STEG WORKING PAPER

UNEVEN PRODUCT DIVERSIFICATION: EXPLAINING THE LAG OF AGRICULTURAL ECONOMIES

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AUGUST 2022
STEG WP018

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18 August 2022

This paper documents that product diversification is on average lower in the agricultural sector than in manufacturing activities. A simple model shows how this regularity can yield income divergence enhanced by terms of trade deterioration, a pattern that characterizes development of agricultural economies in the data. The model explains these facts without the need of heterogeneous consumers or products. Key parameter values are estimated and used in an exercise showing that the mechanism proposed is quantitatively important.

JEL Codes: F43, F62, O30, Q17.

Keywords: diversification, growth, welfare, agricultural economies.

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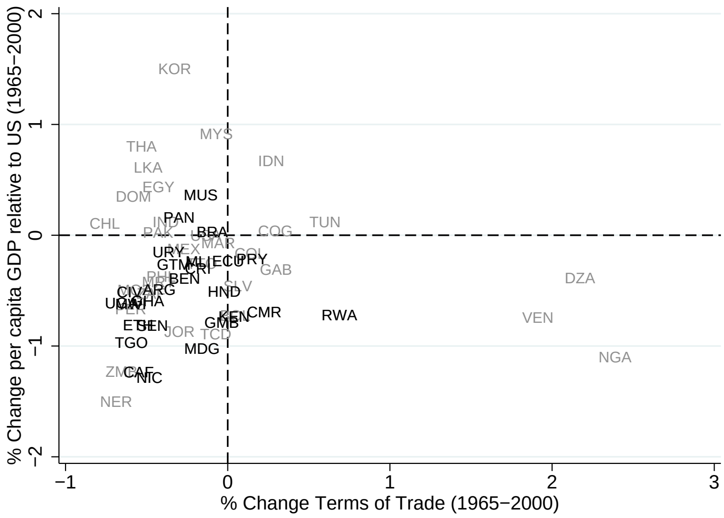
1. Introduction

Explaining differences in living conditions across countries demands not only consideration of how output evolves in different regions, but also of how the purchasing power generated by that output moves over time. Changes in the prices of exports relative to those of imports, usually referred to as terms of trade, affect the purchasing power of consumers. Acemoglu and Ventura (2002) explain that economies experiencing fast output growth tend to suffer deterioration in terms of trade, since they typically increase their export supply pushing the market equilibrium through a downward sloping demand, so the price of their exports falls. At the same time, they increase their demand for imports potentially pushing their price up. The counterpart is improvement in terms of trade for slow growing regions. This terms-of-trade effect (TTE) is highlighted by the authors as a mechanism preventing income divergence. Theoretically, a TTE would emerge as long as consumers perceive products from any two regions as imperfect substitutes, so the demand for the exports of a given region is downward sloping, and countries supply world markets with a relatively fixed range of goods (i.e. their exports grow in the intensive margin). Empirically, while the TTE operates on average for a large sample of countries to some degree, the specific group of agricultural economies seems to escape this mechanism.

Economies specialized in agricultural production exhibit slow growth relative to the rest and deterioration in terms of trade, further depressing their purchasing power, a combination that here will be referred to as *reverse-TTE*. To show this in a simple way, Figure 1 plots the change in terms of trade against the change in real income (relative to the US) for each economy over a period of roughly 40 years.[1] A fully operational TTE would yield a negative relationship between these two variables. While the correlation for the full sample of countries is negative (-0.07), it is clear that the group of countries

[1] Appendix 1 replicates and extends the exercise in Acemoglu and Ventura (2002), which implies controlling for steady state determinants, and highlighting the particular position of agricultural economies. It also shows that the TTE is independent of the size of the economy. This is compatible with an Armington world, as the one set by Acemoglu and Ventura (2002), where consumers differentiate goods by country of origin. The result is robust to alternative time periods. Moreover, it is shown that a larger weight of agricultural goods in export values is positively correlated with a larger fall in terms of trade.

Figure 1:
Change in real income and terms of trade (1965-2000)



Notes: Change in terms of trade for the period 1965-1985 from Barro and Lee (1993) and for the remaining period from WDI. Data on per capita GDP (constant prices) from PWT. Agricultural countries are signaled in bold and are defined as those for which exports of agricultural goods (A1 list in Appendix 2.1) exceed 30% in 2000. Export data from Feenstra et al. (2005).

with large shares of agricultural exports (in bold) contribute to a great extent against a stronger TTE, since almost all of them are located in the lower-left quadrant (the correlation for a sample ignoring these countries rises to -0.20). Given the relatively low growth in real income experienced by these economies, the fact that their terms of trade have not improved enough to shift their location to the right of the previous figure, creates a puzzle that is important to explain. The finding that terms of trade movements depend on specialization patterns is of particular importance in the light of recent empirical literature attributing income differences between regions to the sectoral composition of output.[2] Understanding the driving forces behind this pattern becomes crucial to a proper explanation of the development problems faced by economies in which comparative advantage lies largely in the agricultural sector, most notably in South America and Sub-Saharan Africa. This paper argues that lower product diversification in the agricultural sector can help explain the reverse-TTE found in the data for agricultural economies.

Economic development is characterized by productive capabilities being expanded in different dimensions. This paper focuses on what is arguably the least explored of them,

[2]See for example Gollin et al. (2004), Caselli (2005) or McMillan et al. (2014).

i.e. the expansion of the set of goods produced, or in other words, the extensive margin of growth. The contribution of the paper is twofold. First, it presents evidence showing that growth in the extensive margin is not balanced between sectors. Diversification happens at consistently lower rates in agricultural activities. This result appears both in export and domestic production data. Moreover, the result proves robust to the classification and disaggregation level in which the data are presented, and the definition of agricultural goods employed.

Second, this paper highlights the largely unexplored, but very intuitive role that uneven diversification can play to account for divergence enhanced by a reverse-TTE. For this, uneven product creation is introduced into a simple model of expanding varieties and trade. The theory abstracts from all other sources of growth, i.e. productivity growth, quality improvements and structural change, allowing growth only in the extensive margin. This structure gives the trend in terms of trade that is expected in a world where product diversification is uneven and no other mechanism is in place. The model comprises two regions (N and S) and each is completely specialized in one of two industries (M and A, respectively). Within each industry, firms develop new products in every period and the rate of product creation is sector-specific. Love of diversity pushes consumers to increase their expenditure on the industry in which diversification is larger (say M), in both regions. In the asymptotic balanced growth path of the model, the total value of firms producing A decreases relative to those producing M, driving income and welfare in N to dominate that in S. Falling relative wages in S reduces prices of exports relative to imports, moving terms of trade against S, and this further enhances the divergence process. Thus, the theory provides an explanation for the existence of a reverse-TTE, based on uneven growth in the extensive margin between regions.[3] The same result does not obtain in a similar model with unbalanced output growth (intensive margin), absent further structure in the preference side.[4]

[3]The model is designed to explain terms of trade movements of countries in the South, not in the North. This is because, as is well established, most trade for the South is South-North, while North-North trade dominates trade for the North.

[4]One of the earliest contributions on the relationship between diversification and terms of trade can be found in Krugman (1989). That work highlights the case of Japan during the period 1955-1965, a remarkable episode of fast output growth without falling terms of trade. Krugman's explanation is that,

The present paper contributes to different streams of the development literature. The classic literature on uneven sectoral growth normally focuses on growth in the intensive margin. A common result is relative prices moving in favor of the lagging sector creating a *substitution effect* of a magnitude that depends on the between-industry elasticity of substitution (see Feenstra, 1996 or Ngai and Pissarides, 2007).[5] The present paper contributes to this literature by showing that adverse price movements for the lagging sector (a reverse-TTE in an international context) can be obtained in an uneven growth model, so long as the extensive margin of growth is accounted for.

Expenditure shifts against the agricultural sector could also be driven by an *income effect*. The empirical regularity that consumers tend to respond to rising income by reducing their expenditure share on basic needs (known as the Engel's law), drove several works to explore the macroeconomic consequences of non-homotheticicities in preferences.[6] In these models, either heterogeneous goods or consumers are responsible for shifts in patterns of consumption. As the world economy grows and consumers get richer, they shift expenditure away from basic needs and towards more sophisticated products. When expenditure shifts are the result of income effects, relative prices do not necessarily offset uneven changes in production. Although these contributions have enriched our understanding of the implications of consumer behavior regularities on important macroeconomic patterns such as structural change, they have not provided a link between uneven technological improvements and biased preferences between sectors, thus treating these two sources of divergence in income as independent forces. This literature often assumes a high correlation between how goods rank according to the income elasticity of their demand and the technological differences in the production of each good (Assumption 2

while the demand for what Japan exported at any given point in time could be considered relatively fixed, an important process of export diversification meant that the demand for Japan's exports was shifting outwards over time. This made it possible for Japan to grow fast without necessarily seeing export prices falling. Epifani and Gancia (2008) propose a similar static model to explore movements in skill premium. The model presented here expands the framework in Krugman (1989) to a dynamic two-sector setting and focuses on between-industry differences given that the empirical evidence highlights important differences across sectors.

[5] Notice that only when this elasticity equals one the resulting TTE is one-to-one as in Acemoglu and Ventura (2002).

[6] See for example Matsuyama (2000), Kongsamut et al. (2001), Foellmi and Zweimüller (2008), Fieler (2011), Boppart (2014) or Caron et al. (2014).

in Matsuyama, 2000, makes it explicit). Such setting configures a suitable environment for reproducing a reverse-TTE, but no explanation is provided of why such correlation should be expected.[7] Caron et al. (2014) explicitly draw attention to the lack of a theoretical link between the characteristics of goods in the technological and preference sides. The model presented here is able to account for uneven expenditure paths between sectors (e.g. a declining relative expenditure on agricultural goods A), without resorting to product-specific income elasticities or household-specific preferences. The model proposes that technological differences across sectors and shifts in consumers expenditure between them may not be orthogonal to each other, proposing a very intuitive link between the two.[8] The mechanism proposed here adds a technological component to the story: it is because diversification is uneven between sectors that diversity-loving consumers shift weights in their consumption across industries. This complements the recent contribution in Matsuyama (2019), which bases expenditure shifts on exogenously determined income-elasticities, and explains productivity differences as the outcome of the resulting economies of scale.

To quantify the importance of the mechanism proposed in this paper, uneven product creation is embedded into a general framework that includes the aforementioned price and income effects in the form of sector-specific growth in the intensive margin and non-homothetic preferences. Values for the preference parameters of the model are obtained from existing estimations (Herrendorf et al., 2013), using final expenditure for the US and Western Europe. With these results, a quantitative exercise shows that unbalanced growth in the extensive margin accounts for over 15% of the decline in the expenditure share of agricultural goods in the US, on top of the usual price and income effects. The same figure is larger in other economies such as France.

An additional contribution of the theory proposed here is to shed light on the main

[7]Considering broad sectors, the structural change literature normally finds a negative correlation between growth and income elasticity of demand. Nevertheless, when more disaggregation is allowed for, recent evidence has shown the correlation to be positive and closer to one (see for example Comin et al., 2019).

[8]This should not be interpreted as an argument against the existence of non-homothetic preferences, a feature for which plenty of evidence has been gathered. Rather, the model suggests that the declining share of worldwide value being captured by the agricultural sector may not be solely driven by such preferences, but also by the fact that diversification in this sector is relatively less prolific.

drivers of unbalanced product diversification between sectors. The model yields expressions for the sector-specific diversification rates, and shows that both higher costs of product creation and higher elasticities of substitution, can provide firms in the agricultural sector with less incentives to differentiate products. The parameter conditions that need to hold for diversification to be unbalanced to the detriment of the agricultural sector are supported by existing empirical evidence.

Finally, by showing that growth in the extensive margin is uneven, and by highlighting its consequences for development, this paper introduces a new argument to the literature pointing at specialization as a source of welfare divergence. Potential development problems are underlined for regions that remain specialized in a lagging sector.

The rest of the paper proceeds as follows. Section 2 presents the data and definitions used. Section 3 complements and expands on the evidence presented above on the reverse-TTE. Section 4 documents that growth in the extensive margin is lower in the agricultural sector than in other goods-producing activities. Section 5 introduces a simple model of product creation and trade to explore how terms of trade should be affected by uneven diversification in an international setting. Section 6 highlights the importance of focusing on the extensive margin of growth to obtain the result. Section 7 presents the estimations of the model and an exercise showing the quantitative importance of the proposed mechanism. Finally, Section 8 concludes.

2. Data and definitions

Measuring growth in the extensive margin is not a straightforward task since there is not a clear definition of what constitutes a product. This paper tackles the issue by using a plethora of definitions and datasets, and showing that results are robust to all of them. International trade data have the advantage of being reported for a large sample of countries and long periods of time, at high disaggregation levels. Moreover, to consider how diversification may impact terms of trade, it seems natural to focus not on production itself, but on the part of it that is traded across national borders. The primary source used here is UNCOMTRADE which gathers trade flows at the five-digit disaggregation level (SITC Rev1) since 1962, thus providing a sufficient time span for evaluating long-term trends. To tackle potential issues with the reliability of reporters, results are also obtained with data presented in Feenstra et al. (2005). This dataset matches reports from exporters with those from importers using the raw UNCOMTRADE data, to establish consistent trade flows at four-digits (SITC Rev2).

As is standard in the trade literature (at least since Feenstra, 1994), a good is defined as one code in a classification.[9] Data at five-digits allow for a decent distinction of goods. For example, it is possible to distinguish between code 02221 *Whole Milk and Cream* and code 02222 *Skimmed Milk*. More disaggregated data are available for shorter and more recent periods. Results are also reported using data at six-digits of the HS0 classification also matching reports of exporters and importers for consistency, over the period 1995-2007, as reported by Gaulier and Zignago (2010) (BACI92 hereafter). Such disaggregation level allows further detail, e.g. we can identify code 040221 *Milk and cream powder unsweetened* $<$ 1.5% *fat*. Besides the difference in the time span covered and disaggregation level, there is a relevant difference between data classified using the SITC and HS systems: while SITC is constructed according to goods' stage of production, HS is based on the nature of the commodity. Using both aims at showing that the results are robust to the classification and the disaggregation level.

To further clear concerns that results could be driven by biases in how classifications are constructed or which goods are traded, results are also presented using domestic production records. The use of these data is not free from shortcomings, as such records are typically harder to collect and less comparable between countries. Moreover, these data are recorded in domestic classifications, which are normally tailored to production, leaving little room for changes in the number of active codes. An alternative approach is then required to measure changes in the extensive margin using domestic production data. This paper proposes to count firms producing under each code at different moments in time for the US and EU countries, as is explained in detail below. This approach is

[9]It must be noted that the exercise of counting codes in a classification constitutes only an approximation to growth in the extensive margin. Any code is in reality a bundle of goods defined ex-post, so there can always be new production within an already counted code. This issue is mitigated by using highly disaggregated data.

consistent with a framework where consumers are not completely indifferent between goods coming from different firms. Data from US firms come from the Census Bureau's Statistics of US Businesses (SUSB) which reports the number of producing firms by six-digit sectors in the NAICS classification for the period 1998-2015. Data on producing firms in the European Union is collected by Eurostat: information for agricultural producers is extracted from the Agricultural Training of Farm Managers dataset covering years 2005, 2010 and 2013. Manufacturing firm records in the EU are reported for the period 2008-2015 in the Structural business statistics (SBS).

In what follows, focus is placed on primary goods of the non-extractive type, denoted as A-goods. Unlike a large part of the literature on the resource curse, goods based on natural resources of the extractive type (E-goods) are excluded from the analysis. This is due to the main characteristics of E-goods: the fact that they are non-renewable and the possibility of depletion, link their prices to fundamentals that are different from those driving prices of A-goods. As will be evident, the mechanism formalized in the model presented here does not consider these fundamentals. The set of the remaining good-producing activities, excluding A and E, are defined as M-goods.

The reader can find in the Appendix the list of products classified here as A (Table A.2 in the Appendix 2.1). A restrictive list of products, called $A1$, includes only narrowly defined non-manufactured goods of the non-extractive type. Results for two broader alternatives are provided as robustness checks. List $A2$ adds to the previous list basic chemical compounds that intensively use primary inputs of a non-extractive nature. List $A3$ further incorporates manufactured goods that use those resources intensively. None of the lists for agricultural products proposed here is a good proxy for homogeneous products.[10] Nevertheless, products classified here as agricultural are perceived by consumers as more substitutable than manufactures. Using elasticities of substitution for four-digit products presented by Broda and Weinstein (2006), we can compare the mean and me-

[10] Rauch (1999) classifies goods in three categories, according to how homogeneous they are in world markets. Comparing these categories with the lists for agricultural products defined here, the strongest correlation is 0.3941 (corresponding to our A2 list and Rauch's liberal list including both types of homogeneous goods together), while the smallest correlation is 0.2319 (between the list for A3 here and Rauch's conservative list including only strictly homogeneous goods).

dian elasticity of substitution within each group Ak and Mk (for $k = 1, 2, 3$, and where Mk is the set of all goods remaining when Ak and E are excluded). Results are reported in Table 1 and show both statistics being higher for A-goods. Moreover, notice that as the list for agricultural products gets broader and more inclusive, the mean and median elasticity of substitution is reduced.

Table 1:
SUMMARY STATISTICS: ELAST. OF SUBSTITUTION WITHIN LISTS OF GOODS

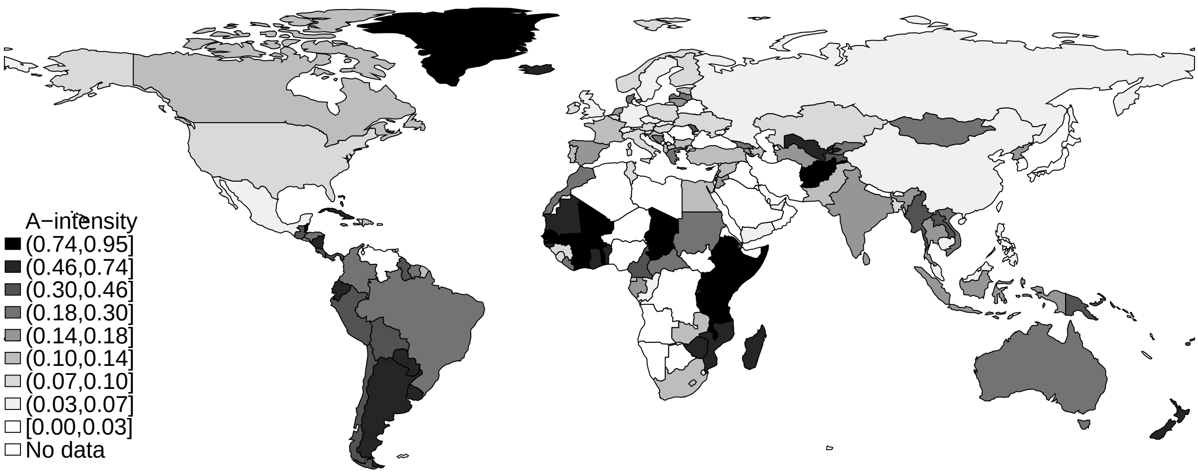
k	Ak				Mk			
	mean	median	sd	Obs.	mean	median	sd	Obs.
1	9.851	3.509	20.713	184	5.596	2.527	13.245	491
2	8.954	3.442	19.398	213	5.743	2.527	13.628	462
3	8.335	3.390	18.134	248	5.839	2.527	14.100	427

Notes: Elasticities of substitution are as reported by Broda and Weinstein (2006) for four-digit SITCR2 classification. List of products Ak and Mk ($k = 1, 2, 3$) are as listed in Table A.2.

When looking at the share of A-goods in total exports, almost all countries show a decline over recent decades, a fact consistent with the structural change that the world economy has experienced during this period. Only 10 out of 165 countries show an increase in the importance of $A1$-goods in their exports during the period 1962-2000, the most salient cases being Venezuela and Bolivia for which the share of those goods at the beginning of the period was very low (below 12% and 5% respectively). A similar trend is present when considering $A2$ and $A3$ goods. Figure 2 shows in a world map the intensity of exports in $A1$-goods for the year 2000. Inspection of this figure reveals that countries exporting A-goods intensively (A-countries in short) are not necessarily poor. Some rich and middle income countries have remained largely specialized in agricultural products. In fact, A-countries seem to be characterized not by wealth, but by being rich in fertile land and not densely populated, i.e. features that would give these countries a comparative advantage in agricultural goods.

The probability of remaining highly specialized in agricultural goods is positively correlated with being an important exporter of those products at the beginning of the period and negatively correlated with initial levels of population density and trade openness (see Table A.3 in the Appendix). Explaining why some countries remain specialized in agricul-

Figure 2:
Intensity of A-exports by country (2000)



Notes: The list of A1-goods was used for the construction of this figure (check Table A.2). Data on exports from Feenstra et al. (2005).

tural production is beyond the scope of this paper.[11] Nevertheless, a strong comparative advantage based on factor endowments cannot be ruled out, given this indicative evidence. Other potentially relevant variables such as the initial level of per capita income or the size of the government do not seem to play important roles in the process.

