Web Appendix: Re-Examining the Role of Sticky Wages in the U.S. Great Contraction: A Multi-sector Approach*

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1 Introduction

This appendix provides some additional background details on the data and numerical experiments used in Amaral and MacGee (2012). In addition, we also outline some robustness exercises. To make the discussion below reasonably self-contained, we repeat some details discussed in the main paper.

This appendix is organized as follows. Section 2 provides some additional data details on wages (Sections 2.1), hours (Section 2.2), and prices (Section 2.3). Section 3 discusses the data on intermediates and intermediates prices. Section 4 outlines the model details for the two-sector model without intermediates and the one-sector model. Section 5 outlines details on additional experiments with respect to the impact of TFP and robustness exercises which are referenced in passing in the paper.

2 Aggregate and Sectoral Wages and Hours Data

Our guide in constructing estimates of hours and wages is the neoclassical growth model. As the model does not distinguish between hours worked by employees and the self-employed our measure of the (aggregate and industry) workforce is persons engaged in production as given by full-time equivalent (FTE) employees plus sole-proprietors. Total hours worked are the product of total workers and average hours worked per FTE worker.

2.1 Aggregate Data

A key measurement issue for hours and wages is how to consistently account for sole-proprietors (self-employed), who were roughly a fifth of the workforce during the Great Depression. We find that, once self-employed workers are taken into account, there is little rise in the real economy wide average (consumption) wage during the Great Contraction, and that average hours worked per adult fall by less than those of employees. This is due to both a smaller decline in the number of self-employed workers compared to full time equivalent employees, as well as a larger (percentage) decline in the income of sole-proprietors.

The importance of sole-proprietors for the estimate of economy-wide real wages can be seen by comparing our estimates to two alternative approaches taken in the literature. Bordo, Erceg, and Evans (2000) look at the average wages of employees – and find a significant rise in real wages (we replicate this measure below). A different extreme approach is that of Christiano, Motto, and Rostagno (2003) who, like Bordo, Erceg, and Evans (2000), use total compensation of employees as the gross amount of earnings, but use a measure of hours that includes hours worked by sole-proprietors (see endnote 15 of Christiano, Motto, and Rostagno (2003)). Since self-employed hours fall by less than those of employees (as we discuss below and in Amaral and MacGee (2012)), it is not surprising that this approach delivers a fall in the aggregate real wage during the Great Contraction.

2.1.1 Hours Worked

Our measure of the workforce is persons engaged in production and can be divided into the number of FTE employed workers plus sole-proprietors (i.e, self-employed workers). Total hours worked are the product of total workers and average hours worked per FTE worker.[1]

The aggregate hours estimate in Amaral and MacGee (2012) is based on the Denison (1962) estimates for aggregate hours, so as to be directly comparable with Bordo, Erceg, and Evans (2000).[2] Specifically, we use average annual hours worked and the index of total employment from Table 5 in Denison together with working-age population to compute an index of total hours worked per adult (see Table 1).[3] The Denison total employment index is nearly identical to that of total persons (full time equivalent) persons engaged in production reported by the BLS.

Since we base our estimates of industry hours worked on Kendrick (1961) (necessitated by the disaggregated industry hours reported therein), we also report an estimate of economy-wide hours worked per adult based on this source (Kendrick Tot. Civil in Table 1). Comparing columns 2 and 3 in Table 1, it is clear that Kendrick and Denison imply similar estimates of hours per adult over 1929-39. This similarity between the series is not surprising, as the Denison numbers are based on data prepared by Kendrick.

The Denison (and Kendrick) estimates of hour worked (consistent with the modelling approach in Amaral and MacGee (2012)) are based on persons engaged in production. This implies a smaller decline in hours worked than that based on the number of employed workers. To illustrate this, we used the Denison average hours worked per worker and the BLS numbers for Employed (FTE) to estimate the fall in hours worked of employees. As can be seen from comparing columns 3 and 4 in Table 1, total person engaged declined by less than total employees. Finally, the Denison estimates of the decline in quality-adjusted hours over 1929-1933 is slightly smaller than the hours measure we use. This should impart a slight upward bias to our wage estimates.

2.1.2 Average Wage

Since direct measures of hourly wages exist for only a few industries, we use estimates of hours worked and total labor income to construct hourly wages. The nominal wage is total labor income divided by total hours. Since hours worked includes sole-proprietors, we define total income as total employee compensation plus 60 percent of sole-proprietors' income. We use the Balke and Gordon (1986) GNP deflator to compute real (consumption) wages. As Hanes (2000) notes, this series likely overstates the decline in the average price level since it overweighs the prices of less processed goods, which fell

[1]This series is similar to the one in Kendrick (1961) over 1929-39.

[2]The underlying data as well as the calculations are in the excel file Hours_Wages_multi_sector_Data_Appendix.xls, sheet Agg_Hours.

[3]Since the adult population rises, our index of hours per worked is correspondingly lower than the index of total hours worked.

more than processed goods during the Great Contraction.

Our measure of the average real wage (*Benchmark* in Table 2) exhibits little increase during the Great Contraction, rising only after the introduction of New Deal policies/beginning of the recovery. This contrasts with the conventional wisdom that real wages increased over 1929-33, recently outlined by Bordo, Erceg, and Evans (2000). The main difference is our inclusion of the self-employed, who comprised nearly 25 percent of the work force in 1929. To illustrate this, we construct an average real wage for employed workers only (*Employees* in Table 2), where labor income is total compensation of employees and total hours worked are the product of FTE employees and average hours worked. This measure of the average real wage rises roughly 12 percent between 1929 and 1932.

Since the consistent treatment of the self-employed quantitatively matters for measured real wages, we discuss several possible concerns with our approach as well as a robustness exercises below, as well in our discussion of sectoral wage estimates.

One concern is whether the self-employed should be included in the estimate of economy-wide average wages. There are several reasons for their inclusion. At a theoretical level, the neoclassical growth model does not distinguish between hours worked by employees and the self-employed. This reflects a theoretical structure that links aggregate measures of inputs (hours worked, capital services) to aggregate output (GDP). Thus, whether an individual supplies market labor via a sharecropping scheme, which classifies them as sole proprietor, or works on a piece-rate contract for the owner of the farmer, what matters is total market hours supplied.[4] Indeed, this view was espoused by contemporaneous observers, as a BLS report stated that: "...there is a basis in the economic status of many farm operators for classifying them with wage earners." (pg. 66, Bureau of Labor Statistics (1939)).

At a practical level, taking the self-employed into account is important for two reasons. First, the self-employed accounted for a large fraction of the of the work force – roughly a quarter of persons engaged in production. Second, the self-employed were concentrated in a few industries, with over half in agriculture, and roughly 30 percent in retail and services. In turn, the self-employed accounted for a relatively large share of workers in these sectors, especially in agriculture where self-employed workers accounted for between 66 and 72 percent of FTE workers during the Great Depression.

A related concern is that the income of the self-employed may be subject to greater measurement error than wage earners. While we follow an established practice in the macro literature of splitting sole proprietors' income between labor income and capital income according to the economy-wide factor repartition, this could introduce measurement error if this share varied during the Contraction.[5]

[4]This is not to say that these different contractual frameworks will not impact the level of output – indeed, one would expect that different contractual arrangements are chosen to mitigate incentive problems due to information asymmetries or for tax reasons. In the context of the growth model, these type of contractual details likely impact measured productivity.

[5]We find that varying the split between labor and capital income around 60 percent (but holding it fixed across years) does not significantly impact our estimates of the average wage.

As a check of the reasonableness of our approach, we use a direct estimate of the agriculture wage as a proxy for the average wage of self-employed workers. This assumes that the average wage of agricultural workers is a reasonable proxy for the opportunity cost of sole-proprietors (over half of sole proprietors worked in agriculture).[6] Specifically, we take the Alston and Hatton (1991) estimate of monthly earnings of agricultural workers, which we convert to an hourly wage by dividing by an estimate of hours worked in agriculture (Kendrick total hours divided by Persons Engaged in Farms from the BEA). The average national wage is the weighted average of the employee average wage series we computed and the agricultural wage, where as weights we use the fraction of FTE Persons Engaged (i.e., FTE Employees/FTE Persons Engaged and FTE Sole-Proprietors/FTE Persons Engaged). As can be seen from comparing columns 2 and 4 in Table 2, this wage series resembles our benchmark wage series.

2.2 Sectoral Data on Hours and Wages

We follow a similar procedure to construct average hours and wages at the industry level, which are reported in Table 1 in Amaral and MacGee (2012) and reproduced here as Table 3. All measures are per working-age person. Below we briefly summarize the underlying calculations and discuss the robustness of these estimates.

2.2.1 Hours data

The estimates of industry hours draw heavily on Kendrick (1961). We use the Kendrick estimates for hours worked in Agriculture (Farm), Government, Manufacturing, Mining, and Transportation plus public utilities (here we combine component series, using as weights the number of employees in each industry in 1929).[7] In industries where Kendrick reports an index of hours worked (i.e., Mining, Transportation and Communications and Public Utilities), we convert the index into levels by multiplying by the number of hours worked in 1929.[8] For the remaining private non-farm industries, total hours are constructed by subtracting hours worked in manufacturing, mining and transportation and communications from private non-farm hours. Lacking better information, we apportion these hours to each industry using the number of persons engaged in production in each year.[9] Total labor income is labor compensation plus 60 percent of sole-proprietors' income with inventory and Capital

[6] Johnson (1953) examines data from the 1940 Census, and finds that the wages of workers who migrate from farms to urban areas are close to those of urban workers of the same age and sex.

