower transaction costs, thus easier access to international borrowing and lending.

2.6 Conclusion

Economic theory predicts that countries will trade securities to insure themselves against idiosyncratic output shocks in order to smooth income and consumption growth. However, several empirical papers have found very low levels or even zero risk sharing across countries, creating a puzzle to the macroeconomic literature. Using a pairwise approach, this paper provides empirical evidence of the determinants that do help income and consumption risk sharing, and those that do not.

The first step is to estimate levels of risk sharing for each pair of countries. The median value of income risk sharing is nearly zero, whereas for consumption it is .37. This implies that countries seem to be smoothing some of the idiosyncratic shocks to output growth through international borrowing and lending as opposed to primary income.

Then I use the estimated coefficients on the left-hand side and look for direct and indirect determinants. Among the direct determinants, holding portfolio equity assets seems to be an important instrument for income risk sharing, whereas BIS deposits seem to be important for consumption smoothing. BIS and IMF loans, SDR and reserves seem to be working pro-cyclically.

Some of the indirect determinants of risk sharing are significant with a positive sign. Having a common language, strong migration and a large share of companies listed in the stock market seems to be contributing to income smoothing, whereas the list of significant determinants of consumption risk sharing includes the product of output of the pair of counties, geographic distance, WTO and other regional trade agreements memberships, legal rights index and the ease-of-doing-business index.

Several candidate determinants of risk sharing were reported significant, specially regarding consumption risk sharing. Most of them do have the expected sign, being coherent with theoretical predictions. The pairwise approach seems to be a better strategy for studying the puzzle of low levels of international risk sharing, and identifying the determinants that do help and the ones that fail to help seems to be a good starting point for clarifying this macroeconomic puzzle.

This paper aims at the determinants of risk sharing, not its components. Future research can approach the problem by using the same pairwise strategy to look at the components of income and consumption that derive from the macroeconomic identities, e.g., by doing a variance-covariance decomposition with the elements of the GDP-GNI and the GNI-Consumption relations.

Table 2.1: Summary Statistics on the Estimated $\widehat{\beta}^I_{ij}$ — income risk sharing

Confidence Interval	Obs.	Median	Mean	Min	Max
Lower Bound (95% CI)	820	-0.115	-0.134	-0.493	0.457
$\widehat{\beta}^I_{ij}$	820	-0.010	-0.000	-0.249	0.839
Upper Bound (95% CI)	820	0.093	0.133	-0.098	1.220

Notes: $\widehat{\beta}^I_{ij}$ is estimated from $\widetilde{gdp}_{ijt} - \widetilde{gni}_{ijt} = \alpha^I_{ij} + \beta^I_{ij}\widetilde{gdp}_{ijt} + \epsilon_{ijt}$, where $\widetilde{gdp}_{ijt} = \Delta \ln gdp_{it} - \Delta \ln gdp_{jt}$ is the output growth differential between the pair of countries i and j. Similarly, $\widetilde{gni}_{ijt}$ is the national income growth differential for i and j. For each pair of countries there is a $\widehat{\beta}^I_{ij}$ with its own confidence interval. The table shows the summary statistics for the estimate of β^I_{ij} itself and its upper and lower bounds over all pairs.

Table 2.2: Average Income Risk Sharing per Country — $\widehat{\beta}^I_i$

Country i	$\widehat{\beta}^I_i$	Country i	$\widehat{\beta}^I_i$	Country i	$\widehat{\beta}^I_i$
Switzerland	0.195	Algeria	0.008	UK	-0.024
Egypt	0.092	Germany	0.005	Finland	-0.026
Brazil	0.085	Austria	0.003	Colombia	-0.027
Peru	0.060	Italy	0.003	Thailand	-0.028
Philippines	0.057	USA	0.003	Singapore	-0.034
Greece	0.055	China	0.002	Belgium	-0.034
Spain	0.032	Portugal	-0.001	Turkey	-0.047
Netherlands	0.028	France	-0.004	Chile	-0.054
Malaysia	0.026	Norway	-0.005	Korea	-0.061
Pakistan	0.024	India	-0.006	Venezuela	-0.075
SouthAfrica	0.022	Canada	-0.008	Indonesia	-0.079
Denmark	0.017	Japan	-0.009	Sweden	-0.092
Iran	0.016	Russia	-0.012	Argentina	-0.121
Australia	0.013	Mexico	-0.017		.