3. Reverse-TTE for agricultural economies

This section presents further evidence on the fact highlighted in Figure 1, showing that agricultural economies experience, on average, a reverse terms of trade effect. The literature on the resource curse has extensively shown that countries with large endowments of natural resources tend to exhibit lower growth rates than the rest (see for example Sachs and Warner, 2001 or Auty, 2007). Section 7 in the Appendix provides in-depth evidence in support of such trend specifically for the subset of countries that this paper targets, i.e. those specialized in non-extractive primary products (A-countries). The evidence presented there is compatible with the well-known fact that economies that converge to the club of wealthiest countries in the world, do so by undergoing processes of struc-

[11] In most market economies specialization is the outcome of decentralized decisions made by firms. While governments can provide incentives to direct it strategically, the effectiveness of those measures is limited by incomplete information, bounded rationality problems in general, or changes in leaders priorities, among many other factors.

tural change, i.e. reallocating resources from primary sectors towards more productive activities as they grow. Nevertheless, remaining specialized in a lagging sector should not automatically yield income divergence if a TTE was operational, i.e. if differences in output growth between sectors were compensated by relative price movements. Evidence showing A-countries' income diverging from the rest is enough to discard a one-to-one TTE, but it is not sufficient to refute the possibility of terms of trade improving for lagging economies, at least to some degree.

Concern regarding declining terms of trade for resource-intensive economies has been around policy circles for a long time. Since first stated several decades ago, the Prebisch-Singer hypothesis (see Prebisch, 1950 and Singer, 1950) was targeted by many empirical works. Most of these works focused on the evolution of the price of primary goods relative to manufactures.[12] Declining prices of primary goods relative to manufactures only yields falling terms of trade for economies that are net exporters of the first group of goods and importers of the second. Moreover, this position needs to remain sufficiently constant over time for changes in trade composition not to offset price movements. As explained before, many agricultural economies experienced important structural changes that affected the composition of their imports and exports over the period of analysis. This is probably why many of the papers analysing trends in relative prices are not conclusive regarding trends in terms of trade for agricultural producers (Grilli and Yang, 1988 and Sarkar and Singer, 1991 explicitly make this point). A further condition is that relative productivity changes between sectors do not compensate for price losses something that seems at odds with the evidence presented above.

In what follows, focus is placed on the evolution of terms of trade during the period 1962-2000, specifically for the set of economies defined as largely agricultural in this paper. Given that the goal is to explore the conditions under which an economy can experience income divergence due to its specialization, we need an environment that is sufficiently exempted from external shocks. In other words, the mechanism stressed here can only become evident in a world where some region specializes in A-goods, another specializes

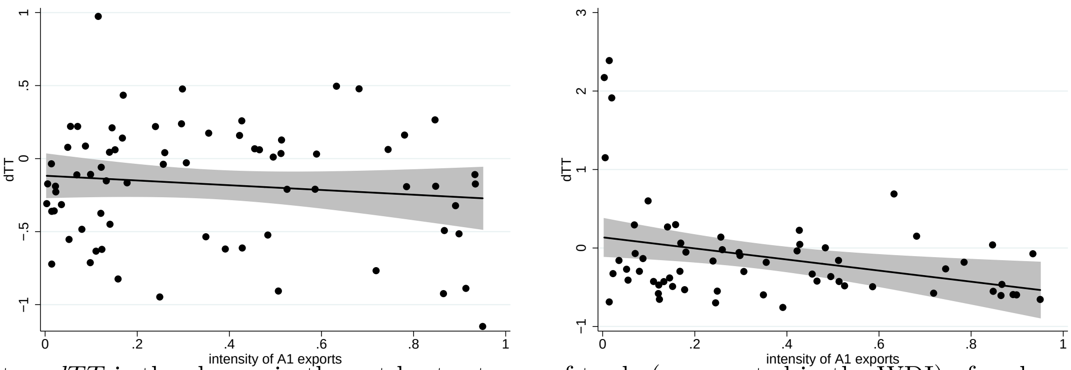
[12] See for example Grilli and Yang (1988), Ardeni and Wright (1992), Cuddington (1992), Harvey et al. (2010), Arezki et al. (2014) or Yamada and Yoon (2014).

in the rest of the activities and expenditure paths follow a natural trajectory driven by trade patterns between these two regions over the long term. As it is well known, the years following China's trade liberalization program (after 2000), provided an important shock in the relative price of primary goods to manufactured products, which is certainly disruptive to the mechanism highlighted here. This is the main reason why the analysis here stops in 2000.

Two different data sources are used: Barro and Lee (1993) report 5-year changes in net barter terms of trade for the period 1960-1985, while for the period 1985-2000 the index available in the World Development Indicators (WDI) can be used. Figure 3 plots the change in net barter terms of trade against the intensity of exports of $A1$-goods at the end of the period. The panel in the left considers total changes in the period 1965-2000 combining both available datasets. The panel in the right uses only the most recent data from WDI. According to both figures, it is not possible to state that terms of trade deteriorate for countries with a low share of A-exports, as the average effect, signalled by the fitted line, is not different from zero. As the intensity of A-exports increase however, terms of trade movements clearly go below the zero line. The correlation between A-export intensity and negative movements in terms of trade becomes significant at the 95% level when that share is relatively high (i.e. greater than 40% when considering the entire period and 25% when only the last 15 years are considered) for $A1$ products. A very similar picture arises using the broader classifications for A-products: $A2$ and $A3$. We also evaluate the robustness of this relationship for alternative periods finishing in years 1995, 2005 and 2010. The change in terms of trade is still declining in the intensity of agricultural exports, but when the period after 2000 is included the slope becomes less steep. In fact, considering the period until 2010, the hypothesis that the change is different from zero cannot be rejected even for largely agricultural economies. This is the result of the aforementioned improvement in terms of trade for agricultural economies in the period 2000-2010, following China's trade integration.

Finally, evidence supports the idea that movements in terms of trade are correlated with changes in the number of products internationally traded (see Appendix 3). Overall,

Figure 3: Evolution of net barter terms of trade and intensity of A-exports



Notes: dTT is the change in the net barter terms of trade (as reported in the WDI) of each country and $A1$ corresponds to the $A1$ list of agricultural products in the Appendix. The figure in the left presents results with data from the period 1985 and 2000 using net barter terms of trade reported in WDI. The figure in the right extends the period using data from Barro and Lee (1993) for years between 1965-1985. Export data are from Feenstra et al. (2005) in both cases. The grey area reports the 95% confidence interval for the position of the fitted line.

the evidence suggests that agricultural economies have experienced a reverse terms of trade effect since a relatively slow real income growth is not offset but rather enhanced by terms of trade movements. Moreover, terms of trade movements are correlated with product diversification.

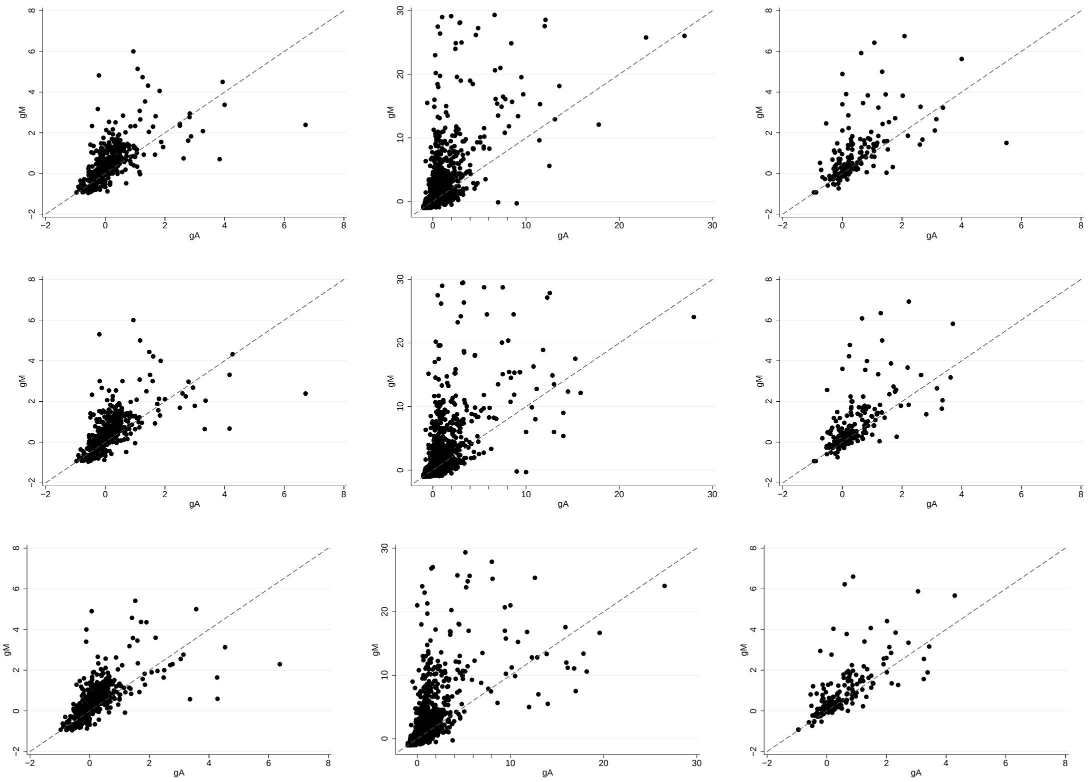
4. Uneven product diversification

The rate at which countries diversify their production is significantly unbalanced to the detriment of agricultural goods. To show this, diversification rates in both industries (g_A and g_M respectively) for each country are compared. A diversification rate is computed here as $g_{ckt} = (n_{ckt+dt} - n_{ckt})/n_{ckt}$, where n_{ckt} is the number of goods exported with positive value by country c, in industry $k = A, M$, at moment t.

Figure 4, plots the resulting rates for periods of ten years using export data, along with a 45-degree line. Inspection of these figures show that while both rates are normally positive, the rate of diversification in manufactures tends to be larger than that in non-extractive primary goods. Several mean tests are performed, where the null hypothesis is that on average $g_A = g_M$. As shown in Table 2, these reject $g_A = g_M$ and $g_A > g_M$, but not $g_A < g_M$, at a high confidence level.

Given that the diversification rates are computed by counting codes in a given clas-

Figure 4:
DIVERSIFICATION RATES g_{Ak} AND g_{Mk} (EXPORT DATA)



Notes: Each dot represents a pair (g_{Ak},g_{Mk}) for one country in one sub-period. Figures in row $k = 1, 2, 3$ use lists Ak, and its complement Mk. Rates in the first column use four-digit exports from Feenstra et al. (2005) and for 10-year periods starting in 1962, 1972, 1982 and 1991. Rates in the second column use five-digits UNCOMTRADE data and are calculated for each 10-year period starting between 1962-2004. The last column features rates for six-digit data from BACI92 constructed for only one 13-year period starting in 1995.

Table 2:
DIFFERENCES IN DIVERSIFICATION RATES (EXPORT DATA)

	4-digits			5-digits			6-digits		
$gMk = gAk$	$k = 1$	$k = 2$	$k = 3$	$k = 1$	$k = 2$	$k = 3$	$k = 1$	$k = 2$	$k = 3$
mean(gM)	0.681	0.673	0.653	0.379	0.362	0.368	0.766	0.770	0.754
sd(gM)	5.599	5.478	4.935	1.013	0.981	0.998	1.264	1.281	1.218
mean(gA)	0.210	0.233	0.270	0.162	0.192	0.198	0.375	0.393	0.428
sd(gA)	1.668	1.725	1.997	0.516	0.551	0.559	0.806	0.759	0.812
Obs.	559	559	559	4,679	4,674	4,658	219	219	217
$Ha : gM < gA$	0.996	0.995	0.998	1.000	1.000	1.000	1.000	1.000	1.000
$Ha : gM \neq gA$	0.008	0.009	0.004	0.000	0.000	0.000	0.000	0.000	0.000
$Ha : gM > gA$	0.004	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Each column presents the result of a mean-comparison t-test, where the null hypothesis is $g_{Mk} = g_{Ak}$ for $k = 1, 2, 3$ as listed in Table A.2. The first and third row give the mean of g_{Mi} and g_{Ai} respectively, while the second and fourth provide the respective standard deviation. The last three rows show the p-value of a t-test for different alternative hypothesis.

sification, they are sensitive to how the classification is built. In the classification used, if one of the broad sectors defined here (A and M) is split into many more codes than the other, balanced product creation between sectors could artificially appear uneven in these exercises. It must be noted that in all classifications used, the broader definition of agricultural goods (A3) regularly comprises a similar number of codes to M goods. In any case, to reach results that are less dependent on how classifications distribute codes, and provided that the data prevents going deeper into the classifications, results moving in the opposite direction are tested. We proceed to compute diversification rates for a given sector as the simple average of diversification rates in each two-digit product line belonging to that sector. It is expected that results from this exercise are less affected by a biased availability of codes for each industry. Table 3 shows the outcome of this exercise, providing further support for the previous finding.

Table 3:
DIFFERENCES IN DIVERSIFICATION RATES (WITHIN TWO-DIGITS)

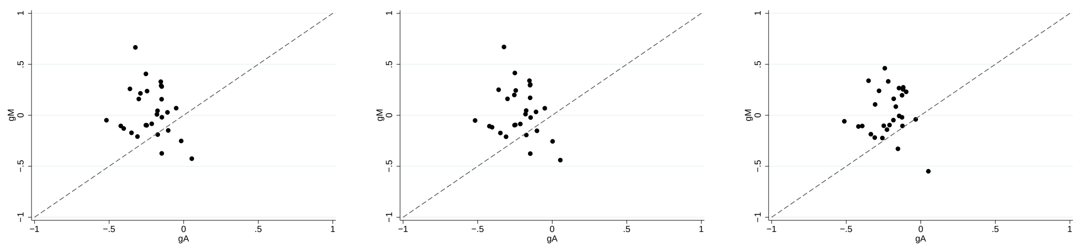
	4-digits			5-digits			6-digits		
$gMk = gAk$	$k=1$	$k=2$	$k=3$	$k=1$	$k=2$	$k=3$	$k=1$	$k=2$	$k=3$
mean(gM)	0.530	0.541	0.540	0.625	0.608	0.622	1.302	1.310	1.352
sd(gM)	1.398	1.606	1.604	1.553	1.521	1.593	2.651	2.653	2.611
mean(gA)	0.266	0.285	0.314	0.313	0.354	0.393	1.021	1.052	1.080
sd(gA)	0.649	0.705	0.764	0.666	0.791	0.872	1.917	1.949	2.220
Obs.	562	562	561	491	490	489	876	879	884
$Ha : gM < gA$	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
$Ha : gM \neq gA$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$Ha : gM > gA$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Each column presents the result of a mean-comparison t-test, where the null hypothesis is $g_{Mk} = g_{Ak}$ for $k = 1, 2, 3$ as listed in Table A.2. The reported diversification rate in each sector (A and M) is the simple average of diversification rates computed within every two-digit line belonging to that sector. The first and third row give the mean of g_{Mk} and g_{Ak} respectively, while the second and fourth provide the respective standard deviation. The last three rows show the p-value of a t-test for different alternative hypothesis.

The literature on trade with differentiated varieties often treats varieties as pairs of goods and country of origin, since consumers tend to perceive product-origin pairs as imperfect substitutes (following the Armington approach). This can be true for goods belonging to both A and M. For example, some consumers perceive guitars produced in the US as different from those from Mexico, similarly coffee from Colombia is regarded as a different variety to that from Costa Rica. The diversification rate of product-origin pairs within each broad industry (A and M) are computed for each year in the database. This approximates the yearly change in the availability of varieties for a *global consumer*, i.e. one that can shop around the world. Moreover, this exercise can be considered to better reflect the structure of the model in Section 5, where products are created by regions. While the evidence presented thus far does not disentangle between product adoption and product creation, every new good-origin can be considered as a variety created. Comparing the resulting rates gives similar results as obtained before.[13]

Finally, it is possible to see the same regularity emerging in domestic production data. Using the data described in Section 2, diversification rates in each sector are computed by counting firms producing in each of them, within the EU and the US. Given the limited time frames of these data, one observation per country is obtained using the information for the first and last years available. This gives 29 observations. Results are presented in Figure 5. The observation that $g_A < g_M$ holds with domestic production data helps rule out the possibility of the regularity being exclusively driven by M-goods being more tradeable or more finely classified than A-goods.

Figure 5:
DIVERSIFICATION RATES g_{Ak} AND g_{Mk} (DOMESTIC PRODUCTION, EU & US)



Notes: Each dot represents a pair (g_{Ak},g_{Mk}) for one country. Figures in column $k = 1, 2, 3$ use lists Ak and its complement Mk. Rates are computed by counting firms from Eurostat and the US Census Bureau.

The fact that growth in the extensive margin happens at a lower rate in the agricultural sector than in manufacturing is compatible with a growing literature arguing that technological linkages between production lines are not uniformly distributed. For example, evidence in Hidalgo et al. (2007) and Hausmann and Hidalgo (2011) supports the notion that technological proximity within manufacturing is much greater than that

[13]See Appendix 4.

within primary activities, suggesting that it may be easier for diversification to happen in the former industry rather than the latter. In a different vein, Koren and Tenreyro (2007) argue that industry-specific volatility is a very important factor preventing diversification in developing economies. These elements may help explain uneven diversification between sectors. The model in the next section provides a theory for which factors determine diversification and how they interact with each other, finding that both technological and preference factors play a role.

5. Theory

This section presents a theory in which product creation is the only source of growth and economies are open to trade. Such a setting allows me to explore the macroeconomic consequences of uneven product creation across sectors and, in particular, its potential in driving income divergence enhanced by falling in terms of trade for agricultural economies. Time is continuous and the world is composed of two regions (denoted $c = N, S$) and two sectors ($i = M, A$).[14] In both sectors, technology is such that labor is the sole input and each region is endowed with an amount L_c of labor. Each region is perfectly specialized in one industry: region N produces M-goods and region S produces A-goods.[15] Every firm in each industry undertakes two activities: they engage in R&D efforts to develop a new product, and then they use that knowledge and labor to produce and sell their product. Their R&D efforts generate a private return but also spillovers to other firms within the industry. Firms within a given sector are homogeneous. There is no population growth and labor cannot move between regions. Financial resources are also constrained within borders. Finally, there are no frictions to international trade.

[14] Departing from one-sector models (as in Feenstra, 1996) provides this setting with a more natural context for the absence of spillovers between countries, which constitutes an important feature of uneven development models. Instead of assuming away international spillovers, in the present model the absence of international spillovers is based on the difference in specialization between regions and industry specific spillovers.

[15] Although not necessary for the mechanism to hold, this assumption greatly simplifies the exposition. Excluding the possibility of structural change, which in reality constitutes an important driver of development, helps highlight the role played by uneven growth in the extensive margin. Specialization could be originally rooted in an asymmetric distribution across regions of a specific factor of production not included in the model (i.e. fertile land).

5.1 Consumers

Consumers from country c face three choices at each moment t. First, they choose how much to consume and save, i.e. they decide their optimal expenditure level $E_c(t)$ for a given income $Y_c(t)$. Aggregate expenditure in region N is set as *numeraire* ($E_N = 1$). Then, they choose how much to spend in each industry, i.e. $E_{ci}(t)$ with $E_c(t) = E_{cM}(t) + E_{cA}(t)$. In the third stage, consumers split their industry-specific expenditure among the different products of that industry available at each t. Welfare in country c at t is defined as the present value of future consumption of the final good composite $Q_c(t)$, that is:

$$U_c(t) = \int_t^{\infty} e^{-\rho(s-t)} \ln\left[Q_c(s)\right] \mathrm{d}s \tag{1}$$

where $\rho > 0$ is the rate of pure time preference, common to individuals in both regions. At every moment in time t, consumers maximize (1) subject the usual budget constraint. The conditions for an optimal path for expenditure $E_c(t)$ arising from this dynamic problem are a transversality condition and the standard Euler equation $\dot{E}_c(t)/E_c(t) = r_c(t) - \rho$. Each of the L_c consumers in country c is endowed with one unit of labor which is inelastically supplied in the labor market in return for a wage w_c. Consumers also receive the returns on their past savings at rate $r_c(t)$.

Once consumers have established their optimal level of aggregate consumption, they choose how much to spend in each industry $i = M, A$, with a constant elasticity of substitution $\beta > 0$ between the composite of each industry driving their preferences:

$$Q_c(t) = \left[\omega_M^{\frac{1}{\beta}} Q_{cM}(t)^{\frac{\beta-1}{\beta}} + \omega_A^{\frac{1}{\beta}} Q_{cA}(t)^{\frac{\beta-1}{\beta}}\right]^{\frac{\beta}{\beta-1}} \tag{2}$$

with $\omega_i > 0$ representing consumers' taste for the composite of industry i and $\omega_M + \omega_A = 1$.