[7] Using the Kendrick estimates of hours worked in 1929 as weights would result in similar estimates.

[8] If we construct hours worked using persons engaged in production and Denison's average hours series, we obtain similar hours worked (and hence wages) in agriculture, and slightly smaller declines in hours worked in manufacturing (and hence larger wage declines). This estimate of the manufacturing wage closely tracks the BLS's series for entrance wages in manufacturing during the Great Contraction.

[9] The underlying data as well as the calculations are in the excel file Hours_Wages_multi_sector_Data_Appendix.xls, sheet IndustryH.

Cost Allowance (CCA) adjustments. All wages are deflated using the GNP deflator, and quantities are per working-age person.

Table 4 compares the index of hours worked per adult for several key industry break-outs with total civilian hours. As is well known, agriculture hours declined less than total hours, while manufacturing hours decline more. This pattern is reflected in our grouping of industries into flexible- and sticky-wage sectors. However, the decline in hours worked in flexible industries is larger than in agriculture, while hours worked in manufacturing decline by more than hours in sticky industries as a group.

2.2.2 Wage data

We follow the same procedure used for the aggregate data and construct estimates of average nominal wages by dividing total labor income by hours worked. The hours estimates are based on data from Kendrick (described above). For each industry, total labor compensation is taken from NIPA and is defined as total employee compensation plus 60 percent of sole-proprietor income (with inventory and CCA adjustments).[10] The real wage is the nominal wage deflated by the Balke-Gordon GNP deflator (see Table 3).

Agriculture is the most straightforward industry to deal with since data on wages plus salary accruals, as well as proprietors' income with inventory valuation and capital consumption adjustments is reported for the Farm sector. However, proprietors' income for *Agricultural services, forestry, and fisheries* is reported separately (our series for compensation of employees includes agricultural services, forestry, and fisheries, as does the Kendrick hours series). The calculation of wages for Government is also straightforward, since there are no self-employed workers.

For the other industries, we take proprietors' income for non-farm industries from NIPA Table 6.12A (Non-farm Proprietors' Income by Industry). Since this table does not include inventory valuation adjustment or CCA, while our aggregate wage calculations do, we adjust it by adding Non-corporate Inventory Valuation Adjustment (IVA) (Table 6.14A) and Capital Consumption Adjustment (CCAdj) (Table 7.6).[11] National Income by Type of Income) Unfortunately, Table 7.6 does not break the CCadj out by industry. To assign the CCadj, we assume that the CCadj by industry is proportional to the Capital Consumption Allowance by industry (reported in Table 6.14a).[12] Overall, the inclusion of the IVA and CCadf has relatively minor impacts on the index of real wages reported in Table 3. For example, if one drops the IVA adjustment from Retail (the industry where the impact is largest, due to relatively large swings in the IVA), one finds that real wages fall by 2 to 3 percentage

[10]The changes in real wages are not very sensitive to reasonable (constant) values for the labor share of sole-proprietors' income. Using wages instead of employee compensation also does not change the result.

[11]See http://www.bea.gov/national/pdf/chapter11.pdf for a discussion of the BEA approach to Non-farm Proprietors' Income. The IVA only applies to Mining, Construction, Manufacturing, Wholesale and Retail trade. However, over half of the total value is accounted for by Retail.

[12]We also tried attributing the CCadj based on the fraction of all self-employed workers in each industry. While this changes the industry allocation, it has only minor effects on real wages over time.

points more in 1930, 31 and 32 but have a smaller trough in 1933 at roughly 91 (instead of the value of roughly 85 reported in Table 3).

2.2.3 Are the Industry Wage Estimates Reasonable?

An important question is how reasonable are our estimates of industry wages? To help assess the reasonableness of our estimates, we look at two additional sources of data. The most directly comparable are direct estimates of average wages from survey data. While this data is only available for a few industries, our estimates are similar. Second, we compute the wage of employees only in each industry.

For manufacturing and agriculture we can compare our constructed wages with direct estimates of wages. In 1929, each of these industries accounted for roughly 20 percent of employment, although value added in agriculture was roughly 10 percent of GDP versus 25 percent in manufacturing. Figure 1.B plots our imputed real wage series for agriculture and manufacturing as well as a commonly cited real wage series for each sector. Our estimate of the manufacturing wage tracks the National Industrial Conference Board's (NICB) average manufacturing wage series closely. Compared to the Alston and Hatton (1991) farm laborer wage series, our agricultural real wage initially declines faster, before rebounding over 1932-1935.[13] This larger fall is not surprising, as most (roughly two-thirds) of the workforce in agriculture were sole-proprietors and there were large swings in farm income during the Depression. Overall, the imputed wage series implies a slightly larger decline in agricultural wages relative to manufacturing than direct estimates of average wages. As Figure 3 illustrates, this large decline in nominal wages in agriculture relative to manufacturing of roughly 40 percent is large by historical standards.[14]

The self-employed were concentrated in Agriculture, Contract Construction, Retail Trade and Services. Overall, roughly a fifth of persons engaged in production were self-employed. Only Agriculture, Construction and Retail had above average shares or self-employed workers (See Table 5). Agriculture accounted for over half of the total number of self-employed, and retail trade (including automobile services) accounted for nearly a fifth. The industries we characterize as *flexible* are all ones where the self-employed accounted for a large share of employment. For the agricultural sector, there is anecdotal evidence that self-employed workers were similar to employed workers. For example, the BLS at the time viewed most self-employed workers in agriculture as similar to employed

[13]The agricultural wage is from Alston and Hatton (1991). This series declines slightly more than series K-177 from Historical Statistics of the United States, which is a composite farm wage index. This series includes the value of room and board received by agricultural workers. Alston and Hatton adjust this series to account for changes in the value of other perquisites provided to many farm workers.

[14]The agricultural wage is series K-177 from Historical Statistics of the United States, which is a composite farm wage index. This series includes the value of room and board received by agricultural workers. The manufacturing wage data is series Ba4361 from Historical Statistics of the United States, and is an hourly wage index of production and non-supervisory workers in manufacturing. These figures may slightly understate the relative decline, as the wage data reported by Alston and Hatton (1991) suggest an even larger decline.

farm workers:
"...there is a basis in the economic status of many farm operators for classifying them with wage earners." (p.66, Bureau of Labor Statistics (1939)).

We replicated our procedure to estimate hourly wages for employees only. As can be seen from Table 3, real wages of employees rise by more than real wages for all workers. However, for the industries classified as *sticky*, the difference is very small. This reflects the fact that the share of self-employed workers in these industries was very small.

The pattern for the flexible industries is mixed. In agriculture and construction, real wages of employees fall by less than our estimated real earnings of all workers (and, hence of the self-employed), but still exhibit large declines (especially relative to sticky sector employees). In the retail sector, our estimate of real wages by employees is similar to manufacturing real wages. Interestingly, in retail, virtually the entire decline in persons engaged (i.e., the extensive margin) is accounted for by employees. This is consistent with the Census of Retail Distribution findings for 1929 and 1933, that there was little change in the number of retail establishments (or sole proprietors) between 1929 and 1933, but a large fall in employed workers (see Bureau of the Census (1935)). Mechanically, this translated into a nearly 50 percent decline in average (nominal) sales per retail establishment. In 1933, over two-thirds of retail establishments had gross sales of less than $10,000. These small stores were mainly run by proprietors, as they averaged only 0.4 full-time employees per store (see table 4c in Bureau of the Census (1935)). Given that retail gross margins were roughly 25 percent, the income of proprietors of small stores were modest (e.g., a store with $5,000 in sales would net $1250 before operating expenses such as rent, utilities, etc), as average earnings of full-time retail employees in 1933 was just under $1000 (see Bureau of the Census (1935)). The data from the 1929 and 1933 Retail Census thus seems consistent with the estimates in Table 3, showing a large fall in earnings of sole-proprietors and a rise in real earnings of employees along with a large fall in employee hours (and a rise in the proprietor share of total hours worked). Finance, Insurance, and Real Estate (FIRE) exhibits a similar pattern, with virtually the entire change in the number of persons engaged being accounted for by the number of employees with only a small decline in the number of self-employed (from 1.6 million in 1929 to 1.54 million in 1933).

2.2.4 Mapping Hours and Wage Data into a Two-Sector Environment

We map our data into a two-sector environment, with the sectors labelled as *sticky* and *flexible*. We allocate industries where real wages rose to the sticky sector (i.e., manufacturing, transportation and communications, government, mining, services, and wholesale trade) and industries where real wages fell (i.e., agriculture, construction, retail trade and FIRE) to the flexible sector. The flexible industries accounted for roughly 41 percent of GDP in 1929.

To construct average hours worked in each sector (Figure 2.B), we sum the hours worked in each of the industries (e.g., for the flexible sector, we sum hours worked in Agriculture, Construction, Retail and FIRE).[15] As a check, we verify that the total hours in both sectors add up to total hours worked.

Average wages are the ratio of total compensation of labor (the sum of our industry estimates) divided by total hours (Figure 2.A).

2.3 Prices

We use the Balke-Gordon GNP deflator as our deflator for aggregate output. While we made this choice to facilitate comparability with other work in the literature, as Table 6 shows, the Balke-Gordon GNP deflator is similar to both the GNP deflator reported in Historical Statistics and the GDP Deflator reported by the BEA.

