

Do Richer Countries Have Higher Distribution Margins?*

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Abstract

Combining the Benchmark Data from the *Penn World Table* on consumer price indices and producer price data from the *Food and Agricultural Organization*, I show that richer countries have higher distribution margins (spreads between consumer and producer prices) for food commodities than poorer countries. The distribution margins between the 10% income rich and the 10% income poor differ by a factor of 2.2. Interestingly, time series data on the distribution margin for food in the US over the 20th century indicate that it has increased by a factor of about 2.3. I develop a general equilibrium model with an explicit distribution sector, in which transportation and wholesale-retail services are used to deliver final goods to consumers. The model is rich enough to allow for competing demand and supply explanations about the observed pattern of distribution margins. The quantitative experiments indicate that the majority of the variation in distribution margins can be accounted for by the variation in relative productivities across sectors. These results point to an extension of the Balassa-Samuelson hypothesis.

JEL classification: O1, O41, E39, F40.

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1 Introduction

It is well known that, at the consumer level, rich countries have higher price levels than poor countries (see for example Kravis and Lipsey, 1988). Balassa (1964) and Samuelson (1964) suggested that the parity failure of aggregate consumer price indices can be rationalized if it is recognized that such measures include both traded and non-traded goods. They argued that richer countries had higher price levels, because they had higher relative prices for non-tradables given that they were particularly productive in tradables.

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An implication of the Balassa-Samuelson hypothesis is that there should be no systematic variation in the prices of tradables across countries.

Based on benchmark data from the Penn World Table, Fig.1 shows that the consumer price of food, a highly traded good, is higher in rich than in poor countries. Based on data from the Food and Agricultural Organization, Fig.2 reveals the less known fact that the producer price of food is no higher in rich than in poor countries. These observations suggest that there is a systematic relationship between the gap in the consumer and producer price of food and the level of income. One explanation for the margin of the consumer over the producer price of food is the distribution sector, which consists of transportation and wholesaling-retailing services.

Recent evidence by Burstein, Neves and Rebelo (2003) indicates that distribution costs account for a large fraction of retail prices in the United States and Argentina. While other studies also find evidence of high distribution margins for developed economies (Betancourt, 1992; Ito and Maruyama, 1991), there is no systematic evidence on how distribution margins may vary with a country's level of development.

In this paper, I study the role of the distribution sector in understanding why consumer prices vary with income. This paper has two objectives. First, to provide evidence on the relationship between distribution margins (retail over producer price) and income for a cross section of countries as well as within the United States over time. Second, to develop a model of distribution, with both supply and demand features, to account for the relationship between distribution margins and income. I focus on distribution margins associated with agricultural goods since for this category of commodities good data is available at the consumer and producer level, both internationally and within the United States historically.

Using information from the Food and Agricultural Organization (FAO) of the United Nations and the International Comparisons Project (ICP) of the World Bank I show that, distribution margins for food are 2.2 times higher in the 10% rich than in the 10% poor countries (with the highest and lowest differing by a factor of 4). I also document that the positive relationship between distribution margins and income is not only a cross-sectional phenomenon but is observed over time in a developed economy, the United States. Compiling a long series of data, I show that the distribution margin on food in the US has increased by a factor of 2.3, between 1913 and 2000.

A key follow-up question is, *why* do distribution margins vary systematically with the level of income? The distribution margin for food summarizes three relative prices: the relative producer price of farm goods, the relative cost of wholesale-retail trade, and the relative cost of transportation. Therefore understanding the trend in the distribution margin for food requires an understanding of the movements in these relative prices.

In order to impose discipline on potential explanations it is instructive to examine data on the size and the composition of the distribution sector. Such data are not available for a large cross section of countries. However, studying the distribution sector in the United States,¹ over the period 1870-2000, I document a remarkable change in its composition, with a decline in the share of labor in transportation

¹The idea behind studying the US over time is that we can learn something that will help us interpret and understand the current cross-section of rich and poor nations.

and a rise in the share of labor in wholesaling-retailing. I call this change, that has accompanied the process of modern growth in the United States, the *transformation of distribution*.

A seemingly unrelated feature of modern growth, is the well documented *structural transformation* of economic activity, namely the decline in the share of agriculture and the increase in the share of industry and later on services (see for example Kuznets, 1966; Chenery and Syrquin, 1975; and more recently Kongsamut, Rebelo and Xie, 2001).

In the theory part of the paper, I interpret, (i) the movements in relative prices (and therefore the distribution margin for food), (ii) the structural transformation, and (iii) the transformation of distribution as being the equilibrium result of the same economic process: the relative movement in productivities across sectors and differences in demand elasticities with respect to the goods produced by these sectors. The idea is that, since development is accompanied by a process of structural change and a process of change within the distribution sector, a model that embeds mechanisms that generate such changes may prove useful in understanding and interpreting the current differences in relative prices between rich and poor countries. This approach does not rely on distortions of any kind.

I build a dynamic general equilibrium model, by extending the two sector model of agriculture - nonagriculture,² to include a distribution sector that employs transportation and wholesaling-retailing technologies.³ I assume that consumers have preferences over composite consumption goods which consist of produced generic goods and distribution services of both types.

Following the hypothesis of Victor Fuchs (1968), the model I develop is a hybrid model of structural change.⁴ Structural change between agriculture and non-agriculture and the transformation of the distribution sector (between transportation and wholesale-retail services) are driven by: (a) non-homothetic preferences (as in Kongsamut, Rebelo and Xie, 2001), (b) differences in sectoral TFP growth rates (as in Baumol, 1967; and Ngai and Pissarides, 2006),⁵ and (c) differences in sectoral production functions.

In particular, I add two key mechanisms to the model: (a) an income elasticity for the demand of wholesaling-retailing services greater than one and less than one for transportation services and farm goods, (b) a faster growth in total factor productivity (TFP) in transportation and agriculture, relative to the non-agricultural sector and a lower growth in TFP in the wholesaling-retailing sector. The first mechanism implies that as income rises there will be an increase (decrease) in the relative demand for wholesaling-retailing services (transportation services and farm goods) and thus an increase (decrease)

²For two-sector versions of the model, see for example Laitner (2000), Caselli and Coleman (2001), and Gollin, Parente and Rogerson (2002). For three sector versions of the model, that include services, see Kongsamut, Rebelo and Xie (2001) and Echevarria (1997).

³Burstein, Neves and Rebelo (2003), Burstein, Eichenbaum and Rebelo (2005), and MacGee (2003), have all considered a distribution sector to resolve current puzzles in international finance, related mainly to developed economies. The present paper introduces a long-run growth model of distribution.

⁴Fuchs (1968) argued that two of the possible explanations for the growth of the service economy were, (i) the more rapid growth of the final demand for services, and (ii) a relatively slower increase in service sector productivity.

⁵Unlike, Ngai and Pissarides (2006), I do not rely on low substitutability between goods produced in different sectors to generate structural change. Non-homotheticity in preferences yields structural change even if TFP growth is equal across sectors. However uneven productivity growth has a reinforcing role. See next paragraph for details.

in the sector's demand for labor. The second mechanism potentially reinforces the effect of the first by further increasing (decreasing) the number of workers needed to produce the same amount of wholesaling-retailing services (transportation services and farm goods). These mechanisms can generate the structural transformation and the transformation of distribution, observed in the data. Furthermore, they imply that the cost of wholesaling-retailing will rise over time, while the cost of transportation and the producer cost of agriculture will decline.

In addition, technological progress and capital accumulation (in transition) drive an upward trend in wages.⁶ Under the restriction (imposed by the data) that the distribution sector is more labor intensive than the rest of the economy, the rise in the cost of labor will affect the cost of distribution disproportionately.

This model encompasses several popular competing supply and demand explanations that can potentially account for the patterns of distribution margins, such as: distribution services are labor intensive activities and wages are higher in rich countries; even though rich countries are more productive in all sectors, they are particularly productive in goods producing sectors; rich countries have a higher relative demand for distribution services and lower relative demand for generic agricultural goods.

I do not take an a priori stand on which explanation is more important. I allow the quantitative experiments to disentangle the major forces at work in explaining the variation in relative prices. In the quantitative section of the paper I isolate the effects of each of the above forces on the distribution margin by calibrating my model to US data. Using historical data on the decline of real freight costs I infer the TFP progress in the transportation sector. Based on available TFP growth rates for agriculture and wholesaling-retailing I calculate TFP series for both sectors. Taking the constructed TFP series for all sectors as given, I compare the time series for distribution margins and employment shares to those in the data.⁷ The model performs very well in tracking the time paths of all these variables, and can account for over 60% of the ultimate rise in the distribution margin for food.

The counterfactual experiments for the US time series show that, it is mainly supply side forces that account for the behavior of the distribution margin for food over time: (i) movements in relative productivities across sectors (among these the most important factor is the relatively slow TFP growth in wholesale-retail trade), (ii) differences in labor intensities across sectors. The differences in the income elasticity for transportation and wholesale-retail services (demand factors), affect the distribution margin to a lesser extent but are important for matching the labor share observations in the model.

I use a static version of the same economic environment to conduct cross-country experiments. Constructing comparable TFP measures for the aggregate economy and the agricultural sector I ask how much of the variation in the observed distribution margins for food can the model account for? I find that taking differences in economy-wide TFP and agricultural TFP as exogenous, I can account for 48%

⁶Bhagwati (1984) argued that, even if relative productivity differences were the same, richer countries would have higher wages, and thus a higher cost of services due to their higher capital-labor ratios.

⁷While accounting for the distribution margins is the goal, one is more confident that the economic forces captured in this model are indeed the relevant ones if they are also able to account for the patterns of movements in labor shares.

of the cross-country differences in the distribution margin for food, and 67% of the cross-country income differences. Lack of internationally comparable data do not permit a similar exercise, in which distribution specific TFP is taken as exogenous as well. However, a set of numerical illustrations suggests that lower relative TFP in wholesaling-retailing in rich countries has the most potential in accounting for the residual variation in distribution margins.

The paper’s results indicate that supply factors are more important than demand factors in explaining the behavior of the distribution margin for food. Richer countries have higher distribution margins for food because they have lower production costs (which follows from their relatively higher agricultural productivity) and because the relative cost of distributing goods is higher in rich countries (which follows from their particularly high productivity in goods vs. services production). The latter result suggests that extending the Balassa-Samuelson hypothesis to include distribution charges for tradable goods can potentially explain the systematically higher consumer prices for highly traded goods in rich countries. The results also suggest that expenditure data confound productivity differences in goods production and distribution service production, and therefore one should be careful when measuring sectoral productivities across countries.

The rest of the paper is organized as follows. The main empirical facts are presented in section 2. In section 3 the model is developed. The quantitative experiments for the US time series and the cross-section are discussed in sections 4 and 5. The final section concludes and provides a discussion of the paper’s results for outstanding research questions.

2 Empirical Observations

The measure of distribution margin for food used in this paper is defined as the ratio of the price paid by the consumer, over the price received by the producer:

$$DISTRIBUTION\ MARGIN = \frac{RETAIL\ PRICE}{PRODUCER\ PRICE}$$

The idea is that any increase in the price from the farm gate to the consumer purchase point is accounted for by payments for services offered by the distribution sector. This measure cannot identify the source of the cost and thus cannot decompose the total distribution margin into margins reflecting the channels through which the commodity travels before reaching the consumer. This, however, is not a limitation as long as one is interested in the overall effect that the distribution sector imparts on the final consumer price⁸.

In this section I present two sets of facts. One set related to a cross section of countries and one

⁸There are however at least two reasons that are likely to mask the significance of distribution margins for an economy as a whole by the use of this measure. (1) It does not account for distribution margins for intermediate inputs, e.g., pesticides, tractors etc. used by farmers. (2) In many instances the distribution costs cannot be isolated from the production costs, because some goods are sold directly by the producer to the consumer (vertical integration). Thus the measure I use constitutes a lower bound to the true size of the distribution margin.

set related to the US time series. For the cross section I document the relationship between distribution margins for food and the level of income. The analysis on the US time series focuses not only on the relationship between distribution margins and income but also on the behavior of the distribution sector and its sub-components (transportation and wholesaling-retailing) over the course of development.