Notes: $\widehat{\beta}^I_{ij}$ is defined as in Table 2.1. For each country i, $\widehat{\beta}^I_i$ is the average over all j's in $\widehat{\beta}^I_{i,j}$.

Table 2.3: Top 10 and Low 10 Income Risk Sharing Measures

Top 10			Low 10		
Country i	Country j	$\widehat{\beta}_{ij}^I$	Country i	Country j	$\widehat{\beta}_{ij}^I$
Austria	Switzerland	0.839	Egypt	Turkey	-0.249
Switzerland	Pakistan	0.566	Singapore	Sweden	-0.222
Australia	Switzerland	0.488	Indonesia	Singapore	-0.219
Switzerland	Norway	0.413	Austria	Sweden	-0.192
Switzerland	Egypt	0.392	France	Sweden	-0.175
Switzerland	Peru	0.386	Netherlands	Sweden	-0.160
Switzerland	Denmark	0.386	Italy	Sweden	-0.149
Switzerland	Italy	0.382	Argentina	Italy	-0.144
Belgium	Switzerland	0.366	Indonesia	Sweden	-0.137
Brazil	Egypt	0.353	Argentina	Japan	-0.133

Notes: $\widehat{\beta}_{ij}^I$ is defined as in Table 2.1. The list on the left shows the pairwise relations with the highest levels of income risk sharing, whereas the list on the right shows those with the lowest levels of income risk sharing.

Table 2.4: Top 10 and Low 10 Measures of Income Risk Sharing with USA

Top 10		Low 10	
Country j	$\widehat{\beta}^I_{USA,j}$	Country j	$\widehat{\beta}^I_{USA,j}$
Switzerland	0.253	Sweden	-0.167
Philippines	0.171	Indonesia	-0.152
Peru	0.108	Argentina	-0.142
Pakistan	0.093	Belgium	-0.112
Brazil	0.073	Singapore	-0.104
Egypt	0.066	Korea	-0.061
Greece	0.056	Turkey	-0.057
SouthAfrica	0.051	Venezuela	-0.052
Malaysia	0.039	Chile	-0.031
Australia	0.031	Portugal	-0.025

Notes: $\widehat{\beta}^I_{ij}$ is defined as in Table 2.1. For the pairwise relations with USA, the list on the left shows those with the highest levels of income risk sharing, whereas the list on the right shows those with the lowest levels of income risk sharing.

Table 2.5: Summary Statistics on the Estimated $\widehat{\beta}^C_{ij}$ — consumption risk sharing

Confidence Interval	Obs.	Median	Mean	Min	Max
Lower Bound (95% CI)	820	0.104	0.122	-1.058	0.771
$\widehat{\beta}^C_{ij}$	820	0.371	0.394	-0.520	1.243
Upper Bound (95% CI)	820	0.632	0.666	0.017	1.728

Notes: $\widehat{\beta}^C_{ij}$ is estimated from $\widetilde{gni}_{ijt} - \widetilde{c}_{ijt} = \alpha^C_{ij} + \beta^C_{ij}\widetilde{gni}_{ijt} + \omega_{ijt}$, where $\widetilde{c}_{ijt} = \Delta \ln c_{it} - \Delta \ln c_{jt}$ is the consumption growth differential between the pair of countries i and j. Similarly, $\widetilde{gni}_{ijt}$ is the national income growth differential for i and j. For each pair of countries there is a $\widehat{\beta}^C_{ij}$ with its own confidence interval. The table shows the summary statistics for the estimate of β^C_{ij} itself and its upper and lower bounds over all pairs.