At each t, consumers must decide how much of their expenditure in industry i is spent in each product θ belonging to the set $\Theta_i(t)$ of available products in that industry ($i = M, A$). Free trade implies that the set $\Theta_i(t)$ is the same in both regions $\forall i = M, A$. Consumer preferences over products within a given industry are CES, with $\sigma_i > 1 \forall i =$

M, A as the constant elasticity of substitution between any two products. This, together with Dixit-Stiglitz competition in the market of final goods yields:

$$
\begin{aligned}
Q_{ci}(t) &= \left[\int_{\theta\in\Theta_i(t)} q_{ci}(\theta,t)^{\frac{\sigma_i-1}{\sigma_i}}\mathrm{d}\theta\right]^{\frac{\sigma_i}{\sigma_i-1}} \\
P_{ci}(t) &= \left[\int_{\theta\in\Theta_i(t)} p_{ci}(\theta,t)^{1-\sigma_i}\mathrm{d}\theta\right]^{\frac{1}{1-\sigma_i}} \qquad (3)
\end{aligned}
$$

where $q_{ci}(\theta,t)$ and $p_{ci}(\theta,t)$ represent quantities demanded and price paid in c for each product θ of industry i at time t. Without trade costs, the price charged for a certain product is the same in every market so $p_{ci}(\theta,t) = p_i(\theta,t)\ \forall\theta\in\Theta_i(t)$, which gives $P_{ci}(t) = P_i(t)$, $\forall i = M, A$ and $\forall t$. Consumers from different regions of the world have the same preferences, which is reflected here by the fact that ρ, β, ω_i and σ_i, are not country-specific. This gives $P_c(t) = P(t)\ \forall c = N, S$. In words, the price index faced by consumers in both regions of the world are the same. This means that any difference in consuming possibilities between regions is going to be rooted in their respective expenditure paths. Finally, global expenditure is the sum of expenditure in each region of the world $E(t) = E_N(t) + E_S(t)$.

5.2 Producers

The setting for producers within each country resembles that in the standard model of endogenous growth with expanding product varieties and knowledge spillovers. Any potential entrant to industry i must develop a blueprint for producing good θ which implies incurring a one-time sunk cost that is independent of future production. The fact that it is costless for producers to differentiate their production, together with all products entering within-industry preferences symmetrically, gives firms no incentive to produce a good that is produced by a competitor. Moreover, there are no multi-product firms, so firms and products are matched one to one. Once in business, a firm continues to produce forever. After sinking the cost of developing a product, a firm can perfectly estimate their expected stream of income. Since only one sector operates in each region, the use of the country sub-index can be spared in this section.

Technology in each industry i is represented by a linear cost function where labor is the sole input and there are no fixed costs. Dixit-Stiglitz competition in the final good sector implies that every firm in i sets the same price of

$$p_i(t) = \frac{\sigma_i w_i(t) z_i}{\sigma_i - 1} \tag{4}$$

In the previous expression, $z_i > 0$ is the marginal cost in terms of labor of final goods production in sector i.[16] Changes in parameter z_i reflect changes in efficiency in the production of final goods in that sector. Since the current model abstracts from this source of growth, $z_i = 1, \forall i = M, A$ is assumed for simplicity. The assumption of homogeneous firms in sector i, together with (3) gives $Q_i(t) = q_i(t) n_i(t)^{\sigma_i/(\sigma_i - 1)}$ and $P_i(t) = p_i(t) n_i(t)^{1/(1-\sigma_i)}$, where $n_i(t)$ is the number of existing products in industry i at time t.

Consumers' love of diversity and the absence of trade costs, results in all firms of industry i being present and enjoying the same market share in both regions $1/n_i(t)$. The pricing rule in (4) gives operating profits of any single firm within that sector are $\pi_i(t) = [E_{Ni}(t) + E_{Si}(t)]/n_i(t)\sigma_i$. Equilibrium in the capital market requires the returns from investing in financing the production of final goods to equal those of a risk-free loan. The returns at t of owning all shares of a firm from sector i over a period dt, equal the operating profits made plus the eventual capital gains during that period, i.e. $[\pi_i(t) + \dot{v}_i(t)]dt$, where $v_i(t)$ is the present value at time t of a firm in sector i. If the same amount is instead placed as a loan for the same period of time, the return equals $r_i(t) v_i(t) dt$. The absence of arbitrage opportunities in the financial market imposes equality between the two options that yield the following no-arbitrage condition:

$$\pi_i(t) + \dot{v}_i(t) = r_i(t) v_i(t) \tag{5}$$

A firm developing a final product in industry i generates its own private return by acquiring the right to sell its product forever. But the activity of product creation also

[16] Regions' full specialization in this model could be rationalized by assuming that $z_{A,N}$ and $z_{M,S}$ are large enough, while maintaining $z_{M,N} = z_{A,S} = 1$.

generates spillovers in the form of knowledge within that industry. In other words, the fact that previous firms have created products in the past reduces the cost of future developments. Knowledge spillovers are crucial for the model to reproduce sustained growth in equilibrium. Product creation in industry i follows $\dot{n}_i(t) = L_{R,i}(t)K_i(t)/a_i$, where $L_{R,i}(t)$ represents the amount of labor devoted to the creation of products and $K_i(t)$ is the level of knowledge in industry i. This stock of knowledge is the measure of spillovers within sector i and the larger it is, the more productive are resources devoted to research in that sector. We follow Grossman and Helpman (1991) (and many others including Feenstra, 1996) in setting $K_i = n_i$. That is, the stock of knowledge is equal to the number of products existing in that industry, which is a simple way of introducing learning-by-doing at the industry level. Industry-specific spillovers, together with the assumption of regions fully specialized in different sectors, implies there are no international spillovers. Finally, $1/a_i$ represents the part of efficiency in R&D activities of industry i that is independent of spillovers.[17] Then, the diversification rate in i is $g_i(t) = \dot{n}_i(t)/n_i(t) = g_i(t) = L_{R,i}(t)/a_i$. From here on, the growth rate of any other variable X is denoted as $g_X = \dot{X}/X$.

Finally, free-entry into production of final goods imposes the following free-entry condition:

$$\frac{w_i(t)a_i}{n_i(t)} = v_i(t) \tag{6}$$

The left-hand side of this expression represents the cost of developing a new product in sector i at moment t, while the right-hand side constitutes the discounted value at time t, of being able to sell that product in the final goods market.

5.3 Instantaneous equilibrium

At any moment t the vector $[E_c, v_i, n_i]$ is given by history. The instantaneous equilibrium of the model implies solving for the rest of the endogenous variables. Given between-industry preferences (2), the following expression for the share of expenditure in

[17] A very intuitive way to endogenize parameter a_i is to introduce firm heterogeneity in the model, in the vein of Baldwin and Robert-Nicoud (2008) or Ourens (2016). In those works, efficiency in the development of new products depends on average efficiency in the production process in the industry.

the agricultural sector is obtained:

$$\alpha(t) = \left[\frac{\omega_M}{\omega_A} \left(\frac{n_A(t)^{1/(1-\sigma_A)} p_A(t)}{n_M(t)^{1/(1-\sigma_M)} p_M(t)} \right)^{\beta-1} + 1 \right]^{-1} \tag{7}$$

The share $\alpha(t)$ is determined by the proportion of A-products in the set of all consumption goods (weighted by a function of the elasticity of substitution within industry σ_i) and by its relative price. When goods from different industries are substitutes for one another, i.e. $\beta > 1$, a greater number of A-goods available or a lower relative price yields expenditure shift towards A-goods, to the detriment of M. On the other hand, when products of different industries are perceived as complements, i.e. $\beta < 1$, then the same conditions yield an increase in the expenditure share devoted to M, to the detriment of A. The share of A-goods in world expenditure is time-variant since the number of products of each industry available to consumers at every t can change over time, as can relative prices that follow wage movements. The only exception is when $\beta = 1$ in which case α is a parameter and expenditure shares in each industry are constant.

Equilibrium in the labor market imposes that the amount of resources used in the development of products and in their production equals its fixed supply L_c, at each economy. The amount of labor used in product development equals $L_{R,i} = g_i a_i$. For final goods production, each firm in industry i requires a quantity of labor of $L_{F,A} = \alpha E / n_A p_A$ and $L_{F,M} = (1-\alpha)E/n_M p_M$, so the total amount of labor used in industry i equals n_i times that amount, $\forall i = M, A$. This gives the following labor market clearing conditions

$$g_A(t) a_A + \frac{\alpha(t) E(t)}{p_A(t)} = L_S \ , \ g_M(t) a_M + \frac{(1-\alpha(t))E(t)}{p_M(t)} = L_N \tag{8}$$

The above conditions give the allocation of resources to both final good production and R&D activities which yields the growth rate of products in each industry:

$$g_i(t) = \frac{L_i}{a_i} - (\sigma_i - 1) \frac{\pi_i(t)}{v_i(t)} \tag{9}$$

Trade balance at every t requires exports of one region to match exports of the other, i.e. $E_{S,M} = E_{N,A}$, which together with $E_N = 1$, yields the following condition:

$$E_S(t) = \frac{\alpha(t)}{1-\alpha(t)} \tag{10}$$

The instantaneous equilibrium in the model resembles that in the static model of Krugman (1989), the main difference being that the present model allows for different elasticities among the sectors and unequal wages between countries, resulting in price differences between industries.

5.4 Dynamics of the model

The choice for the numeraire implies N act as the anchor of this model as $g_{E,N} = 0$, $r_N = \rho$ and $g_{v,M} = \rho - \pi_M/v_M$. A solution with both positive product creation and final good production requires the following condition to hold:[18]

$$g_i(t) = \frac{\pi_i(t)}{v_i(t)} - \rho \tag{11}$$

Merging (11) together with equation (9) yields:

$$g_i = \frac{L_i}{a_i \sigma_i} - \frac{\sigma_i - 1}{\sigma_i}\rho \tag{12}$$

Products are created at constant rates in both industries. For the model to reproduce positive growth, it is assumed that the allocation of resources towards the development of new products is positive. Equation (12) provides a microfounded explanation of why diversification can differ across sectors. The diversification rate in any industry depends positively on the size of the producing economy (L_i). In other words, the model features a scale effect that is common in the literature.[19] Diversification happens at a higher

[18]See Appendix 6.1 for a proof and discussion. The section also shows an alternative solution where this condition is not imposed in S. The main results in this paper still hold in this environment and, in particular, the model replicates a reverse-TTE under certain conditions.

[19]Scale effects in models of intensive-margin growth have been disputed as unrealistic since they imply that larger economies should grow faster ceteris paribus. While it is possible to eliminate scale effects from the model, their existence is less problematic when growth is in the extensive margin, since the implication of more varieties being created in larger markets is not debated empirically.

pace when product creation requires fewer units of labor (lower a_i), i.e. when efficiency in the R&D sector is larger. A smaller elasticity of substitution within industry σ_i also contributes to larger sectoral diversification since lower substitutability increases firms' operating profits, ultimately increasing entry. Intuitively, firms face reduced incentives to develop new products in a given industry when consumers perceive goods in that industry to be highly replaceable by other goods within the same industry.

The model yields uneven growth in the extensive margin when diversification rates are different between sectors. Given the evidence presented in Section 4, the analysis that follows is constrained to the case in which $g_A < g_M$ holds, and this amounts to imposing the following assumption:

Assumption 1 *Assume* $\frac{L_A}{a_A} - \frac{\sigma_A L_M}{\sigma_M a_M} < \rho(\sigma_A - 1)\left[1 - \frac{(\sigma_M-1)\sigma_A}{(\sigma_A-1)\sigma_M}\right]$, *so* $g_A < g_M$.

Notice that Assumption 1 is the only asymmetry imposed between sectors and therefore regions. For this assumption to hold, either $\sigma_A > \sigma_M$, $L_A < L_M$, $a_A > a_M$, or a combination of some of these conditions need to hold. None of these conditions is imposed in particular, since the results of the model do not require any more structure to replicate the facts targeted here.

Empirically, results in Table 1 suggest that the elasticity of substitution within each industry is much higher in the agricultural sector (the median σ_A is around 35% larger than the median σ_M), and this can partially explain the result $g_A < g_M$. Inspection of Figure 2 hints that population in agricultural economies is much lower than in the rest, which provides scale economies that also contribute to this outcome. Even considering the largest list of agricultural economies, the population advantage in non-agricultural economies is greater than 50% in the year 2000. Finally, while there is no direct evidence regarding relative efficiency in product development between sectors, recent empirical evidence has shown that diversification is likely to be easier in labor and knowledge-intensive sectors where production processes may be more flexible in allowing new developments. Hidalgo et al. (2007), suggest a measure of technological proximity between any two products based on the probability that both are exported by the same country. Their proximity indicator is used here as an approximation to the inverse of the cost of diversification.

We compute the average proximity that a good belonging to sector $i = A, M$ has with all other goods (see Table A.4 in the Appendix). A lower average proximity is found for A, suggesting that the distance between a representative A-good and any other good in the product space is larger than that of the representative M-good. According to this result, product creation is more costly in the former than in the latter industry. Table A.5 shows results for average proximity between a representative good in industry i and all other goods belonging to the same industry. The fact that the average proximity is lower in A in this exercise suggests that within industry diversification is also more costly in the agricultural sector. This constitutes primary evidence supporting $a_A > a_M$. Overall, it is not impossible that all three of the conditions on σ's, L's and a's making Assumption 1 hold may be contributing together to explain the relative lag in diversification within the agricultural sector that was documented in Section 4.

It is important to notice at this point that an equilibrium path with uninterrupted introduction of products yields growth in real income. Although the present model does not feature improvements in the productive process of firms, the fact that consumers love diversity implies that an ever-expanding set of products increases consumers' utility over time. In this sense, whenever this model reproduces increasing living conditions, it resembles models of output growth.[20]

It is possible to show that if consumers are forced to devote an exogenous share of their expenditure to each industry ($\beta = 1$, so α is fixed and equal to ω_A), terms of trade cannot deteriorate for the lagging economy.[21] Even though exogenous shares of expenditure between industries is a widely used simplifying assumption, it is against intuition and also against the declining trend in the share of expenditure in agricultural products (i.e. $g_\alpha < 0$), shown by the data.[22] In what follows $\beta \neq 1$ is assumed in order to explore how uneven product creation shifts expenditure shares and is able to reproduce

[20]A formal argument showing how product expansion in this setting implies growth, even in the absence of efficiency improvements in the production of final goods, is provided in Ethier (1982). Notice that the amount of resources used in the production of final goods in industry i is $q_i n_i(t)$. However, by (3), consumption of final goods is $Q_i = n_i(t)^{\sigma/(\sigma_i - 1)} q_i$. This means that the ratio of consumed final goods to resources devoted to their production is $n_i(t)^{1/(\sigma_i - 1)}$, which increases with the number of products in sector i.

[21]See Appendix 5 for the full proof.

[22]See the Appendix 8.

a reverse-TTE for agricultural economies.

Setting $E_N = 1$ implies $g_{E,N} = 0$ and $r_N = \rho$. It can be shown that aggregate profits ($\pi_M n_M$) are constant, since the rate at which products are created in M is the same as that at which profits in that industry fall. Constant product creation in industry N gives a time-unvarying ratio $\pi_N = v_N$ so $g_{\pi M} = g_{vM} = -g_M$. These results, together with the free-entry condition in (6) give constant wages in the North.

Moving to the South, the time-varying rate at which expenditure in S evolves is obtained from the trade balance condition:

$$g_{ES}(t) = \frac{g_\alpha(t)}{1-\alpha(t)} \tag{13}$$

This shows in a very straightforward way that expenditure in S is directly linked to the share of consumption attracted by its firms in world markets. Using the previous result it is possible to solve for the dynamic version of equation (7):

$$g_\alpha(t) = [1-\alpha(t)]\frac{\beta-1}{\beta}\left[\frac{g_A}{\sigma_A - 1} - \frac{g_M}{\sigma_M - 1}\right] \tag{14}$$

The share of consumers' expenditure in A is affected by the difference in product creation between sectors. Note that if industries were symmetric (so $g_A = g_M$ and $\sigma_A = \sigma_M$), then $g_\alpha = 0$. The solution in such a case would resemble one with fixed expenditure shares across sectors, a situation that can also be obtained if $\beta = 1$. In such situation, no income nor welfare divergence would follow.

For simplicity, focus is placed from now on, on the case in which the term in brackets is different from zero. Remember that, under Assumption 1, $g_A/g_M < 1$ holds. This is something supported by the evidence presented in Section 4. Given this and the indicative evidence that $\sigma_A > \sigma_M$ in Table 1, the case in which $g_A/g_M = (\sigma_A - 1)/(\sigma_M - 1)$ seems implausible.

At this point it is important to make explicit the kind of equilibrium that is analyzed here. The unbalanced nature of the model prevents the existence of a balanced growth path for the global economy in the absence of too restrictive assumptions. Therefore, in the remainder of the section, results are provided for an Asymptotic Balanced Growth Path defined as follows:

DEFINITION 1 *The Asymptotic Balanced Growth Path (ABGP) is characterized by constant $L_{R,i}$, $L_{F,i}$ and g_i, $\forall i = A, M$. Under Assumption 1, $\alpha(t)$ converges to a constant when $t \to +\infty$.*

Fixed allocation of labor between different activities within each sector is consistent with constant product creation, and uneven product creation yields a time varying share of expenditure in the agricultural sector. Following this definition, the asymptotic value of α depends on the sign of the bundle of parameters in the right hand side of equation (14): it is zero if the bundle is negative, or 1 if the bundle is positive. The fact that the ratio $g_\alpha(t)/[1-\alpha(t)]$ must be constant according to (14), implies that g_{ES} also is , and as is shown next, most other endogenous variables in the South are either constant or growing at a constant rate.

The case in which $g_\alpha < 0$ is analyzed from here on, since this is the empirically relevant scenario. Declining expenditure shares in agricultural products have been extensively documented in both the growth and trade literatures. Equation (14) shows that our model of product creation can replicate a declining α in a number of ways. Focus is placed on the case in which uneven diversification is such that the term in brackets is negative, combined with $\beta > 1$.[23] While this is not the only combination of parameter values that could yield $g_\alpha < 0$ in theory, other options are disregarded as empirically ungrounded.[24]

[23] A discussion on the value of β is presented in Section 7.

[24] An interesting novelty in the model lies in the possibility of having $g_\alpha < 0$ even with $\beta < 1$. As is shown in Section 6, this is not possible in a similar model of uneven growth in the intensive margin, where the combination of $\beta < 1$ and uneven development yields expenditure shifts in favor of the lagging sector ($g_\alpha > 0$). This new possibility can be achieved if $\beta < 1$, combined with a positive term in brackets. This is compatible with $g_A < g_M$ as long as $(\sigma_A - 1)/(\sigma_M - 1) < g_A/g_M < 1$. In such a situation, even though product creation is smaller in A, consumer valuation of any new product in that sector is very high (because substitutability within that industry is very low). Consumers' valuation of product development is larger in industry A, even when actual diversification is smaller. Although theoretically possible, this scenario does not seem to square with the empirical evidence presented here (Table 1) suggesting that $(\sigma_A - 1)/(\sigma_M - 1) > 1$.

The rest of the solution in S is given by the Euler and no arbitrage equations:

$$r_S = g_{ES} + \rho \tag{15}$$

$$g_{vA} = r_S - \frac{\pi_A(t)}{v_A(t)} \tag{16}$$

Notice that the Euler equation determines that a constant expenditure path must be accompanied by a constant rate of returns to savings in S. Then, the no arbitrage condition imposes a constant growth rate of firm's value in the agricultural sector. The path followed by the most relevant variables of this model can now be fully determined.

Evolution of relative consumption between regions. According to (13), a shrinking expenditure share in agricultural goods ($g_\alpha < 0$), pushes down aggregate expenditure in S, so it undertakes a divergent path with respect to expenditure in N. Given that the price index is identical for consumers in both countries, divergent expenditure paths directly yield divergence in consumption paths. The mechanism for this result is very straightforward in this model: when consumers in both regions shift their consumption shares to the detriment of A, then S earns a decreasing part of global expenditure, so the region has to reduce its consumption level relative to N. The conclusions regarding the time path of relative consumption between regions can be summarized as follows:

RESULT 1 *When uneven product creation reduces α, consumers from S obtain a decreasing share of world income, translating into expenditure divergence between regions. All consumers face the same price index, so divergence in consumption follows.*

The Euler condition establishes that a negative expenditure path in S must be accompanied by a rate of returns to savings (r_S) that is lower than the time-preference parameter (ρ). This result means that returns on savings in S are always lower than in N ($r_S < r_N = \rho$), the intuitive outcome of firms from S earning a shrinking share of world value.