2.1 International Comparisons

Construction of Cross - Section Data Set

Constructing distribution margin data for aggregate consumption categories for a large set of countries is non-trivial, primarily because comparable production and consumption data are not generally available. In this paper I construct a measure of distribution margins on food for a set of 48 countries that span from poor to rich. I exploit two different data sources: (1) the benchmark data from the Penn World Table (PWT - mark 5.6), which are based on the data collected under the World Bank's, International Comparisons Project (ICP), and (2) data from the Food and Agricultural Organization (FAO) of the United Nations.

The ICP collects the following information: (1) *final sales prices* (retail prices) in local currency, for 1,500 items (commodities, services, labor inputs), then grouped in 150 detailed categories which comprise GDP, and (2) expenditure data in local currency for each of the 150 detailed categories. Final sales prices include trade and marketing margins, as well as taxes.

The FAO on the other hand collects information on: (1) *producer prices* received by farmers at the farm gate for a set of 300 agricultural commodities, which do not reflect any activity other than agricultural production, and (2) actual quantities of the agricultural commodities. Transportation costs, profits accruing to middlemen, and marketing costs are not included in these prices, although farmer support prices could be.

Summers and Heston (1991) have used the information provided by the ICP to construct comparable measures of real GDP (and its components) as well as comparable price indices for GDP, for a set of 64 benchmark countries (1985). Rao (1993) has utilized the FAO data to conduct a similar exercise, i.e., to construct comparable measures of agricultural output, as well as comparable agricultural price indices for a set of 103 countries.

The idea used in the two projects to construct output and price indices is the same. The concept is to price a common basket of commodities across countries, at both domestic and international prices. The price parity of that basket, which can actually be thought of as a price index for it, is defined as the ratio of the value of the basket in domestic prices over the value of the basket in international prices.⁹ Fig.1 and Fig.2 plot the consumer price of food and the producer price of agriculture relative to the US values against relative real GDP per worker, where real GDP per worker is the series reported in the PWTv5.6. The figures indicate that there is a systematic difference between the consumer and producer price, which

⁹A more detailed description of the methodology used by Summers and Heston (1991) and Rao (1993) is provided in an extended Appendix of this paper, available online at (<http://dept.econ.yorku.ca/%7Etasso/DMappendix.pdf>).

motivates the exercise here.

Based on data from these studies as well as raw price and quantity data from the FAO (*FAOSTAT-Agriculture*) I construct my measure of distribution margin as the ratio of the ICP price index over the FAO price index. For any category s , the distribution margin of country j , is defined as $PPP_s^{j,ICP} / PPP_s^{j,FAO}$.

In this exercise I exploit that the ICP reports consumer prices while the FAO reports producer prices. The task is facilitated by the fact that the years for which Rao (1993) conducts his study correspond to the phases of the ICP. I construct my measure of distribution margin for 1985, which is the first year for which data are available for a wide range of countries.

Constructing my measure of distribution margin becomes non-trivial due to discrepancies in the nature of information between the two original data sets, primarily in terms of countries and categories. Out of the 103 countries in the FAO data and the 64 in the ICP data, only 48 overlap, and these are the ones for which I construct my measure (see Table 1 for the complete list of the countries). Furthermore, and most importantly, the ICP data includes all GDP categories, while FAO includes only the agricultural production categories. To address this issue I have to go to the lowest level of aggregation in the two studies (the 150 detailed categories of the ICP, and the 300 commodities of the FAO), and select the FAO commodities that correspond to the pertinent detailed categories of the ICP. I exclude all non-food categories from the ICP and choose only those food subcategories that correspond to categories present in the production accounts of the FAO.

Using 20 of the detailed categories of the ICP and 123 commodities from the FAO, I construct distribution margins for an *aggregate* food category, as well as for 10 food subcategories: *cereals, livestock products, fruit, vegetables, nuts, tubers, sugar, stimulants, spices, tobacco*. These categories have been chosen so that (a) there is a close overlap between the categories of the ICP and the commodities of the FAO, and (b) there is a national price, a quantity and an international price available by FAO (see Table 2 for a complete list of the detailed categories and the corresponding agricultural commodities).

Finally, out of the resulting categories, I construct a single *core* category,¹⁰ based on more stringent criteria: (i) there is one-to-one correspondence (rather than just close) between the categories of the two studies, and (ii) there is zero (or minimum) processing involved between the farmer and the consumer. This allows me to attribute any difference in the consumer and producer price to distribution services rather than to processing, manufacturing or anything else.

Observation 1 *Distribution margins for food are higher in rich countries.*

The distribution margins for the aggregate and core categories appear in Fig.3 and Fig.4. On the vertical axis is the measure of distribution margin relative to the US margin, and on the horizontal axis is real GDP per worker relative to US GDP per worker. The common message from both figures is that distribution margins are positively related to the level of prosperity, i.e., richer countries have higher distribution margins. However this relationship is non-monotonic, in the sense that rich countries as a group have higher distribution margins than poor countries as a group. Results are similar for the

¹⁰Commodities corresponding to the core category are highlighted in Table 2. 10 detailed categories from the ICP and 70 commodities from the FAO comprise the core category.

distribution margin measures for more disaggregated categories: Figs.5-8. Since the core category is the most reliable (as has been explained earlier) I restrict the remainder of the discussion to Fig.4. The correlation coefficient between the measure of distribution margin and income is 0.7. Distribution margins between the 10% richest and 10% poorest countries in this sample differ by a factor of 2.2, while the highest and lowest differ by a factor of 3.8. A simple OLS regression of the logarithm of the measure of distribution margin (relative to the US) on a constant and the logarithm of relative income, indicates that for the whole sample the coefficient on the log of relative income is positive and statistically significant (see Table 3).¹¹

Observation 2 *The correlation between the size of the distribution margin and real GDP per worker is positive and strong within the group of rich countries but is weak within the group of poor countries.*

To examine the strength of the relationship between distribution margins and real GDP per worker across income groups, I break the sample into two subsamples, with the cutoff being the median income level. I repeat the above regression within the groups of poor and rich countries (see Table 3). The coefficient on income in the rich group is positive and statistically significant, while within the group of poor countries the coefficient is slightly negative and insignificant. These results suggest that the relationship between the distribution margin and income is non-linear: at low levels of income, distribution margins do not have any correlation with income, but as income rises the relationship becomes positive.

Discussion Due to the novelty of the relationship, between distribution margins and income, presented here, several questions arise regarding other possible factors that may account for this relationship, besides the distribution sector per se.

Could differences in qualities or varieties consumed between rich and poor countries account for the disparity in distribution margins? It is possible that richer countries consume better varieties which are more expensive and these are reflected in higher distribution margins. While this could be generally true, the focus of this study is on a relatively homogenous group of commodities: food items that are not subjected to any processing. One would expect that quality is more likely to be a factor when comparing prices of manufactured goods across countries. By looking at food items I am virtually controlling for quality differences across countries.¹²

Is the pattern of distribution margins observed between poor and rich countries specific to agricultural goods? To the best of my knowledge, there is no comprehensive work that studies the relationship between distribution margins and income for any other category of goods. Any information, at best, comes from case studies. For example, Burstein, Neves and Rebelo (2003) find that the aggregate distribution margin in the US is 42% while in Argentina it is 60%. This would seem to contradict the pattern observed in the figures above. Such a conclusion however could be misleading. First, these are only two data points.

¹¹This regression is meant to provide a simple pair-wise correlation and is not intended as hard evidence on the existence of a causal effect of income on the size of the distribution margin, or as evidence on the magnitude of such an effect.

¹²This is not to say that the qualities of farm products are identical across countries, only that their differences are not as pronounced as those of processed goods.

Second, if one focuses only on the food goods reported in Burstein, Neves and Rebelo (2003) then the US distribution margin is on average 79% (comparable numbers for Argentina are not reported). The model developed in Section 3 will explicitly incorporate an agricultural sector to allow for the possibility that distribution margins for food could be different than in the rest of the economy.

Could imports account for the higher distribution margins in rich countries? It could be the case that rich countries import a lot of their agricultural goods and thus these commodities go through not only the domestic transportation and wholesaling-retailing channels but also through the international ones. In such a case the distribution margin for rich countries would appear inflated because it includes international distribution costs too. The fact that I am able to calculate a distribution margin for each country in my sample, means that I have a domestic producer price for that country from the FAO, and thus at least part of consumption is covered by domestic production. Furthermore, international transport costs are relatively low. Burstein, Neves and Rebelo (2003) report that the average distribution margin for exported goods in the US is 12.7%, which suggests that goods in the international trade sector do not incur the same costs as those in the domestic market.

Could systematic differences in policies (taxes and subsidies) account for the differences in distribution margins between rich and poor countries? It is true that consumer prices gathered by the ICP include sales taxes and producer prices collected by the FAO include government support prices (which are subsidies to farmers). In other words, the measured consumer price is equal to the true consumer price plus any possible taxes, and the measured producer price is equal to the true producer price plus any government subsidy. The evidence suggests that rich countries tend to subsidize farmers, while poor countries tend to tax farm output. Schiff and Valdes (1998) report that developed countries traditionally subsidize the agricultural sector while developing countries traditionally tax it. As reported by Iorwerth and Whalley (2002) among others, rich countries such as the US, the U.K., and Canada tend to exempt retail sales of food from taxation. According to Khan (2001), on the other hand, developing countries tax agricultural goods heavily through the price system (sales, excise taxes etc.). Thus the patterns of tax and subsidy policies observed across rich and poor countries would imply that the distribution margin differences I measure here are a lower bound to the true distribution margin differences.

2.2 United States Time Series

Observation 1 *The distribution margin in the US has increased non-linearly over the past century, exhibiting no trend until the mid 1960s, with a clear positive trend after that.*

I compile a long time series for the distribution margin on food for the US that spans from 1913 to 2000. The data for the period 1954-2000 are from the *US Department of Agriculture* (USDA), while the data for the earlier period, 1913-1970, are obtained from the *Historical Statistics of the United States*. The index reported in these sources is the *farm value share*, which is defined as farm value¹³ over the retail

¹³Farm value consists of prices received by farmers for the raw commodities that must be purchased to sell food at the retail level. The index is based on consumer expenditures for domestic farm foods only. It does not include imported foods or alcoholic beverages.

cost of food. The measure of distribution margin I use, the ratio of consumer to producer price, is the reciprocal of this.

The distribution margin for the aggregate food category, for the US over the period 1913-2000 is plotted in Fig.9. Besides the raw data, the graph also includes a cubic trend and the Hodrik- Prescott filter trend component.¹⁴ In 1913 the retail price was two times higher than the producer price while in 2000 it was almost five times higher than the producer price, an increase of the distribution margin over this period by a factor of 2.3. However, as the figure indicates this rise in the distribution margin has not been monotonic, but instead displays a non-linearity. Until the mid 1960s there is essentially no trend in its behavior, but after that point it exhibits a systematic upward trend. The distribution margin has a statistically significant trend at the 1% level. The cubic trend is also significant at the 1% level, implying a stronger rise after the 1960s. The distribution margin as a fraction of the retail price went from 53% in 1954 to 80% in 2000.¹⁵

Observation 2 *Over the period 1967-2000 labor costs in the distribution sector increased and agricultural production costs decreased.*

The USDA provides detailed information for the components of the Marketing Bill for domestically produced farm food, over the period 1967-2000. These data indicate that transport costs have not been responsible for the increase in the distribution margin, since they have remained between 4 – 5% of the consumer price for the entire period. Instead the data reveal that the main reasons for the rise in the distribution margin have been the decrease in production costs¹⁶ and the rise in labor costs (associated with wholesaling-retailing activities). Energy prices or taxes that might be suspected of exhibiting a systematic change over this period are flat as a fraction of the retail price, according to USDA data.