Figure 2.1: Histograms of the $\widehat{\beta}_{ij}^{I}$ Coefficients and their Bounds

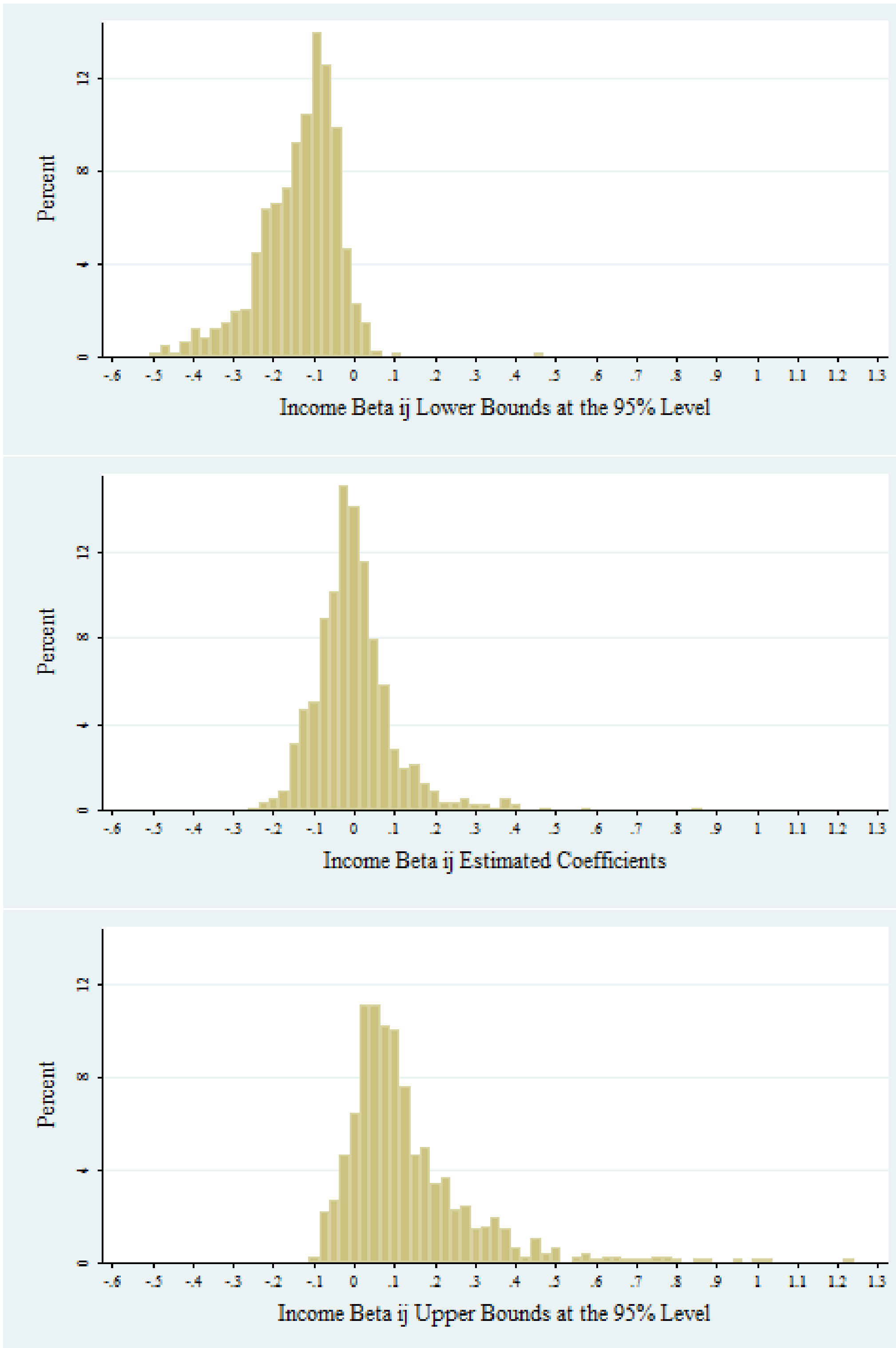


Table 2.6: Average Consumption Risk Sharing per Country $\widehat{\beta}_i^C$

Country i	$\widehat{\beta}_i^C$	Country i	$\widehat{\beta}_i^C$	Country i	$\widehat{\beta}_i^C$
Indonesia	0.725	France	0.438	Portugal	0.311
Egypt	0.680	Norway	0.430	Spain	0.303
Switzerland	0.635	Australia	0.428	Algeria	0.296
Singapore	0.566	Japan	0.428	Thailand	0.293
Sweden	0.554	Canada	0.420	Venezuela	0.278
Philippines	0.549	Pakistan	0.408	Turkey	0.268
Russia	0.520	Denmark	0.402	Greece	0.237
Colombia	0.496	China	0.396	Malaysia	0.234
Finland	0.494	Iran	0.395	Peru	0.228
Germany	0.483	USA	0.384	Chile	0.215
Austria	0.473	UK	0.360	SouthAfrica	0.194
Belgium	0.471	Italy	0.341	Mexico	0.187
Brazil	0.445	Korea	0.339	Argentina	0.077
Netherlands	0.440	India	0.338		.

Notes: $\widehat{\beta}_{ij}^C$ is defined as in Table 2.5. For each country i, $\widehat{\beta}_i^C$ is the average over all j's in $\widehat{\beta}_{i,j}^C$.

Table 2.7: Top 10 and Low 10 Consumption Risk Sharing Measures

	Top 10		Low 10		
Country i	Country j	$\widehat{\beta}_{ij}^C$	Country i	Country j	$\widehat{\beta}_{ij}^C$
Colombia	Egypt	1.243	Russia	Turkey	-0.520
Algeria	Indonesia	1.143	Spain	SouthAfrica	-0.102
Switzerland	Pakistan	1.050	India	SouthAfrica	-0.068
Switzerland	Colombia	1.049	Argentina	Malaysia	-0.047
Germany	Egypt	0.979	Argentina	Australia	-0.034
Egypt	Sweden	0.955	Argentina	China	-0.001
Australia	Egypt	0.954	Argentina	Norway	0.012
Indonesia	Turkey	0.936	Chile	Netherlands	0.031
Switzerland	Egypt	0.935	Australia	SouthAfrica	0.051
Belgium	Egypt	0.930	Argentina	Denmark	0.070