What has received less attention (at least recently) are the large changes in *relative* prices. While we lack the data to construct industry-specific price deflators, the available Wholesale Price Index (WPI) and Cost of Living Index (COLI) data, largely coincide with sectoral wage movements during the Great Contraction. Commodity prices, especially for agricultural goods, experienced large declines relative to prices of final manufactured goods and services. The WPI is based on the prices of raw and processed materials, semi-finished goods and fully manufactured products. While most of the prices were for large transactions, not all occurred at the "wholesale" level, although the prices are generally for transactions below the retail level. This large relative price change at the wholesale level can be seen in Figure 4, as raw materials' prices declined by roughly 40 percent over 1929-1933, while manufactured goods' prices declined by only half as much.

A similar pattern can be seen in consumer prices where agricultural items had the largest decline in prices. The COLI, the precursor of the CPI, was based on retail prices of goods purchased by wage earners and lower-salaried workers. The weights on the components varied slightly over time, and are reported in Table 8. The food index was based on retail food prices. The *miscellaneous* category was a weighted average of transportation prices, medical care prices, household products and services, recreation as well as prices of personal services. A detailed list of the various categories is given in Bureau of Labor Statistics (1940).

Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition reports CPI estimates for all goods, food and rent that overlap with our COLI data. These series are similar to the corresponding COLI numbers we use (see the Excel file where both series are reported).

We use the sub-indices of the COLI and its 1935-39 weights to construct a price index for the flexible and sticky sectors. The flexible sector price index is the weighted average of Food (33.9 percent) and Rent (18.1 percent). The inflexible sector price index is the (weighted) average of Clothing (14.1 percent), Fuel, Electricity, and Ice (6 percent), House-furnishings (4.8 percent), and

[15] The Kendrick Farm hours includes Agriculture Services, Forestry and Fishing hours.

Miscellaneous (23.7 percent). As can be seen from Table 9, this implies a much larger decline in the flexible-sector price than in the sticky one.

2.3.1 PCE Data

An alternative source of data is the PCE. In Table 19 we list the available PCE categories in order of the price decline from 1929 to 1933 (i.e., we report the ratio of prices in 1933 to 1929). The ordering is broadly consistent with our division of industries into flexible and sticky.

One practical issue is that we lack direct price data for the value-added components of retail and construction, which are two of the industries we classify as flexible.[16] However, we can construct an approximate retail price deflator by looking at the ratio of consumption (final good) and producer price (intermediates) deflators for similar categories of goods. This exercise requires us to take a stand on the retail share of final consumption prices. For construction, we can undertake a similar exercise, as we have deflators for final construction costs as well as for building materials.

We back out an implied retail price deflator using the PCE for *Food and Beverages purchased for off-premises consumption* as well as the PCE categories for *Clothing and Footwear* and for *Furnishing*. Our approach is to use data on final consumption prices and wholesale prices to back out the implied retail deflator.[17] In our calculations, we assume that the retail price index is a weighted average of the cost of retail services and food prices, where we set the share of the retail price accounted for by farm value at 42 percent.[18]

For *Furnishing*, we use the WPI for *House furnishing goods*. For *Clothing and Footwear*, we use the average of the WPI index for *Hides and leather products* and *Textile products*. Both of these series are biased down for our purposes since they include a number of less processed commodities (e.g., cow skins) as well as final goods (e.g., Shoes: Little boy's, blucher, tan calf). We construct estimates of the combined wholesale and retail margins using data reported in Stewart and Dewhurst (1939), which draws on the Census of Retail Distribution and the Census of Wholesale Distribution (see Table 10). For furniture, the total margin is roughly 55 percent, while estimates for shoes and clothing are roughly 45 percent. Erring on the conservative side (since the retail price falls by more than the wholesale price index), we assume that the distribution share is 55 percent.

There are several alterative indices of the cost of construction. We use the Department of Commerce Composite Index (*Historical Statistics*, Dc207), which falls by less than the index of *Farm housing* or *Other farm construction*. The WPI reports an index of the cost of construction materials. Bureau of Labor Statistics (1932) reports a survey of construction costs of residential and nonres-

[16]The flexible industries are Agriculture, Retail, FIRE and Construction.

[17]A limitation of our analysis is that if the wholesale price reported did not include all wholesale services, then our estimated retail share will include part of the wholesale margin.

[18]This is the value for 1929 reported in Table Da1347-1350. Indexes of the retail cost of food and the farm-value component of retail cost: 1913-1999.

idential buildings in 15 cities in 1932. The average cost share of labor (materials) was 36.4 (63.6) percent. Consistent with a decline in the relative price of labor, Bureau of Labor Statistics (1932) reports that a 1928 survey of costs in three cities found an average cost share of labor (materials) of 41.8 (58.1) percent, which was largely driven by a fall in residential construction cost shares of labor from 46 to 37.1 percent. Byer (1935) reports estimates from a sample of projects which received P.W.A. funding. The allocation of this funding was 27 percent to labor employed in construction, 56 percent to materials and the remaining 17 percent to overhead costs. This gives an upper bound for labor cost share of 44 percent.

Table 11 summarizes these change in prices. For Retail, the implied fall in the cost of retail services is roughly 35 percent (with the level of the retail services component between 65 and 68 percent). Our construction deflator falls by less, with an estimated decline of roughly 13 percentage points over 1929 to 1933.

3 Industry data

The interwar economy featured a high level of intermediate usage. Table 12 reports the intermediate share of gross output for manufacturing and agriculture for selected years during the interwar period. The intermediate share of output fluctuated relatively little during the Great Contraction, decreasing slightly in manufacturing and increasing slightly in agriculture.

The seven manufacturing industries' data reported in Tables 13, 14, and 15 are from several different sources. Industrial output is from the Federal Reserve Board, while data on value added, gross output and intermediates is from the Census of Manufacturing (as reported in various issues of the *Statistical Abstract of the United States*). The price data is primarily from various issues of *Wholesale Prices*. We briefly summarize the data sources for each industry in Section 3.0.2.

Table 13 reports the intermediate share of gross output for these seven industries as well as for manufacturing as a whole. The intermediate share varied considerably across these industries, ranging from just over 50 percent in Boots and Shoes to over 80 percent in Meat Packing.[19]

Most industries saw a small decline in the intermediate share during the Great Contraction. This decline is consistent with a substitution away from labor and into intermediates, as the price of intermediates fell by more than nominal wages for these industries.

We report two measures of real wages at the industry level during the Great Contraction. The first measure reported in Table 14 deflates the nominal wage using the GNP deflator (we call that a *real consumption wage*), while the second uses the industry's output WPI (a *real product wage*). Both series show a similar upward trend, consistent with the view that real wages rose during the Great Contraction. A closer look suggests some differences, as the real product wages for Leather,

[19] In the case of Iron and Steel and Automobiles, the classifications changed slightly in 1931. The intermediate share was very similar for both classifications.

and Meat Packing, for example, exhibit much larger increases than the respective real consumption wages. These differences reflect the large shifts in relative prices across industries.

Table 15 reports industry level wholesale prices for output and main inputs. Shifts in relative industry output prices are closely related to shifts in the relative prices of intermediate inputs. The pattern of prices largely lines up with the observation that the prices of more processed commodities declined less than primary good prices. The largest price declines are in Meat Packing, Leather, and Wool. The one industry which faced flat input prices was iron and steel. This reflects the fact that the input price series places considerable weight on iron ore and coke, which had very small price declines.[20]

We report the value added deflators we construct for each industry in Table 16. In computing these deflators, we assume a CES production structure, and set the intermediate share to its value in 1929.

3.0.2 Industry Data Sources

Wages

The average wage series we use for each industry was originally collected by the National Industrial Conference Board (NICB), and is described in Beney (1936), which also reports the raw data until June 1936. The data series we use are taken from the NBER Macrohistory database (`http://www.nber.org/databases/macrohistory/contents/chapter08.html`). These data are monthly, and we construct annual averages.

The wage series we use are:

- m08142 U.S. Average Hourly Earnings, Twenty-Five Manufacturing Industries, NICB 01/1920-07/1948;
- m08207a U.S. Average Hourly Earnings, Automobile Manufacturing, NICB 06/1920-12/1921, 07/1922-07/1948;
- m08210a U.S. Average Hourly Earnings, Iron and Steel Manufacturing, NICB 06/1920-12/1921, 07/1923-07/1948;
- m08202a U.S. Average Hourly Earnings, Meat Packing, NICB 06/1920-12/1921, 07/1922-07/1948;
- m08235a U.S. Average Hourly Earnings, Paper and Pulp, NICB 06/1920-12/1921, 07/1922-12/1948;

[20] It is also worth noting that the iron and steel industry featured a significant degree of vertical integration. A large fraction of the iron ore production were owned by final steel producers. On this see Hines (1951).

- m08205a U.S. Average Hourly Earnings, Boot and Shoe Manufacturing, NICB 06/1920-12/1921, 07/1923-07/1948;
- m08231a U.S. Average Hourly Earnings, Wool Manufacturing, NICB 06/1920-12/1921, 07/1922-07/1948;
- m08204a U.S. Average Hourly Earnings, Leather Tanning and Finishing, NICB 06/1920-12/1921, 07/1922-07/1948;
- m08206a U.S. Average Hourly Earnings, Furniture Manufacturing, NICB 06/1920-12-1921, 07/1922-07/1948.

Output and Input Prices

Automobiles: For the output price we use the *Index of Wholesale Prices of Passenger Automobiles for United States*, Index 1926=100, Monthly, Not Seasonally Adjusted, which we take from FRED and convert to annual by averaging. This index is similar to that of the Weighted average price of Buick, Cadillac, Chevrolet, Dodge, Ford, and Packard passenger cars which we take from various issues of *Wholesale Prices*.

