Migration, Specialization, and Trade: Evidence from the Brazilian March to the West

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1 Thailand

These are regressions of migration flows on previous stock of workers for Thailand, using census 1970 and 1980. The geographical unit are provinces. Crops on these census are sufficiently disaggregated to do the analysis. We keep data on people that are farmers that work on the following crops: rice, corn, rubber, cassava, coconut, wood, fish, and hunting. For migration from origin to destination province, the notion of origin that we use is the province where the person was born. As in the original paper, we exclude cases where the origin province are equal to the destination province in the regressions. In Table 1 we construct L_{ikt-1} with the 1970 census, and L_{ijkt} with the 1980 census. In Table 2 we construct both L_{ikt-1} and L_{ijkt} from the 1970 census. In Table 3 we construct both L_{ikt-1} and L_{ijkt} from the 1970 census. Finally, in Table 4 we use both 1970 and 1980 census to construct both L_{ikt-1} and L_{ijkt}.

1.1 Thailand, balance check between 1970 and 1980 census

The 1970 census had a sample of 2% for a total of 772169 people, where district was the smallest geography in the sampling design. The 1980 census had a sample of 1% for a total of 388141 people, where provinces were in this case the smallest geography in the sampling design. In the ocassions where there is production of a crop in both census, the number are sufficiently close such that they could reflect structural change and not errors of some kind. There are ocassions where the production of some crop in some province disappears in or the production of a new crop appears in 1980, but in the majority of cases production of a crop happens in both census.

1.2 Thailand, regressions with migration flows at the person level

Still working on this, but I've been thinking expanding the datasets according to the person weights and then run probit regressions since we assume that the

Table 1: Regressions, 1970 is lag, 1980 is present

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Migration flows, OLS									
Farmers in origin	0.058	0.058	0.148***	0.048	0.048	0.145***	0.053	0.053	0.161***
	(0.045)	(0.045)	(0.019)	(0.046)	(0.046)	(0.019)	(0.042)	(0.042)	(0.019)
R^2	0.833	0.833	0.250	0.835	0.835	0.257	0.832	0.832	0.251
Obs	921	921	921	871	871	871	982	982	982
Migration flows, PPML									
Farmers in origin	0.119***	0.104**	0.536***	0.115***	0.097**	0.561***	0.115***	0.116***	0.544***
	(0.025)	(0.045)	(0.092)	(0.026)	(0.044)	(0.095)	(0.023)	(0.039)	(0.087)
R^2	-	-	-	-	-	-	-	-	-
Obs	18559	921	18559	18559	871	18559	18559	982	18559
Dest-Crop-Year FE	Y	Y		Y	Y		Y	Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Without zeros		Y			Y			Y	
Men HH heads				Y	Y	Y			
Men HH heads, 20-65 y/o							Y	Y	Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. Columns (1), (2), and (3) are based on a sample of 30-65 years old migrants. In columns (4), (5), and (6) the sample is comprised by men between 30-65 years old. In columns (7), (8), and (9) the sample is comprised by men between 20-65 years old. The covariate is the log of of agricultural workers in the same activity in the region of origin. The dependent variable is the log of migrant agricultural workers from an origin to a destination region working in an activity. The covariate is based on the 1970 census, while the dependent variable is based on the 1980 census. We exclude non-migrants from the sample.

Table 2: Regressions, 1970 is both lag and present

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Migration flows, OLS									
Farmers in origin	0.057	0.057	0.093***	0.061	0.061	0.104***	0.077	0.077	0.114***
	(0.054)	(0.054)	(0.027)	(0.050)	(0.050)	(0.027)	(0.049)	(0.049)	(0.030)
R^2	0.869	0.869	0.526	0.862	0.862	0.526	0.869	0.869	0.518
Obs	839	839	839	803	803	803	895	895	895
Migration flows, PPML									
Farmers in origin	0.145***	0.210***	0.506***	0.133***	0.225***	0.505***	0.132***	0.218***	0.505***
	(0.032)	(0.073)	(0.114)	(0.031)	(0.066)	(0.114)	(0.029)	(0.063)	(0.116)
R^2	-	-	-	-	-	-	-	-	-
Obs	18559	839	18559	18559	803	18559	18559	895	18559
Dest-Crop-Year FE	Y	Y		Y	Y		Y	Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Without zeros		Y			Y			Y	
Men HH heads				Y	Y	Y			
Men HH heads, 20-65 y/o							Y	Y	Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. Columns (1), (2), and (3) are based on a sample of 30-65 years old migrants. In columns (4), (5), and (6) the sample is comprised by men between 30-65 years old. In columns (7), (8), and (9) the sample is comprised by men between 20-65 years old. The covariate is the log of of agricultural workers in the same activity in the region of origin. The dependent variable is the log of migrant agricultural workers from an origin to a destination region working in an activity. Both the covariate and the dependent variable are based on the 1970 census. We exclude non-migrants from the sample.