Notes: $\widehat{\beta}_{ij}^C$ is defined as in Table 2.5. The list on the left shows the pairwise relations with the highest levels of consumption risk sharing, whereas the list on the right shows those with the lowest levels of consumption risk sharing.

Table 2.8: Top 10 and Low 10 Measures of Consumption Risk Sharing with USA

Top 10		Low 10	
Country j	$\widehat{\beta}^C_{USA,j}$	Country j	$\widehat{\beta}^C_{USA,j}$
Egypt	0.854	Argentina	0.013
Singapore	0.744	Peru	0.081
Switzerland	0.742	Mexico	0.105
Indonesia	0.690	SouthAfrica	0.113
Russia	0.619	Spain	0.153
Colombia	0.593	Chile	0.201
Germany	0.561	Malaysia	0.212
Sweden	0.544	Greece	0.226
Belgium	0.501	Italy	0.241
Philippines	0.498	Turkey	0.250

Notes: $\widehat{\beta}^C_{ij}$ is defined as in Table 2.5. For the pairwise relations with USA, the list on the left shows those with the highest levels of consumption risk sharing, whereas the list on the right shows those with the lowest levels of consumption risk sharing.

Table 2.9: Direct Determinants of Income Risk Sharing

Dependent Variable	GDP Correlation	$\hat{\beta}^C_{ij}$	GDP Correlation	$\hat{\beta}^C_{ij}$
FDI	37.720	-140.518**	20.293	-52.879
	(91.123)	(56.247)	(134.066)	(99.122)
Portfolio Equity	-0.964	2.859***	-2.714	1.250
	(1.363)	(0.753)	(1.876)	(1.020)
Migration	0.103	0.078	0.219	0.003
	(0.087)	(0.059)	(0.154)	(0.113)
Country F.E.	No	No	Yes	Yes
R-squared	0.003	0.036	0.053	0.347
Obs.	780	780	780	780

Notes: GDP Correlation is the correlation of output of countries i and j. $\widehat{\beta}^I_{ij}$ is defined as in Table 2.1. FDI and Portfolio Equity are percentages of GDP. Migrantion is international migrant stock as a percentage of population. The regressors are averaged over the period of 1978 - 2013.