Data on the major input sources were obtained from Leontief (1951). The largest source of intermediates was the automobile sector (25 percent of gross output), followed by iron and steel (16 percent) and other industries (15 percent). As a rough proxy, we use the price index of iron and its products (also reported as "Iron and Steel") as the input price index. We take this from the Statistical Abstract of the United States (various issues), where this index is reported in Wholesale prices of Commodity Subgroups).

Boots and Shoes: The output price index is the (wholesale price) *Shoe index*, referred to as *Boot and Shoe index* in some early years of BLS publications. This index is a subcomponent of the leather products group. Mack (1956) discusses the production structure of the leather industry. She reports that tanned leather accounts for the majority of material costs in (leather) shoe making. Based on this, it seems reasonable to use the price index for leather as the gross input price. The source of these price indexes are various issues of the *Monthly Labor Review* (in the articles on "Wholesale Prices") various issues of the BLS's annual (bulletin) publication *Wholesale Prices* as well as various issues of *Statistical Abstracts of the United States*.

Iron and Steel The wholesale price index for iron and steel includes the price of iron ore (see *Wholesale Prices 1931*). This is unfortunate, since pig iron is produced using iron ore and energy inputs. In turn, pig iron (and scrap iron) are key inputs into the production of steel. The iron and steel industry also featured a significant degree of vertical integration, as a large fraction of the iron ore production was owned by final steel producers (see Hines (1951)).

The price index for intermediates is a weighted average of price indexes for iron ore (0.29), Coke (0.276) Electricity (0.166), Gas (0.154) and Coal, bituminous (0.112). The weights are based on data from the Canadian iron and steel industry for 1933.

Leather Tanning and Finishing: Mack (1956) discusses the production structure of the leather industry. She reports that hides and skins accounted for the majority of material costs in leather tanning (nearly 90 percent). Based on this, it seems reasonable to use the wholesale price index of hides and skins as a measure of material costs in leather tanning and the wholesale price index for leather as the gross output price. The source of these price indexes are various issues of the *Monthly Labor Review* (in the articles on "Wholesale Prices") as well as various issues of the *Bureau of Labor Statistics* annual (bulletins) publication *Wholesale Prices*. Data on leather & hide and tanning & finishing are also available for recent census years. Interestingly, in 1997, the values are quite similar to the interwar values. The material share of gross output was roughly 69 percent, and hides and skins accounted for $1,4487,834 of the $2,325,541 spent on materials (roughly 65 percent).

Meat Packing: We use the WPI for Meats as our output price index. This sub-index of the WPI was based on the prices of Beef (cured and fresh carcass), lamb, mutton, pork (cured: bacon, bellies, hams, mess and fresh) as well as poultry).

As an input price, we use the WPI sub-index for Livestock and poultry. This sub-index of the WPI was based on the prices of cattle, hogs, sheep and poultry (quoted in Chicago or New York, as with the Meat price quotes). We abstract from the revenue from by-products, which were mostly accounted for by hides that accounted for roughly 10 - 12 percent of the value of a typical carcass, and were the most valuable by-product of meat packers (Mack (1956)). Meat packers were the source of just over half of the hides used by leather tanners (Mack (1956)). Including hides would slightly lower the gross output price series up to 1932, as the WPI for hides fell slightly more than the Meats index.

Paper and Pulp: We use the WPI sub-index Paper and Pulp as our output price. This sub-index of the WPI was based on the prices of final outputs (prices for three different boxboards, book paper, newsprint, tissue, wrapping paper) as well as 4 different types of wood pulp at domestic mills. Bureau of the Census (1933) reports that total spending on materials and energy by the U.S. pulp and paper industry in 1929 was roughly 723 million. For the paper industry (which accounted for roughly three-quarters of gross output and intermediates) the Bureau of the Census (1933) reports energy and non-energy materials separately (p.546, Table 10), and the energy share of total materials (i.e., materials plus energy) was 10.6 percent. Pulpwood accounted for roughly 100 million of cost. Anderson (1942) reports that the main energy input was electricity.

Mapping this into our production structure is somewhat complicated by the fact that pulp is an input into making final (paper) products, so that the production statistics for pulp and paper counts the output of pulp plants as intermediates used in paper. Many mills produced both pulp and paper (especially newspaper), although some mills purchased most of their wood pulp. In addition some plants imported wood pulp (mainly from Canada, but also Scandinavia) (Anderson (1942)). This leads us to compute the input price index as the weighted average of pulpwood (*fob* at mill, reported in the Forest Products section of *The Statistical Abstract of the United States*) and the WPI for electricity (which we take from various issues of *The Statistical Abstract of the United States*), with weights 0.894 and 0.106, respectively.

This mix of price indexes arguably biases against our exercise. The underlying woodpulp series (Chemical sulphite, unbleached; and Mechanical, No. 1, domestic) for which the wholesale price series available falls by more than the pulp and paper index (the 1933 prices relative to 1929 are 0.66 and 0.78, respectively). In contrast, the prices of final paper products (Wrapping, Manila, No. 1, jute, Manilla-lined chip boxboard) in 1933 were within a few percentage points of their 1929 level.

Woolen: We use the WPI subindex for Woolen and Worsted Goods as our output price.

Prices of (raw) wool were used to construct an input price index. The weights were those reported in *Wholesale Prices 1929* (page 74) for nine grades of wool. The original prices for these goods were take from various issues of *Wholesale Prices*. One rough measure of the usage of raw (scoured) wool is from Hyson (1947) who reports the usage of scoured wool at mills for apparel.

Manufacturing: The price index for manufacturing is Manufactured articles (series Cc112, Index 1926 = 100) from Table Cc109-112: Wholesale price indexes, by stage of processing: 1913-1951 BLS, *Historical Statistics of the United States*.

4 Model variations used in the paper

This section outlines the model details for the two-sector model without intermediates and the one-sector model we use in the main paper.

4.1 A two-sector model with no intermediates

In our default specification, sectoral production uses intermediates from both sectors in addition to capital and labor. Here, we highlight the differences between that baseline economy and one where sectoral production does not use intermediates and all sectoral output is used in the production of the final good.

The household problem differs only in that households do not invest in sectoral intermediates. In the benchmark economy, households buy sectoral intermediates and resell them to sectoral producers.

In the economy with no intermediates the household chooses consumption, hours of work in the flexible sector, nominal bond holdings B_t, money holdings, M_t, and capital in each sector $K_{i,t+1}$ so as to solve:

$$
\begin{aligned}
\max \quad & \sum_{t=0}^{\infty} \beta^t \left[\log C_t - \frac{\mu_L}{1-\sigma_L} L_{1,t}^{1-\sigma_L} + \mu_M \log \left(\frac{M_t}{P_t} \right) \right] \\
s.t. \quad & B_t = (1+R_{t-1})B_{t-1} + \sum_{i=1}^{2} (J_{i,t}K_{i,t} + W_{i,t}L_{i,t}) + \sum_{i=1}^{2} \pi_{i,t} + X_t \\
& - \left(M_t - M_{t-1} + P_t C_t + P_t \sum_{i=1}^{2} I_{i,t} \right), \\
& K_{i,t+1} = (1-\delta_i)K_{i,t} + I_{i,t}, \qquad i = 1, 2,
\end{aligned}
$$

where R is the nominal interest rate on bonds, δ is the (common) depreciation rate, X is a lump-sum cash transfer from the government, while J_i, W_i, I_i, L_i, and π_i are sectoral variables: the rental rate of capital, the nominal wage, investment, hours worked and sectoral nominal profits, respectively.

On the sectoral firm side, the technology is Cobb-Douglas. Firms in both sectors seek to maximize static profits. They have access to a constant returns to scale production in capital and labor and take sectoral prices, $P_{i,t}$, and factor prices as given when making production decisions to solve:

$$
\max P_{i,t} K_{i,t}^{\theta_i} L_{i,t}^{1-\theta_i} - W_{i,t}L_{i,t} - J_{i,t}K_{i,t}.
$$

Final production and the details on wage setting and monetary shocks are exactly as in the default set-up in the main paper.

4.2 A one-sector model

Our one-sector model is that of Bordo, Erceg, and Evans (2000).[21] In particular, households take prices as given and choose sequences of consumption C_t nominal bond holdings B_t, money holdings, M_t, and capital K_{t+1}, which they rent to firms, so as to solve:

$$
\begin{aligned}
\max \quad & \sum_{t=0}^{\infty} \beta^t \left[\mu \log C_t + (1-\mu) \log \left(\frac{M_t}{P_t} \right) \right] \\
s.t. \quad & B_t = (1+R_{t-1})B_{t-1} + J_t K_t + W_t L_t) + \pi_t + X_t \\
& - (M_t - M_{t-1} + P_t C_t + P_t I_t), \\
& K_{t+1} = (1-\delta)K_t + I_t,
\end{aligned}
$$

[21] We use the version without labor adjustment costs on the part of firms.

and the firm problem is maximizing static profits by renting labor services and capital from households:

$$\max P_t K_t^{\theta} L_t^{1-\theta} - W_t L_t - J_t K_t,$$

where firms take prices as given and the wage rate adjusts according to the same Taylor-type contracts described in the main paper.

Bordo, Erceg, and Evans (2000) obtain a decline of 35 percent of output through the first quarter of 1932, we get 36.5 percent. We are targeting the same real wage path, but using slightly different measures of M1 shocks (and implied estimated parameters for their auto-regressive law of motion). We adjust M1 by the adult population, to be consistent with the model. This results in slightly larger negative shocks.