Table 3: Regressions, 1980 is both lag and present

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Migration flows, OLS									
Farmers in origin	0.120***	0.120***	0.118***	0.121***	0.121***	0.113***	0.122***	0.122***	0.141***
	(0.038)	(0.038)	(0.020)	(0.043)	(0.043)	(0.020)	(0.042)	(0.042)	(0.020)
R^2	0.816	0.816	0.226	0.817	0.817	0.237	0.830	0.830	0.230
Obs	1012	1012	1012	960	960	960	1087	1087	1087
Migration flows, PPML									
Farmers in origin	0.199***	0.178***	0.626***	0.191***	0.183***	0.633***	0.187***	0.207***	0.624***
	(0.028)	(0.035)	(0.098)	(0.029)	(0.038)	(0.098)	(0.028)	(0.035)	(0.092)
R^2	-	-	-	-	-	-	-	-	-
Obs	20770	1012	20770	20770	960	20770	20770	1087	20770
Dest-Crop-Year FE	Y	Y		Y	Y		Y	Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Without zeros		Y			Y			Y	
Men HH heads				Y	Y	Y			
Men HH heads, 20-65 y/o							Y	Y	Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. Columns (1), (2), and (3) are based on a sample of 30-65 years old migrants. In columns (4), (5), and (6) the sample is comprised by men between 30-65 years old. In columns (7), (8), and (9) the sample is comprised by men between 20-65 years old. The covariate is the log of of agricultural workers in the same activity in the region of origin. The dependent variable is the log of migrant agricultural workers from an origin to a destination region working in an activity. Both the covariate and the dependent variable are based on the 1980 census. We exclude non-migrants from the sample.

Table 4: Regressions, 1970 + 1980

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Migration flows, OLS									
Farmers in origin	0.092***	0.092***	0.104***	0.093***	0.093***	0.108***	0.101***	0.101***	0.127***
	(0.032)	(0.032)	(0.017)	(0.033)	(0.033)	(0.017)	(0.032)	(0.032)	(0.018)
R^2	0.854	0.854	0.462	0.853	0.853	0.466	0.860	0.860	0.461
Obs	1851	1851	1851	1763	1763	1763	1982	1982	1982
Migration flows, PPML									
Farmers in origin	0.178***	0.187***	0.570***	0.169***	0.196***	0.572***	0.166***	0.210***	0.568***
	(0.021)	(0.033)	(0.078)	(0.021)	(0.033)	(0.079)	(0.020)	(0.031)	(0.077)
R^2	-	-	-	-	-	-	-	-	-
Obs	39329	1851	39329	39329	1763	39329	39329	1982	39329
Dest-Crop-Year FE	Y	Y		Y	Y		Y	Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Without zeros		Y			Y			Y	
Men HH heads				Y	Y	Y			
Men HH heads, 20-65 y/o							Y	Y	Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. Columns (1), (2), and (3) are based on a sample of 30-65 years old migrants. In columns (4), (5), and (6) the sample is comprised by men between 30-65 years old. In columns (7), (8), and (9) the sample is comprised by men between 20-65 years old. The covariate is the log of of agricultural workers in the same activity in the region of origin. The dependent variable is the log of migrant agricultural workers from an origin to a destination region working in an activity. Both the covariate and the dependent variable are based on both the 1970 and 1980 census. We exclude non-migrants from the sample.

error terms in the transmission of knowledge regression distributes lognormal. Regarding the first point, that is, if a row has a person weight of 38, which means that that observation represents 38 people in ZA, then I repeat that row 38 times. This will yield millions of observations. Regarding the second point, this would be a probit regression where the dependent variable is the dummy variable L_{wijkt}, which equals 1 when the person w lives in region j, was born in region i, grows crop k, 0 otherwise. Given that in the equation $log(u^{migration})$ distributes normal, then the probability that $L_{wijkt} = 1$ is $\Phi(\iota_{jkt} + \iota_{ijt} + \kappa\beta log L_{ijkt-1})$.