Evolution of relative income between regions. To assess the evolution of income in both regions notice first that, while aggregate profits in N are constant, this is not the case in S. Indeed, aggregate profits in N remain constant due to a combination of an increasing global market share captured by sector M, with an exactly offsetting fall in global expenditure, explained by the decreasing expenditure level of the South. On the contrary, in S:

$$g_{\pi A} = -g_A + \frac{g_\alpha(t)}{1-\alpha(t)} \tag{17}$$

Again, since $g_\alpha(t)/[1-\alpha(t)]$ is constant, then $g_{\pi A}$ must be constant too. The above expression shows how firms in A experience an additional source of profit loss not experienced by firms in M. This is because firms in A not only compete with new firms, but on top of that they compete in a relatively shrinking market: unlike what happens in N, aggregate profits in S fall unequivocally over time (at rate $g_\alpha/[1-\alpha]$).

To establish the time-path of wages, notice that using the free-entry condition (6), together with (17) and a constant ratio π_A/v_A (which follows from condition 11), yields

$$g_{wS} = \frac{g_\alpha(t)}{1-\alpha(t)} \tag{18}$$

This expression shows that wages in S evolve at a constant rate and in the same direction as the share of agricultural products in consumers expenditure. When that share is decreasing, the aggregate value of firms in S falls as a consequence, and wages move downwards in the South. With aggregate profits falling in S, then decreasing wages imply falling income in that region. Notice that both variables are constant in N. The following result summarizes the findings regarding income divergence:

Result 2 *With α falling, the model reproduces income divergence since both aggregate profits and wages fall in S with respect to those in N.*

Income divergence among primary economies is a stylized fact as documented by much of the resource curse literature (see for example Sachs and Warner, 2001). Section 7 in the Appendix provides in-depth evidence in support of such trend specifically for the subset of agricultural economies, as defined here. The above result suggests that terms of trade deterioration, often assumed to be exogenous in this literature, may actually be the outcome of relatively low diversification.

Evolution of consumption in each region. Result 1 summarizes the conclusions regarding the evolution of expenditure and real consumption of one country relative to the other. Reaching welfare conclusions requires knowing the time path of the aggregate price index. The evolution of the price index over time may not be trivial. Even if the price of each industry decreases monotonically ($g_{P,i}(t) < 0$, $\forall i = M, A$ and $\forall t$), the aggregate price index could potentially rise at some moment in time, driven by weight shifts within the index. For example, if the price of the M-good maintains a positive difference with that of good A, an increase in the weight that the former has on the aggregate index P can make this index grow, even when its two main components (P_M and P_A) are falling.

Nevertheless, it can be shown that in the case of $\beta \neq 1$, the dynamic price index is given by:

$$g_P(t) = \alpha(t) g_{PA} + [1 - \alpha(t)] g_{PM} \qquad \text{with} \qquad g_{Pi} = g_{wi} - \frac{g_i}{\sigma_i - 1}$$

The previous expressions show that the aggregate price level needs to fall over time. The reason why the possibility of a rising aggregate price is ruled out lies in the fact that, as is usual in expanding variety models, real consumption must grow in the anchor economy. This means that aggregate prices must fall relative to expenditure in N.

For real consumption to increase in the South too, the fall in expenditure in that region needs to be lower than the fall in prices, i.e. $g_{ES} > g_P$ has to hold, occurring if and only if:

$$\frac{\alpha(t)}{1 - \alpha(t)} > \frac{1 - \beta}{\beta} - \frac{g_M(\sigma_A - 1)}{\beta g_A(\sigma_M - 1)} \tag{19}$$

The term in the left-hand side is always positive and goes to zero when α does. The sign of the constant term in the right-hand side depends on the value of β. If $\beta > 1$, the entire term is negative so the condition always holds. Only if $\beta < 1$ and the value of that parameter is low enough, can the constant term be positive and the entire condition could not hold at some t. Conclusions regarding the evolution of real consumption in absolute terms, within each region, can be summarized as follows:

Result 3 *With α falling, the North experiences growing consumption. If condition (19) also holds, then the same is true for the South.*

According to this condition, it is theoretically possible that the South experiences growing aggregate consumption during a certain period and this is suddenly reversed when α falls below the threshold established in the previous result.

Evolution of terms of trade for the South. Finally, the model reproduces terms of trade deterioration for S (falling p_A/p_M). Equation (4) establishes that the only determinant for changes in relative prices are movements in relative wages. Since wages are constant in N, the price of products created there is also time-invariant. The price of final production in S evolves following wages in that region, and according to previous results, they fall due to a shrinking α. The following result summarizes the straightforward conclusion regarding terms of trade in this version of the model:

Result 4 *With α falling, terms of trade deteriorate for S.*

Notice that a situation where terms of trade fall in S is also one in which aggregate income in that region falls with respect to that in N. Such a situation constitutes what it is called here a reverse-TTE, i.e. terms of trade enhancing rather than offsetting income divergence, a result supported by the evidence presented above for agricultural economies.[25]

6. Relative price movements and the margins of growth

A reverse-TTE cannot be obtained in a similar model of uneven growth in the intensive margin, i.e. technological improvements increasing quantities produced at different rates between sectors. The reason is that in such setting, relative prices always move in favor of the lagging sector as the TTE would predict. It is easy to show this by deriving the

[25]Section 3 presents further evidence on the support of the reverse-TTE and its link with the number of products traded.

FOC of the maximization problem of the consumer and including (3) to obtain:

$$\left[\frac{p_M(t)}{p_A(t)}\right]^\beta = \frac{\omega_M q_A(t) n_A(t)^{\frac{\sigma_A-\beta}{(\sigma_A-1)}}}{\omega_A q_M(t) n_M(t)^{\frac{\sigma_M-\beta}{(\sigma_M-1)}}} \tag{20}$$

Models where growth happens exclusively in the intensive margin feature changes in the ratio of quantities. With a constant ratio of available varieties (n_A/n_M), changes in relative prices must go in the opposite direction, as long as $\beta > 0$. In a context of specialization, this implies that terms of trade offset differences in output growth to some degree.

A model of uneven diversification is capable of reproducing a reverse-TTE because it processes a different adjustment mechanism. A time-varying ratio of varieties in each sector means that relative prices in equation (20) do not necessarily compensate for changes in relative quantities. In the present model, changes in relative prices follow shifts in relative wages, as efficiency in the production of final goods remains unchanged. Relative wages are in turn determined by the aggregate value of firms in each sector (according to the free-entry condition in 6) and ultimately by the movements in the share of expenditure devoted to each sector in (14). Since a falling share of expenditure in A reduces the value of A-firms relative to M-firms, the relative wage of workers in S also falls and terms of trade deteriorate for that region. Differences in product creation between sectors are adjusted by changes in sales for individual firms so the equality in (20) holds.

7. Quantification

The theory proposed here posits terms of trade movements as the result of uneven product creation between sectors. At the core of the mechanism highlighted here is the possibility that uneven product diversification pushes expenditure to shift away from the agricultural sector. The literature on structural transformation has identified income effects as the main sources of expenditure shifts across sectors.[26] Thus providing us with

[26] The literature proposes trade openness and changing wedges between factor costs across sectors as additional sources of shifts in labor or value added shares across sectors (see Matsuyama, 2009 and Buera

an alternative and plausible alternative to the mechanism proposed here. How much of expenditure share shifts can then be attributed to the available explanations? This section proposes a quantitative exercise to measure precisely this. A general version of the model in Section 5 is proposed, where the main simplifying assumptions are lifted. After estimating the required preference parameters, the model is put to use and counter-factual exercises are presented to quantify the importance of uneven product diversification for expenditure shifts.

7.1 A general version of the model

The model comprises C economies (indexed c), each freely deciding how much to produce of two goods ($i = M, A$). Trade is now costly which means that prices consumers face are country specific. Preferences of consumers in country c over consumption of A and M (both domestically produced or imported) are now represented by

$$Q_c(t) = \left[\omega_M^{\frac{1}{\beta}} Q_{cM}^{\frac{\beta-1}{\beta}}(t) + \omega_A^{\frac{1}{\beta}} (Q_{cA}(t) + \bar{Q}_A)^{\frac{\beta-1}{\beta}}\right]^{\frac{\beta}{\beta-1}} \tag{21}$$

Here, $\bar{Q}_A$ is a constant that can take any real value. Agricultural goods are inferior if $\bar{Q}_A < 0$ and preferences are homothetic only if $\bar{Q}_A = 0$. Again, preference parameters are common to consumers in all regions. Given these preferences, equation (7) is now replaced by:

$$\alpha_c(t) = 1 - \left[1 + \frac{P_{cA}(t)\bar{Q}_A}{E_c(t)}\right] \left[1 + \frac{\omega_A}{\omega_M} \left(\frac{P_{cM}(t)}{P_{cM}(t)}\right)^{\beta-1}\right]^{-1} \tag{22}$$

The structure of firms decisions is the same as before, but now technology in sector i improves at an exogenous constant rate $g_{\phi i} = \dot{\phi}_i/\phi_i$. This introduces growth in the intensive margin, which is going to create the standard price effect usually explored in the literature.

In this version of the model, it is easy to show how changes in the share of expenditure of agricultural goods are driven by an income effect, a standard price effect produced by

and Kaboski, 2009). However these sources do not appear as relevant for shifts in expenditure shares.

growth in the intensive margin, and the effect proposed in this paper created by growth in the extensive margin. We can write a dynamic version of (22) as follows

$$g_{\alpha c}(t) = \frac{1-\alpha_c(t)}{\alpha_c(t)} \left[\frac{(\beta-1)\mathcal{P}_c(t)}{1+\mathcal{P}_c(t)} \left(\underbrace{\frac{g_{cA}}{\sigma_A - 1} - \frac{g_{cM}}{\sigma_M - 1}}_{extensive} + \underbrace{\frac{\dot{p_{cM}}}{p_{cM}} - \frac{\dot{p_{cA}}}{p_{cA}}}_{intensive} \right) - \underbrace{\frac{\dot{\mathcal{Y}}_c(t)}{1+\mathcal{Y}_c(t)}}_{income} \right] \tag{23}$$

with $\mathcal{P}_c(t) = (\omega_A/\omega_M)(P_{cM}(t)/P_{cA}(t))^{\beta-1}$ and $\mathcal{Y}_c(t) = P_{cA}(t)\bar{Q}_A/E_c(t)$. According to the previous equation, obtaining accurate values for preference parameters is key in our quantification as the importance of uneven growth in both margins is affected by parameter β and the coefficient ω_A/ω_M, while the value of $\bar{Q}_A$ is crucial for assessing the importance of the income effect.

7.2 Estimation of preference parameters

Values for the preference parameters can be estimated using consumption data. In recent papers evaluating structural change in closed economies, similar estimations are performed, for a wide range of specifications in preferences. Among these papers, Herrendorf et al. (2013) uses the preference structure that is closer to the one used here, so it constitutes a reasonable benchmark for the exercise. However, the quantitative exercise performed here refrains from directly using the point estimations found in that paper, since their setting includes a service sector (S), that our framework omits due to the impossibility of assessing growth in the extensive margin for that sector. In particular, the consumption aggregator is defined in that paper as a generalized version of (21), that can be referred to as a Generalized Stone-Geary (GSG) structure:

$$Q_c = \left[\sum_i \omega_i^{\frac{1}{\beta}} (Q_{ci} + \bar{Q}_i)^{\frac{\beta-1}{\beta}} \right]^{\frac{\beta}{\beta-1}} \text{ with } i = A, M, S, \quad \sum_i \omega_i = 1, \text{ and } \bar{Q}_M = 0 \tag{24}$$

Maximizing this with the usual budget constraint gives the following share system:

$$\alpha_{ci} = \omega_i \left(\frac{P_i}{P}\right)^{1-\beta} \left(1 + \sum_{j=A,M,S} \frac{P_j \bar{Q}_j}{E_c}\right) - \frac{P_i \bar{Q}_i}{E_c}$$

where α_{ci} represents the expenditure share in sector i ($i = A, M, S$) at country c, and P is the corresponding aggregate price index of all three sectors. To deal with the issue of these parameters being constrained, the estimation is done in terms of unrestricted parameters b_0, b_1, $b_2 \in (-\infty, +\infty)$, where:

$$\beta = e^{b_0}, \quad \omega_A = \frac{1}{1 + e^{b_1} + e^{b_2}}, \quad \omega_M = \frac{e^{b_1}}{1 + e^{b_1} + e^{b_2}} \text{ and } \omega_S = \frac{e^{b_2}}{1 + e^{b_1} + e^{b_2}}$$

To obtain parameter estimations that are consistent with the framework of the present paper, but at the same time are comparable to the literature, we use the same database on US household final expenditure from the US Bureau of Economic Analysis (BEA). For robustness, results are also reported on a country-sample that includes Western European economies, by making use of *Table 5, Final consumption expenditure of households*, of the OECD Annual National Accounts Detailed Tables. Uy et al. (2013) is followed here.[27] While this source includes data on other countries, the estimation of preference parameters is restricted to Western Europe where consumption patterns are closer to those in the US.

Table 4 shows the results using the same non-linear seemingly unrelated regression estimator as Herrendorf et al. (2013), a particular form of the feasible generalized non-linear least square estimation. Column 1 shows the results for the baseline estimation of the share system that results from the GSG utility function with all three sectors (equation 24), using US data, and therefore replicating the results in the first column in Table I of Herrendorf et al. (2013). Column 2 removes the service sector and considers only expenditure in goods (A and M) as total expenditure, a framework in line with

[27] Agriculture (A) expenditure corresponds to the categories P31CP010 (Food and non-alcoholic beverages) and P31CP020 (Alcoholic beverages, tobacco and narcotics). Manufacturing (M) includes categories P311B (Durable Goods), P312B (Semi-durable goods) and P313B (Non-durable goods) net of A-expenditures. Finally, Services (S) are composed of category P314B (Services).

equation (21). Note that in all specifications $\bar{Q}_M = 0$ is assumed, and $\bar{Q}_A < 0$ and $\bar{Q}_S > 0$ are obtained, a standard outcome in the literature. More importantly, notice the coefficient for β turns out to be higher than unity in this exercise, suggesting that A and M could be considered substitutes. Columns 3 and 4 replicate the exercise on data for expenditure of Western European households showing similar results: while sectors appear as complements when all three sectors are considered, the degree of substitutability is larger between M and A, suggesting these are substitutes.

Table 4:
Estimation of preference parameters

	(1) US GSG	(2) US GSG (no S)	(3) W-Europe GSG	(4) W-Europe GSG (no S)	(5) US Nested GSG	(6) W-Europe Nested GSG
β	0.848***	1.663***	0.776***	1.224***	1.621***	1.192***
	(0.060)	(0.093)	(0.083)	(0.091)	(0.103)	(0.112)
$\bar{Q}_A$	-1350.382***	-1140.740***	-1369.761***	-1318.224***	-1136.875***	-1358.252***
	(31.177)	(48.194)	(107.980)	(93.989)	(57.118)	(91.008)
$\bar{Q}_S$	11237.402***		2764.868***		8725.382***	1246.069*
	(2840.770)		(684.125)		(2252.515)	(625.206)
ω_A	0.021***	0.118***	0.092***	0.231***	0.120***	0.228***
	(0.001)	(0.004)	(0.007)	(0.011)	(0.005)	(0.011)
ω_M	0.169***	0.882***	0.303***	0.769***	0.880***	0.772***
	(0.010)	(0.004)	(0.010)	(0.011)	(0.005)	(0.011)
ω_S	0.810***		0.605***		0.817***	0.719***
	(0.011)		(0.014)		(0.008)	(0.066)
ω_G					0.183***	0.281***
					(0.008)	(0.066)
ϵ					0.768***	0.447***
					(0.057)	(0.117)
N	64	64	410	410	64	410
AIC	-932.549	-436.714	-3515.743	-1518.805	-963.495	-3569.736
$RMSE_A$	0.004	0.008	0.024	0.038	0.003	0.023
$RMSE_M$	0.009	0.008	0.033	0.038	0.000	0.033
$RMSE_S$	0.010		0.042		0.000	0.040
$RMSE_{\sum_i}$	0.023	0.015	0.099	0.075	0.003	0.096

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. AIC is the Akaike information criterion, $RMSE_i$ is the root mean squared error for i.

The previous evidence suggests that the degree of substitutability within different categories of goods (G, including A and M) might differ from the existing between G and S, and that the difference is relevant qualitatively. Following this intuition, the next step is to test a nested preference structure as follows

$$Q_c = \left[\omega_G^{\frac{1}{\epsilon}} Q_{cG}^{\frac{\epsilon-1}{\epsilon}} + \omega_S^{\frac{1}{\epsilon}} (Q_{cS} + \bar{Q}_S)^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}} \tag{25}$$

with

$$Q_{cG} = \left[\omega_M^{\frac{1}{\beta}} Q_{cM}^{\frac{\beta-1}{\beta}} + \omega_A^{\frac{1}{\beta}} (Q_{cA} + \bar{Q}_A)^{\frac{\beta-1}{\beta}}\right]^{\frac{\beta}{\beta-1}}$$

where parameter ϵ guides the substitutability between G and S, while β does so between M and A.[28] Evidently, this specification is more general than (24), as it can be reduced to it by imposing $\epsilon = \beta$ and $\omega_G = 1$. Results are reported in the remaining columns of Table 4: Column 5 shows results for the US, and Column 6 does so for Western Europe.[29] As can be seen, the evidence indicates that β is significantly greater than one, while ϵ is significantly lower than that value.

7.3 Quantitative results

The following Table summarizes the parameter values used in our main quantitative exercise:

Table 5:
Choices for parameters

β	1.44
$\bar{Q}_A$	-1136.86
ω_A/ω_M	0.22
σ_A	3.44
σ_M	2.53
g_A	0.210 and 0.428
g_M	0.681 and 0.754

According to the results presented in Table 4, reasonable values for β should be in the interval $(1.22, 1.66)$, while values for ω_A/ω_M are estimated to belong to $(0.14, 0.3)$. Intermediate values are used as reference here. Table 1 indicates that 3.44 and 2.53 are reasonable values for σ_A and σ_M respectively. Finally, Table 2 contains plausible values for g_A and g_M. For robustness, two scenarios are considered here. Scenario #1 uses a pair of values for the vector (g_A, g_M) computed upon 4-digit data and using our narrower definition of agricultural goods $A1$. This corresponds to values in the first column of Table 2. Scenario #2 takes vales from the last column of the same table, those calculated on 6-digit data and for the broader definition $A3$.

[28] A similar structure can be found in Moro et al. (2017), albeit defined over different sectors.

[29] Herrendorf et al. (2013) highlights that estimations for between-industry substitutability parameters might differ when using data on value added instead of final expenditure data. Although not relevant for the present paper, for the sake of completeness of the estimation exercise, the latter specification is also estimated using value added data. This, again, gives significant coefficients for β larger than unity. Results are available in Section 9 of the Appendix.

Armed with these parameter values, it is possible to quantify the importance of the extensive margin of growth in the decline of the expenditure share to agricultural goods. Introducing the previous values into (23) gives model predictions for the decline in α. Again, this share is computed as expenditure in these goods over total expenditure in all goods. Services are excluded so the exercise matches the structure proposed by the model. Results are presented for the two alternative scenarios (#1 and #2), each using a different set of values for the pair (g_A,g_M). Table 6 shows the corresponding results along with a final column where uneven product diversification is shut down, i.e., $g_A = g_M = 0$ is assumed. This allows to put a number to the magnitude of the missing effect. Results are presented for countries in North America and Western Europe, for which expenditure and price data are available for long periods of time, and for which relative price movements go in the same direction as in the US. Keeping economies with long series for these key variables is important since the model is constructed to reproduce long-term trends, i.e., the model features no adjustment mechanism to the different shocks that could affect expenditure shares in the short term. While preference parameters take the same value for every country, initial values of the relevant variables are extracted from the country specific data.

Table 6:
Decline in α observed vs predicted

Country	period	$\%\Delta\alpha$			
		observed (1)	full #1 (2)	full #2 (3)	no extensive (4)
Canada	1981-2014	-32.96	-36.83	-35.29	-23.57
France	1970-2014	-31.45	-27.23	-26.16	-17.98
Norway	1970-2014	-43.34	-28.11	-27.22	-20.44
United States	1947-2010	-71.05	-72.65	-71.16	-59.79

Notes: Results presented for the sample of countries with a timespan longer than 30 years, in North America and Western Europe. $\Delta\alpha$ is the percentage change in the share of expenditure to agricultural products over all goods (services not included). Full model #1 corresponds to the prediction of the model including all effects and where changes in the extensive margin are g_A=0.21 and g_M=0.68. Full model #2 gives results for alternative values g_A=0.428 and g_M=0.754.