5 Alternative Experiments

We briefly summarize several additional experiments that are either discussed briefly in the text, or which serve as additional robustness checks.

5.1 Introducing TFP

In this section we investigate whether sectoral total factor productivity (TFP) shocks can interact with our benchmark framework in a way that helps bring the model's outcomes closer to the data. It should be clear that one can re-engineer TFP shocks that drive output as low as in the data. At the same time, by lowering production efficiency in such a way, one should expect both aggregate and sectoral prices to drop by less than in the benchmark. Two questions arise. First, does the smaller fall in prices remains sufficiently close to the data; the second one is whether output is falling for the same reasons it falls in the data. That is, whether the relative contributions to the fall in output from hours (or more generally from the value-added component), intermediate goods, and measured productivity are similar to the data.

To answer this question we endow the sectoral production functions with neutral technology shocks $z_{i,t}$, so that sectoral output is given by:

$$Y_{i,t} = z_{i,t}\left[\alpha_i\left(K_{i,t}^{\theta_i} L_{i,t}^{1-\theta_i}\right)^{\rho_i} + (1-\alpha_i)\min\left\{Q_{1i,t}, \chi_i Q_{2i,t}\right\}^{\rho_i}\right]^{\frac{1}{\rho_i}}, \qquad i = 1, 2.$$

We assume that for $i = 1, 2$, TFP shocks follow an AR(1) process $z_{i,t+1} = \rho_{z_i} z_{i,t} + \varepsilon_{z_i,t+1}$, where the ε_{z_i} are *iid* normally distributed with mean zero and standard deviation σ_{z_i}.

Since we lack estimates of sectoral TFP, and for parsimony's sake, we assume that z_i decreases linearly from the third quarter of 1929 to the third quarter of 1933, and it evolves according to its law of motion after that.[22] This means we only need to worry about the two parameters indexing how fast TFP drops in each sector. We then jointly pick η, γ, ρ and these two TFP parameters to match the same targets as in the benchmark model and two new ones: the drop in each sector's GDP at the third quarter of 1933. That is, we are picking the drop in TFP so that we match the trough in each sector.[23]

As a result of this calibration, the model exactly matches the decline in sectoral output shown in the top two panels of figure 6, as well as the corresponding aggregate decline shown in panel A of figure 5. Because of the drop in efficiency, the aggregate price level is now counterfactually higher, as shown in panel B of figure 5, as it drops by less than half relative to the data, at the trough. This happens mostly because the model misses on matching the fall in the sticky-sector price as shown in panel D of figure 6.

The drop in TFP directly lowers the marginal product of labor schedule in both sectors. As a result, hours fall across the board as shown in panels C and D of figure 6. In the sticky-sector, because we keep the increase in real wages constant (it is one of the targets), this effect is compounded, resulting in a drop in hours that is considerably larger than in the data – recall that our benchmark model predicts a fall in sticky-sector hours that is only half as large as the data.

Because the contribution of hours to the decline in output is so much larger than in the data, the measured contribution of TFP is mechanically much smaller. In a previous paper, Amaral and MacGee (2002), we measured the decline in TFP during the Great Contraction in the U.S. using a one-sector model with a Cobb-Douglas production function in capital and labor. When we perform the same measurement using the aggregate variables in the present model, we find a decline less than a third that in the data, as panel D of figure 5 shows.

There is no amplification or interaction between TFP and monetary shocks when it comes to accounting for the decline in output. At the trough, in the model with both shocks, output declines by 52 percent, while this number is 35 percent for the model with TFP shocks only and 16 percent for the model with monetary shocks alone. However, the wage rigidity does amplify TFP shocks. With TFP shocks but without rigid wages in the sticky sector, the drop in output is 20 percent rather than 35 percent.

Cole, Ohanian, and Leung (2007) perform an exercise where they treat TFP shocks and monetary shocks as latent variables and back them out by fitting output and deflation from 1929 to 1933 in a cross-sample of countries. Despite the fact that money enters differently in their model, through a Lucas (1972)-type misperception, some of their results are similar to ours in that roughly two-thirds of the changes in output are accounted for by TFP shocks, while the remaining third is accounted

[22]For which we assume that $\rho_i = 0.95$ for $i = 1, 2$. Since the model is solved by a linear approximation method, the value of σ_{z_i} is irrelevant.

[23]The resulting values are $\eta = 0.3586$, $\gamma = 0.411$, $\rho = -0.273$, and drops in TFP from steady-state to trough of 8.2 percent and 11.6 percent in the flexible and sticky sectors, respectively.

for by money supply shocks.

5.2 Above steady-state in 1929

A common perception is that the "roaring 20s" resulted in the US economy being above its steady-growth trend when the Great Contraction hit in 1929. Indeed, when we run our quarterly real GNP per working age person series through an HP-filter we find that in the third quarter of 1929, the US economy was roughly 10 percent above its trend.

Because our model is solved by log-linearizing around a steady-state, which we assume to be the third quarter of 1929:3, we are implicitly assuming the US economy was on trend at this point. To evaluate whether this assumption quantitatively impacts our findings we use the setup with TFP shocks in Section 5.1 to get the economy up 10 percent above trend. To get there we use TFP shocks that hit final good production instead of using sectoral output TFP shocks, as we would be hard-pressed to come up with a plausible sector breakdown.

Once the economy reaches the third quarter of 1929 and is 10 percent above steady-state we introduce the same monetary shocks as in our benchmark experiment. This is not a completely "clean" experiment because the coefficients in our model's laws of motion were obtained via a log-linearization approximation around the steady-state, therefore they are only valid in the neighborhood of this steady-state. In this case we are 10 percent above the output's steady-state, so the results should be interpreted with a degree of caution.

Regarding the behavior of TFP shocks, once the peak is reached we let them depreciate according to their AR(1) law of motion. Again, we recalibrate all parameters so that we continue to hit all targets, adjusting for being 10 percent above steady-state in the third quarter of 1929. As the blue line in figure 7 shows, we get a peak-to-trough decline of 18 percentage points. Although that is higher than the 11 percent drop we get in our benchmark, it is still very far from the 50 percent drop in the data. Moreover, this value is exaggerated by the assumption we are making regarding the behavior of technological shocks following the peak. Indeed, the very reason the economy is 10 percent above steady-state – a string of positive technological shocks – is contributing to the exaggerated decline. To find out exactly how much that contribution is vis-à-vis the one we are interested in, monetary shocks, we let TFP shocks remain at its peak. As the red line in figure 7 shows we get a decline of 12 percent, only a percentage point lower than in our benchmark.

5.3 Intermediates' shares of gross sectoral output

While in our model labor shares are not a constant share of gross output, they are a constant share of GDP (value-added) and therefore of NIPA income. This is consistent with our treatment of the data when we assume that self-employment compensation was a constant share of sole-proprietor income.

A slightly different, but related, question is whether the gross output shares of value added and intermediates move similarly in the data and in the model. As table 12 shows, the intermediates' share of gross output in manufacturing decreases slightly from 55 percent to 54.2 percent between 1929 and 1933, while in agriculture this share increases from 30.1 to 32.2 percent. Figure 8 shows that our model does a very good job at capturing these movements. Proxying manufacturing for the sticky sector and agriculture for the flexible, the model delivers exactly the 1.5 percent decrease in the intermediates' share in the sticky sector, while it falls a bit short of delivering the full 7 percent increase in the flexible sector.

5.4 Sensitivity Analysis: Sectoral elasticities of substitution between value-added and intermediates

In the model benchmark we use an elasticity of substitution between sectoral value added and intermediates of 0.69 that accords well with the evidence in Rotemberg and Woodford (1996). In addition, we also perform some sensitivity analysis that shows the main thrust of our results does not change when we let this elasticity of substitution increase to one (Cobb-Douglas). Here we conduct further sensitivity analysis by letting the elasticity of substitution decrease to 0.5 (low ρ_i) and increase to 0.9 (high ρ_i). As in the text, we recalibrate all other parameters so that we keep hitting the same targets.

As figures 9 and 10 show, for aggregate and sectoral variables, respectively, our results do not change much.

5.5 FIRE in the Sticky Sector

Our approach to decomposing the US economy into flexible and sticky sectors was to look at the behavior of sectoral real wages. Sectors with declining real wages were aggregated into the flexible sector, and those where real wages rose were aggregated into the sticky sector. This dividing line seems like the most natural interpretation of what it means for a sector to exhibit sticky wages. If sticky wages were not present at all, real wages would not move as a result of a negative money shock.

This decomposition draws a sharp line between sectors, and some sectors are close to that line. FIRE, a large sector at 15 percent of GDP, is classified as flexible because its real wages go down even though they only fall between 2 and 5 percent. As a robustness check, we move FIRE to the sticky sector and recalibrate the model economy to be consistent with this breakout. In particular, the flexible share of value added goes from 41 to 26.3 percent. Moreover, the share of intermediates in the flexible sector becomes 36.8 percent (39 percent of which are themselves from the flexible sector), while the share of intermediates in the sticky sector becomes 32 percent (26 percent of which from the flexible sector). Finally, the path of the real consumption wage in the sticky sector (particularly important in calibrating the stickiness parameter, γ) is now slightly below the benchmark, as shown in panel H of Figure 12 below, a consequence of the fact that real wages in FIRE did not increase.