2 South Africa

These are the regressions for the 2007 census of South Africa. Location is at the province level, there are 9 provinces. There are 18 crops: grain and staple farming, vegetable farming, nursery farming, fruit farming, vineyards, sugar cane, cotton, cattle, chicken, horse, dairy, sheep, ostrich, goat, ocean fishing, inland fishing, fish farms, and mixed farming. For the regressions of wages of migrant farmers on L_{ikt-1}, we calculate average earnings by origin-destination-crop. The origin variable is determined by which province the person was born. In Table 5 we construct both L_{ikt-1} and L_{ijkt} based on the 2007 census. In Table 6 we construct both L_{ikt-1} and w_{ijkt} from the 2007 census.

3 Brazil

These are regressions of migration flows and earnings on previous stock of workers for Brazil. Dependent variables are from census 2000 and 2010, and the main covariate is lagged by thirty years, so it is derived from censuses 1970 and 1980. For both migration flows L_{ijkt} and earnings w_{ijkt}, origin is the state where the person was born, and destination is the mesoregion the person resides at the time of the census. We consider 13 crops: banana, cassava, chicken, cocoa, coffee, cotton, corn, fish, livestock, rice, soy, sugarcane, and tobacco. In contrast to the original paper, we exclude fruits and horticulture since it is unclear how to code this from IPUMS's categorization. Table 7 present results for both OLS and PPML regressions. Results are very similar to those in the original paper, but higher values. This might be due to many reasons, including these regressions not including other covariates, the location variable not being as granular (in the original paper, origin and destination are both at the mesoregion), not including fruits and horticulture, our sample of migrants being comprised by 30-65 year old head of households, etc.

3.1 Summary Statistics

Income. We use person's total monthly income from their labor. Amounts are expressed as they were reported at the time of the census in the currency of the respective country. They are not adjusted for inflation or devaluation. Specifically relating to the Brazilian data: All Brazilian figures are monthly

Table 5: Migration Flows Regression for ZA, 2007

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Migration Flows, OLS									
Farmers in origin	0.076	0.076	0.194**	0.116	0.116	0.181**	0.042	0.042	0.102
	(0.091)	(0.091)	(0.076)	(0.098)	(0.098)	(0.085)	(0.088)	(0.088)	(0.088)
R^2	0.778	0.778	0.380	0.740	0.740	0.357	0.754	0.754	0.340
Obs	329	329	329	306	306	306	327	327	327
Migration Flows, PPML									
Farmers in origin	0.075	0.066	0.270***	0.102*	0.068	0.246**	0.071	0.042	0.255**
	(0.057)	(0.055)	(0.097)	(0.055)	(0.052)	(0.100)	(0.057)	(0.063)	(0.103)
R^2	-	-	-	-	-	-	-	-	-
Obs	1208	329	1208	1208	306	1208	1208	327	1208
Dest-Crop-Year FE	Y	Y		Y	Y		Y	Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Without zeros		Y			Y			Y	
Men HH heads				Y	Y	Y			
Men HH heads, 20-65 y/o							Y	Y	Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. Columns (1), (2), and (3) are based on a sample of 30-65 years old migrants. In columns (4), (5), and (6) the sample is comprised by men between 30-65 years old. In columns (7), (8), and (9) the sample is comprised by men between 20-65 years old. The covariate is the log of of agricultural workers in the same activity in the region of origin. The dependent variable is the log of migrant agricultural workers from an origin to a destination region working in an activity. Both the covariate and the dependent variable are are based on the 2007 census. We exclude non-migrants from the sample.

Table 6: Earnings Regression for ZA, 2007

	(1)	(2)	(3)	(4)	(5)	(6)
Earnings, OLS						
Farmers in origin	-0.116	-0.080	-0.172	-0.096	-0.117	-0.019
	(0.144)	(0.090)	(0.149)	(0.097)	(0.135)	(0.094)
R^2	0.533	0.278	0.525	0.263	0.529	0.274
Obs	311	311	288	288	312	312
Earnings, PPML						
Farmers in origin	-0.067	-0.043	-0.302*	-0.023	-0.235	-0.008
	(0.163)	(0.104)	(0.171)	(0.111)	(0.161)	(0.109)
R^2	-	-	-	-	-	-
Obs	312	312	288	288	312	312
Dest-Crop-Year FE	Y		Y		Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y
Men HH heads			Y	Y		
Men HH heads, 20-65 y/o					Y	Y

Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. Columns (1) and (2) are based on a sample of 30-65 years old migrants. In columns (3) and (4) the sample is comprised by men between 30-65 years old. In columns (5) and (6) the sample is comprised by men between 20-65 years old. The covariate is the log of of agricultural workers in the same activity in the region of origin. The dependent variable is the log of average wages of migrant agricultural workers from an origin to a destination region working in an activity. Both the covariate and the dependent variable are based on the 2007 census. We exclude non-migrants from the sample.