Observation 3 *Real transportation costs in the US declined rapidly until 1915, continued to decline but at a slower pace until the mid 1960s and have remained relatively constant after that.*

It is difficult to get long and consistent time series for transport costs, even for the United States. I have compiled data for real transport costs for the period 1858-2000 from three different data sources.¹⁷ These data reveal the following main observations: (1) The freight rates on transporting wheat from Chicago to New York by rail and water decreased over the period 1860-1895 by over 60% and 80% respectively.

¹⁴For the HP Filter I have used a smoothing parameter of 400.

¹⁵The behavior of distribution margins for more disaggregated categories (fresh vegetables, fresh fruit, meat products, cereal products) is very similar for the period that data is available (1967-2000).

¹⁶One possible explanation for the sharp increase in the US distribution margin after the 1970s could be the increase in international trade activity. Increased competition from trade could have driven the less efficient producers out of the market. If only the low cost producers survived then this could explain why the distribution margin increased even if distribution costs remained the same. As the evidence suggests both the decline in farmer production costs and the increase in distribution costs contributed to the rise in the distribution margin. The above and other possible explanations about the decline in production costs are interesting and should be kept in mind, but they will be reflected, in a reduced form sense, in the measured TFP growth in agriculture (which will be taken into account explicitly in the quantitative experiments).

¹⁷The data along with their sources are available online, in the extended Appendix of the paper at (<http://dept.econ.yorku.ca/%7Eetasso/DMappendix.pdf>).

(2) From 1900 to 1970 the real cost per ton mile of transporting goods by rail declined by 50% although more than half of this decline occurred in the first 15 years of this period. (3) The real cost per ton mile of transporting goods by any means of transportation has not changed since 1968.

Observation 4 *There has been a change in the composition of the distribution sector (mainly in terms of employment share) with a rise in the importance of wholesaling-retailing and a decline in the importance of transportation.*

Over time the size of the distribution sector, in terms of employment share, has increased and its composition has changed. In 1900 the total size of the distribution sector in terms of employment share was 17.6% which consisted of 6.8 % transportation and 10.8% wholesaling and retailing. In 2000 these same numbers were 23.4%, 3.4% and 20% respectively. In 1900 the distribution sector accounted for 23.8% of GDP from which 7.4% was transportation and 16.4% was wholesaling retailing. In 2000 it accounted for a total of 19.2% out of which 3.3% was transportation and 15.9% distribution. Data for the entire period are provided in Table 4. The source for the earlier data is the *Historical Statistics of the US* while for the later period it is the *Bureau of Economic Analysis* (industry accounts).¹⁸ What is interesting from these numbers is that both the employment and GDP share in transportation declined while in wholesaling-retailing the main trend was the rise in the employment share. The GDP share in wholesaling-retailing instead has remained roughly constant, exhibiting a slightly inverse U-shaped pattern.¹⁹

The facts presented here suggest that a story about the behavior of the distribution margin on food over time must assign a role to the behavior of: (a) agricultural production costs, (b) transportation costs, and (c) costs in wholesale-retail trade.

3 A Growth Model With Distribution

I develop a dynamic general equilibrium growth model with a distribution sector to address the question of why distribution margins rise with income, and in particular why do they rise non-linearly. To impose discipline on any potential explanation I require that the model is also quantitatively consistent with the behavior of employment shares for agriculture, transportation and wholesaling - retailing services. Given that it is not clear a priori what can account for the empirical observations, I embed in the model both supply and demand features and allow my counterfactual experiments to determine which of these forces are the important ones for understanding the data.

I consider an infinite-lived representative agent model with two consumption goods, food and non-food. Food and non-food are composite goods which consist of the generic goods produced on farms and in factories respectively, as well as transportation and wholesaling-retailing services provided by the distribution sector.

¹⁸See the extended Appendix to this paper for a detailed description of the series construction.

¹⁹Anderson and Betancourt (2002) find this behavior of the share of wholesaling-retailing in GDP to hold in the time series of several countries as well as in the cross section.

3.1 Production Sectors

There are three production sectors in the model: (i) the agricultural goods sector, indexed by a , (ii) the non-agricultural goods sector, indexed by m , and (iii) the distribution sector, which employs two technologies, wholesaling-retailing, indexed by d , and transportation, indexed by T . At every date, each technology produces a distinct good. The agricultural good can be used only for consumption but must be combined with distribution services of both types (wholesaling-retailing and transportation) before consumed. The non-agricultural good can be used for consumption or investment purposes, and is combined with distribution services only if consumed.²⁰ Distribution services are produced only to supply consumption goods to the market.

The production function in each sector exhibits constant returns to scale with respect to all factors of production employed. All sectors use capital and labor to produce output but the agricultural sector uses rural land in addition. The wholesale-retail technology of the distribution sector also employs a sector specific factor, which can be thought of as urban land.²¹ Capital and labor are perfectly mobile across sectors, and thus no-arbitrage conditions imply that in equilibrium the returns to capital and labor must be equalized.

The agricultural and non-agricultural technologies are described by the following Cobb-Douglas production functions

$$Y_{at} = A_{at} (K_{at}^\mu L_a^{1-\mu})^\alpha N_{at}^{1-\alpha} \quad (1)$$

$$Y_{mt} = A_{mt} K_{mt}^\theta N_{mt}^{1-\theta} \quad (2)$$

while the wholesale-retail and transport technologies of the distribution sector are given by

$$Y_{dt} = A_{dt} (K_{dt}^\lambda L_d^{1-\lambda})^\psi N_{dt}^{1-\psi} \quad (3)$$

$$Y_{Tt} = A_{Tt} K_{Tt}^\xi N_{Tt}^{1-\xi} \quad (4)$$

L_a and L_d are the non-reproducible factors used in agricultural and wholesaling-retailing production respectively. For $i \in \{a, m, d, T\}$, K_{it} is capital in sector i , N_{it} is labor in sector i , A_{it} is the level of total factor productivity (TFP) which grows exogenously at the possibly time varying rate $A_{it+1}/A_{it} = \gamma_{it} > 1$. All labor share parameters lie in the zero-one interval, $0 < \alpha, \mu, \psi, \lambda, \xi < 1$.

Capital accumulation follows a standard law of motion

$$K_{t+1} = (1 - \delta) K_t + X_t \quad (5)$$

where $\delta \in (0, 1)$ is the rate of depreciation and X_t is gross investment, which can be made using only the

²⁰The reason is that distribution margins for investment goods (mainly equipment) are much smaller, around 16%. See Burstein, Neves and Rebelo (2003).

²¹The fixed factor in the wholesale-retail technology is meant to capture the possibility that higher urban land prices can feed into higher distribution margins, as is often noted in informal accounts of distribution costs for developed countries.

non-agricultural good.

3.2 Households

Population and Preferences

The economy is populated by a stand-in representative household of size N_t , with preferences over consumption sequences given by

$$\sum_{t=0}^{\infty} \beta^t \frac{[C_t/N_t]^{1-\sigma}}{1-\sigma} N_t \quad (6)$$

with $\beta \in (0,1)$ and $\sigma > 0$, and where the per period utility function is weighted by the size of the household. C_t is a consumption index defined over final food goods and non-food goods,²²

$$C_t = (C_{at} - \bar{a})^\rho C_{mt}^{1-\rho} \quad (7)$$

where $\rho \in (0,1)$ is the share of food in consumption and \bar{a} is subsistence food consumption. Engel's law, i.e., that the income elasticity with respect to food is less than unity, is embedded in these preferences. This implies that as income rises the share of food in total consumption falls. In a dynamic context, Engel's law is capable of producing the secular decline in agriculture that we observe in the data.

Food and non-food are composite goods in the household's consumption basket: each household combines the respective generic good (agriculture or non-agriculture) with distribution services (both transportation and wholesaling-retailing). The idea is that the final goods purchased by households in the market are no longer the generic goods that left the farm or factory gate, but new products that have distribution services attached to them. I assume that preferences over final consumption goods are non-homothetic and are given by,

$$C_{at} = (D_{at} + \bar{d}_a)^{\phi_a} (T_{at} - \bar{T}_a)^{\tau_a} Z_{at}^{1-\phi_a-\tau_a} \quad (8)$$

$$C_{mt} = (D_{mt} + \bar{d}_m)^{\phi_m} (T_{mt} - \bar{T}_m)^{\tau_m} Z_{mt}^{1-\phi_m-\tau_m} \quad (9)$$

for food and non-food respectively. C_{it} is the consumption index for good i , Z_{it} is the amount of the corresponding generic good, D_{it} , is the amount of wholesaling-retailing services attached to good i , T_{it} is the total amount of transportation services required to deliver the good to the consumer. ϕ_i is the share of wholesaling-retailing services in final good i , while τ_i is the share of transportation services in final good i . The presence of the terms \bar{d}_i , \bar{T}_i make these preferences non-homothetic. These terms imply that the income elasticity with respect to wholesaling-retailing is greater than one, with respect to transportation services it is less than one, and with respect to the generic goods equal to one. The term \bar{d}_i can be thought of as "home production", i.e., when income is low these services are produced in house but as income rises they are outsourced. The term \bar{T}_i can be thought of as "subsistence consumption" of transportation

²²These are known as Stone-Geary preferences. For empirical support of these preferences see Atkinson and Ogaki (1996).

services.²³ This is a reduced form way of modelling the idea that given and finite distances require a minimum transportation network in place to service those distances. Once the network is in place, the relative demand for additional transportation services declines.²⁴

Households are endowed with K_0 units of capital at time 0, L_a units of rural land, L_d units of urban land, and one unit of productive time every period. The population is assumed to grow at an exogenous rate $\eta - 1$ every period, with the initial population size normalized to one, which implies that $N_t = \eta^t$. L_a and L_d are also normalized to unity.

Prices and Budget Constraint

Let the non-agricultural good be the numeraire. All prices are normalized by the producer price of the non-agricultural good. Let the relative producer price of the non-agricultural good be q_{at} . Denote by p_{dt} and p_{Tt} the relative prices of wholesaling-retailing and transportation services respectively. Let the wage rate per unit of time be w_t , the rental rate of capital r_t , the rural land rent Q_{at} , and the urban land rent Q_{dt} . Consumers directly purchase all elements of their consumption basket. The budget constraint for the representative household is then

$$q_{at}Z_{at} + Z_{mt} + X_t + p_{dt}(D_{at} + D_{mt}) + p_{Tt}(T_{at} + T_{mt}) = r_tK_t + w_tN_t + Q_{at}L_a + Q_{dt}L_d \quad (10)$$

3.3 Market Clearing Conditions

The following market clearing conditions will have to hold in a competitive equilibrium. The non-agricultural good can be used for investment or consumption activities,

$$Y_{mt} = Z_{mt} + X_t$$

The agricultural good can only be consumed,

$$Y_{at} = Z_{at}$$

The total amount of wholesale-retail services produced in the distribution sector must be used to sell the two generic goods,

$$Y_{dt} = D_{at} + D_{mt}$$

²³According to the US Department of Agriculture the main reason for the rise in distribution services for food is consumers' increased demand for convenience, which fits naturally with the interpretation of \bar{d}_i . According to Glaeser and Kohlhase (2003) today we are shipping far fewer tons of goods relative to GDP than in the past. This fits naturally with the interpretation of \bar{T}_i .

²⁴The reduced form modelling of transportation and wholesaling-retailing here is sufficient to capture the compositional change in the distribution sector and to study its effects on distribution margins. A more explicit modelling of the distribution sector would require to put more structure on the terms \bar{d}_i and \bar{T}_i .