As shown in Figures 11 and 12 below, the results are robust to moving FIRE from the flexible to the sticky sector despite the aforementioned relative importance of the sector. In particular, aggregate GDP drops by only an extra 3 percentage points relative to the 11.5 percent drop in the benchmark. For comparison, dropping intermediate linkages from our model nearly doubles the predicted decline in output (i.e., over 10 percentage point additional drop).

Table 1: **Kendrick vs Denison Hours Worked (per adult, 1929=100)**

Year	Kendrick Tot. Civil	Dension	Denison Hrs & BLS Employed
1929	100	100	100
1930	91.9	91.8	90.6
1931	83.5	82.9	79.7
1932	73.4	72.4	67.4
1933	72.6	71.9	67.3
1934	71.7	71.6	68.9
1935	74.7	74.7	72.4
1936	80.7	81.1	80.6

Table 2: **Average Real Wage (1929=100)**

Year	Benchmark	Employees	Ag as proxy self-employ.
1929	100	100	100
1930	99.0	102.6	100.5
1931	99.8	107.3	100.2
1932	96.8	110.2	98.3
1933	94.2	106.0	93.8
1934	101.0	109.1	99.4
1935	105.4	109.2	100.2

Table 3: **Sectoral labor market statistics (per adult, 1929=100)**

Hours Worked

Year	Agric.	Constr.	Retail	FIRE	Flex.	Manuf.	Transp.	Gov.	Min.	Serv.	Wholesale	Sticky	Total
1929	100	100	100	100	100	100	100	100	100	100	100	100	100
1930	97.6	91.3	92.6	94.9	95.0	83.5	89.9	101.3	83.3	93.9	93.1	89.6	91.9
1931	98.0	80.7	85.0	88.6	91.0	67.2	75.3	100.8	64.3	85.8	82.4	77.5	83.5
1932	93.4	64.5	75.3	81.8	83.1	53.0	60.8	96.6	49.0	76.0	72.4	65.5	73.4
1933	92.0	53.5	73.9	77.7	80.3	56.1	56.3	113.7	51.4	72.5	71.2	66.4	72.6

Real Wages

Year	Agric.	Constr.	Retail	FIRE	Flex.	Manuf.	Transp.	Gov.	Min.	Serv.	Wholesale	Sticky	Total
1929	100	100	100	100	100	100	100	100	100	100	100	100	100
1930	78.5	92.1	99.6	94.9	91.1	104.0	104.8	104.5	105.9	102.4	103.6	104.4	98.9
1931	65.7	80.3	99.8	97.0	84.2	109.0	116.5	116.3	108.6	106.4	107.3	111.1	99.6
1932	50.0	58.8	91.7	99.7	72.6	108.6	125.7	125.9	110.9	107.3	103.6	113.5	96.3
1933	56.0	53.0	85.3	99.1	70.5	105.9	125.7	113.3	106.3	101.7	92.8	111.5	94.2

Real Wages: Employees Only

Year	Agric.	Constr.	Retail	FIRE	Flex.	Manuf.	Transp.	Gov.	Min.	Serv.	Wholesale	Sticky	Total
1929	100	100	100	100	-	100	100	100	100	100	100	-	-
1930	98.9	95.9	103.3	100.6	-	104.4	104.9	104.5	106.7	103.9	103.5	-	-
1931	86.7	86.4	110.2	105.6	-	109.9	117.0	116.3	113.0	109.6	109.5	-	-
1932	79.3	73.2	112.3	108.2	-	109.7	126.6	127.9	114.5	114.8	108.9	-	-
1933	76.0	71.8	104.5	104.2	-	106.5	123.5	113.3	110.7	109.4	98.5	-	-

% Self-Employed

Year	Agric.	Constr.	Retail	FIRE	Flex.	Manuf.	Transp.	Gov.	Min.	Serv.	Wholesale	Sticky	Total
1929	66	36	31	10	-	1	4	0	2	21	6	-	23

Source: Hours data from Kendrick (1961).

Note: Transp. is Transportation, Communications and Public Utilities.

Figure 1: **Labor market estimates**

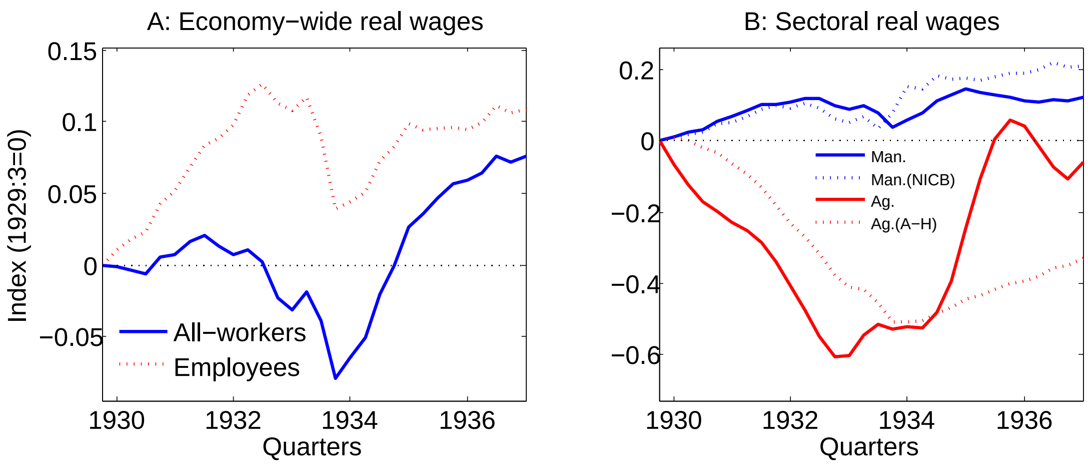

Figure 2: **Sectoral real wages and hours**

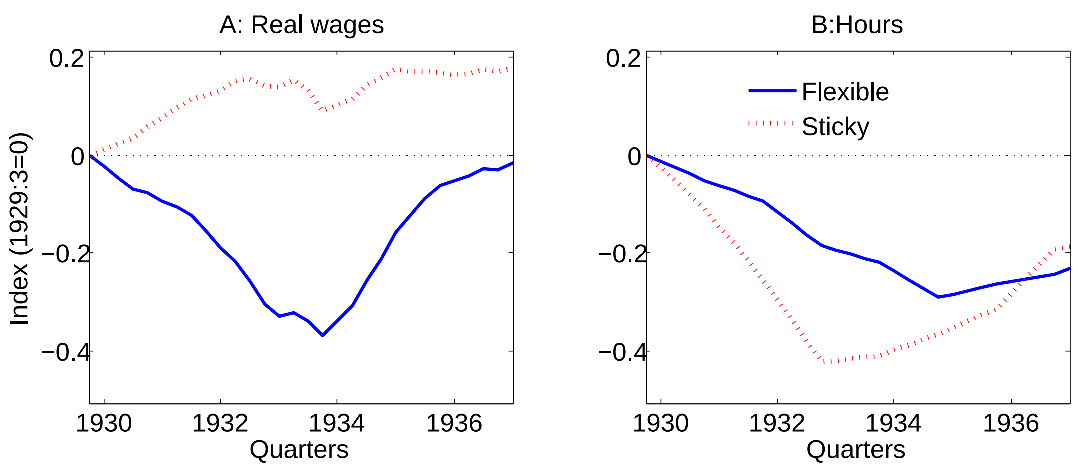

Table 4: **Hours Worked by Industry (per adult, 1929=100)**

Year	Civil	Non-Farm	Farm	Manuf	Gov't	Flex	Inflex
1929	100	100	100	100	100	100.00	100.00
1930	91.9	89.8	97.6	83.5	101.3	95.0	89.6
1931	83.5	78.4	98.0	67.2	100.8	91.0	77.5
1932	73.4	66.4	93.4	53.0	96.6	83.1	65.5
1933	72.6	64.7	92.0	56.1	113.7	80.3	66.4
1934	71.7	65.0	81.5	58.4	138.2	74.7	69.3
1935	74.7	67.9	83.7	64.8	146.3	76.8	73.1
1936	80.7	74.6	80.2	74.2	183.9	78.4	82.5

Source: Hours data based on Kendrick (1961).

Figure 3: **Agriculture Wages Relative to Manufacturing**

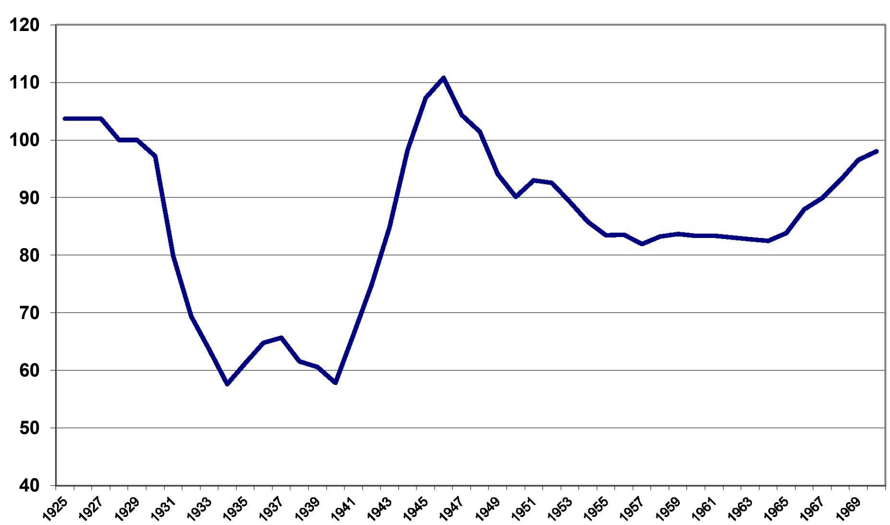

Table 5: **Self Employed as Share of FTE**

Year	Total	Farm	Construction	Retail	FIRE	Services
1929	0.226	0.663	0.356	0.306	0.102	0.212
1930	0.237	0.678	0.374	0.318	0.104	0.220
1931	0.256	0.687	0.396	0.336	0.108	0.234
1932	0.279	0.706	0.448	0.364	0.110	0.253
1933	0.276	0.711	0.492	0.365	0.112	0.257
1934	0.257	0.715	0.448	0.342	0.113	0.244
1935	0.251	0.717	0.428	0.333	0.115	0.240
1936	0.233	0.703	0.374	0.322	0.115	0.230

Source: Ratio of self-employed by Industry (Table Ba934-945) and Persons Engaged in Productions (Table Ba988-1002).