The table highlights the sharp decline observed in agricultural expenditure shares for all countries. As has been documented before this share fell 71% in the US over the period 1947-2010. For the other countries, the fall is similarly sharp, at least for the shorter time periods for which data is available. The decline predicted by our model does not differ much across the two presented scenarios. In both cases, the predicted decline approaches very closely the actual fall observed in the US. The fall in α that is predicted when ignoring changes in the extensive margin leaves unexplained 15.85% of the total decline, but introducing uneven product diversification closes the gap almost completely. In France, the observed decline is 31% for the period 1970-2014. The prediction ignoring product diversification only accounts for 57% of that, but including action in the extensive margin improves the prediction by over 28% of the total fall, raising the explained percentage to over 85%.

Overall, these results indicate that the extensive margin of growth can play a quantitatively relevant role in explaining expenditure shifts. This has important implications for growth-promoting policy design, as it provides new support to product diversification incentives. The recommendation becomes particularly crucial for economies with strong specialization in agricultural goods as a shrinking global expenditure share in agricultural goods can contribute to falling terms of trade for these economies. According to the above results, fostering product diversification could contribute to alleviating the fall in terms of trade, which would certainly contribute to prevent real income divergence for these economies.

8. Conclusion

This work joins a large literature in pointing at specialization as a cause of welfare divergence. Focus is placed on the extensive margin of development to highlight the role that uneven diversification between sectors can play to account for key development facts left unexplained by previous literature, i.e. divergence enhanced by falling terms of trade for agricultural producers. The first contribution of this paper is to document that growth in the extensive margin is unbalanced between sectors: diversification happens at a lower rate in the agricultural sector than in the rest of goods-producing activities. This finding is in line with recent works showing that technological linkages are rarer, and the elasticity of substitution is higher, among goods belonging to the primary sector.

The second contribution is to highlight in a simple model, how uneven diversification can account for terms of trade movements that enhance divergence. Such outcome cannot be achieved in a model of uneven technological improvements absent further structure in the preference side. The mechanism proposed here is quantitatively relevant and connects low diversification with terms of trade deterioration in an intuitive way. This paper focuses on agricultural economies since both regularities appear clearly in the data for those economies. Nevertheless, the same mechanism is potentially valid in other contexts in which different sets of products (or services) could exhibit unbalanced diversification. Future research in this matter should be welcomed.

Acknowledgements

I am thankful to Raouf Boucekkine, Lorenzo Caliendo, David de la Croix, Swati Dhingra, Jonathan Eaton, Gino Gancia, Manuel García-Santana, Tim Kehoe, Florian Mayneris, John Morrow, Yasusada Murata, Peter Neary, Rachel Ngai, Gianmarco Ottaviano, Mathieu Parenti, Franck Portier, Víctor Ríos Rull, Kim Ruhl, Thomas Sampson, Sjak Smulders, Gonzague Vannoorenberghe, Jaume Ventura and participants in presentations at LSE, Nottingham, Kiel IFW, Oxford, RIDGE Workshop in Trade and Firm Dynamics, ECARES-ULB, GSIE Seminar, RIEF, ETSG, DEGIT, Vigo Workshop on Dynamic Macroeconomics, UPF, and CEPR-ESSIM, for their valuable comments. I am also grateful to Matthias Haensel for data assistance. Any remaining errors are my own responsibility. I gratefully acknowledge financial support from FNRS, Belgium and Tilburg University. Declaration of interest: none. The accompanying Appendix contains detailed derivations and supplementary material for the paper. A previous version of this paper circulated under the name “Uneven growth in the extensive margin: explaining the lag of agricultural economies”.

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Appendix to "Uneven Product Diversification and Declining Expenditure Shares on Agricultural Products"

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1 Terms of trade effect

This section replicates and extend the empirical results showing the *terms of trade effect* (TTE) in Acemoglu and Ventura (2002) (AV02 from now on), and highlights the particular situation of A-countries.

Economies tend to converge to a steady state that is determined by a set of fundamentals (Z), an idea that can be represented in the following equation:

$$g_{GDP,t} = -\mu_1 GDP_{t-1} + Z_t'\mu_2 + u_t$$

where $g_{GDP,t}$ is the growth rate of output at t.

Then, estimations of the relationship between terms of trade and growth are potentially biased. An economy could experience fast growth either because it managed to accumulate more resources moving forward along its current growth path or because it achieved a shift upwards in its steady state. Only the first of these causes is related to falling terms of trade. To properly identify the relationship, we follow AV02 computing the following specification

$$g_{TT,t} = \epsilon_1 g_{GDP,t} + Z_t'\epsilon_2 + e_t$$

where $g_{TT,t}$ is the growth rate of terms of trade and the vector Z_t includes determinants of steady state income. This equation is estimated using Two-Stage Least Squares (2SLS) and instrumenting $g_{GDP,t}$ by its predicted value stemming from the previous equation. The excluded instrument is GDP_{t-1} since, conditional on growth and the steady state determinants, terms of trade should not be related to the initial level of income. Results for these regressions for the period (1965-1985) are reported in columns (1) and (2) of Table A.1, using years of education, life expectancy at 1965 and a dummy variable signalling OPEC countries, as basic determinants of steady state income so results replicate those in AV02. Columns (3) and (4) expand the time span to cover 1965-2005. The remaining columns introduce different indicators of A-countries in the set Z.

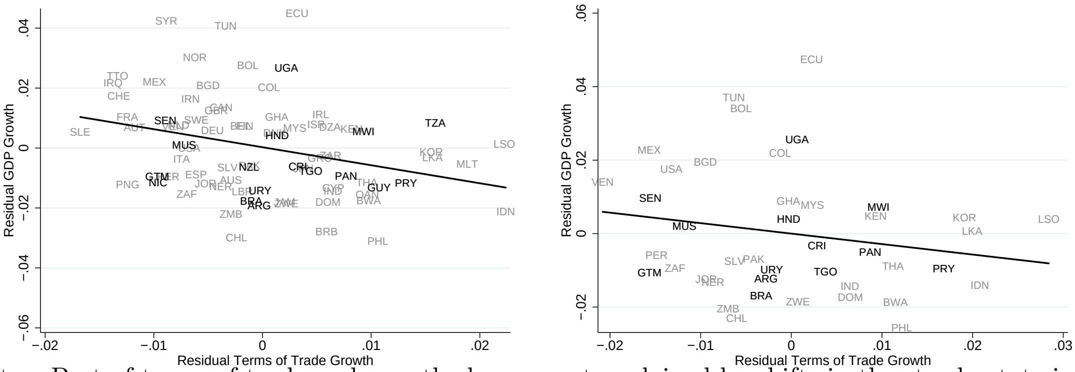
Table A.1: Terms of trade and growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					Panel A: 2SLS					
gdpgr	-0.595**	-0.578**	-0.693**	-0.688**	-0.680**	-0.609**	-0.671**	-0.609**	-0.602**	-0.609**
	(0.266)	(0.261)	(0.316)	(0.319)	(0.306)	(0.272)	(0.304)	(0.272)	(0.274)	(0.272)
yr	-0.001		-0.003							
	(0.002)		(0.002)							
syr		-0.002		-0.001	-0.002	-0.000	-0.002	-0.000	-0.001	-0.000
		(0.006)		(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
hyr		0.019		0.001	-0.005	-0.012	-0.005	-0.012	-0.009	-0.012
		(0.034)		(0.037)	(0.036)	(0.035)	(0.036)	(0.035)	(0.035)	(0.035)
pyr		-0.002		-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
		(0.003)		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
llifee	0.043*	0.046*	0.055*	0.057*	0.054*	0.051*	0.055*	0.051*	0.048*	0.051*
	(0.024)	(0.025)	(0.028)	(0.030)	(0.028)	(0.027)	(0.029)	(0.027)	(0.027)	(0.027)
opec	0.091***	0.090***	0.082***	0.082***	0.078***	0.081***	0.078***	0.081***	0.082***	0.081***
	(0.010)	(0.010)	(0.012)	(0.013)	(0.013)	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)
A1_30end					-0.013					
					(0.009)					
A1_50end						-0.019*				
						(0.011)				
A2_30end							-0.011			
							(0.008)			
A2_50end								-0.019*		
								(0.011)		
A3_30end									-0.013**	
									(0.007)	
A3_50end										-0.019*
										(0.011)
_cons	-0.172*	-0.182*	-0.210*	-0.216*	-0.203*	-0.195*	-0.207*	-0.195*	-0.180*	-0.195*
	(0.090)	(0.092)	(0.106)	(0.111)	(0.106)	(0.101)	(0.107)	(0.101)	(0.100)	(0.101)
					Panel B: First-stage for GDP Growth					
loggdp	-0.019***	-0.020***	-0.021***	-0.021***	-0.021***	-0.023***	-0.021***	-0.023***	-0.023***	-0.023***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
R^2	0.350	0.359	0.330	0.335	0.481	0.509	0.450	0.509	0.449	0.509
					Panel C: OLS					
gdpgr	0.037	0.037	-0.045	-0.045	-0.076	-0.100	-0.073	-0.100	-0.105	-0.100
	(0.106)	(0.107)	(0.139)	(0.141)	(0.155)	(0.152)	(0.151)	(0.152)	(0.146)	(0.152)
Obs.	79	79	55	55	55	55	55	55	55	55

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. t-statistic in parenthesis. Columns (1) and (2) replicate results of Acemoglu and Ventura (2002) using data from Barro and Lee (1993) for the period (1965-1985). Columns (3) and (4) expand the time period using product figures from PWT and terms of trade from WDI and OECD. The remaining columns introduce different indicators for A countries to the group of determinants of steady state income. Each variable $Ak_j end$ takes value 1 when a country's exports of Ak exceeds the share of $j\%$ in 2000.

All specifications show a negative coefficient for the growth rate which can be interpreted as evidence in favor of the existence of a TTE. The dummy indicating A-countries takes negative values implying that, other things being equal, terms of trade tend to adjust less favourably for agricultural economies. Figure A.1 plots the part of terms of trade changes and growth changes not explained by shifts in the steady state income determinants. These determinants are the same as those used in column (1) of Table A.1. The figure in the left replicates the result of AV02 using data for 1965-1985 only, and the figure in the right presents results for the extended time period.

Figure A.1: Changes in Terms of trade and GDP growth controlling for steady state income shifts



Notes: Part of terms of trade and growth changes not explained by shifts in the steady state income determinants (i.e. years of education, life expectancy at 1965 and a dummy for OPEC countries). The panel in the left uses data for 1965-1985 only and therefore replicates results in as in Acemoglu and Ventura (2002). The panel in the right expands the time period until 2005.

In both figures, the position of A-countries is highlighted, so it is easy to notice that these group of countries tend to be below the fitted line. This implies that terms of trade adjustment tends to be lower than expected for agricultural economies.

Finally, it is possible to test whether the TTE is related to the size of the economy. Total population is introduced into Z as measure for size, to evaluate whether the relationship between changes in terms of trade and growth is influenced by this variable. Results show that size is not significant as a control Z. As a parallel exercise, we used the residual GDP and terms of trade changes, as plotted in the left panel of Figure A.1, and evaluated whether the correlation between these two variables is affected by controlling for size. Again, results give non-significant coefficients for that variable.

2 Agricultural goods and countries

2.1 Classification of goods: A, M and E

Table A.2 lists the products considered in this work as A1, A2, A3 and E respectively. The categorization is based in the SITCRev2 classification. The set of Mi comprises all products not included in Ai or E $\forall i = 1, 2, 3$. Using this classification yields 308, 351, 401 and 158 different products in categories A1, A2, A3 and E, respectively out of a total of 1239 four-digit goods in SITCRev2. In the SITCRev1 five-digit classification, the same figures are 375 (A1), 461 (A2), 669 (A3) and 206 (E) over a total of 1659. In the HS0 six-digit classification, these figures are 833 (A1), 1183 (A2), 1983 (A3), 1032 (E) and 5038 (total).

Table A.2:
List of Ak and E-goods ($\forall k = 1, 2, 3$) in SITCRev2 (four-digits)

SITCRev2 Code	Description	A1	A2	A3	E
0011-0XXX	Food and live animals chiefly for food	X	X	X	
1110-1XXX	Beverages and tobacco	X	X	X	
2111-2320	Hides, skins and furskins, raw; Oil-seeds and oleaginous fruit; Natural rubber Cork and wood; Pulp and waste paper; Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)	X	X	X	
2331-23XX	Synthetic or reclaimed rubber, waste and scrap of unhardened rubber.				X
2440-271X	Cork and wood; Pulp and waste paper; Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric); Fertilizers, crude	X	X	X	
2731-28XX	Stone, sand and gravel; Sulphur and unroasted iron pyrites; Natural abrasives, N.E.S. (including industrial diamonds); Other crude minerals; Metalliferous ores and metal scrap				X
2911-29XX	Crude animal and vegetable materials, N.E.S.	X	X	X	
3221-3XXX	Mineral fuels, lubricants and related materials				X
4111-4XXX	Animal and vegetable oils, fats and waxes	X	X	X	
5111-51XX	Organic Chemicals		X	X	
5221-52XX	Inorganic chemicals				X
5311-55XX	Dyeing, tanning and colouring materials; Medicinal and pharmaceutical products; Essential oils and perfume materials; Toilet, polishing and cleansing preparations				
5621-56XX	Fertilizers, manufactured		X	X	
5721-5XXX	Explosives and pyrotechnic products; Artificial resins and plastic materials, and cellulose esters and ethers; Chemical materials and products N.E.S.				
6112-61XX	Leather, leather manufactures, N.E.S., and dressed furskins			X	
6210-62XX	Rubber manufactures, N.E.S.				
6330-64XX	Cork and wood manufactures (excluding furniture); Paper, paperboard and articles of paper pulp, of paper or of paperboard			X	
6511-65XX	Textile yarn, fabrics, made-up articles, N.E.S. , and related products				
6611-661X	Lime, cement and fabricated construction materials (except glass and clay materials)				X
6623-666X	Clay construction materials and refractory construction materials; Mineral manufactures N.E.S; Glass; Glassware; Pottery				
6671-672X	Pearls, precious and semi-precious stones, unworked and worked; Pig iron, spiegeleisen, sponge iron, iron or steel powders and shot, and ferro-alloys; Ingots and other primary forms of iron and steel				X
6731-67XX	Iron and steel bars, rods, angles, shapes and sections; Universal plates and sheets of iron and steel; Hoops and strip of iron or steel, hot-rolled or cold-rolled; Rails and railway track construction materials of iron or steel; Wires, tube pipes and fittings of iron or steel.				
6811-68XX	Non-ferrous metals				X
6911-7XXX	Manufactures of metal N.E.S; Machinery and transport equipment				
8121-8XXX	Miscellaneous manufactured articles				
9110-9XXX	Commodities and transactions not classified elsewhere in the SITC				

2.2 Characterization of A-countries

The characterization of A-countries is complemented by evaluating which variables are correlated with countries finishing the period of analysis as large exporters of agricultural products. Table A.3 presents results of probit regressions where the indicator of countries exporting more than $j\%$ of their exports in Ak products at the year 2000, is the main dependent variable. Columns (1)-(3) present results for $k = 1$, while columns (4)-(6) do so for $k = 2$ and (7)-(9) for $k = 3$. Within each set of results, the first column sets the export threshold at 30%, the second at 40% and the third at 50%. Explanatory variables selected are relevant variables evaluated in 1965 and include different measures of the degree of comparative advantage in the production of agricultural products (the export intensity in Ak, size and share of arable land as a total country's territory) and other variables that could potentially be relevant for comparative advantage to change over time (degree of trade openness, per capita GDP, population density, size of government expenditure). Overall, results show that the most important feature of countries that finish the period as large exporters of agricultural products is the initial intensity of those exports. The size and share of arable land does not present an important correlation. Population density has a negative effect in most specifications and this can be interpreted as a relevant factor for industrialization. A similar conclusion can be drawn regarding the degree of trade openness: more open economies tend to reduce the intensity of their exports in agricultural products over this period. Finally it is interesting to see that the initial income level of the economy and government size do not seem to play an important role.

Table A.3:
Characterizing A-countries

Dependant variable:	Dummy for exporting A$k > j$% in 2000								
$[k, j] =$	$[1, 30]$	$[1, 40]$	$[1, 50]$	$[2, 30]$	$[2, 40]$	$[2, 50]$	$[3, 30]$	$[3, 40]$	$[3, 50]$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
exports in A1 (%)	2.287***	3.212**	1.750*						
	(0.005)	(0.021)	(0.088)						
exports in A2 (%)				2.265***	3.180**	1.726*			
				(0.004)	(0.013)	(0.094)			
exports in A3 (%)							1.238*	2.614***	1.605
							(0.061)	(0.007)	(0.121)
Trade openness	-0.012*	-0.005	-0.006	-0.013*	-0.006	-0.006	-0.013**	-0.006	-0.006
	(0.079)	(0.450)	(0.537)	(0.054)	(0.403)	(0.539)	(0.045)	(0.374)	(0.555)
Pop. density	-0.009*	-0.013**	-0.007	-0.010**	-0.010*	-0.007	-0.009**	-0.013**	-0.007
	(0.079)	(0.031)	(0.208)	(0.040)	(0.089)	(0.205)	(0.023)	(0.026)	(0.188)
arable land (% of land)	0.004	0.030*	0.019	0.014	0.015	0.019	0.005	0.015	0.019
	(0.817)	(0.088)	(0.295)	(0.398)	(0.414)	(0.298)	(0.756)	(0.405)	(0.284)
arable land (total)	-0.000*	-0.000*	-0.000	-0.000*	-0.000	-0.000	-0.000*	-0.000	-0.000
	(0.099)	(0.098)	(0.455)	(0.058)	(0.336)	(0.454)	(0.082)	(0.205)	(0.448)
GDPpc (logs)	-0.249	-0.027	-0.311	-0.214	-0.058	-0.317	-0.341*	-0.174	-0.337
	(0.181)	(0.905)	(0.170)	(0.242)	(0.788)	(0.160)	(0.055)	(0.396)	(0.124)
Gov. expenditure	0.009	-0.030	0.011	0.011	-0.021	0.011	-0.016	-0.051	0.008
	(0.838)	(0.508)	(0.758)	(0.801)	(0.625)	(0.769)	(0.671)	(0.252)	(0.829)
Constant	0.773	-2.038	0.100	0.611	-1.897	0.167	2.747	0.061	0.416
	(0.695)	(0.445)	(0.966)	(0.753)	(0.443)	(0.943)	(0.133)	(0.978)	(0.855)
Obs.	83	83	83	83	83	83	83	83	83
Pseudo-R^2	0.332	0.355	0.213	0.335	0.313	0.211	0.282	0.331	0.204

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. GDPpc (in logs) extracted from PWT, the rest of the controls are from WDI2015.

2.3 Proximity by sector

This section presents summary statistics by sector using the technological proximity index presented in Hidalgo et al. (2007). The index is constructed using export data and defines technological proximity between goods a and b as the minimum between the probability of a given country exporting good a conditional on it exporting b, and the probability that a country exports b provided it exports a. Table A.4 reports the technological proximity between the representative good belonging to industry $k = A, M$ and all other goods in the product space. It is possible to see that for any list of A-goods the average proximity is smaller for goods in sector A than in M, interpreted here as evidence supporting a higher diversification cost in that industry ($a_A > a_M$). Table A.5, presents the average proximity within each industry and shows that the average proximity within A is lower than in M, further suggesting that diversification is harder in the agricultural sector.

Table A.4:
Summary statistics by sector: proximity of goods

k	Ak			Mk		
	mean	sd	Obs.	mean	sd	Obs.
1	0.143	0.047	195	0.184	0.045	489
2	0.147	0.048	222	0.184	0.044	462
3	0.158	0.051	312	0.184	0.044	372

Notes: Proximity as reported by Hidalgo et al. (2007). For each good, the average proximity with all other products is computed. The average of that at the sector level is reported.

Table A.5:
Summary statistics by sector: proximity of goods within a sector

k	Ak			Mk		
	mean	sd	Obs.	mean	sd	Obs.
1	0.159	0.045	195	0.209	0.054	489
2	0.156	0.044	222	0.212	0.055	462
3	0.163	0.046	312	0.216	0.055	372

Notes: Proximity as reported by Hidalgo et al. (2007). For each good, the average proximity with all other products belonging to the same sector is computed. The average of that at the sector level is reported.

3 Terms of trade movements and products traded

Table A.6 regresses changes in terms of trade against the change in the number of products exported and imported. Controls include the initial number of products exported, the initial level and the change in the degree of openness, the initial level of per capita income and country fixed effects. While the mechanism highlighted here is expected to become evident in the very long run, we use 10 year changes to multiply observations. Nevertheless, results show that the change in products exported is correlated positively with changes in terms of trade as highlighted by the theory in the next section.