The total amount of transport services produced in the distribution sector must be used to deliver either the agricultural or the non-agricultural good to the market,

$$Y_{Tt} = T_{at} + T_{mt}$$

The capital and labor market clearing conditions require,

$$K_t = K_{at} + K_{mt} + K_{dt} + K_{Tt}$$

$$N_t = N_{at} + N_{mt} + N_{dt} + N_{Tt}$$

This model allows for a balanced growth path with a declining relative producer price of agriculture q_a , a constant relative cost of transportation p_T , and a rising relative price of wholesaling-retailing p_d . These relative price movements require imposing restrictions on the sectoral TFP growth rates which are consistent with the data in the quantitative section of the paper.²⁵

Mechanics of The Model

The presence of the subsistence constraint in agriculture implies that when income is low many resources (capital and labor) have to be devoted to agriculture to meet subsistence needs of the population. A high relative producer price for the agricultural good is required to ensure that resources will remain in agriculture in equilibrium. Over time as income rises Engel's law implies that the relative demand for food will decline. The share of food in the consumption basket will decline as will the share of agricultural value added in GDP. This force along with productivity growth in agriculture imply that the relative producer price of agriculture will decline which will tend, other things equal, to increase the distribution margin for food.

In transition to the balanced growth path, the accumulation of capital by agents implies that over time the capital labor ratio will rise, which will lead to an increase in the wage rate. However, because of exogenous technological progress, the wage rate will continue to grow on the balanced growth path. Since the distribution sector is labor intensive, as shown in the quantitative section, this will tend to increase the distribution margin.

The specified non-homothetic preferences for final goods consumption imply that over time, as income rises, there will be an increase in the relative demand for wholesaling-retailing services and a decrease in the relative demand for transportation services. This demand force along with the relatively faster technological progress in transportation and the relatively slower technological progress in wholesaling-retailing imply that over time there will be an increase in the relative cost of providing wholesaling-retailing services and a decrease in the relative cost of transporting goods. These two trends will have opposing effects on the distribution margin over time. Which of all of these forces is the prevailing one becomes a

²⁵A detailed description of the balanced growth path equilibrium and the transitional dynamics of the model are provided in an extended Appendix of the paper available at (<http://dept.econ.yorku.ca/%7Etasso/DMappendix.pdf>).

quantitative question which I address in the next section.

4 Quantitative Analysis for the U.S. Time Series

I now ask whether the model presented in the previous section can account quantitatively for the following three sets of facts, over the period 1870-2000: (i) the secular decline of agriculture, (ii) the change in the composition of the distribution sector, (iii) the non-linear rise in the distribution margin. To answer these questions I calibrate the model to U.S. data. A key element of my calibration procedure is that I feed in the model TFP series for agriculture, wholesaling-retailing, and transportation. These series are taken as exogenous and are constructed based on productivity growth rates for agriculture and wholesaling-retailing and rates of decline in transport costs.

4.1 Calibration

The length of a time period is chosen to be one year. There are two sets of parameters that I have to choose. One set of parameter values is based on a priori information for the US economy. The second set of parameters is chosen to match key ratios in the model to their counterparts in the data (modern and historical).

Parameters based on a priori information Assuming logarithmic utility σ is set equal to 1. The depreciation rate δ is set at 0.06, consistent with an investment to capital ratio of 0.095. The subjective discount factor β is chosen to match an asymptotic real interest rate of 6.5% (see Siegel, 1995). The preference parameter ρ , is chosen to match the share of *final* agricultural goods in total *final* consumption expenditures, where “final” includes generic goods and distribution services. According to the model definition, this is the appropriate mapping from the data to the model. Using the Benchmark Data from the PWTv5.6, ρ is set equal to 4.94%. The population growth parameter is chosen to match an average annual population growth rate of 1.59% over the period 1870-1998 (calculated from Maddison, 2001). The non-agricultural sector in the model is the benchmark sector, with its parameters chosen to correspond to the aggregate US economy ones. The capital share parameter in this sector is chosen to be 0.4, which is standard for the US economy. The rate of growth of TFP in the non-agricultural sector is assumed to be constant, and is set to 1.0114 to match an average annual rate of growth of real GDP per capita over the period 1870-1998 of 1.91% (calculated from data in Maddison, 2001).

I choose the capital intensity parameters in the agricultural (α), the wholesaling-retailing (ψ), and the transportation (ξ) sectors respectively to match the labor compensation shares in these technologies. Table 5 reports the employee compensation shares for agriculture, transportation, and wholesale-retail trade,²⁶ which I have calculated from the benchmark data (*use tables*) of the *US Input-Output Tables*

²⁶For each sub-sector and each year, the employment share parameter is measured as *compensation of employees* over (*value added - indirect taxes and non-tax liability*). The labor share parameter for each of the three sectors is calculated as the simple average of the labor share parameters of its subcomponents. Weighted average shares produced very similar

(1987, 1992, 1997).

The parameter in the agricultural sector, that determines the fraction of the total rental cost of capital that goes to physical capital, μ is chosen to match a share of the rental cost of land in the total rental cost of 0.4754. This is reported by the *Bureau of Labor Statistics* (see Caselli and Coleman, 2001). This number implies an income elasticity with respect to land of 0.28 which is within the range of values obtained from cross-country estimation of agricultural production functions (see for example Hayami and Ruttan, 1985). Parameter λ is chosen to match a share of land income in the wholesaling-retailing technology of 0.09. This is the value used by Burstein, Neves and Rebelo (2003). This value is very close to the one reported in Caselli and Coleman (2001) for the non-farm sector in their model (their implied value is 0.108). All of these parameters along with their values and targets are presented in Table 6.

TFP growth rates A key element of my calibration procedure is to feed into the model exogenously TFP series for transportation, wholesaling-retailing, and agriculture. I use the relative transport costs series described in Section 2, to calculate rates of decrease in these costs for three time periods. First, 1870-1915, where transport costs decreased rapidly, at an average annual rate of -0.0258. Then, 1915-1967, where the decrease in transport costs slowed down to an average annual rate of -0.0106, and finally 1968-2000 where there is virtually no further decrease. Using these rates I construct a 3-piecewise linear function $g(t)$, which satisfies $p_{Tt+1} = g(t)p_{Tt}$, where p_T is the relative price of transport services. The resulting function is then used to infer technological progress in the transportation sector over the pertinent time periods.

The TFP growth rates for agriculture are taken directly from other studies, given that they are available back to 1889. The TFP growth rates for wholesaling-retailing are the hardest to estimate especially for the earlier period. Table 7 presents the TFP growth rates, for 6 different time periods, which I have used to construct TFP series for agriculture and wholesaling-retailing. The TFP growth rates for agriculture for the two early periods (1870-1914, 1915-1947) are taken directly from the *Historical Statistics of the US*. For the same two periods I calculate the TFP growth rate for wholesaling-retailing based on information provided by Fuchs (1968). In particular Fuchs reports that the TFP growth rate in this sector over the period 1929-1965 was 0.2% below the average economy wide one (in my case 1.91%). Lacking an estimate for the first period I use the same value. For the periods after 1948 the TFP growth rates are calculated directly on an average annual basis from Jorgenson and Gollop (1992). Based on these rates I construct the TFP series for agriculture and wholesaling-retailing which I feed into the model exogenously.²⁷

estimates.

²⁷Jorgenson and Gollop (1992) also report TFP growth rates for transportation. However, these TFP growth rates include both passenger and freight transportation. There is reason to believe that there are innovations in freight transportation that do not affect passenger transportation, such as refrigeration. For this reason it seems more appropriate to infer TFP growth in freight transport directly from real freight costs. It turns out that the growth rates inferred from the freight cost series and those reported in Gollop and Jorgenson for the pertinent time periods are not far apart. To have a consistent series of transport TFP for the earlier period too, I choose to use the TFP growth rates from the freight costs.

Parameters chosen to match US data I choose the remaining parameters so that key ratios in the model match their counterparts in the data. Since I have no a priori information on how to set the parameters corresponding to the share of distribution services in final consumption goods, I assume that $\phi_a = \phi_m = \phi$. I then choose ϕ so that the model reproduces for the benchmark economy, the share of labor in wholesaling-retailing in 2000, 20%, as reported by the *Bureau of Economic Analysis* (see Table 4). Similarly I assume $\tau_a = \tau_m = \tau$ and set τ to match a share of transportation costs in the retail price of food in 2000 of 5%, as reported by the *USDA*. The subsistence term in agriculture \bar{a} is chosen to match an initial employment share in agricultural production of 48.3%, based on data from the *Historical Statistics*. The constant terms in the final goods production technologies are set as follows. $\bar{d} = \bar{d}_a = \bar{d}_m$ is set to match an initial share of employment in wholesaling-retailing of 7.8% in 1870 (see Table 4). $\bar{T} = \bar{T}_a = \bar{T}_m$ is chosen to match a labor share in transportation of 7.6%, in 1890. These parameters along with their targets are reported in Table 8.

4.2 Benchmark Results

In the baseline experiment, I take as given the time paths for the relative TFP series in agriculture, wholesaling-retailing, transportation and I ask, how the model does in matching the time series behavior of the (i) the structural transformation (decline of share of agriculture), (ii) the change in the composition of the distribution sector (decline in the share of transportation and increase in the share of wholesale-retail trade), and (iii) the non-linear rise in the distribution margin for food.

Fig.10-12 present the time series for the labor shares produced from the model against those from the data for the US economy, over the period 1870-2000.²⁸ Fig.10 displays the labor share in agriculture. Even though the initial point is matched by construction, the model does well in capturing the continuous decline of the agricultural sector, and resonates particularly well with the data after 1970 (even though it was not calibrated to do so). What stands out from Fig.10 is that the structural transformation in the model takes place faster than in the data. Frictions to the mobility of labor out of agriculture, which are not present in the model, can potentially account for the gap between the model and the data.²⁹

The labor share in the wholesale-retail sector, in Fig.11, matches the rise in the data closely for the entire period, even though only the two end points have been calibrated to match. The share of labor in transportation produced by the model, in Fig.12, accounts well for the data after 1940. The only point targeted in the calibration here is the 1890 point. The model does not reproduce the inverted U-shaped behavior of the labor share in transportation observed in the data, and instead follows a monotonic decline. The reduced form way in which transportation is modelled here is not rich enough to account for this U-shaped pattern.³⁰

²⁸The wholesale-retail and transportation data are the ones from Table 4. The agricultural data are obtained from the *Historical Statistics* for the earlier period and the *Bureau of Economic Analysis* for the modern period.

²⁹See for example Caselli and Coleman (2001), and Restuccia, Yang and Zhu (2006) for such frictions.

³⁰See Schmitz (2003) for an explicit modelling of transportation that is capable of producing such a pattern.

Fig.13 plots the distribution margin for food generated by the model against the one in the data, over the period 1913-2000 for which data are available. The initial point in both series has been normalized to 1. The model does a good job in accounting for the behavior of the distribution margin for most of the period. For the period 1913-1970 the behavior of the distribution margin for food is very close to that in the data, and the timing of the structural break is also matched well. The increase in the distribution margin in the model is smaller than in the data, but nevertheless the model can account for over 60% of the ultimate rise. It is noteworthy, that nothing in this series has been targeted in the calibration of the benchmark economy.

In Table 9, I report summary statistics regarding the performance of the model for each of the variables of interest. The metric I construct, is similar to an “R-squared” in a regression. In particular the success of the model for a given variable, is measured as $1 - \frac{RSS}{TSS}$, where RSS is the squared distance between the series produced by the model and the data and TSS is the squared data series. Complementing Figs.10-13, the summary statistics indicate that the benchmark economy does quite well in capturing the dynamics of both the structural transformation as well as the change in the composition of the distribution sector, and the behavior of the distribution margin, for the US economy.