Table 7: The Influence of the Region of Origin on Earnings and Employment of Agricultural Workers in their Destination Region

	OLS			PPML		
	(1)	(2)	(3)	(4)	(5)	(6)
A. Migration Flows						
Farmers in origin	0.150***	0.150***	0.290***	0.166***	0.159***	0.742***
	(0.013)	(0.013)	(0.015)	(0.012)	(0.015)	(0.030)
R^2	0.886	0.886	0.264	-	-	-
Obs	5700	5700	5700	65212	5700	65212
B. Earnings						
Farmers in origin	0.038***	0.038***	0.054***	0.043***	0.043***	0.136***
	(0.011)	(0.011)	(0.007)	(0.014)	(0.014)	(0.039)
R^2	0.774	0.774	0.550	-	-	-
Obs	5261	5261	5261	5700	5700	5700
Dest-Crop-Year FE	Y	Y		Y	Y	
Orig-Dest-Year FE	Y	Y	Y	Y	Y	Y
Without zeros		Y			Y	

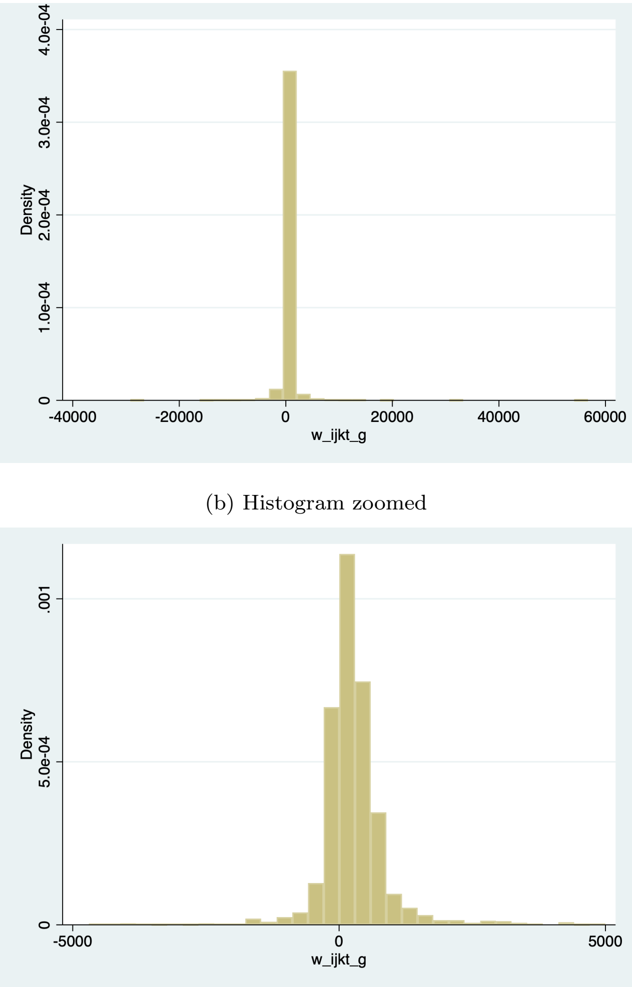
Notes: * / ** / *** denotes significance at the 10 / 5 / 1 percent level. Standard errors are clustered at the destination-crop-year level, and are reported in parentheses. An observation is a cell at the origin-destination-crop-year level. For migration flows, origin is the state where the person was born, and destination is the mesoregion where the person currently lives. The sample is comprised by 30-65 year old migrants. Columns (1), (2), and (3) show results using OLS estimators; while columns (4), (5), and (6) use PPML estimators. The covariate is the log of of agricultural workers in the same activity in the region of origin lagged by thirty years. We include the census of 2000 and 2010 in our regressions. We exclude non-migrants from the sample.