Figure 2.2: Histograms of the $\widehat{\beta}^{C}_{ij}$ Coefficients and their Bounds

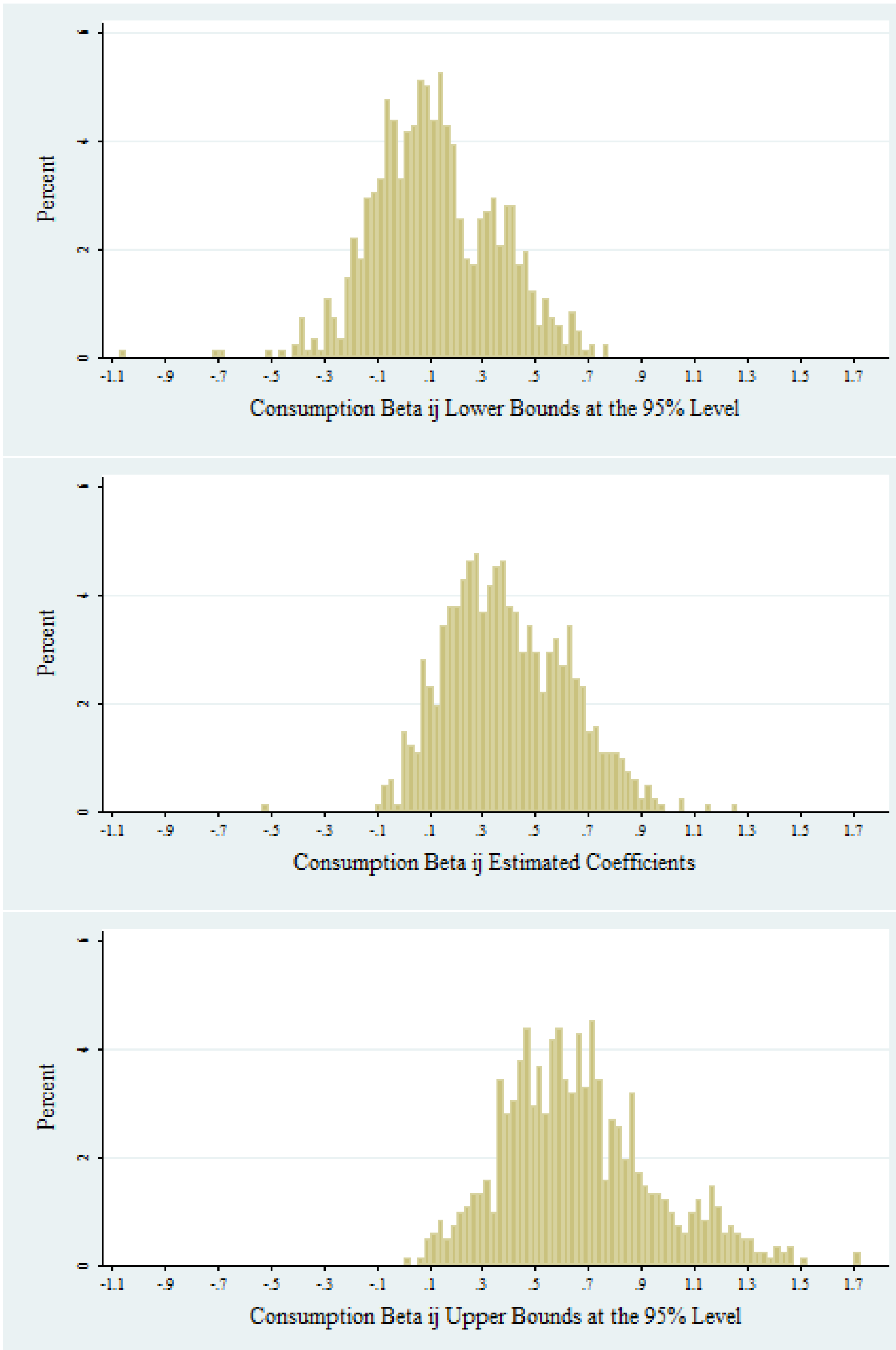


Table 2.10: Direct Determinants of Consumption Risk Sharing

Dependent Variable	GNI Correlation	$\hat{\beta}_{ij}^{C}$	GNI Correlation	$\hat{\beta}_{ij}^{C}$
BIS Deposits	-0.009	0.241***	0.045	0.272***
	(0.038)	(0.044)	(0.082)	(0.050)
BIS Loans	0.020	-0.161***	-0.007	-0.174***
	(0.050)	(0.058)	(0.093)	(0.062)
IMF Loans	0.092	-4.754***	0.728	-2.436***
	(0.611)	(0.763)	(0.921)	(0.914)
Multilateral Loans	-0.291	0.515	-0.465*	0.355
	(0.227)	(0.318)	(0.261)	(0.292)
Reserves	0.047	-0.138***	-0.013	-0.140***
	(0.031)	(0.035)	(0.052)	(0.040)
SDR	2.541	-11.227*	9.447	-7.126
	(4.575)	(5.857)	(8.547)	(8.267)
Securities	0.005	-0.014	0.003	-0.000
	(0.019)	(0.023)	(0.029)	(0.023)
Country F.E.	No	No	Yes	Yes
R-squared	0.010	0.165	0.082	0.425
Obs.	703	703	703	703

Notes: GNI Correlation is the correlation of national income of countries i and j. $\widehat{\beta}_{ij}^{C}$ is defined as in Table 2.5. BIS deposits and loans refer to operations with the Bank for International Settlements reporting banks. All regressors are percentages of GDP averaged over the period of 1978 - 2013.

Table 2.11: Indirect Determinants of Income Risk Sharing

Dependent Variable	GDP Correlation	$\hat{\beta}^C_{ij}$	GDP Correlation	$\hat{\beta}^C_{ij}$
GDPi x GDPj	0.277	-0.003	0.308	-0.150
	(0.213)	(0.108)	(0.258)	(0.103)
GDP Difference	0.001	0.002	0.002	0.002
	(0.005)	(0.003)	(0.006)	(0.002)
WTO/GATT	-0.022	0.013*	-0.013	0.015*
	(0.014)	(0.007)	(0.021)	(0.008)
Reg. Trade Agreem.	-0.070	-0.023	0.092	0.234