4.3 Counterfactual Experiments

The results above are the equilibrium of a number of channels operating on the distribution margin. The model includes two sets of factors that affect relative prices and therefore distribution margins over time. The first set, the supply factors, include changes in the relative productivity (TFP) of agriculture, wholesale-retail trade, and transportation as well as differences in capital intensities across sectoral production functions. The second set, the demand factors, include the non-homothetic terms in preferences, \bar{a} , \bar{d} , \bar{T} . When these terms are positive, as income rises, the relative demand for food and transportation services declines, while the relative demand for wholesaling-retailing services rises. To isolate which of these factors are the most important ones quantitatively, in accounting for the behavior of the distribution margin over time, I run a set of counterfactual experiments where I “shut down” each factor, one at a time.³¹ Figs.14-15 present the resulting distribution margin from each counterfactual along with the distribution margin for the benchmark economy. Table 10, reports the percentage loss in performance of the distribution margin (where performance is measured as the “R-squared” described above) when each factor is omitted when simulating the economy.

There are several interesting conclusions that can be drawn from these experiments. First, supply factors overall are the most important ones in accounting for the behavior of the distribution margin for food. Second, among the supply factors, the TFP in the wholesale-retail sector and the differences in capital intensities across sectors are the most important. The reason is that wholesale-retail services are

³¹In particular, for TFPs I ask the following question: what if TFP growth in sector $i \in \{a, d, T\}$ was not determined from the true TFP series but instead was set to match the restriction for a balanced growth path with a constant relative producer price for that sector, throughout the entire period? In the experiment on capital intensities I assume that all sectors have the same capital intensity as the aggregate US economy, 0.4. In the experiments on the structural transformation and the transformation of distribution, I assume that $\bar{a} = 0$ and $\bar{d} = \bar{T} = 0$ in turn.

a large component of final goods, and the production of these services is highly labor intensive. Third, the demand channels of the distribution sector (\bar{d}, \bar{T}) are almost inconsequential for the behavior of the distribution margin. They are however important in accounting for the change in the composition of the distribution sector. Fourth, the decline in the relative demand for agricultural goods is an important contributor to the behavior of the distribution margin. The reason is that when the economy is close to subsistence, a high relative producer price of agriculture is necessary in equilibrium in order to support a high share of labor in agriculture.

The sharp rise in the distribution margin, after the 1960s (non-linearity), is due to a combination of three factors: (i) the sharp decline in the producer price of agriculture, due to the rise in agricultural productivity in the US since the 1970s (especially after 1979) in combination with the subsistence constraint which amplified its effect, (ii) the rise in the relative price of wholesaling-retailing due to the relative slowing down in this sector's productivity since the 1970s, (iii) the constancy of the relative cost of transportation, due to the fact that productivity gains in the transportation industry virtually ceased in the 1960s.

5 Quantitative Analysis for the Cross-Section

For the cross-section experiments, I consider a static version of the model, in which I abstract from growth and capital accumulation.³² One of the main shortcomings for the cross section experiments is the lack of comparable data on the size and the composition of the distribution sector across countries. I use only the available data for agriculture and the aggregate economy, to construct measures of TFP in agriculture and non-agriculture, for all the countries in my sample. I assume that countries have the same relative TFPs between distribution (transportation and wholesaling-retailing) and the rest of the economy, but differ in aggregate TFP and relative agricultural TFP. Then I ask the following question: to what extent can exogenous differences in aggregate TFP and relative agricultural TFP account for the differences in distribution margins that we observe in the data. The point of this exercise is to see how far one can go in accounting for the observed differences in distribution margins with the observed relative productivity differences in agriculture. I also conduct a set of numerical exercises to provide insight into the importance of distribution productivity.

5.1 Construction of TFP Measures

For the static version of the model, I posit the following production functions for agriculture, wholesaling-retailing, non-agriculture, and transportation,

$$Y_a = A\pi_a L_a^\alpha N_a^{1-\alpha} \quad (11)$$

³²I do not want to take a stance on whether differences across countries are transitional (countries are a few years behind the US but on the same trajectory) or institutional/technological (differences in institutions/technology make otherwise similar countries have different distribution margins). Both these factors appear under "TFP" in the static version of the model.

$$Y_d = A\pi_d L_d^\psi N_d^{1-\psi} \quad (12)$$

$$Y_j = A\pi_j N_j$$

for $j \in \{m, T\}$. A is economy-wide productivity, proxied by productivity in non-agriculture, i.e., $\pi_m = 1$. π_j for $j \in \{a, d, T\}$ measures productivity in sector j relative to economy-wide productivity.

For each country i , I construct an economy-wide TFP measure (A_i) and a relative agricultural TFP measure (π_{ai}) using the production functions posited above. Aggregate TFP is measured as TFP of the non-agricultural sector in the data, $A_i = \frac{Y_{mi}}{N_{mi}}$ where N_{mi} and Y_{mi} are constructed as $N_i - N_{ai}$ and $Y_i - Y_{ai}$ respectively. N_i is the total economically active population (labor force) and N_{ai} is the economically active population engaged in agricultural production (labor force in agriculture), both in thousands, obtained from the FAO Statistical Database. Y_{ai} is agricultural GDP in thousands of international dollars, obtained from Rao (1993, Table 7.3) and Y_i is total GDP in thousands of international dollars, obtained from the PWT v5.6.

Relative productivity of the agricultural sector is measured as the residual from the agricultural production function $\pi_{ai} = A_i^{-1} \frac{Y_{ai}}{N_{ai}} \left(\frac{N_{ai}/N_i}{L_{ai}/N_i} \right)^\alpha$ where A_i is as calculated above and L_{ai} is total arable land in thousands of hectares, obtained from the FAO Statistical Database.

5.2 Calibration to US Data

I calibrate the benchmark economy to 1985 US data. Values for the following parameters need to be determined: α , ψ , ρ , ϕ , τ , π_d , π_T , \bar{a} , \bar{d} , \bar{T} , L_a/N . The rural land to population ratio, L_a/N , is taken directly from the FAO. The ratio of arable land in hectares per working age person for the US economy is 1.57. The labor intensity parameter in agriculture, $1 - \alpha$, is set equal to 0.7 to match a land share of 0.3 which is within the range of parameters estimated from cross-country agricultural production functions. See for example Hayami and Ruttan (1985). Given that no international database exists for land to population ratios in distribution, I assume that $\psi = 0$ in the baseline calibration, but conduct sensitivity analysis with respect to this parameter later.

The technology parameters π_a and A for the US (calculated as sectoral residuals as explained above) are 0.16 and 33,625 respectively. Due to the absence of an international sectoral database with comparable measures of output by sector, I use data from the *Bureau of Economic Analysis* (BEA) Industry Accounts to calculate the relative productivity parameters for the US distribution sector, π_d and π_T . Using GDP and labor force figures for wholesaling-retailing and transportation, I calculate as residuals from the posited production functions $\pi_d = 0.75$ and $\pi_T = 1.05$.³³

The values of the preference parameters for the composite food good ρ , \bar{a} , the wholesaling-retailing services, ϕ , \bar{d} , and the transportation services τ , \bar{T} , are selected to match two targets for the labor shares in agriculture, wholesaling-retailing, and transportation. Loosely speaking, ρ , ϕ , τ determine the long run

³³The GDP shares in current US dollars from the 1985 BEA Industry Accounts are: $\frac{GDP_d}{GDP} = 0.162$, $\frac{GDP_T}{GDP} = 0.033$. I use these shares and the measure of total US output in 1985 from the PWTv5.6, to calculate GDP by sector in international dollars. The labor force shares are 0.212 for wholesaling-retailing and 0.031 for transportation.

labor shares, while \bar{a} , \bar{d} , \bar{T} determine given labor shares away from their long-run values. I assume long run agricultural, wholesaling-retailing, and transportation labor shares of 2.6%, 24%, 2.8%. The labor shares in agriculture, wholesaling-retailing, and transportation for the US economy in 1985 are 3.15%, 21.2%, 3.10%. These targets imply the values for the preference parameters given in Table 11. The assumed long-run labor shares are consistent with the trends for these shares in the US economy until the late 1990s, where the share of labor in wholesaling-retailing continued to rise at a slow pace, and the shares in agriculture and transportation continued to decline at a slow pace. Assuming that these trends imply that the US economy was near its long-run state in 2000 these values seem reasonable. However, given that the choice of the long run labor shares is somewhat arbitrary I conduct sensitivity analysis with respect to their values. A summary of all the calibrated parameter values and their targets is provided in Table 11.

5.3 Experiment and Results

In the quantitative experiment, I assume that countries are otherwise identical to the benchmark economy except in their TFP parameters, π_{ai} and A_i , which are calibrated to labor productivity differences in the agricultural and non-agricultural sectors as described above. Given these TFP measures, for each of the 48 countries in my sample, I ask how the predicted distribution margins from the model compare to those in the data.³⁴ To assess the quantitative reliability of my results, I also examine how the model performs in explaining agricultural labor shares and agricultural and aggregate labor productivities.

For every country in my sample, I compute distribution margins, equilibrium labor shares in all sectors, sectoral and aggregate labor productivities and compare them to their counterparts in the data. Agricultural and aggregate labor productivities are computed using a common set of prices (those of the benchmark economy). In order to summarize the results of the model, I follow Klenow and Rodriguez-Clare (1997) and calculate the percentage of the variation in each variable of interest in the data that is accounted for by the model, defined as $\frac{cov[\ln(MODEL), \ln(DATA)]}{var[\ln(DATA)]}$. These results are reported in Table 12.

The model, with exogenous relative productivity in agriculture, accounts for almost half of the variation in distribution margins, and for a large fraction of the variation in the other variables of interest. In particular, the model accounts for 85% of the variation in the agricultural employment shares and 95% of the variation in agricultural productivity.³⁵ For my benchmark parameterization, exogenous differences in agricultural productivity can explain 48% of the cross-country differences in the distribution margins for food. Fig.16 plots the distribution margins predicted by the model against those in the data. Deviations from the 45 degree line signify discrepancies between the model and the data. It is clear that the model performs fairly well in accounting not only for the overall variation in the data but also for the particular pattern of distribution margins that we observe. The model can also account for 67% of the cross-country

³⁴Given the lack of cross-country data for the distribution sector, the relative price of distribution will be constant in the experiment and all variation in the distribution margin for food will come solely for the producer price of agriculture.

³⁵This should not be surprising given that I am taking both agricultural and non-agricultural productivity as exogenous in the experiment. However, this model is silent on what explains these TFPs.

income differences.

The above results have two important implications: (1) differences in agricultural productivity, which are essential for replicating the cross-country observations for agriculture, are also important for understanding differences in distribution margins for food across countries, (2) differences in distribution productivity can be at least as important, since more than half of the variation cannot be explained relying on relative agricultural TFP alone. Furthermore, differences in distribution TFP can also be important in accounting for the unexplained component of the cross-country income disparity.

Sensitivity analysis To examine the sensitivity of my results to the choice of benchmark parameter values, I consider alternative parameterizations of the model, which are presented in Table 13. Row (1) repeats the benchmark results. As discussed above the choice of the long run employment shares in all sectors is somewhat arbitrary. In rows (2), (3), and (4) I consider alternative long run employment shares for agriculture, wholesaling-retailing and transportation respectively. These change the performance of the model but not in a fundamental way. Row (5) presents the results for the case in which the labor intensity parameter is 0.41 ($\alpha = 0.59$), which was used in Section 4. This reduces the performance of the model slightly on all dimensions. The reason is that a lower α intensifies the decreasing returns in the agricultural sector. In row (6) I shut off “subsistence” in transportation and “home production” in wholesaling-retailing. This does not alter the performance of the model in any way, suggesting that these demand channels are not important for the variables of interest, when relative productivities in the distribution sector are not varied. In row (7) I consider the case in which I allow for urban land in the distribution sector, and choose the labor compensation share for this sector as in Section 4. The benchmark results are robust to this alternative value of ψ . Row (8) shows that when $\bar{a} = 0$ the results of the model change drastically. The reason is that a low relative productivity in agriculture induces labor to remain in farming only in the presence of a subsistence constraint for food consumption. The last row, (9), shows what happens when the only source of variation is the economy-wide productivity A , while π_a is held constant across countries. This experiment indicates that differences in sector specific productivity in agriculture are essential for generating variation in distribution margins and the other variables of interest.