incomes. Brazilian currency changed considerably over time. The cruzeiro was devalued at 1000 to 1 in 1967. The cruzado, equal to 1000 cruzeiros, was introduced in 1986. In 1989 the cruzado was devalued, with 1 new cruzado = 1000 old cruzados. In March 1990, the cruzeiro replaced the cruzado, with no change in value. In 1993, the cruzeiro reais replaced the cruzeiro, with 1 cruzeiro reias = 1000 cruzeiros. Finally, in 1994 the currency was changed to the real, where 1 real = 2750 cruzeiros reais. For our purposes, we only use income data for 2000 and 2010, so units are consistent across censuses. In Figure XX we show the distribution of $\Delta w_{ijk2010} = w_{ijk2010} - w_{ijk2000}$. There are 44252 potential cells, 42060 missing values so 2192 positive values. Only 19 cells report a value of zero, so it is not a major issue. The distribution exhibit two very long tails, with the right tail being slightly larger. When we zoom in, we see that the distribution is slightly skewed to the left, so in general wages increase.

Number of people. We see how L_{jt} and L_{kt} evolve over time. Units are weighted number of people, so we can go all the way back to 1970 whenever possible. In Figure XX we see L_{jt} over time normalized at 1970. Expected behavior no weird jumps. In Figure XX we see L_{kt} over time from 1970 to 2010 excluding cassava, corn, and soy since they were not produced in 1970 and 1980. There are more people working in producing bananas, chicken, fish, and livestock in 2010 than in 1970. For the rest of crops, there are less people working on these crops. In Figure XX we see L_{kt} over time from 1991 to 2010 including cassava, corn, and soy. There are only more people working in producing fish and chicken in 2010 with respect to 1991. This probably reflects structural change.

Migration. For our purposes, we only use migration data for 2000 and 2010. In Figure XX we show the distribution of $\Delta L_{ijk2010} = L_{ijk2010} - L_{ijk2000}$. There are 44252 potential cells, 39570 cells where there is no change in migration patterns, so 4955 cells exhibit changes in migration patterns. The distribution has a huge spike at 0. If we remove these zeroes, we see that the distribution is slightly skewed to the left. If we zoom in, we confirm that people have been migrating out of many places, probably to migrate to a few places such as Minas Gerais, and probably to produce main products.