	(0.056)	(0.034)	(0.135)	(0.217)
Common Language	0.000	0.054***	0.014	0.050***
	(0.012)	(0.007)	(0.017)	(0.008)
Geographic Distance	-0.021	-0.017	0.012	-0.007
	(0.030)	(0.022)	(0.039)	(0.027)
Migration	0.142	0.195***	0.257*	0.117*
	(0.099)	(0.060)	(0.146)	(0.068)
Ease-of-Business Index	0.013	0.005	0.005	0.001
	(0.013)	(0.007)	(0.018)	(0.009)
Credit Info Index	-0.011**	0.003	-0.011	0.007**
	(0.005)	(0.003)	(0.007)	(0.003)
Legal Rights Index	-0.004	-0.013***	-0.007	-0.011***
	(0.004)	(0.002)	(0.005)	(0.003)
Listed Companies	0.006	0.052***	0.012	0.040***
	(0.015)	(0.008)	(0.022)	(0.010)
Country F.E.	No	No	Yes	Yes
R-squared	0.021	0.171	0.066	0.421
Obs.	780	780	780	780

Notes: GDP Correlation is the correlation of output of countries i and j. $\widehat{\beta}^I_{ij}$ is defined as in Table 2.1. GDPi x GDPj and GDP Difference ij are in logs of Dollars. WTO/GATT takes the value of 2, 1 or 0, if both, one or neither country is a member of the WTO (or used to be of the GATT). Reg. Trade Agreem. is a dummy variable indicating a regional trade agreement in force for the pair of countries. Common language is a dummy variable indicating that the two countries share one official language. Geographic distance is the distance between the pair of countries weighted by their major cities. Migrantion is international migrant stock as a percentage of population. Ease-of-Business, Credito Info, Legal Rights Index and Listed Companies in the stock market are provided by the World Bank Development Indicators and their appropriate names are listed in the appendices. All the variables are averaged over the period of 1978 - 2013.