4 Uneven diversification in varieties

Table A.7 presents similar results to those in Table 2 counting varieties (i.e. product-origin pairs) instead of products. It therefore measures the change in the number of

Table A.6: Changes in terms of trade and product diversification

Dependant variable: 10yr change in Terms of Trade	(1)	(2)	(3)	(4)	(5)
# of exports (10yr growth rate)	3.528**	3.718**	3.779**	3.291**	1.652**
	(1.468)	(1.483)	(1.493)	(1.512)	(0.789)
# of imports (10yr growth rate)	0.463	0.505	0.475	-0.158	0.325
	(2.312)	(2.313)	(2.317)	(2.335)	(0.973)
# of exports (initial level)	0.004	0.004	0.004	0.004	0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
# of imports (initial level)	-0.015***	-0.015***	-0.015***	-0.015***	-0.012**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
GDPpc (logs)		-0.560	-0.619	-0.532	-3.465
		(0.610)	(0.629)	(0.629)	(3.856)
Openness (initial level)			0.005	0.010	0.049
			(0.013)	(0.014)	(0.046)
Openness (10yr growth rate)				2.810*	1.456
				(1.559)	(3.042)
Constant	7.682***	11.413**	11.580**	10.668**	28.916
	(1.976)	(4.521)	(4.548)	(4.559)	(28.143)
Country-FE					Yes
Obs.	302	302	302	302	302
R^2	0.071	0.073	0.074	0.084	0.083

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Standard errors in parenthesis. Main variables computed using 4-digit data from Feenstra et al. (2005) for 1962-2000 and UNCOMTRADE for 2000-2010. Openness (measured as the value of trade over GDP) and GDPpc from PWT.

varieties available at the world level. Given that this exercise gives only one observation per period and industry, results at 6-digits are not presented as the very few resulting observations prevent proper mean tests.

Table A.7:
Differences in diversification rates (varieties)

	4-digits		
	$gM1 = gA1$	$gM2 = gA2$	$gM3 = gA3$
mean(gM)	0.026	0.023	0.028
sd(gM)	0.560	0.558	0.564
mean(gA)	-0.158	-0.139	-0.123
sd(gA)	0.441	0.450	0.460
Obs.	44	44	44
$Ha : gM < gA$	1.000	1.000	1.000
$Ha : gM \neq gA$	0.000	0.000	0.000
$Ha : gM > gA$	0.000	0.000	0.000

Notes: Each column presents the result of a mean-comparison t-test, where the null hypothesis is $g_{Mk} = g_{Ak}$ for $k = 1, 2, 3$. The first and third row give the mean of g_{Mk} and g_{Ak} respectively, while the second and fourth provide the respective standard deviation. The last three rows show the p-value of a t-test where the alternative hypothesis are $g_{Mk} < g_{Ak}$, $g_{Mk} \neq g_{Ak}$ and $g_{Mk} > g_{Ak}$ respectively.

5 Model with exogenous shares of expenditure between industries

While the mechanism put forward by this model is fundamentally technological, this section shows that uneven diversification rates between industries cannot reproduce a reverse-TTE when too many restrictions are imposed in consumers' preferences. In particular, if consumers are forced to devote an exogenous share of their expenditure to each industry ($\beta = 1$, so α is fixed and equal to ω_A), terms of trade cannot deteriorate for the lagging economy. Under such restrictions, preferences in (2) are reduced to a Cobb-Douglas specification, a widely used setting in both trade and growth literatures, so it is useful to analyze the results of the theory proposed here in this benchmark case. Moreover, this exercise puts forward interesting results regarding the mechanics of the model useful for the following section.

An exogenous α implies by definition $g_\alpha(t) = 0$, and also gives:

$$P(t) = P_A(t)^\alpha P_M(t)^{1-\alpha} B \quad \text{where} \quad B = \alpha^{-\alpha}(1-\alpha)^{\alpha-1} \tag{1}$$

Under this setting, imposing $E_N = 1$ yields constant expenditure in both regions ($g_{E,S} = g_{E,N} = 0$), by the trade balance condition (10). The Euler condition consumers follow in each region determines that the returns from savings in both countries must equal the time preference parameter. By equality of preferences among consumers from both regions we can establish $r_S = r_N = r = \rho$.

Equation (12) determines constant creation of new goods within each industry i. According to the pricing rule that firms follow, with constant shares of expenditure to each industry, profits for any given firm in sector i fall as the creation of new varieties reduces its market share, creating a competition effect within each industry ($g_{\pi i} = -g_i$). Nevertheless, aggregate profits in each sector ($\pi_i n_i$) are constant. Constant product creation in industry i also implies a time-unvarying ratio π_i/v_i (by 11), so $g_{vi} = g_{\pi i} = -g_i$. Then, the free-entry condition in (6) determines constant wages in both regions. As a result, this version of the model predicts no income divergence, as consumers' aggregate income is the sum of the mass of wages ($L_c w_c$) and aggregate firm's profits and both components remain unchanged over time. Constant wages in both regions has another important implication. Defining terms of trade for the South as p_A/p_M, it is possible to see that this ratio is constant, even in a context of uneven product creation between industries.

Even when costs and markups remain unchanged over time, constant creation of new products in industry i pushes the price of the CES composite in that industry to fall at rate $g_{Pi} = -g_i/(\sigma_i - 1)$. By (1), this results in a falling aggregate price level.

The predictions of this version of the model regarding welfare outcomes are straightforward. At the equilibrium path, constant expenditure and falling price indexes lead to real consumption growing in both regions. Since all consumers face the same prices across borders, they enjoy the same reduction in the price index over time, so the evolution of consumers' purchasing power is the same in both regions. This means that, even though the level of real consumption may differ between countries (due to different levels of constant expenditure), there is no divergence at the equilibrium path. Intuitively, the fact that consumers devote fixed shares of their expenditure to the different industries means that greater product creation in one of them does not contribute to revenue differences between industries. Since wages are constant in both regions, a parallel path for firms' revenues between economies implies that income grows at the same rate in both of them. Uneven diversification affects only the level of competition within-industry and therefore yields a larger reduction in sales for firms of the industry where creation is greater. In other words, the fact that S has specialized in an industry in which product expansion is less prolific, means that firms within that region face lower future entry from competing firms, but is innocuous in terms of its consumers' income and welfare. These conclusions can be summarized in the following result

RESULT 1 *With fixed expenditure shares to each industry product creation reduces prices and rises consumption in both regions at the same rate, so there is no divergence in income or welfare between them.*

At this point it is important to underline a fundamental difference between models of product creation and output growth that is relevant to the purpose of this paper. As shown above, specializing in a relatively laggard industry is not a sufficient condition for income or welfare to follow a divergent path in the present model. The same outcome appears in models with different sources of real income growth, as long as exogenous shares of expenditure between industries are imposed. The compensating mechanism however does depend on the type of growth we consider. To show this notice that a constant α yields a fixed expenditure ratio between sectors, so the relative value of production in each sector (i.e. $[Q_M P_M]/[Q_A P_A]$) must be constant. In a model of uneven output growth, the ratio Q_M/Q_A changes over time, but constant expenditure to each industry pushes relative prices to perfectly offset differences in quantities. If the technological gain is directed towards reducing costs, then is relative prices that change and quantities compensate. In the model presented here we obtain $(Q_M P_M)/(Q_A P_A) = (q_M p_M n_M)/(q_A p_A n_A)$. With constant relative wages, relative prices do not change over time. It is then clear that uneven product creation must be perfectly compensated by changes in the relative sales of the representative firm in each industry. The following result can be stated

RESULT 2 *With fixed expenditure shares to each industry, welfare results in the model of uneven product creation resemble those that would obtain in a similar model of technological improvements, but the adjustment mechanism is different. In the former, prices* *are constant, and unbalanced growth is perfectly offset by changes in relative quantities. In the latter, changes in prices offset changes in quantities.*

The previous result highlights that the type of growth considered affects the adjustment mechanism of the model. The implications of this conclusion to explain important development facts becomes evident in a context in which expenditure shares between sectors are endogenous.

6 Stability

6.1 Stability Condition

With values of E_c, v_i and n_i given by history ($\forall c = N, S$ and $i = A, M$), equation (6) gives w_i, which implies p_i is known and therefore the value of α is also known. Firms are able to compute their profits which amount to $\pi_M(t) = \frac{(1-\alpha)(E_S+1)}{\sigma n_M(t)}$ and $\pi_A(t) = \frac{\alpha(E_S+1)}{\sigma n_A(t)}$. Then, the full solution of the model can be expressed in terms of known variables π_i and v_i. The non-arbitrage condition can be rewritten as:

$$g_{v,i} = r_i - \frac{\pi_i}{v_i} \tag{2}$$

Using (6) and (8) gives an expression for the diversification rate in each sector:

$$g_i = \frac{L_c}{a_i} - (\sigma - 1)\frac{\pi_i}{v_i} \tag{3}$$

where $c = S$ if $i = A$ and $c = N$ if $i = M$. The above solution allows the ratio π_i/v_i to be time variant. In fact, for the North, were $r_N = \rho$ given the choice for the numeraire, it is possible to find that:

$$g_{\left[\frac{\pi}{v}\right]_M} = -g_M - g_{v,M} = \frac{\pi_M}{v_M} - g_M - \rho$$

According to this equation, the ratio π_M/v_M can only be constant if

$$g_M = -g_{v,M} = \frac{\pi_M}{v_M} - \rho$$

A similar condition can be derived for the South:

$$g_{\left[\frac{\pi}{v}\right]_A} = \frac{g_\alpha}{1-\alpha} - g_A - g_{v,A}$$

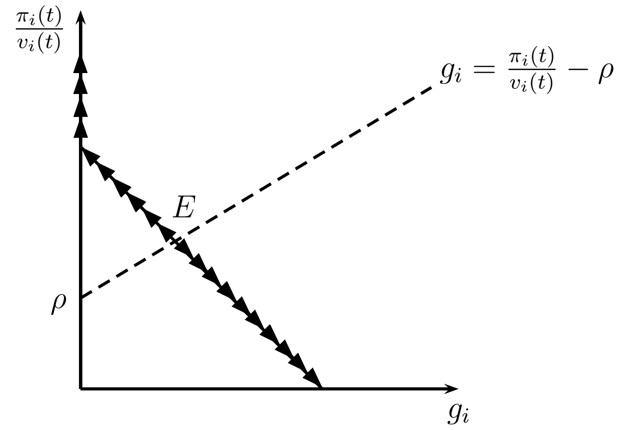
so the ratio π_A/v_A can only be constant if

$$g_A = \frac{g_\alpha}{1-\alpha} - g_{v,A} = \frac{g_\alpha}{1-\alpha} - r_S + \frac{\pi_A}{v_A} = \frac{\pi_A}{v_A} - \rho$$

were the last equality follows by using the Euler equation for expenditure and (13). Notice the same result would follow in the case in which α is a parameter. Then the ratio π_i/v_i is constant if

$$g_i = \frac{\pi_i}{v_i} - \rho \tag{4}$$

Figure A.2:
Stability in the equilibrium of the model



The equilibrium for both economies can therefore be represented in Figure A.2. The full line represents equation (3) which must hold in equilibrium. The dashed line in the figure represents the locus of points for which condition (4) holds. Arrows show the dynamics that the system follows. Notice that for a given value of $\frac{\pi_i}{v_i}$, if $g_i > \frac{\pi_i}{v_i} - \rho$ then $\frac{\pi_i}{v_i}$ falls until it reaches zero, a situation that can be regarded as infeasible since it implies all resources in the economy are devoted to the development of new products (R&D), but no final goods are being produced. If on the contrary $g_i < \frac{\pi_i}{v_i} - \rho$ then $\frac{\pi_i}{v_i}$ grows until $g_i = 0$. Theoretically nothing prevents diversification rates to be zero. If such situation is reached then (3) no longer holds and is replaced by $g_i = 0$. Then, as depicted in the figure, the ratio $\frac{\pi_i}{v_i}$ is free to continue growing indefinitely. This possibility is disregarded as is not supported by the empirical evidence presented here.

As a result, stability in this version of the model requires that the economy starts at the intersection of both lines and stays there, meaning the condition in (4) must hold.

6.2 Allowing S to follow an unstable trajectory

This section shows that the main results of the model also hold when the S follows an unstable path. Again, the stability condition in (11) is imposed to N, so the northern economy plays the role of the stable anchor in this model. The full solution for N is exactly the same as one where α is exogenous: diversification rate in M is constant and equals that in (12), firm profits and value are reduced by exactly that rate and wages and the return rate are constant.

For the S, equations (13)-(17) still hold, but the fact that the stability condition is not imposed in S, implies that the ratio π_A/v_A is not constant and can follow a divergent trajectory. The value of any firm in sector A (v_A) depends positively on r_S and π_A. While it was established that profits in A are decreasing over time, the time-path of v_A is also determined by how the return rate evolves over time, a path that is not determined in the model when the stability condition is not present. Indeed, notice that the ratio π_A/v_A can rise or fall, depending on the velocity with which firms' profit in that sector fall and the value of individual's discount factor.

The time path of the value of firms in A determines that of wages in S since, by the free-entry condition, $g_{wS} = g_A + g_{vA}$. The condition for wages in S to follow a decreasing trajectory is:

$$\begin{aligned} \frac{\pi_A(t)}{v_A(t)}\left[1+\frac{\sigma_A}{H}\right] > Z \quad \text{if} \quad \frac{H}{1+H} > 0 \\ \frac{\pi_A(t)}{v_A(t)}\left[1+\frac{\sigma_A}{H}\right] < Z \quad \text{if} \quad \frac{H}{1+H} < 0 \end{aligned} \tag{5}$$

with $Z = \frac{L_S}{a_A}\left[\frac{2-\sigma_A}{\sigma_A-1}+\frac{1+H}{H}\right] - \frac{L_N}{a_M}\left[\frac{2-\sigma_M}{\sigma_M-1}\right] - (\sigma_M-1)\frac{\pi_M}{v_M} + \frac{\rho(1+H)}{H}$. Wages in S rise if the previous condition is not met. Notice that, depending on the time path followed by the ratio $\pi_A(t)/v_A(t)$, an outcome in which the condition is met at some point in time, and not in another, can arise.

With aggregate profits falling in S, then decreasing wages represent a sufficient condition for falling income in that region. Notice that both variables are constant in N. The following result summarizes the findings regarding income divergence in this version of the model and replaces Result 2 in the main text:

Result 3 *The model is able to reproduce income divergence. Relative aggregate profits unequivocally fall in S and the same is true with wages if condition (5) is met. Otherwise, wages in S grow and in that case income divergence follows only if the fall in profits is large enough to compensate for rising wages.*

Finally, a condition for terms of trade in S to be decreasing over time can be established. Notice that equation (4) establishes that the only determinant for changes in relative prices are changes in relative wages. Since wages are constant in N the price of products created there are also time invariant. The price of final production in S evolves following wages in that region, and according to the previous result, they can fall when condition (5) is met. It is clear that the very requirement for wage divergence is also a necessary and sufficient condition for terms of trade to deteriorate for the South. Result 4 can be replaced by:

Result 4 *Terms of trade can improve or deteriorate for S. They deteriorate if wages in S fall over time, i.e. condition (5) is met. They improve if the opposite happens.*

Notice that a situation of terms of trade falling in S is also one in which aggregate income in that region falls with respect to that in N, since it has been already established that aggregate profits fall in S. Result 4 shows that relative prices can improve or deteriorate for the A-sector depending on the speed at which endogenous variables move.

7 Agricultural economies are outgrown by the rest

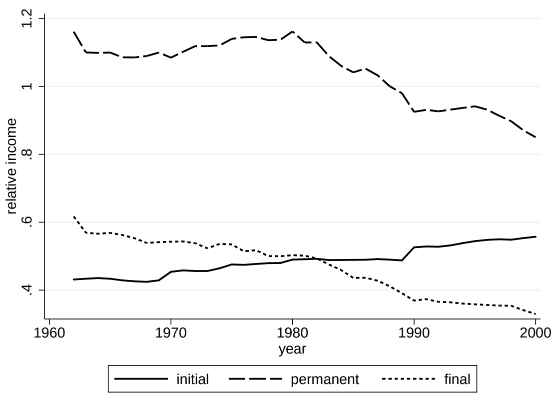
In this section, we analyse the growth path followed by A-countries during the period 1962-2000.[1] A-countries are defined by using two sets of dummy variables: variable Ak_j signals countries for which Ak-goods account at least $j\%$ of their total export, for more than 30 years in the time span analysed here, while Ak_j_end equals one when the share of Ak-goods exported by an economy is above $j\%$ at the end of the period (with $k = 1, 2, 3$ and $j = 30, 40, 50$). The list of A-countries can vary greatly depending on the criteria used: the list can range from 54 countries when $A3\_30 = 1$ to 15 when $A1\_50end = 1$. Finally, to signal countries that were important exporters of agricultural products at the beginning of the period, we set $Ak\_j\_ini = 1$ when share of Ai-goods exported is above $j\%$ at each country's initial year. A list of such countries can rise up to 131 (when $A3\_30ini = 1$).

Figure A.3 shows the per capita income (in constant prices) of A-countries relative to world average. Real income of agricultural exporters is represented by the dotted and dashed lines, the former considering countries that were large exporters of agricultural products at the end of the period ($A1\_30end = 1$) and the latter including a sample of countries that exported agricultural products to a large extent for a long period of time ($A1\_30 = 1$). The full line includes countries that were agricultural exporters only at the beginning of the period ($A1\_30ini = 1$).

This figure clearly shows that exporting a large share of A-goods at some moment in time does not necessarily prevent future income convergence. Notice that the bold line depicting the relative income of countries with initial specialization in A-goods exhibits an upward trend consistent with a reduction in the income gap between this set of countries and world average. Nevertheless the figure also shows that remaining specialized in A-goods over the period is positively correlated with lower growth: there is a clear divergent trend for the income per capita of exporters of A-goods in most years of the sample and also for those that finished the period being heavy exporters of those products. This result is robust to changing the variables used to define A-countries (similar pictures arise $\forall k = 1, 2, 3$ and $\forall j = 30, 40, 50$) and also to limiting the country sample to regions

[1]See Section C for a discussion on the time period.

Figure A.3: Evolution of per capita real income in A-countries relative the rest



Notes: Evolution of per capita GDP (constant prices) of A-countries (defined using A1 list, check Appendix) relative to sample average. The line *initial* shows the evolution of relative per capita GDP of countries for which the proportion of A1-exports was above 30% at the initial year ($A1\_30ini = 1$), *permanent* shows the same for countries for which exports in A1 where above the same threshold for 30 years or more ($A1\_30 = 1$), and *final* group those economies for which the same threshold is surpassed at the end of the period ($A1\_30end = 1$).

that were relatively rich at the beginning of the period.

The same result obtains when controlling for other growth determinants. We perform cross-country growth regressions using the growth rate of the whole period as dependent variable and including as controls all variables identified in Martin et al. (2004) as robust growth regressors. The controls selected in that work constitute a wide range of measures of basic growth fundamentals (initial wealth, investment costs, human capital, etc.), as well as indexes of institutional quality, regional, cultural and geographical characteristics. Table A.8 lists all controls used along with the description for each variable, and provides the source were the data can be found.

The first column in Table A.9 shows how the baseline regression looks like when all 20 controls are included. The rest of the table presents results for similar specifications but replacing geographical and regional dummies by indicators signalling A-countries. For this task, we use variable $A1\_jend$ which signals countries for which the share of $A1$-goods exported is above $j\%$ (with $j = 30, 40, 50$) at the end of the period (year 2000). In columns (2)-(4) variables excluded are those strictly geographical. For columns (5)-(7), even more controls related with geographical factors and therefore closely linked with the type of specialization of an economy are excluded. Results show that the variable indicating economies that remained specialized in A during the period 1962-2000 is highly significant and negative in most specifications.