5.4 An Exploratory Exercise

The experiment of the previous section indicates that more than half of the variation in the distribution margin for food across countries cannot be explained by differences in economy-wide productivity (A) and sector-specific agricultural productivity (π_a). A key question is, to what extent can differences in the sector-specific wholesaling-retailing (π_d) and transportation (π_T) productivities across countries account for the rest. Lack of cross-country data on the distribution sector do not permit an experiment for the whole sample. Here, I conduct a set of numerical illustrations to assess the quantitative potential of distribution productivity in explaining the residual variation in distribution margins across countries.

Consider the benchmark economy to be one that is endowed with the economy-wide productivity and the sector-specific agricultural productivity of the US. For the sake of illustration I assume that $\alpha = \psi = 0$

for the benchmark economy. I normalize the distribution margin for this economy to 1. Table 14 reports how the distribution margin changes relative to this benchmark.

First, consider an economy that has only 1/4 of the economy-wide productivity of the US, but is otherwise identical.³⁶ When $\alpha = \psi = 0$, differences in economy-wide productivity are inconsequential for differences in relative prices, and thus distribution margins across countries (first row in Table 14). When there is a diminishing marginal product of labor in agriculture and wholesaling-retailing ($\alpha > 0$ and $\psi > 0$), then differences in economy-wide productivity lead to differences in relative distribution margins even if there are no differences in sector-specific productivities across countries.³⁷ The second and third row of Table 14, report the effect of setting $\alpha = 0.3$ and $\psi = 0.2460$ in turn.

When $\alpha = \psi = 0$, the only thing that matters for differences in relative prices is differences in sector-specific productivities. The last three rows report how the distribution margin changes when the sector-specific productivity, π_i for $i \in \{a, d, T\}$, term varies relative to the benchmark economy. Given that poor countries are particularly unproductive in agriculture (Restuccia, Yang and Zhu, 2006) and transportation (Adamopoulos, 2005) I consider a 10% reduction, relative to the benchmark, in each of π_a and π_T in turn. According to Balassa-Samuelson, the relative productivity of services (including wholesaling-retailing services) is higher in poor countries, because differences in service productivities across nations are much less pronounced than in other sectors of the economy. Thus, in Table 14 I consider a 10% increase in the sector-specific wholesaling-retailing productivity for the poor economy.

An interesting result from the last three rows of Table 14, is that the elasticity of the distribution margin with respect to π_d (0.23) is similar in absolute terms to the elasticity of the distribution margin with respect to π_a (0.28). This result suggests that quantitatively the dispersion in π_d 's across countries (as long as it is similar in size to the dispersion of π_a 's) could potentially account for the majority of the residual variation in the distribution margins for food across countries. More generally, the results suggest that it is mainly sector-specific productivity differences that can account for the disparities in cross-country distribution margins.

6 Concluding Discussion

This paper has studied the behavior of the distribution sector and its effect on prices as income rises. It has documented two main facts: (1) in both the cross section and the US time series, distribution margins show little correlation with real GDP per worker at low levels of income, but as income rises the correlation becomes strongly positive, (2) in the US there has been a change in the composition of the distribution

³⁶This choice of A is motivated by the fact that the 10% richest countries in the sample have an A that is four times that of the 10% poorest.

³⁷A country that has a lower economy-wide productivity than the benchmark will have a higher relative producer price of agriculture and a lower relative price of wholesaling-retailing. The reason is that, when A is low, $\bar{a} > 0$ and $\bar{d} > 0$, imply that there is a high relative demand for agricultural output and a low relative demand for wholesaling-retailing services. This in turn, implies that there will be a higher share of labor employed in agriculture, and a lower share of labor in wholesaling-retailing. With $\alpha > 0$ and $\psi > 0$ this requires a higher relative producer price of agriculture, and a lower relative price of wholesaling-retailing.

sector over time (a decline in transportation and a rise wholesaling-retailing). A theory, which features both supply and demand forces, has been proposed to rationalize these observations.

The quantitative results suggest that supply forces are the most important in understanding why rich countries have higher distribution margins. The experiments for the US time series assign a prominent role to wholesaling-retailing TFP, agricultural TFP and differences in labor intensities across sectors. The experiments for the cross section show that differences in agricultural productivity, through their effects on agricultural production costs, can account for almost half of the variation of food distribution margins. Numerical exercises suggest that particularly high productivity in goods vs. service production in rich countries, can potentially account for much of the rest.

Often, expenditure data and final sales prices are used to make inferences about relative labor productivity across sectors. To the extent that consumer and producer prices differ in a systematic manner, as shown in this paper, the inferences based on consumer prices can be erroneous. The reason is that consumer prices include charges relating to transportation and wholesaling-retailing. These activities belong to the distribution sector and should not affect measures of productivity in other sectors.

The model developed here has been a closed economy one. This is because the purpose of the paper has been to understand *why* distribution margins vary systematically with the level of prosperity. A better understanding of the determinants of distribution margins is key to building open economy models in which systematic differences in distribution margins can potentially have significant implications for trade, development and international finance.

The pattern of distribution margins presented here, although only for food, may shed light on why rich countries have higher prices than poor countries even for highly traded goods (see Rogoff, 1996 for a discussion of the PPP puzzle). The implication is that all goods, even traded ones, have a significant component of non-tradable distribution services attached to them by the time they reach the consumer. Given that these costs are higher in rich countries, this result could potentially explain why their price levels are higher. In this sense, the results of this paper, point to an extension of the Balassa-Samuelson hypothesis, and thus to a theory of the long run *level* of the real exchange rate. Scholars have suspected for some time that distribution costs could be responsible for the higher price levels in rich countries but there had been no systematic evidence in favor of this (see for example Dornbusch, 1989). The evidence here helps in this direction.

The relative price of investment to consumption is key to understanding differences in investment rates across rich and poor countries. Among the possible explanations that have been proposed for why this relative price is higher in poor countries are: (i) distortionary policies that discourage investment (see for example Chari, Kehoe, McGrattan, 1996; Restuccia and Urrutia, 2001), (ii) particularly low productivity in producing investment goods (see for example Hsieh and Klenow, 2003). The difference in this relative price across countries is now known to be driven by the low price of consumption in poor countries rather than the high price of investment. The evidence presented here along with recent evidence by Burstein, Neves and Rebelo (2004), suggesting that the non-tradable component of investment is lower in rich countries, might help understand the patterns in the relative price of investment.

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7 Tables and Figures

Table 1: Countries and Codes

Australia (AUS), Austria (AUS), Bangladesh (BGD), Belgium - Luxemb. (BEL), Cameroon (CMR), Canada (CAN), Denmark (DNK), Egypt (EGY), Ethiopia (ETH), Finland (FIN), France (FRA), Germany, West (DEU), Greece (GRC), Hungary (HUN), India (IND), Iran (IRN), Ireland (IRL), Italy (ITA), Ivory Coast (CIV), Japan (JPN), Kenya (KEN), Korea, South (KOR), Madagascar (MDG), Malawi (MWI), Mali (MLI), Morocco (MAR), Nepal (NPL), Netherlands (NLD), New Zealand (NZL), Nigeria (NGA), Norway (NOR), Pakistan (PAK), Philippines (PHL), Poland (POL), Portugal (PRT), Rwanda (RWA), Senegal (SEN), Spain (ESP), Sri Lanka (LKA), Sweden (SWE), Tanzania (TZA), Thailand (THA), Tunisia (TUN), Turkey (TUR), United Kingdom (GBR), United States (USA), Yugoslavia (YUG), Zimbabwe (ZWE).

Table 2: Categories and Commodities

Category	PWT Detailed Category	FAO Commodity
CEREALS	Rice , Flour and Cereals, Other Cereal Products.	Barley, buckwheat, canary seed, canary seed, cereal nes, fonio, maize millet, mixed grain, oats, quinoa rice, rye, sorghum, triticale, wheat.
LIVESTOCK PRODUCTS	Fresh Milk , Cheese, Eggs , Beef and Veal , Pork , Lamb , Mutton and Goat , Poultry , Other Fresh/Frozen.	Asses, beef , veal , buffalo , buffalo milk, camel, camel milk, chicken , cow milk , duck, eggs rest, game meat, goat, goat milk, goose, hen eggs , horse, meat nes, mules, pig , rabbit, sheep , goat , sheep milk, turkey.
FRUIT	Fresh Fruit .	Apples , apricots , avocados , bananas , berries nes , blueberries , carobs , cherries , citrus nes , cranberries , currants , dates , figs , fruit nes , goose berries , grapes , kiwi , lemons , mangoes , oranges , papayas , peaches , pears , persimmons , sour cherries , stone fruit , strawberries , tangerines , tropical nes , cantaloupes, watermelons.
NUTS	Dried fruit and nuts.	Almonds, brazil nuts, cashew nuts, chestnuts, hazelnuts, nuts nes, pistachios walnuts.
VEGETABLES	Fresh Vegetables .	Asparagus , cabbages , carrots , cauliflower chillies , cucumbers , eggplants , garlic , green beans , green corn , lettuce , mushrooms , onions dry , onions shallots , pumpkins , spinach , string beans , tomatoes , vegetables fresh nes .
TUBERS	Potatoes and other tubers .	Cassava , potatoes , roots and tubers nes , sweet potatoes , taro , yams , yautia .
SUGAR	Raw and refined sugar.	Sugarcane, sugarbeeds.
STIMULANTS	Coffees, Teas, Cocoa.	Cocoa beans, coffee, hops, mate, tea.
SPICES	Salt, Spices and Sauces.	Anise, cinnamon, cloves, nutmeg, pepper, peppermint, pimento, spices nes, vanilla.
TOBACCO	Cigarettes, Other Tobacco Products.	Tobacco leaves.