Table 2.12: Indirect Determinants of Consumption Risk Sharing

Dependent Variable	GNI Correlation	$\hat{\beta}_{ij}^{C}$	GNI Correlation	$\hat{\beta}_{ij}^{C}$
GDPi x GDPj	0.347	1.127***	0.331	1.551***
	(0.215)	(0.213)	(0.258)	(0.205)
GDP Difference	-0.005	0.002	-0.003	0.005
	(0.005)	(0.005)	(0.005)	(0.004)
WTO/GATT	-0.026*	0.066***	-0.010	0.022
	(0.014)	(0.015)	(0.021)	(0.015)
Reg. Trade Agreem.	-0.064	0.309***	0.092	0.658***
	(0.052)	(0.068)	(0.193)	(0.204)
Common Language	0.018	-0.004	0.032*	-0.004
	(0.013)	(0.015)	(0.018)	(0.019)
Geographic Distance	0.011	0.066*	0.055	0.158***
	(0.030)	(0.035)	(0.039)	(0.039)
Migration	0.244**	0.334***	0.497***	0.334**
	(0.107)	(0.112)	(0.150)	(0.134)
Ease-of-Business Index	0.021	0.070***	0.005	0.102***
	(0.013)	(0.014)	(0.019)	(0.015)
Credit Info Index	-0.013**	-0.081***	-0.007	-0.099***
	(0.005)	(0.005)	(0.007)	(0.006)
Legal Rights Index	-0.008**	0.008*	-0.010*	0.011*
	(0.004)	(0.005)	(0.005)	(0.006)
Listed Companies	0.017	-0.025	0.009	-0.036*
	(0.015)	(0.017)	(0.024)	(0.021)
Country F.E.	No	No	Yes	Yes
R-squared	0.028	0.329	0.086	0.587
Obs.	780	780	780	780

Notes: GNI Correlation is the correlation of national income of countries i and j. $\widehat{\beta}_{ij}^{C}$ is defined as in Table 2.5. GDPi x GDPj and GDP Difference ij are in logs of Dollars. WTO/GATT takes the value of 2, 1 or 0, if both, one or neither country is a member of the WTO (or used to be of the GATT). Reg. Trade Agreem. is a dummy variable indicating a regional trade agreement in force for the pair of countries. Common language is a dummy variable indicating that the two countries share one official language. Geographic distance is the distance between the pair of countries weighted by their major cities. Migrantion is international migrant stock as a percentage of population. Ease-of-Business, Credito Info, Legal Rights Index and Listed Companies in the stock market are provided by the World Bank Development Indicators and their appropriate names are listed in the appendices. All the variables are averaged over the period of 1978 - 2013.

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.1 List of Countries

1. Argentine Republic
2. Commonwealth of Australia
3. Federative Republic of Brazil
4. People's Republic of China
5. French Republic
6. Federal Republic of Germany
7. Republic of India
8. Republic of Indonesia
9. Italian Republic
10. Japan
11. Republic of Korea
12. United Mexican States
13. Kingdom of the Netherlands
14. Russian Federation
15. Kingdom of Spain
16. Switzerland
17. Republic of Turkey
18. United Kingdom of Great Britain and Northern Ireland

19. United States of America
20. People's Democratic Republic of Algeria
21. Republic of Austria
22. Kingdom of Belgium
23. Canada
24. Republic of Chile
25. Republic of Colombia
26. Kingdom of Denmark
27. Arab Republic of Egypt
28. Republic of Finland
29. Hellenic Republic
30. Islamic Republic of Iran
31. Malaysia
32. Kingdom of Norway
33. Republic of Peru
34. Islamic Republic of Pakistan
35. Republic of the Philippines
36. Portuguese Republic
37. Republic of Singapore

38. Republic of South Africa
39. Kingdom of Sweden
40. Kingdom of Thailand
41. Republica Bolivariana de Venezuela

.2 World Bank Development Indicators Variables

1. GDP growth (annual %). Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2005 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

2. GNI growth (annual %). GNI (formerly GNP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.

3. Final consumption expenditure, etc. (annual % growth). Average annual growth of final consumption expenditure based on constant local currency. Aggregates are based on constant 2005 U.S. dollars. Final consumption expenditure (formerly total consumption) is the sum of household final consumption

expenditure (formerly private consumption) and general government final consumption expenditure (formerly general government consumption). This estimate includes any statistical discrepancy in the use of resources relative to the supply of resources.