Table 6: **GDP Deflators (1929=100)**

Year	Balke-Gordon	GNP	BEA GDP
1929	100	100	100
1930	96.9	97.4	96.1
1931	88.1	88.5	86.5
1932	78.4	79.4	76.7
1933	76.7	77.7	74.7
1934	83.3	83.4	78.4
1935	85.1	84.2	79.9
1936	85.5	84.4	80.8

Source: See data file.

Figure 4: **WPI by Stage of Production**

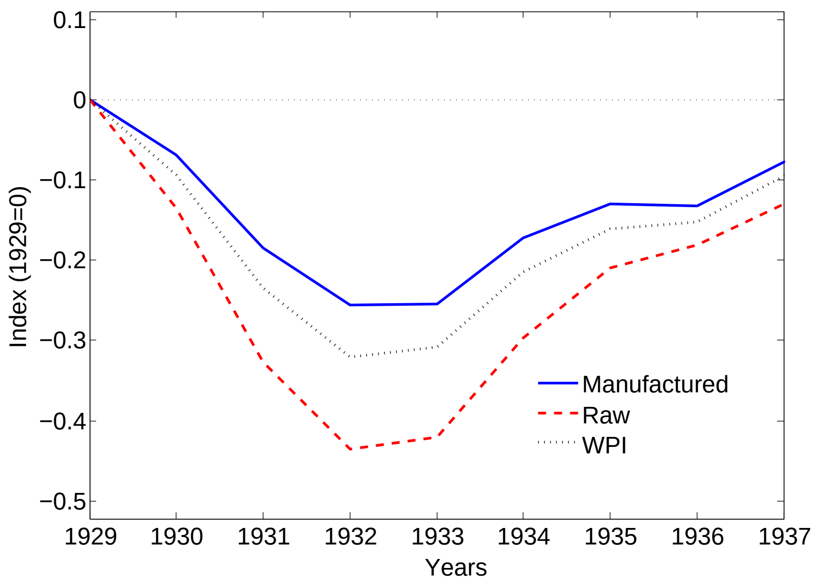

Table 7: **Price Indices (1929=100)**

				COLI						
Year	GNP Defl.	WPI (Man.)	VA Defl. (Man.)	All	Food	Cloth	Rent	Fuel	H. Furn.	Misc.
1929	100	100	100	100	100	100	100	100	100	100
1930	96.9	93.1	100.8	97.5	95.1	97.7	97.2	99.0	97.5	100.5
1931	88.1	81.5	92.1	88.7	78.4	89.0	92.1	96.8	87.7	99.5
1932	78.4	74.4	89.9	79.7	65.3	78.8	82.7	91.9	76.5	97.2
1933	76.7	74.6	81.2	75.4	63.5	76.2	71.2	88.9	75.4	94.1

Source: GNP deflator is from Balke and Gordon (1986).
COLI data is from Table 5 in *Cost of Living in 1941*, BLS Bulletin No. 710.

Table 8: **COLI Weights**

Item	*Original Index* 1923-25	*Original Index* 1935-39	*New Index* 1935-39
Food	31.6	31.1	33.9
Clothing	14.1	13.8	10.5
Rent	19.8	16.0	18.1
Fuel, Elect & Ice	6.0	6.3	6.4
Housefurninshings	4.8	4.7	4.2
Miscellaneous	23.7	28.1	26.9

Source: Table 11 in Bureau of Labor Statistics (1940)

Table 9: **Estimates of Flexible and Inflexible Sector Prices using COLI**

Year	Balke-Gordon	Flexible	Sticky
1929	100	100	100
1930	96.9	95.8	99.4
1931	88.1	83.2	95.8
1932	78.4	71.4	90.7
1933	76.7	66.2	87.8
1934	83.3	69.3	90.0
1935	85.1	72.6	90.3
1936	85.5	73.6	90.8

Source: See data file.

Table 10: **Estimates of Retail and Wholesale Margins**

Year	Retail	Wholesale	Total
Furniture	34.7	20.7	55.4
Shoes	30.8	13.9	44.7
Men's clothings	30.4	13.9	44.3
Women's ready to wear	31.1	13.9	45

Source: Stewart and Dewhurst (1939), Tables M (p. 386) and S (p. 392).

Table 11: **Sectoral Prices: Retail, Construction and FIRE**

1933 Price Relative to 1929

	Agriculture		Retail Deflator (constructed)			Construction		
	PCE Food & bev. for off-premises. cons.	WPI Foods	Food	Clothing	Furnishing	Dept. Commerce composite	Building materials WPI Constr.	Construction Deflator (constructed)
1933/1929	0.62	0.49	0.68	0.66	0.66	0.83	0.81	0.87

Table 12: **Intermediate Share of Gross Output (%)**

Year	Manufacturing	Agriculture
1927	56.3	–
1929	55.0	30.1
1931	53.3	29.3
1933	54.2	32.2
1935	57.7	29.0

Source: Census of Manufacturing,
Statistical Abstract of the United States.

Table 13: **Intermediate Share of Gross Output: Manufacturing industries (%)**

Industry	1927	1929	1931	1933	1935
Automobile	62.9	63.3	61.9	65.0	71.5
Boots and Shoes	52.3	53.3	51.6	51.7	51.8
Iron and Steel	57.3	54.1	55.1	55.0	54.7
Meat Packing	87.1	86.5	84.3	80.7	86.0
Paper and Pulp	63.6	60.0	58.1	56.6	60.0
Leather	67.2	70.1	63.7	58.3	64.7
Wool Man	57.3	57.0	52.8	52.6	54.8
Manufacturing	56.4	55.0	53.3	54.2	57.7

Source: Census of Manufacturing, *Statistical Abstract of the United States.*

Table 14: **Real Wages (1929=100)**

	GNP Deflator					*WPI Deflator*				
Industry	1929	1930	1931	1932	1933	1929	1930	1931	1932	1933
Automobile	100	103.5	111.2	111.8	114.4	100	106.5	109.2	99.7	103.9
Boots and Shoes	100	97.3	98.7	103.2	119.0	100	98.3	98.6	99.9	107.5
Iron and Steel	100	104.3	110.4	103.7	104.4	100	107.7	110.8	97.1	96.7
Meat Packing	100	105.8	111.7	106.7	109.2	100	113.7	142.5	156.7	182.8
Paper and Pulp	100	103.4	111.6	110.3	106.5	100	103.5	107.4	101.7	94.8
Leather	100	103.9	109.1	111.8	111.6	100	112.5	126.3	152.3	135.8
Wool Man	100	105.0	110.7	101.7	108.2	100	113.8	126.3	121.9	105.7
Manufacturing	100	103.1	108.5	107.7	108.5	100	107.3	117.4	113.4	111.5

Source: Nominal wages are from the NICB, GNP deflator is from Balke and Gordon (1986) and the wholesale price deflators are from various issues of *Wholesale Prices*.

Table 15: **Industry Wholesale Output and Main Input Price (1929=100)**

	WPI (GO)					*WPI (Main Input)*				
Industry	1929	1930	1931	1932	1933	1929	1930	1931	1932	1933
Automobile	100	94.2	89.8	87.9	84.4	100	93.9	87.8	83.7	82.8
Boots and Shoes	100	96.0	88.1	81.0	84.9	100	89.5	76.1	57.5	63.1
Iron and Steel	100	93.9	87.8	83.7	82.8	100	101.3	100.6	100.4	98.1
Meat Packing	100	90.2	69.1	53.3	45.8	100	84.1	60.2	45.4	40.9
Paper and Pulp	100	96.9	91.6	84.9	86.2	100	95.1	85.8	74.5	60.9
Leather	100	89.5	76.1	57.5	63.1	100	80.7	53.4	37.3	59.5
Wool Man	100	89.5	77.2	65.3	78.5	100	70.4	51.5	36.9	59.1
Manufacturing	100	93.1	81.5	74.4	74.6	100	86.5	67.3	56.5	57.9

Source: See the discussion in this section and Section 3.0.2. The input price indices are based on the main input for each industry. For manufacturing, the input price index is for raw materials (the values for the index of semi-manufactured goods are 100, 87.1, 73.5, 63.2, 69.5).

Table 16: **Industry Value-Added Deflators (1929=100)**

Industry	1929	1930	1931	1932	1933
Automobile	100	94.7	93.2	98.4	97.2
Boots and Shoes	100	103.8	103.3	115.1	115.6
Iron and Steel	100	85.7	74.2	86.2	67.0
Meat Packing	100	136.7	148.7	127.6	87.2
Paper and Pulp	100	99.6	100.8	102.3	136.5
Leather	100	112.7	153.8	132.2	72.1
Wool Man	100	120.0	123.3	122.4	110.5
Manufacturing	100	100.8	92.0	89.9	81.0

Source: These are the constructed values that are used in Table 4 in Amaral and MacGee (2012).