Table 3: OLS Regression Results

Sample	constant	$\log(\frac{y_i}{y_{US}})$	R^2
Whole (48 countries)	-0.101 (-1.28)	0.204 (4.65)	0.32
Rich (24 countries)	0.185 (2.15)	0.789 (5.34)	0.56
Poor (24 countries)	-0.665 (-2.91)	-0.027 (-0.29)	0.004

Table 4: The US Distribution Sector, 1869-1999

Year	Employment Shares		GDP Shares (current prices)	
	Transportation	Wholesaling-Retailing	Transportation	Wholesaling-Retailing
1869	5.0	7.8	7.4	15.2
1879	4.9	7.9	8.8	16.1
1889	6.5	9.7	7.6	16.8
1899	6.8	10.8	7.0	16.6
1909	7.4	11.8	7.4	16.4
1919	7.7	13.2	7.3	14.4
1929	6.7	16.9	7.6	15.6
1939	4.7	16.3	6.3	17.4
1949	5.0	18.1	5.6	17.9
1959	4.2	18.6	4.5	16.8
1969	3.6	19.1	3.8	16.5
1979	3.3	20.0	3.8	16.3
1989	3.1	21.5	3.1	15.6
1999	3.4	20.0	3.3	15.9

Table 5: Calibration of Employment Share Parameters

	Agriculture	Transportation	Wholesale-Retail Trade
1987 I-O	0.395	0.667	0.755
1992 I-O	0.428	0.690	0.765
1997 I-O	0.397	0.673	0.742
Average	0.406	0.676	0.754

Source: US Input-Output Tables, Benchmark Data (1987, 1992, 1997)

Table 6: Parameters based on a priori information

Parameter	Value	Target
σ	1.00	logarithmic utility
β	0.957	asymptotic real interest rate
ρ	0.0494	share of food in total consumption expenditures
η	1.0159	average annual population growth rate
δ	0.06	investment - capital ratio
γ_m	1.0114	average annual real GDP per capita growth rate
θ	0.40	capital share for US economy
α	0.5940	labor compensation share in agriculture
μ	0.5246	rural land's share in total rental cost of capital in agriculture
ψ	0.2460	labor compensation share in wholesaling-retailing
λ	0.6341	urban land's share in total rental cost of capital in distribution
ξ	0.3240	labor compensation share in transportation

Table 7: TFP Growth Rates for Agriculture and Wholesaling-Retailing

	1870-1914	1915-1947	1948-1966	1967-1973	1973-1979	1979-2000
Agriculture	0.0043	0.0144	0.0133	0.0012	0.0206	0.0358
Wholesale-Retail	0.0102	0.0102	0.0142	0.0068	-0.0042	0.0080

Source: Historical Statistics, Fuchs (1968), Jorgenson and Gollop (1992)

Table 8: Parameters chosen to match US data

Parameter	Value	Target
ϕ	0.245	wholesaling-retailing labor share in 2000
τ	0.050	share of transportation services in food cost
\bar{a}	0.594	employment share in agriculture in 1870
\bar{d}	0.174	employment share in wholesaling-retailing in 1870
\bar{T}	0.030	transportation share in GDP in 1890

Table 9: Performance of the Model:

$$R^2 = 1 - \frac{RSS}{TSS}$$

$\frac{N_{at}}{N_t}$	$\frac{N_{dt}}{N_t}$	$\frac{N_{Tt}}{N_t}$	$\frac{p_{at}}{q_{at}}$
0.80	0.98	0.81	0.94

Table 10: Percentage Loss in Performance When Factor Omitted

Factor Omitted	% Change in R^2 for $\frac{p_{at}}{q_{at}}$
Agricultural TFP	-0.5
Wholesale-Retail TFP	-4.3
Transportation TFP	-0.0
Non-Agricultural TFP	-0.1
All Sectoral TFPs	-4.6
Labor Intensity Differences	-3.2
Structural Transformation ($\bar{a} = 0$)	-3.6
Transformation of Distribution ($\bar{d} = \bar{T} = 0$)	-0.0

Table 11: Calibration of Parameter Values to U.S. Data

Parameter	Value	Target
α	0.3	land share in agriculture
ψ	0	linear technology in labor
A	33,625	labor productivity in non-agriculture
π_a	0.16	residual from agr. production function
π_d	0.75	residual from whol.-retail prod. function
π_T	1.05	labor productivity in transportation
$\frac{L_a}{N}$	1.567	FAO Statistical Database
\bar{a}	264.64	labor share in agriculture
\bar{d}	513.86	labor share in wholesale-retail
\bar{T}	26.90	labor share in transportation
ρ	0.026	long run agricultural labor share
ϕ	0.24	long run wholesale-retail labor share
τ	0.028	long run transportation labor share

Table 12: Percentage of Data Variation Accounted by the Model

p_a/q_a	Y_a/N_a	N_a/N	Y/N
0.48	0.95	0.85	0.67

Table 13: Sensitivity Analysis

Specification	p_a/q_a	Y_a/N_a	N_a/N	Y/N
(1) Benchmark	0.48	0.95	0.85	0.67
(2) $\rho = 0.01$	0.51	0.98	0.99	0.83
(3) $\phi = 0.27$	0.53	0.94	0.82	0.65
(4) $\tau = 0.015$	0.46	0.95	0.87	0.68
(5) $\alpha = 0.59$	0.41	0.89	0.85	0.61
(6) $\bar{d} = \bar{T} = 0$	0.48	0.95	0.86	0.67
(7) $\psi = 0.246$	0.47	0.95	0.86	0.67
(8) $\bar{a} = 0$	0.35	0.76	0.04	0.47
(9) $\pi_a = 0.16$	0.06	0.39	0.40	0.48

Table 14: Percentage Change in Relative Distribution Margin Due to Each Factor

Factor Omitted	% Change in Relative $\frac{p_a}{q_a}$
$A = \frac{1}{4}A_{US}, \alpha = \psi = 0$	0.0
$A = \frac{1}{4}A_{US}, \alpha = 0.3, \psi = 0$	12.7
$A = \frac{1}{4}A_{US}, \alpha = 0, \psi = 0.2460$	-6.0
$A = \frac{1}{4}A_{US}, \pi_a = 0.9\pi_{aUS}$	-2.8
$A = \frac{1}{4}A_{US}, \pi_d = 1.1\pi_{dUS}$	-2.3
$A = \frac{1}{4}A_{US}, \pi_T = 0.9\pi_{TUS}$	0.3