4. Foreign direct investment, net inflows + net outflows (% of GDP). Net inflows plus net outflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.

5. Portfolio equity, net inflows (BoP, current US$) Portfolio equity includes net inflows from equity securities other than those recorded as direct investment and including shares, stocks, depository receipts (American or global), and direct purchases of shares in local stock markets by foreign investors.

6. International migrant stock (% of population) International migrant stock is the number of people born in a country other than that in which they live. It also includes refugees. The data used to estimate the international migrant stock at a particular time are obtained mainly from population censuses.

7. Strength of legal rights index (0=weak to 12=strong). Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 12, with higher scores indicating that these laws are better designed to expand access to credit.

8. Ease of doing business index (-1=most to -189=least business-friendly regulations). Ease of doing business ranks economies from 1 to 189, with first place being the best. A high ranking (a low numerical rank) means that the regulatory environment is conducive to business operation. The index averages the country's percentile rankings on 10 topics covered in the World Bank's Doing Business. The ranking on each topic is the simple average of the percentile rankings on its component indicators.

9. Depth of credit information index (0=low to 8=high). Depth of credit information index measures rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries. The index ranges from 0 to 8, with higher values indicating the availability of more credit information, from either a public registry or a private bureau, to facilitate lending decisions.

10. Market capitalization of listed companies (% of GDP). Market capitalization (also known as market value) is the share price times the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year. Listed companies does not include investment companies, mutual funds, or other collective investment vehicles.

.3 Joint External Debt Hub Variables

1. Cross-border deposits with BIS reporting banks. The data are derived from the BIS locational banking statistics. Deposits with BIS reporting banks are shown in BIS publications as banks' liabilities to their creditors.

2. Cross-border loans from BIS reporting banks. The data are derived from the Bank for International Settlements (BIS) Locational Banking Statistics. The key organizational criteria are the country of residence of the reporting banks and their counterparties. All positions are recorded on a gross basis, including those vis-a-vis own affiliates.

3. Multilateral loans, IMF. The data cover total outstanding loans and other liabilities to the IMF as at the end of the reference period.

4. Multilateral loans, other institutions. The data are sourced from the African Development Bank, Asian Development Bank, and Inter-American Development, and IBRD loans and IDA credits from the World Bank.

5. International reserves (excluding gold). The data on international reserve assets refer to entries published in the world tables of the IMFs International Financial Statistics (IFS). International reserve assets as defined in BPM6, consist of those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy, and serving as a basis for foreign borrowing).

6. SDR allocation. SDRs are international reserve assets created by the IMF and allocated to members to supplement existing official reserves. Holdings of SDRs by an IMF member are recorded as an asset, while the allocation of SDRs is recorded as the incurrence of a liability of the member receiving them

7. International debt securities, all maturities. The data are derived from quarterly BIS statistics on issues of money market instruments, bonds and notes in

international markets and are based on information provided by various market sources (such as Euroclear, Dealogic, Thomson Financial Securities Data and ISMA). International debt securities cover all foreign currency issues by residents and non-residents in a given market, including in the borrowers own currency, and foreign bonds (domestic currency bonds issued by non-residents in a given market).

.4 Head et al. (2010) Dataset Variables

1. Geographic distance. Bilateral distances based on population-weighted great circle distance between large cities of the two countries.

2. WTO/GATT membership comes from the WTO web site.

3. Regional Trade Agreement membership. Dummy variable indicating a WTO reported Regional Trade Agreements in force between the two countries of the pair.

4. Common language. Common official language data come from the CEPII distance database (http://www.cepii.fr/anglaisgraph/bdd/distances.htm).

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