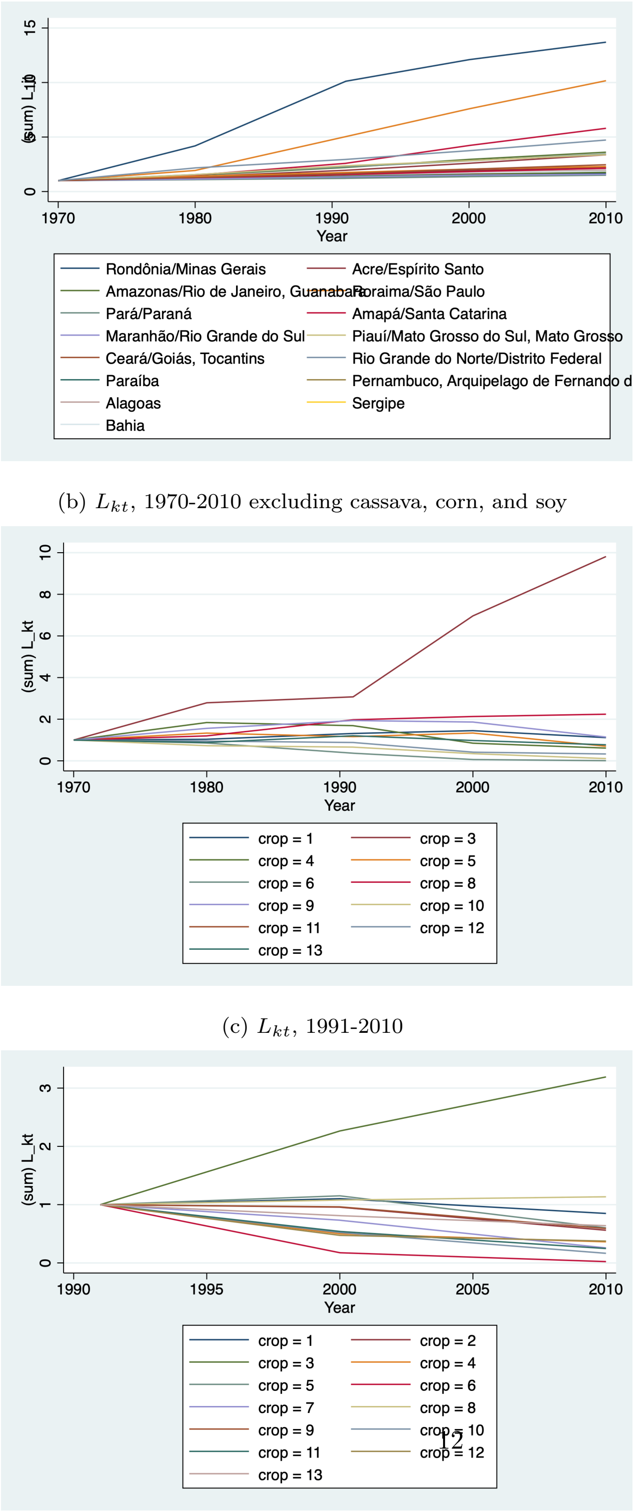
Figure 1: $\Delta w_{ijk2010}$



(a) Histogram

(b) Histogram zoomed

Figure 2: Number of people over time

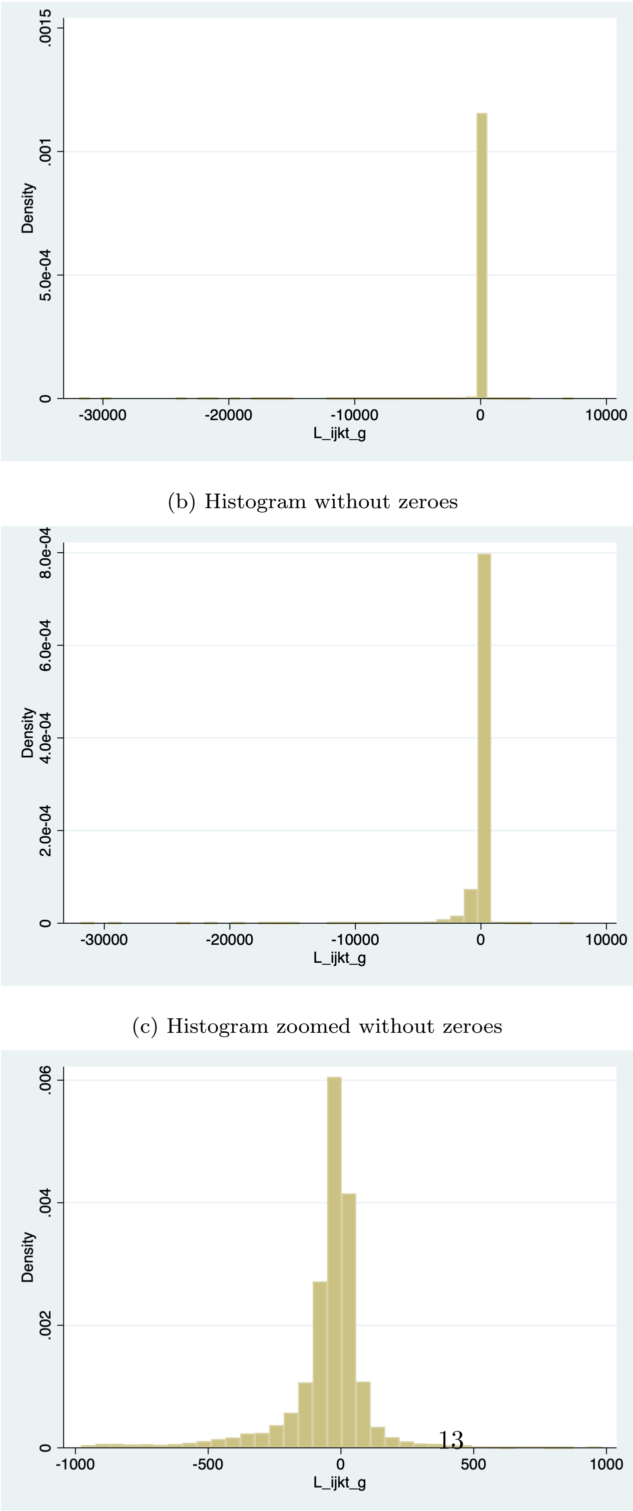


(a) L_{jt}

(b) L_{kt}, 1970-2010 excluding cassava, corn, and soy

(c) L_{kt}, 1991-2010

Figure 3: $\Delta L_{ijk2010}$



(a) Histogram

(b) Histogram without zeroes

(c) Histogram zoomed without zeroes