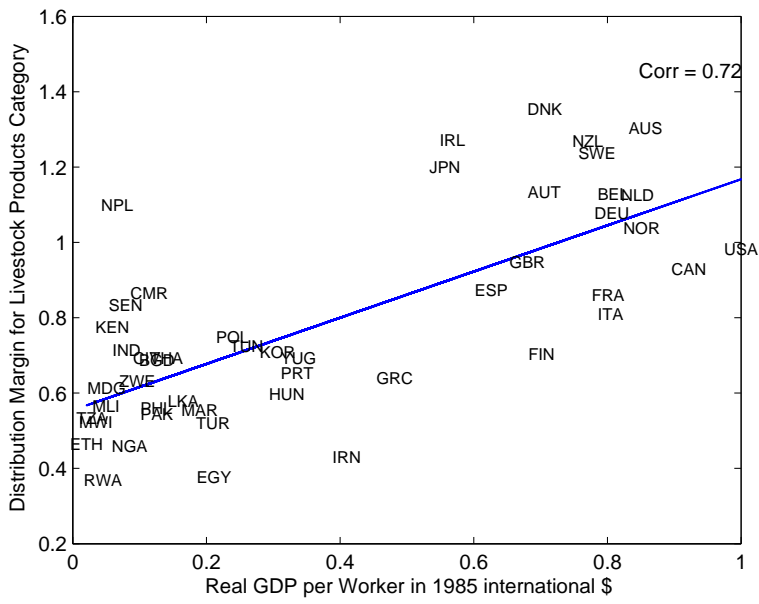


FIG. 5
Distribution Margin for Livestock Products

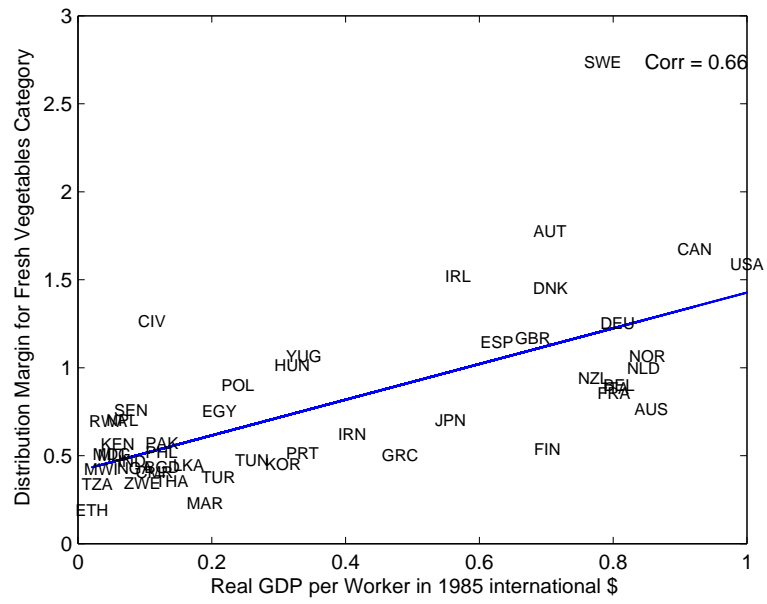


FIG. 6
Distribution Margin for Fresh Vegetables

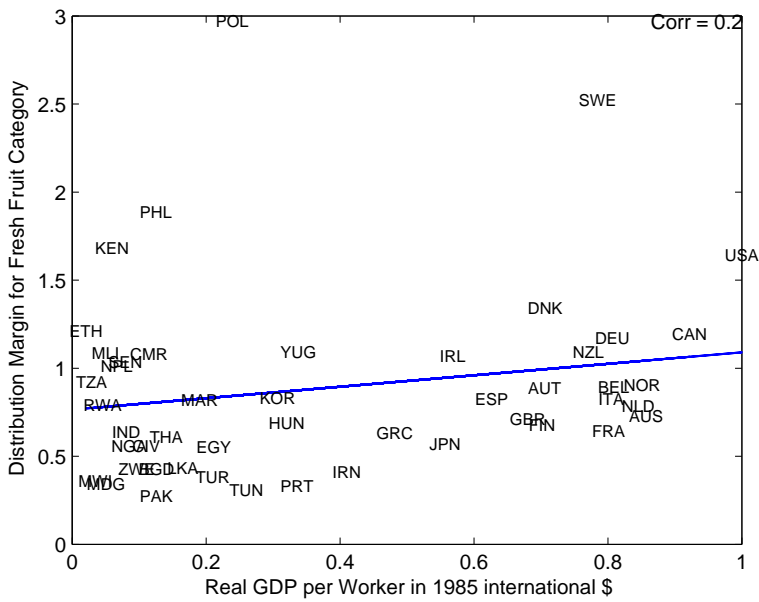


FIG. 7
Distribution Margin for Fresh Fruit

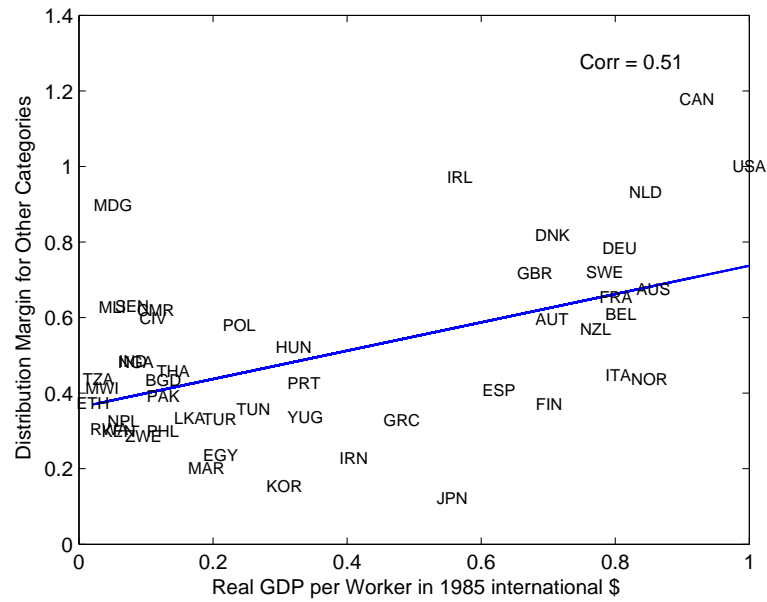


FIG. 8
Distribution Margin for Rest Categories

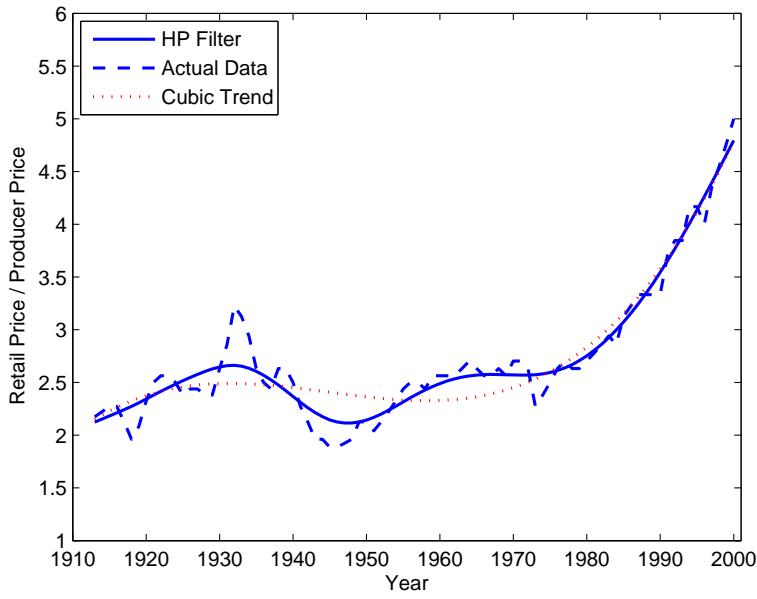


FIG. 9
Distribution Margin for
Food: U.S. 1913-2000

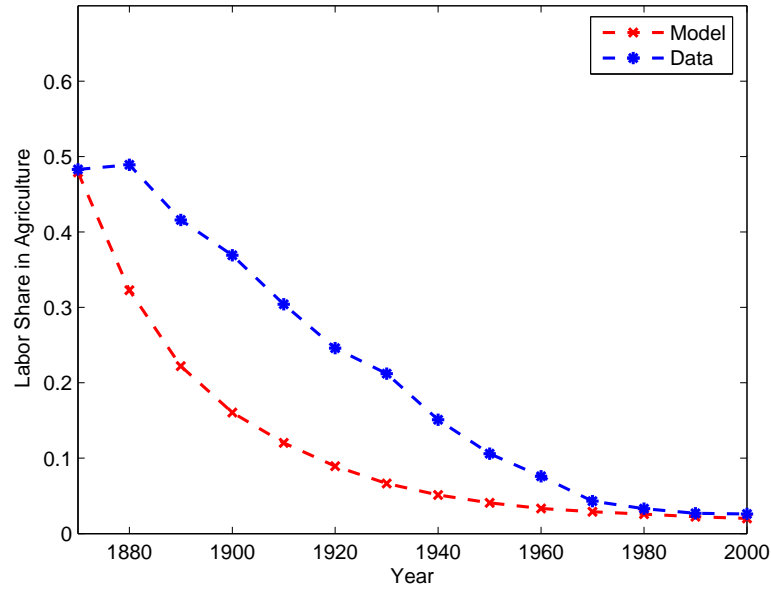


FIG. 10
US Labor Share in Agri-
culture: Model vs. Data

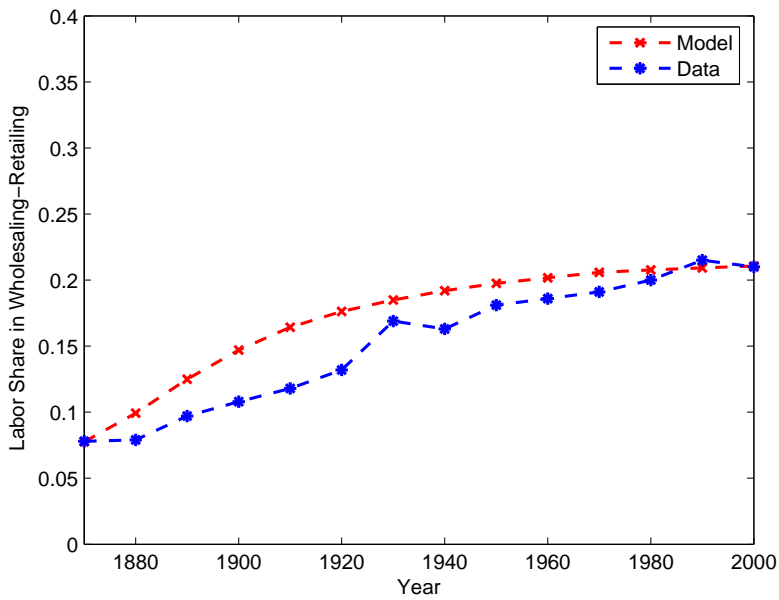


FIG. 11
US Labor Share in Whol.-
Ret.: Model vs. Data

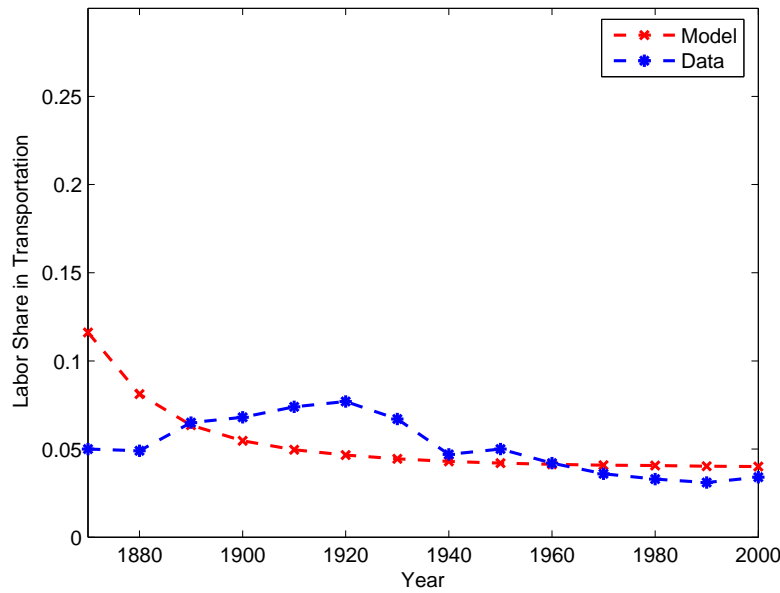


FIG. 12
US Labor Share in Trans-
portation: Model vs. Data

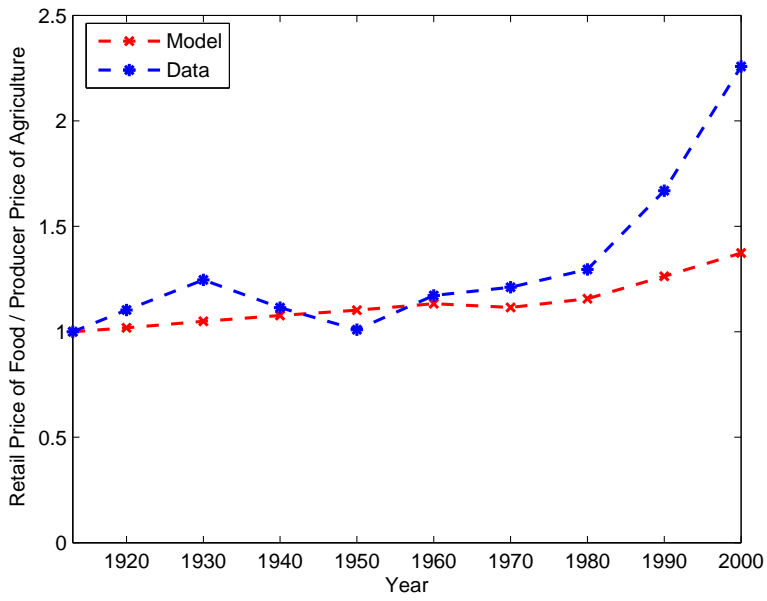


FIG. 13
US Distribution Margin: Model vs. Data

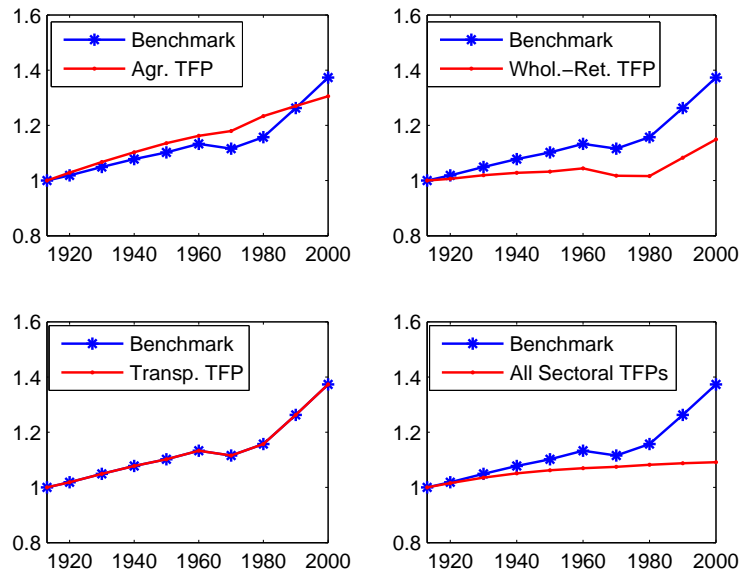


FIG. 14
US Distribution Margin: Counterfactuals I

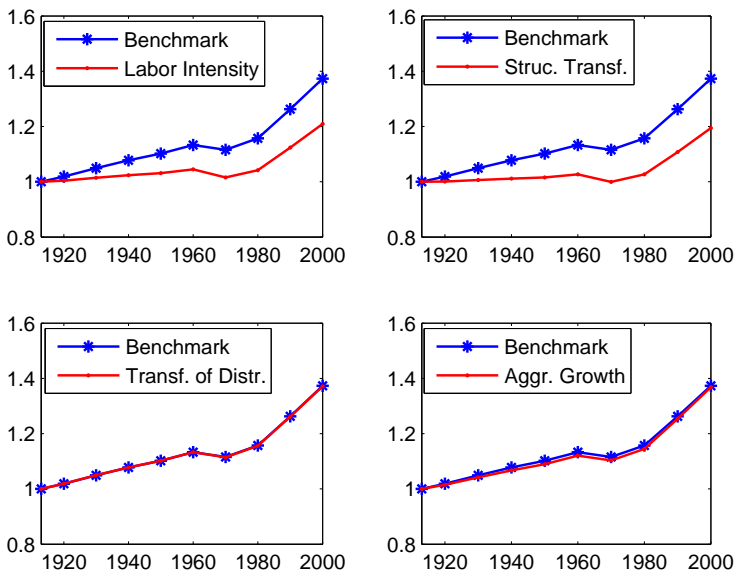


FIG. 15
US Distribution Margin: Counterfactuals II

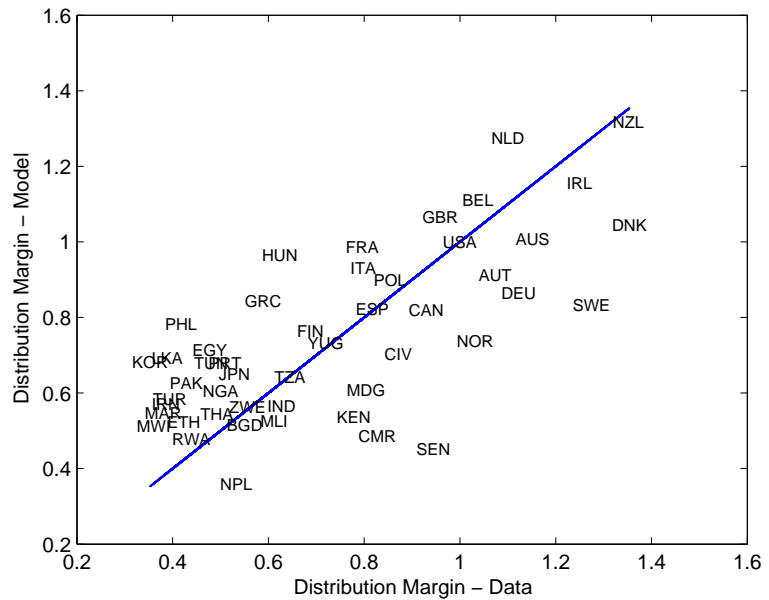


FIG. 16
Cross Section Distribution Margins: Model vs. Data