Similar results are obtained using alternative variables to signal A-countries. Tables A.10-A.14 present results for the same specifications in Table A.9 but using different indicators for A-countries. As these tables show, using different indicators for agricultural economies, still yields significantly negative coefficients for the indicator. The result that

Table A.8: Controls used in growth regressions

var name	Description	Data source
East-Asia	Dummy for East-Asian countries.	Own construction following https://en.wikipedia.org/wiki/East_Asia
Primary enrol. rate	Enrolment rate in primary education (avg. 1962-1972).	Own construction using SE.PRM.TENR in WDI
Investment price PPP	Investment price level (avg. 1960-1964) PPP.	pi in PWT6.3 in Heston et al. (2011)
GDPpc (logs)	Log of GDP per capita in 1960.	rgdpl PWT6.3 in Heston et al. (2011)
Tropic land	Proportion of country's land area within geographical tropics.	lnd100km in geodata.dta in Gallup et al. (2010)
Coastal pop.	Coastal (within 100 km of coastline) population per coastal area in 1960's 1965.	dens65c in geodata.dta in Gallup et al. (2010)
Malaria prevalence	Index of malaria prevalence in 1966.	Mal66a in malaria.dta in Gallup et al. (2010)
Life Expectancy	Life expectancy in 1960.	X2 in Sala-i Martin (1997)
Confucian pop.	Fraction of population Confucian in 1960.	X53 in Sala-i Martin (1997)
S-S Africa	Dummy for Sub-Saharan African countries.	X4 in Sala-i Martin (1997)
LATAM	Dummy for Latin American countries.	X5 in Sala-i Martin (1997)
Mining GDP	Fraction of GDP in mining.	X59 in Sala-i Martin (1997)
Frm Spanish colony	Dummy for former Spanish colonies.	X50 in Sala-i Martin (1997)
Years open	Number of years economy has been open between 1950 and 1994.	X23 in Sala-i Martin (1997)
Muslim pop.	Fraction of population Muslim in 1960.	X56 in Sala-i Martin (1997)
Buddhist pop.	Fraction of population Buddhist in 1960.	X51 in Sala-i Martin (1997)
Linguistic diffs.	Average of five different indices of ethnolinguistic fractionalization which is the probability of two random people in a country not speaking the same language.	muller in othervar.dta in Easterly and Levine (1997)
Gov. expenditure	Share of expenditures on government consumption to GDP in 1961.	NE.CON.GOVT.ZS in WDI
Pop. density	Population per area in 1960.	EN.POP.DNST in WDI
RER distortions	Real exchange rate distortions.	X41 in Sala-i Martin (1997)

Table A.9: Cross-country growth regressions (A1-list 2000)

Dependant variable:	growth rate 1962-2000						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
East-Asia	-63.801						
	(44.963)						
Primary enrol. rate	0.005	0.009	0.007	0.004	0.011*	0.005	0.002
	(0.009)	(0.007)	(0.010)	(0.008)	(0.005)	(0.007)	(0.007)
Investment price PPP	0.000	-0.001	0.002	0.003	-0.002	-0.001	-0.001
	(0.003)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
GDPpc (logs)	-0.032	-0.506	-0.338	-0.253	-0.540***	-0.645***	-0.660***
	(0.287)	(0.299)	(0.399)	(0.194)	(0.150)	(0.200)	(0.209)
Tropic land	0.211	0.176	0.246	0.463			
	(0.293)	(0.345)	(0.415)	(0.307)			
Coastal pop.	0.002	0.001	0.003	0.004	0.001	0.001	0.002
	(0.007)	(0.006)	(0.007)	(0.005)	(0.003)	(0.003)	(0.004)
Malaria prevalence	0.182	0.194	0.343	0.095			
	(0.353)	(0.368)	(0.403)	(0.293)			
Life expectancy	0.025	0.047**	0.043	0.014	0.034**	0.052**	0.053**
	(0.028)	(0.021)	(0.032)	(0.024)	(0.014)	(0.021)	(0.020)
Confucian pop.	151.065	8.653	0.334	5.654			
	(97.905)	(7.055)	(9.137)	(5.870)			
S-S Africa	-0.298						
	(0.807)						
LATAM	0.557						
	(0.527)						
Mining GDP	-2.925	-2.823	-2.446	-2.043	-2.553*	-1.483	-1.153
	(2.349)	(1.838)	(2.203)	(1.229)	(1.394)	(1.548)	(1.559)
Frm Spanish colony	-0.644***	0.215	-0.131	-0.459**			
	(0.194)	(0.262)	(0.258)	(0.163)			
Years open	0.481	0.253	0.250	0.362*	0.331	0.300	0.291
	(0.412)	(0.240)	(0.263)	(0.176)	(0.196)	(0.214)	(0.319)
Muslim pop.	0.692	0.290	0.421	0.061			
	(0.558)	(0.274)	(0.331)	(0.219)			
Buddhist pop.	73.955	0.404	0.210	0.137			
	(51.676)	(0.230)	(0.270)	(0.256)			
Linguistic diffs.	0.749	0.798***	0.462	-0.176	0.415	0.360	0.013
	(0.458)	(0.249)	(0.345)	(0.343)	(0.251)	(0.264)	(0.315)
Gov. expenditure	0.038*	0.027	-0.004	-0.010	0.012	0.007	0.025
	(0.021)	(0.026)	(0.029)	(0.026)	(0.018)	(0.020)	(0.026)
Pop. density	-0.003	-0.002	-0.003	-0.005	-0.001	-0.001	-0.002
	(0.007)	(0.006)	(0.007)	(0.005)	(0.003)	(0.003)	(0.004)
RER distortions	0.002	0.001	0.001	-0.001	0.001	0.003	-0.001
	(0.004)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
A1_30_00		-0.651**			-0.606***		
		(0.274)			(0.138)		
A1_40_00			-0.385			-0.603***	
			(0.290)			(0.184)	
A1_50_00				-0.835***			-0.784***
				(0.166)			(0.143)
Constant	-2.152	0.917	0.006	1.622	2.197**	2.304**	2.803**
	(2.399)	(2.105)	(2.547)	(1.565)	(0.837)	(0.980)	(1.306)
Obs.	33	33	33	33	33	33	33
R^2	0.905	0.861	0.822	0.889	0.817	0.784	0.791

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources.

agricultural economies tend grow less than other economies with other similar characteristics is robust to that choice.

These results indicate that, even controlling for other robust growth determinants, having remained specialized in A-goods is negatively related to growth. A-countries tend to have lower growth rates over the period analysed here than countries with otherwise

Table A.10: Cross country growth regressions (A2-list 2000)

Dependant variable:	growth rate 1962-2000						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
East-Asia	-63.801						
	(44.963)						
Primary enrol. rate	0.005	-0.000	0.007	0.004	-0.000	0.005	0.002
	(0.009)	(0.008)	(0.010)	(0.008)	(0.006)	(0.007)	(0.007)
Investment price PPP	0.000	-0.001	0.002	0.003	-0.004	-0.001	-0.001
	(0.003)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
GDPpc (logs)	-0.032	-0.552	-0.338	-0.253	-0.770***	-0.645***	-0.660***
	(0.287)	(0.320)	(0.399)	(0.194)	(0.192)	(0.200)	(0.209)
Tropic land	0.211	0.242	0.246	0.463			
	(0.293)	(0.351)	(0.415)	(0.307)			
Coastal pop.	0.002	0.001	0.003	0.004	0.002	0.001	0.002
	(0.007)	(0.006)	(0.007)	(0.005)	(0.004)	(0.003)	(0.004)
Malaria prevalence	0.182	0.381	0.343	0.095			
	(0.353)	(0.342)	(0.403)	(0.293)			
Life expectancy	0.025	0.076**	0.043	0.014	0.073***	0.052**	0.053**
	(0.028)	(0.031)	(0.032)	(0.024)	(0.020)	(0.021)	(0.020)
Confucian pop.	151.065	11.171	0.334	5.654			
	(97.905)	(9.533)	(9.137)	(5.870)			
S-S Africa	-0.298						
	(0.807)						
LATAM	0.557						
	(0.527)						
Mining GDP	-2.925	-3.371*	-2.446	-2.043	-2.554*	-1.483	-1.153
	(2.349)	(1.825)	(2.203)	(1.229)	(1.430)	(1.548)	(1.559)
Frm Spanish colony	-0.644***	0.033	-0.131	-0.459**			
	(0.194)	(0.288)	(0.258)	(0.163)			
Years open	0.481	0.088	0.250	0.362*	0.195	0.300	0.291
	(0.412)	(0.313)	(0.263)	(0.176)	(0.247)	(0.214)	(0.319)
Muslim pop.	0.692	0.475	0.421	0.061			
	(0.558)	(0.272)	(0.331)	(0.219)			
Buddhist pop.	73.955	0.494	0.210	0.137			
	(51.676)	(0.287)	(0.270)	(0.256)			
Linguistic diffs.	0.749	0.780*	0.462	-0.176	0.415	0.360	0.013
	(0.458)	(0.398)	(0.345)	(0.343)	(0.332)	(0.264)	(0.315)
Gov. expenditure	0.038*	0.019	-0.004	-0.010	0.019	0.007	0.025
	(0.021)	(0.032)	(0.029)	(0.026)	(0.022)	(0.020)	(0.026)
Pop. density	-0.003	-0.002	-0.003	-0.005	-0.002	-0.001	-0.002
	(0.007)	(0.006)	(0.007)	(0.005)	(0.004)	(0.003)	(0.004)
RER distortions	0.002	-0.002	0.001	-0.001	-0.000	0.003	-0.001
	(0.004)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
A2_30_00		-0.427*			-0.443***		
		(0.220)			(0.145)		
A2_40_00			-0.385			-0.603***	
			(0.290)			(0.184)	
A2_50_00				-0.835***			-0.784***
				(0.166)			(0.143)
Constant	-2.152	0.755	0.006	1.622	3.005**	2.304**	2.803**
	(2.399)	(1.959)	(2.547)	(1.565)	(1.117)	(0.980)	(1.306)
Obs.	33	33	33	33	33	33	33
R^2	0.905	0.829	0.822	0.889	0.753	0.784	0.791

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources.

similar characteristics.

Table A.15 presents an exercise to test how important the indicator of A-countries can be in growth regressions. The first column presents a regression with all 20 variables selected in Martin et al. (2004), plus the main indicator $A1\_30end$. The following specifications (columns 2-13) remove, one by one, the variable that turns out to be the

Table A.11: Cross country growth regressions (A3-list 2000)

Dependant variable:	growth rate 1962-2000						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
East-Asia	-63.801						
	(44.963)						
Primary enrol. rate	0.005	-0.001	0.007	0.008	-0.002	0.005	0.005
	(0.009)	(0.009)	(0.010)	(0.008)	(0.006)	(0.007)	(0.005)
Investment price PPP	0.000	-0.001	0.002	0.004	-0.004	-0.001	0.001
	(0.003)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
GDPpc (logs)	-0.032	-0.491	-0.338	-0.369	-0.746***	-0.645***	-0.732***
	(0.287)	(0.311)	(0.399)	(0.247)	(0.197)	(0.200)	(0.190)
Tropic land	0.211	0.282	0.246	0.316			
	(0.293)	(0.348)	(0.415)	(0.301)			
Coastal pop.	0.002	0.003	0.003	0.001	0.003	0.001	-0.000
	(0.007)	(0.006)	(0.007)	(0.005)	(0.004)	(0.003)	(0.003)
Malaria prevalence	0.182	0.381	0.343	0.230			
	(0.353)	(0.346)	(0.403)	(0.298)			
Life expectancy	0.025	0.073**	0.043	0.038	0.075***	0.052**	0.061***
	(0.028)	(0.031)	(0.032)	(0.025)	(0.019)	(0.021)	(0.016)
Confucian pop.	151.065	11.291	0.334	4.468			
	(97.905)	(10.394)	(9.137)	(6.696)			
S-S Africa	-0.298						
	(0.807)						
LATAM	0.557						
	(0.527)						
Mining GDP	-2.925	-3.407*	-2.446	-3.007*	-2.533	-1.483	-1.951
	(2.349)	(1.880)	(2.203)	(1.473)	(1.478)	(1.548)	(1.339)
Frm Spanish colony	-0.644***	-0.015	-0.131	-0.268			
	(0.194)	(0.284)	(0.258)	(0.193)			
Years open	0.481	0.156	0.250	0.039	0.251	0.300	0.004
	(0.412)	(0.324)	(0.263)	(0.207)	(0.267)	(0.214)	(0.215)
Muslim pop.	0.692	0.474	0.421	0.316			
	(0.558)	(0.275)	(0.331)	(0.213)			
Buddhist pop.	73.955	0.466	0.210	0.130			
	(51.676)	(0.309)	(0.270)	(0.252)			
Linguistic diffs.	0.749	0.754*	0.462	0.154	0.428	0.360	0.094
	(0.458)	(0.385)	(0.345)	(0.326)	(0.330)	(0.264)	(0.306)
Gov. expenditure	0.038*	0.019	-0.004	-0.022	0.023	0.007	-0.002
	(0.021)	(0.035)	(0.029)	(0.027)	(0.023)	(0.020)	(0.021)
Pop. density	-0.003	-0.004	-0.003	-0.002	-0.003	-0.001	0.000
	(0.007)	(0.006)	(0.007)	(0.005)	(0.004)	(0.003)	(0.004)
RER distortions	0.002	-0.001	0.001	-0.001	0.000	0.003	-0.001
	(0.004)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
A3_30_00		-0.385*			-0.419***		
		(0.211)			(0.137)		
A3_40_00			-0.385			-0.603***	
			(0.290)			(0.184)	
A3_50_00				-0.633***			-0.779***
				(0.148)			(0.122)
Constant	-2.152	0.356	0.006	1.099	2.687**	2.304**	3.076**
	(2.399)	(1.870)	(2.547)	(1.622)	(1.179)	(0.980)	(1.197)
Obs.	33	33	33	33	33	33	33
R^2	0.905	0.823	0.822	0.883	0.746	0.784	0.829

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources.

least significant in the previous regression (largest p-value). Variables that are significant at a 10% confidence level are not removed so the exercise ends when all variables have reached that significance level. As can be seen, the variable signalling A-countries is never dropped out in this exercise and it remains within the group of significant regressors even when there is only five variables left. Moreover, the main variable is one of the few that

Table A.12: Cross country growth regressions (A1-list permanent)

Dependant variable:	growth rate 1962-2000						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
East-Asia	-63.801						
	(44.963)						
Primary enrol. rate	0.005	0.000	0.004	0.005	-0.004	0.004	0.002
	(0.009)	(0.008)	(0.012)	(0.011)	(0.006)	(0.008)	(0.008)
Investment price PPP	0.000	-0.001	-0.001	0.003	-0.005*	-0.003	-0.002
	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.002)	(0.003)
GDPpc (logs)	-0.032	-0.414	-0.497	-0.252	-0.783***	-0.656***	-0.668***
	(0.287)	(0.318)	(0.356)	(0.261)	(0.200)	(0.204)	(0.235)
Tropic land	0.211	0.284	0.265	0.508			
	(0.293)	(0.252)	(0.351)	(0.346)			
Coastal pop.	0.002	0.002	0.001	0.003	0.000	-0.002	-0.001
	(0.007)	(0.005)	(0.007)	(0.007)	(0.004)	(0.003)	(0.004)
Malaria prevalence	0.182	0.393	0.253	0.388			
	(0.353)	(0.328)	(0.362)	(0.332)			
Life expectancy	0.025	0.062**	0.056	0.041	0.081***	0.054**	0.060**
	(0.028)	(0.029)	(0.034)	(0.031)	(0.018)	(0.024)	(0.022)
Confucian pop.	151.065	5.819	2.106	1.688			
	(97.905)	(7.170)	(8.379)	(7.075)			
S-S Africa	-0.298						
	(0.807)						
LATAM	0.557						
	(0.527)						
Mining GDP	-2.925	-3.349*	-2.663	-4.018**	-2.253*	-2.267	-3.100*
	(2.349)	(1.865)	(1.928)	(1.710)	(1.250)	(1.403)	(1.590)
Frm Spanish colony	-0.644***	-0.167	0.110	-0.098			
	(0.194)	(0.223)	(0.300)	(0.194)			
Years open	0.481	0.070	0.122	0.025	0.080	0.157	0.000
	(0.412)	(0.269)	(0.221)	(0.231)	(0.194)	(0.177)	(0.278)
Muslim pop.	0.692	0.453	0.357	0.510**			
	(0.558)	(0.267)	(0.278)	(0.228)			
Buddhist pop.	73.955	0.124	0.214	0.110			
	(51.676)	(0.232)	(0.285)	(0.293)			
Linguistic diffs.	0.749	0.217	0.528	0.376	-0.014	0.246	0.123
	(0.458)	(0.399)	(0.342)	(0.351)	(0.370)	(0.281)	(0.357)
Gov. expenditure	0.038*	-0.026	0.003	-0.015	-0.013	-0.002	-0.001
	(0.021)	(0.024)	(0.026)	(0.026)	(0.023)	(0.019)	(0.025)
Pop. density	-0.003	-0.002	-0.001	-0.004	-0.001	0.002	0.001
	(0.007)	(0.005)	(0.007)	(0.007)	(0.004)	(0.003)	(0.004)
RER distortions	0.002	0.002	0.002	-0.001	0.004	0.003	-0.001
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
A1_30_30yr		-0.487**			-0.618***		
		(0.177)			(0.153)		
A1_40_30yr			-0.575*			-0.643***	
			(0.321)			(0.165)	
A1_50_30yr				-0.459**			-0.554***
				(0.187)			(0.181)
Constant	-2.152	0.681	0.812	-0.146	3.297***	2.776**	3.086**
	(2.399)	(1.995)	(2.329)	(1.938)	(1.152)	(1.030)	(1.425)
Obs.	33	33	33	33	33	33	33
R^2	0.905	0.856	0.843	0.846	0.795	0.804	0.753

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources.

presents significant coefficients in all specifications. Again, this result is robust to the use of alternative variables signalling A-countries. Notice that the number of observations increases as variables are removed. This is so because relevant information is not available for many countries. In particular, detailed information on education in the 60's or 70's is limited to a very small sample of countries. Specifications with fewer controls show that

Table A.13: Cross country growth regressions (A2-list permanent)

Dependant variable:	growth rate 1962-2000						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
East-Asia	-63.801						
	(44.963)						
Primary enrol. rate	0.005	-0.001	-0.010	0.005	-0.005	-0.007	0.002
	(0.009)	(0.009)	(0.007)	(0.011)	(0.006)	(0.005)	(0.008)
Investment price PPP	0.000	-0.002	-0.003	0.003	-0.006*	-0.004	-0.002
	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.002)	(0.003)
GDPpc (logs)	-0.032	-0.493	-0.778**	-0.252	-0.848***	-0.801***	-0.668***
	(0.287)	(0.355)	(0.302)	(0.261)	(0.208)	(0.158)	(0.235)
Tropic land	0.211	0.364	0.162	0.508			
	(0.293)	(0.270)	(0.272)	(0.346)			
Coastal pop.	0.002	0.001	-0.004	0.003	0.000	-0.003	-0.001
	(0.007)	(0.005)	(0.005)	(0.007)	(0.004)	(0.003)	(0.004)
Malaria prevalence	0.182	0.303	0.267	0.388			
	(0.353)	(0.339)	(0.297)	(0.332)			
Life expectancy	0.025	0.072*	0.096***	0.041	0.091***	0.076***	0.060**
	(0.028)	(0.034)	(0.025)	(0.031)	(0.021)	(0.016)	(0.022)
Confucian pop.	151.065	10.560	7.080	1.688			
	(97.905)	(9.279)	(8.007)	(7.075)			
S-S Africa	-0.298						
	(0.807)						
LATAM	0.557						
	(0.527)						
Mining GDP	-2.925	-3.777*	-2.151	-4.018**	-2.547*	-1.864	-3.100*
	(2.349)	(1.821)	(1.864)	(1.710)	(1.237)	(1.236)	(1.590)
Frm Spanish colony	-0.644***	-0.143	0.294	-0.098			
	(0.194)	(0.236)	(0.233)	(0.194)			
Years open	0.481	0.021	0.070	0.025	0.049	0.202	0.000
	(0.412)	(0.294)	(0.187)	(0.231)	(0.201)	(0.170)	(0.278)
Muslim pop.	0.692	0.461	0.415**	0.510**			
	(0.558)	(0.272)	(0.189)	(0.228)			
Buddhist pop.	73.955	0.159	0.462*	0.110			
	(51.676)	(0.246)	(0.216)	(0.293)			
Linguistic diffs.	0.749	0.418	0.710**	0.376	0.186	0.242	0.123
	(0.458)	(0.412)	(0.297)	(0.351)	(0.387)	(0.284)	(0.357)
Gov. expenditure	0.038*	-0.016	0.009	-0.015	-0.004	-0.006	-0.001
	(0.021)	(0.026)	(0.021)	(0.026)	(0.024)	(0.019)	(0.025)
Pop. density	-0.003	-0.002	0.003	-0.004	-0.001	0.003	0.001
	(0.007)	(0.005)	(0.005)	(0.007)	(0.004)	(0.003)	(0.004)
RER distortions	0.002	0.002	0.002	-0.001	0.004	0.003	-0.001
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
A2_30_30yr		-0.483*			-0.570***		
		(0.230)			(0.168)		
A2_40_30yr			-0.810***			-0.716***	
			(0.207)			(0.148)	
A2_50_30yr				-0.459**			-0.554***
				(0.187)			(0.181)
Constant	-2.152	0.800	2.190	-0.146	3.200**	3.755***	3.086**
	(2.399)	(2.083)	(1.907)	(1.938)	(1.184)	(0.794)	(1.425)
Obs.	33	33	33	33	33	33	33
R^2	0.905	0.844	0.893	0.846	0.771	0.828	0.753

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources.

the conclusion that specialization in agricultural production is related to lower growth is not driven by a small country sample. Table A.16 shows the result of a similar exercise using nominal income instead of real income since this approximates better the specification in the theory presented in this paper. The same conclusion remains. Overall, these results indicate that there is robust correlation between having remained specialized in

Table A.14: Cross country growth regressions (A3-list permanent)

Dependant variable:	growth rate 1962-2000						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
East-Asia	-63.801						
	(44.963)						
Primary enrol. rate	0.005	-0.003	-0.008	0.005	-0.010	-0.010	0.002
	(0.009)	(0.010)	(0.013)	(0.011)	(0.006)	(0.006)	(0.008)
Investment price PPP	0.000	-0.002	-0.001	0.003	-0.007**	-0.005*	-0.002
	(0.003)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
GDPpc (logs)	-0.032	-0.450	-0.563	-0.252	-0.846***	-0.799***	-0.668***
	(0.287)	(0.290)	(0.353)	(0.261)	(0.212)	(0.194)	(0.235)
Tropic land	0.211	0.336	0.189	0.508			
	(0.293)	(0.259)	(0.324)	(0.346)			
Coastal pop.	0.002	0.003	0.001	0.003	0.001	0.001	-0.001
	(0.007)	(0.005)	(0.006)	(0.007)	(0.004)	(0.004)	(0.004)
Malaria prevalence	0.182	0.317	0.464	0.388			
	(0.353)	(0.321)	(0.317)	(0.332)			
Life expectancy	0.025	0.074**	0.086**	0.041	0.101***	0.086***	0.060**
	(0.028)	(0.032)	(0.040)	(0.031)	(0.020)	(0.018)	(0.022)
Confucian pop.	151.065	2.324	6.404	1.688			
	(97.905)	(6.585)	(8.217)	(7.075)			
S-S Africa	-0.298						
	(0.807)						
LATAM	0.557						
	(0.527)						
Mining GDP	-2.925	-3.462*	-2.800	-4.018**	-2.459*	-2.244*	-3.100*
	(2.349)	(1.688)	(1.910)	(1.710)	(1.232)	(1.285)	(1.590)
Frm Spanish colony	-0.644***	-0.124	0.007	-0.098			
	(0.194)	(0.221)	(0.278)	(0.194)			
Years open	0.481	0.126	0.055	0.025	0.134	0.110	0.000
	(0.412)	(0.271)	(0.315)	(0.231)	(0.214)	(0.233)	(0.278)
Muslim pop.	0.692	0.476*	0.419	0.510**			
	(0.558)	(0.247)	(0.262)	(0.228)			
Buddhist pop.	73.955	0.043	0.416	0.110			
	(51.676)	(0.289)	(0.319)	(0.293)			
Linguistic diffs.	0.749	0.462	0.471	0.376	0.303	0.156	0.123
	(0.458)	(0.372)	(0.319)	(0.351)	(0.349)	(0.311)	(0.357)
Gov. expenditure	0.038*	-0.004	0.001	-0.015	0.011	0.003	-0.001
	(0.021)	(0.028)	(0.027)	(0.026)	(0.020)	(0.024)	(0.025)
Pop. density	-0.003	-0.004	-0.002	-0.004	-0.001	-0.001	0.001
	(0.007)	(0.005)	(0.006)	(0.007)	(0.004)	(0.004)	(0.004)
RER distortions	0.002	0.003	0.000	-0.001	0.004	0.002	-0.001
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
A3_30_30yr		-0.438**			-0.598***		
		(0.175)			(0.138)		
A3_40_30yr			-0.522*			-0.590***	
			(0.284)			(0.167)	
A3_50_30yr				-0.459**			-0.554***
				(0.187)			(0.181)
Constant	-2.152	0.199	0.981	-0.146	2.825**	3.387**	3.086**
	(2.399)	(1.578)	(2.120)	(1.938)	(1.259)	(1.223)	(1.425)
Obs.	33	33	33	33	33	33	33
R^2	0.905	0.847	0.839	0.846	0.793	0.781	0.753

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources.

agricultural production and slow growth relative to other countries with similar values of all other growth determinants during this period.

Table A.15: Evaluating importance of *A*-countries dummy in growth regressions

Dependant variable:	growth rate 1962-2000										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Primary enrol. rate	0.010	0.010	0.010	0.010	0.003						
	(0.182)	(0.137)	(0.141)	(0.151)	(0.700)						
Investment price PPP	0.001	0.001									
	(0.892)	(0.873)									
GDPpc (logs)	-0.366	-0.368	-0.384*	-0.422**	-0.438**	-0.325***	-0.326***	-0.288***	-0.279***	-0.278***	-0.283***
	(0.183)	(0.165)	(0.076)	(0.021)	(0.032)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tropic land	0.268	0.269	0.251	0.212	0.352*	0.231*	0.231*	0.176	0.175	0.156	
	(0.396)	(0.379)	(0.282)	(0.208)	(0.054)	(0.067)	(0.065)	(0.109)	(0.112)	(0.156)	
Coastal pop.	0.002	0.002	0.002								
	(0.697)	(0.689)	(0.674)								
Malaria prevalence	0.267	0.275	0.249	0.225	0.179	0.007					
	(0.430)	(0.320)	(0.264)	(0.287)	(0.474)	(0.974)					
Life expectancy	0.036*	0.037*	0.038**	0.039**	0.047**	0.038***	0.038***	0.037***	0.036***	0.036***	0.038***
	(0.094)	(0.051)	(0.015)	(0.015)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Confucian pop.	6.769	6.883	7.173	8.853	8.743*	4.918***	4.910***	2.901***	2.887***	2.701***	2.780***
	(0.361)	(0.319)	(0.281)	(0.133)	(0.063)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mining GDP	-3.083*	-3.076*	-3.084*	-3.168*	-2.219	-0.217	-0.220	0.351			
	(0.096)	(0.085)	(0.070)	(0.061)	(0.163)	(0.820)	(0.816)	(0.681)			
Years open	0.275	0.275	0.260	0.248	0.210	0.419**	0.419**	0.352**	0.340**	0.320**	0.330**
	(0.279)	(0.261)	(0.255)	(0.283)	(0.365)	(0.018)	(0.019)	(0.012)	(0.015)	(0.022)	(0.017)
Muslim pop.	0.343	0.342	0.336	0.323	0.188	0.321*	0.320*	0.302**	0.297**	0.290**	0.281**
	(0.224)	(0.210)	(0.186)	(0.188)	(0.440)	(0.058)	(0.059)	(0.027)	(0.031)	(0.034)	(0.037)
Buddhist pop.	0.284	0.290*	0.305**	0.317**	0.337**	0.429**	0.428**	0.606***	0.610***	0.571***	0.605***
	(0.210)	(0.087)	(0.046)	(0.045)	(0.020)	(0.023)	(0.024)	(0.003)	(0.003)	(0.003)	(0.001)
Linguistic diffs.	0.633**	0.635**	0.633**	0.675**	0.609*	0.020	0.020				
	(0.048)	(0.035)	(0.029)	(0.033)	(0.075)	(0.933)	(0.931)				
Gov. expenditure	0.011	0.011	0.013	0.011							
	(0.580)	(0.551)	(0.476)	(0.536)							
Pop. density	-0.003	-0.003	-0.003	-0.001	-0.001*	-0.000	-0.000*	-0.000	-0.000		
	(0.614)	(0.602)	(0.577)	(0.157)	(0.078)	(0.112)	(0.098)	(0.454)	(0.441)		
RER distortions	0.000										
	(0.944)										
A1_30_00	-0.513***	-0.511***	-0.514***	-0.539***	-0.582***	-0.222*	-0.221*	-0.207**	-0.216**	-0.219**	-0.225**
	(0.007)	(0.005)	(0.003)	(0.000)	(0.000)	(0.064)	(0.055)	(0.033)	(0.028)	(0.025)	(0.017)
Constant	0.413	0.427	0.557	0.896	1.189	0.845	0.861**	0.640*	0.646*	0.654*	0.643*
	(0.837)	(0.827)	(0.721)	(0.435)	(0.352)	(0.228)	(0.042)	(0.066)	(0.067)	(0.064)	(0.065)
Obs.	33	33	33	33	37	72	72	92	92	93	95
R^2	0.854	0.854	0.854	0.851	0.791	0.695	0.695	0.698	0.698	0.696	0.694

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. All estimations using heteroskedasticity-consistent standard errors. p-values in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources. A-countries defined as those for which the share of exports in A1-goods is larger than 30% in 2000.

Table A.16: Evaluating importance of *A*-countries dummy in growth regressions with nominal income

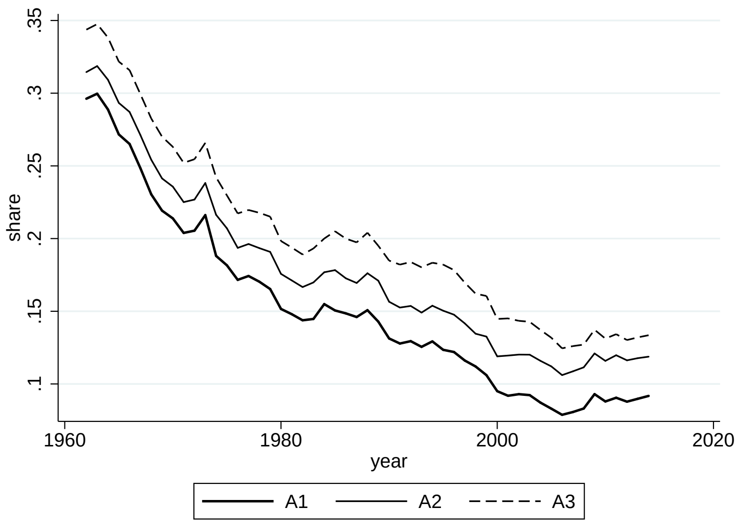
Dependant variable:	growth rate 1962-2000										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Primary enrol. rate	0.004	0.004	0.003								
	(0.730)	(0.621)	(0.657)								
Investment price PPP	-0.003	-0.005	-0.004	-0.000	-0.000	-0.000	-0.000	-0.000			
	(0.403)	(0.183)	(0.331)	(0.106)	(0.153)	(0.150)	(0.316)	(0.300)			
Nominal GDPpc (log)	-0.534**	-0.256	-0.271	-0.247*	-0.259*	-0.255*	-0.353**	-0.365***	-0.372***	-0.371***	-0.390***
	(0.038)	(0.240)	(0.231)	(0.083)	(0.077)	(0.078)	(0.014)	(0.004)	(0.002)	(0.002)	(0.001)
Tropic land	0.046	0.298	0.293	0.240	0.244	0.248	0.233	0.235	0.243*	0.224	
	(0.809)	(0.183)	(0.162)	(0.137)	(0.138)	(0.129)	(0.113)	(0.110)	(0.092)	(0.126)	
Coastal pop.	-0.009**	-0.004	-0.005	0.002*	0.002*	0.002*	0.002*	0.001*	0.002*	0.002**	0.002**
	(0.031)	(0.338)	(0.264)	(0.095)	(0.068)	(0.061)	(0.053)	(0.062)	(0.056)	(0.048)	(0.043)
Malaria prevalence	0.299	0.258	0.290	0.276	0.270	0.268	0.083				
	(0.370)	(0.396)	(0.273)	(0.228)	(0.256)	(0.256)	(0.703)				
Life expectancy	0.080**	0.049**	0.050**	0.053***	0.053***	0.053***	0.062***	0.061***	0.061***	0.057***	0.061***
	(0.023)	(0.034)	(0.026)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Confucian pop.	19.294**	14.175*	14.946*	2.154**	2.191**	2.176**	3.223***	3.253***	3.239***	3.049***	3.082***
	(0.046)	(0.078)	(0.061)	(0.036)	(0.029)	(0.028)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mining GDP	-4.405**	-3.725**	-3.690**	0.176	0.161						
	(0.020)	(0.019)	(0.016)	(0.842)	(0.857)						
Years open	0.035	0.172	0.194	0.660***	0.678***	0.675***	0.595***	0.588***	0.601***	0.614***	0.616***
	(0.847)	(0.443)	(0.371)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Muslim pop.	0.291	0.137	0.133	0.184	0.179	0.182	0.255	0.242	0.249		
	(0.275)	(0.560)	(0.576)	(0.283)	(0.284)	(0.268)	(0.117)	(0.168)	(0.147)		
Buddhist pop.	1.255***	1.163***	1.194***	0.102							
	(0.001)	(0.000)	(0.000)	(0.863)							
Linguistic diffs.	0.830***	0.588*	0.584*	-0.195	-0.195	-0.189					
	(0.004)	(0.077)	(0.079)	(0.482)	(0.477)	(0.484)					
Gov. expenditure	-0.001										
	(0.951)										
Pop. density	0.007*	0.003	0.004	-0.002*	-0.002*	-0.002*	-0.002*	-0.002*	-0.002*	-0.002**	-0.002**
	(0.054)	(0.445)	(0.366)	(0.088)	(0.063)	(0.056)	(0.050)	(0.059)	(0.053)	(0.047)	(0.047)
RER distortions	0.000	0.002									
	(0.929)	(0.635)									
A1_30_00	-0.687***	-0.790***	-0.786***	-0.321***	-0.325***	-0.326***	-0.336**	-0.330**	-0.336**	-0.382***	-0.392***
	(0.000)	(0.000)	(0.000)	(0.006)	(0.005)	(0.004)	(0.015)	(0.013)	(0.011)	(0.001)	(0.001)
Constant	-0.875	-1.301	-1.102	-1.883***	-1.825***	-1.823***	-1.576**	-1.385***	-1.373***	-1.105***	-1.092***
	(0.428)	(0.225)	(0.352)	(0.004)	(0.007)	(0.007)	(0.011)	(0.000)	(0.000)	(0.002)	(0.002)
Obs.	33	37	37	72	72	72	92	92	92	92	92
R^2	0.922	0.889	0.888	0.793	0.793	0.793	0.783	0.783	0.782	0.776	0.770

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. All estimations using heteroskedasticity-consistent standard errors. p-values in parenthesis. Controls are variables identified as robust growth regressors in Sala-i-Martin et al. (2004). See Table A.8 for description of variables and data sources. A-countries defined as those for which the share of exports in A1-goods is larger than 30% in 2000.. Nominal income is the product of real GDP at current prices and current prices as reported in PWT.

8 Declining share of A-products in international trade

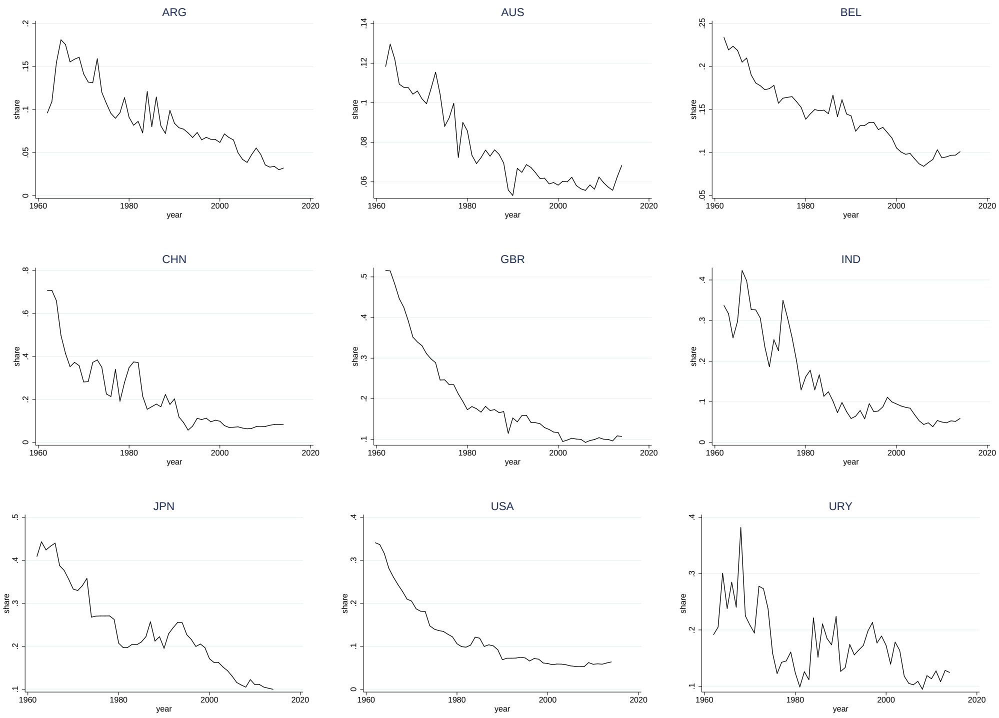
As a part of the ongoing process of globalisation, international trade has been on the rise. However, trends are differentiated between broad industries. In particular, the importance of land-intensive products in worldwide trade has been declining at least for the last fifty years. Figure A.4 shows the share of A-goods in worldwide exports using all three groups (A1, A2 and A3). The declining share is a consequence of trade in M-products growing more than in A and E goods.

Figure A.4:
VALUE SHARE OF A-GOODS IN WORLDWIDE TRADE (1962-2015)



Notes: Value share of world trade devoted to Ak-goods with $k = 1, 2, 3$ as listed in the Appendix. Computed using 4-digit data from Feenstra et al. (2005)

Figure A.5:
Share of A1-goods in imports for a sample of countries (1962-2015)



Notes: Share of imports devoted to $A1$-goods in Argentina, Australia, Belgium, China, Great Britain, India, Japan, United States of America and Uruguay respectively (check list of A1-goods in Appendix). Computed using 4-digit data from Feenstra et al. (2005)

Figure A.5 shows a similar picture for imports of a sample of countries (including some of the largest economies in the world) reflecting how the same phenomenon can be found at the country level for economies with very different characteristics, i.e. large and small, rich and poor, industrialized and specialized in agricultural goods. Overall, it is hard to find cases where a clear negative trend does not show up. A very notable case is that of China. As explained above, the rising importance of China in world trade after 2000 has increased the supply of manufactures in world markets while, at the same time, has dynamized the demand of primary products. What the above graph suggests is that, since the value of A-imports tends to fall even in China, what has constituted good news for primary producers in the last decade and a half, could have been a level effect which might not continue in the future. In terms of Figure A.4, the incursion of China in world markets may explain why the sharp negative trend in the share of A-goods in total trade saw a softening after 2000, but there is nothing preventing the previous trend to resume in the years to come.

While the above trend could be partially driven by an increasing fragmentation of production of M-products, the data on exports of value added (available since 1992) shows that changes in the share that value added represents of total exports for each sector are not large enough to revert the trends as shown above (see for example Francois et al., 2015).

9 Estimation of the model with value added data

In this section we reproduce the last two columns in Table 4 using value added data. This implies estimating preference parameters for a nested non-homothetic CES function as (25), where parameter ϵ drives substitution between goods and services, and parameter β does so between manufactures and agricultural goods. Results are presented in Table A.17. Column (1) presents results for the US and column (2) does so for Western European economies. The data used for the US are the same as in Herrendorf et al. (2013), that can be obtained from the NIPA tables and the BEA Input-Output tables. For the years prior to 1998, BEA does not provide annual IO tables, so linear interpolation is used for years in between those for which data is available.

For Western Europe, data from the World Input-Output Database (WIOD) is used, as presented by Timmer et al. (2015). As in García-Santana et al. (2019), tables from 2013 are used, and values are assigned to sectors closely following their procedure. Relative price levels come from the Productivity Level Database (PDL), as presented by Inklaar and Timmer (2014), which contains relative price levels for different sectors using 2005 as Benchmark year. This data does not distinguishes agricultural from manufacturing prices, so prices of goods are used for both these sectors as a raw approximation.

Results are reported in Table A.17. As it can be seen, using value added data further confirms that substitution between goods and services are significantly different than that across manufactures and agricultural goods, with the former being below one and the latter being larger than unity.

Table A.17:
Estimation of preference parameters (value added data)

	(1) US Nested GSG	(2) WE Nested GSG
β	3.527***	2.693***
	(0.368)	(0.800)
$\bar{Q}_A$	-160.165***	-430.965***
	(3.824)	(40.460)
$\bar{Q}_S$	3330.627***	11699.416***
	(379.323)	(1238.116)
ω_A	0.058***	0.035***
	(0.004)	(0.008)
ω_G	0.152***	0.149***
	(0.003)	(0.006)
ω_M	0.942***	0.965***
	(0.004)	(0.008)
ω_S	0.848***	0.851***
	(0.003)	(0.006)
ϵ	0.000	0.591***
	(.)	(0.049)
N	64	255
AIC	-926.704	-2840.038
$RMSE_A$	0.004	0.012
$RMSE_M$	0.010	0.019
$RMSE_S$	0.011	0.021
$RMSE_{\sum_i}$	0.025	0.052

Notes: *, ** and ***, significant at a 10, 5 and 1% confidence level respectively. Robust standard errors in parenthesis. AIC is the Akaike information criterion, $RMSE_i$ is the root mean squared error for i.

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