Table 17: **Calibration: No-intermediates**

Parameter	Value	Target
β	0.99	Annual risk-free rate 4%
δ	0.025	Annual depreciation rate 10%
σ_L	-0.5	Frisch elasticity of 2
η	0.34	Flexible sector's share of GDP in steady-state: 41%
g	0.0015	Estimated from M1 data
γ	0.02	Sticky sector's real consumption wage path (1929-1933)
μ_L	7.3345	Total market time of 1/3
μ_M	0.013	BEE (2000)
ϕ_i	0.25	Quarterly contracts
ρ_m	0.44	Estimated
ρ	-0.82	Path of Flexible sector's share of GDP (1929-1933)
θ_1	0.3	Capital income share of 30%
θ_2	0.3	Capital income share of 30%

Table 18: **Calibration: One-sector models**

Parameter	Value	Target
β	0.99	Annual risk-free rate 4%
δ	0.025	Annual depreciation rate 10%
g	0.0015	Estimated from M1 data
μ	0.987	BEE (2000)
ϕ_i	0.25	Quarterly contracts
ρ_m	0.44	Estimated
θ	0.3	Capital income share of 30%

Replicating Bordo, Erceg, and Evans (2000)

Parameter	Value	Target
γ	0.0087	Real manufacturing wage (1929-1933) from Bordo, Erceg, and Evans (2000)

Comparison to no-intermediates

Parameter	Value	Target
γ	0.0822	Economy-wide real wage (1929-1933) from no-intermediates model

Comparison to benchmark

Parameter	Value	Target
γ	0.0232	Economy-wide real wage (1929-1933) from benchmark

Figure 5: **Drop in TFP: aggregate variables**

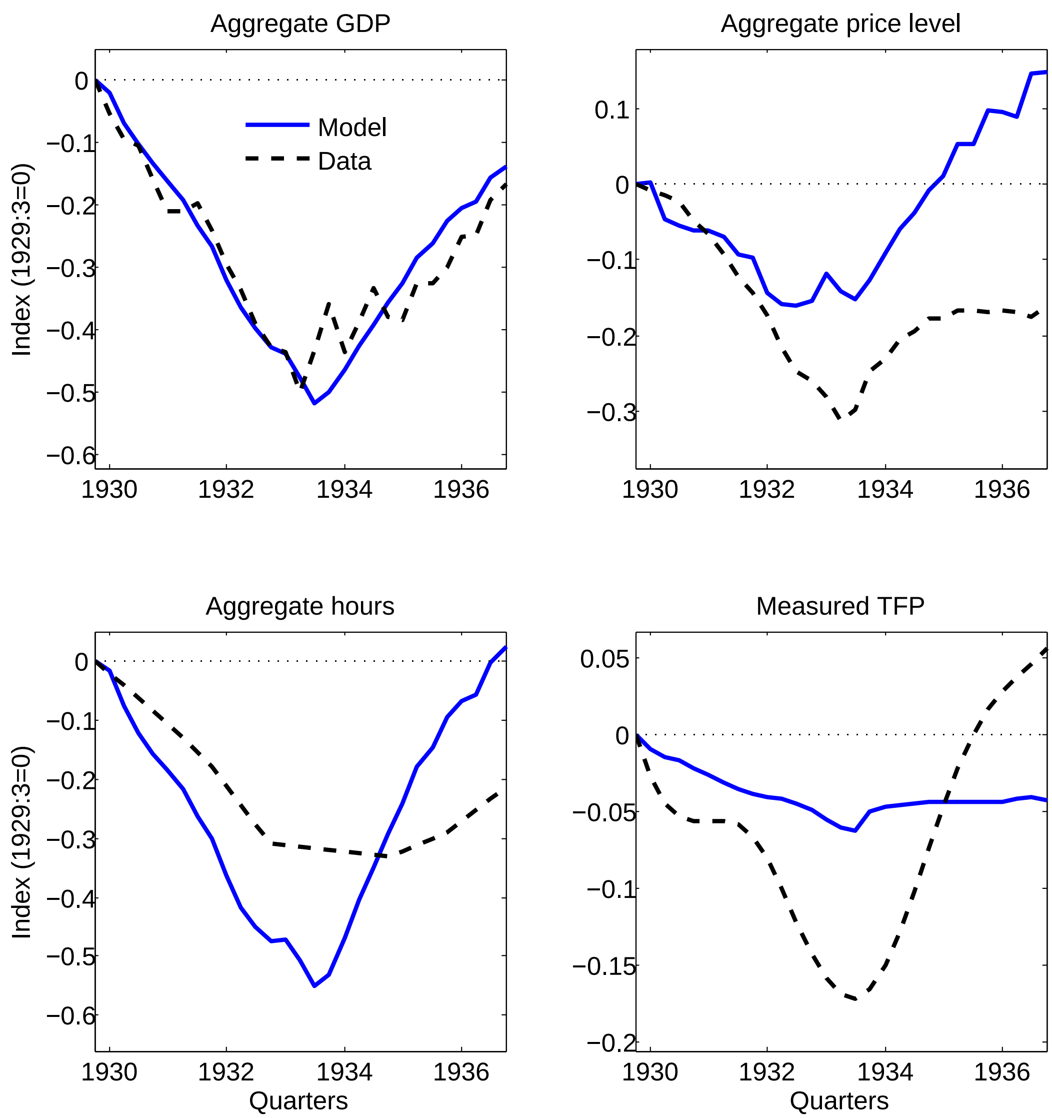

Figure 6: **Drop in TFP: sectoral variables**

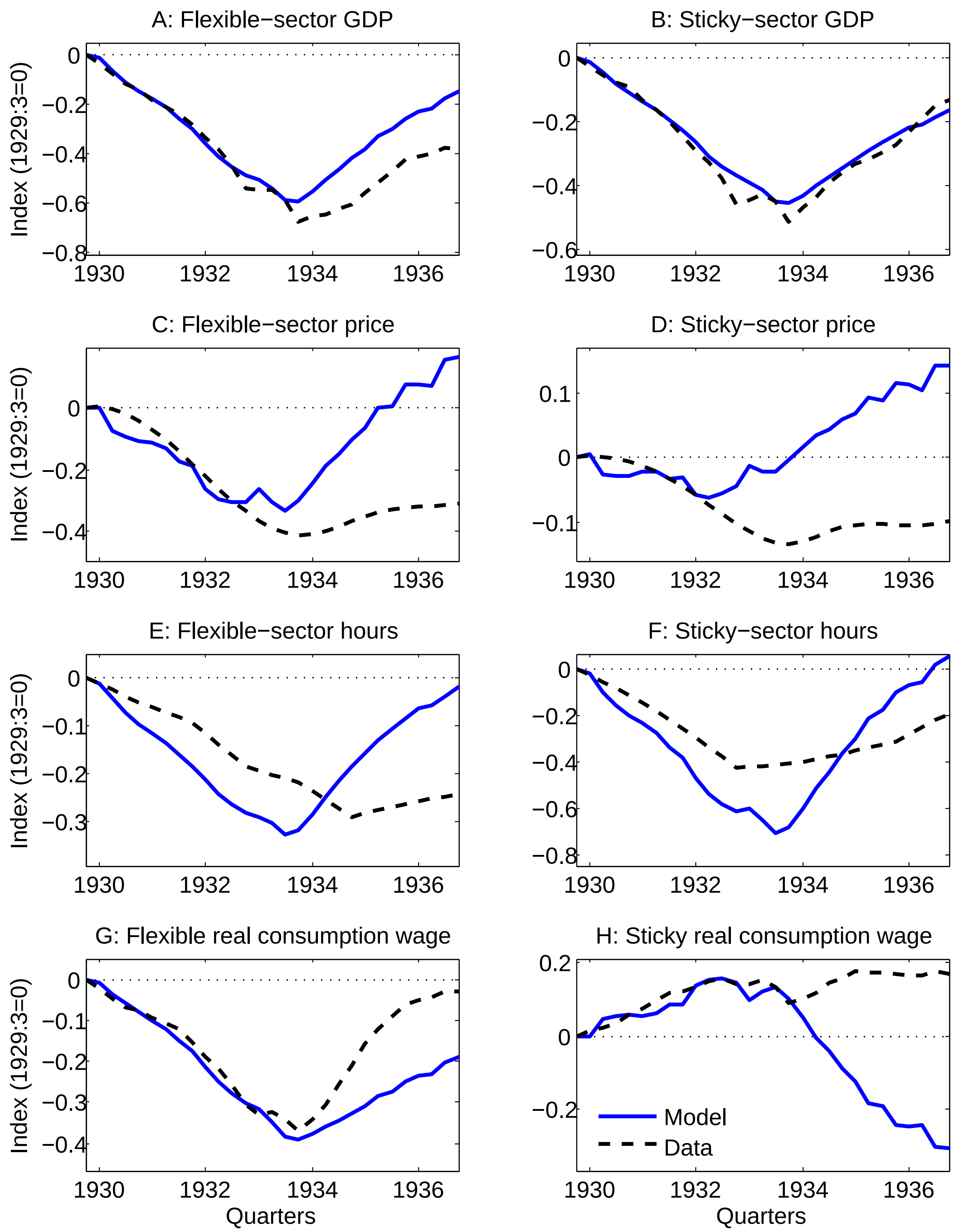

Figure 7: **Starting above steady-state**

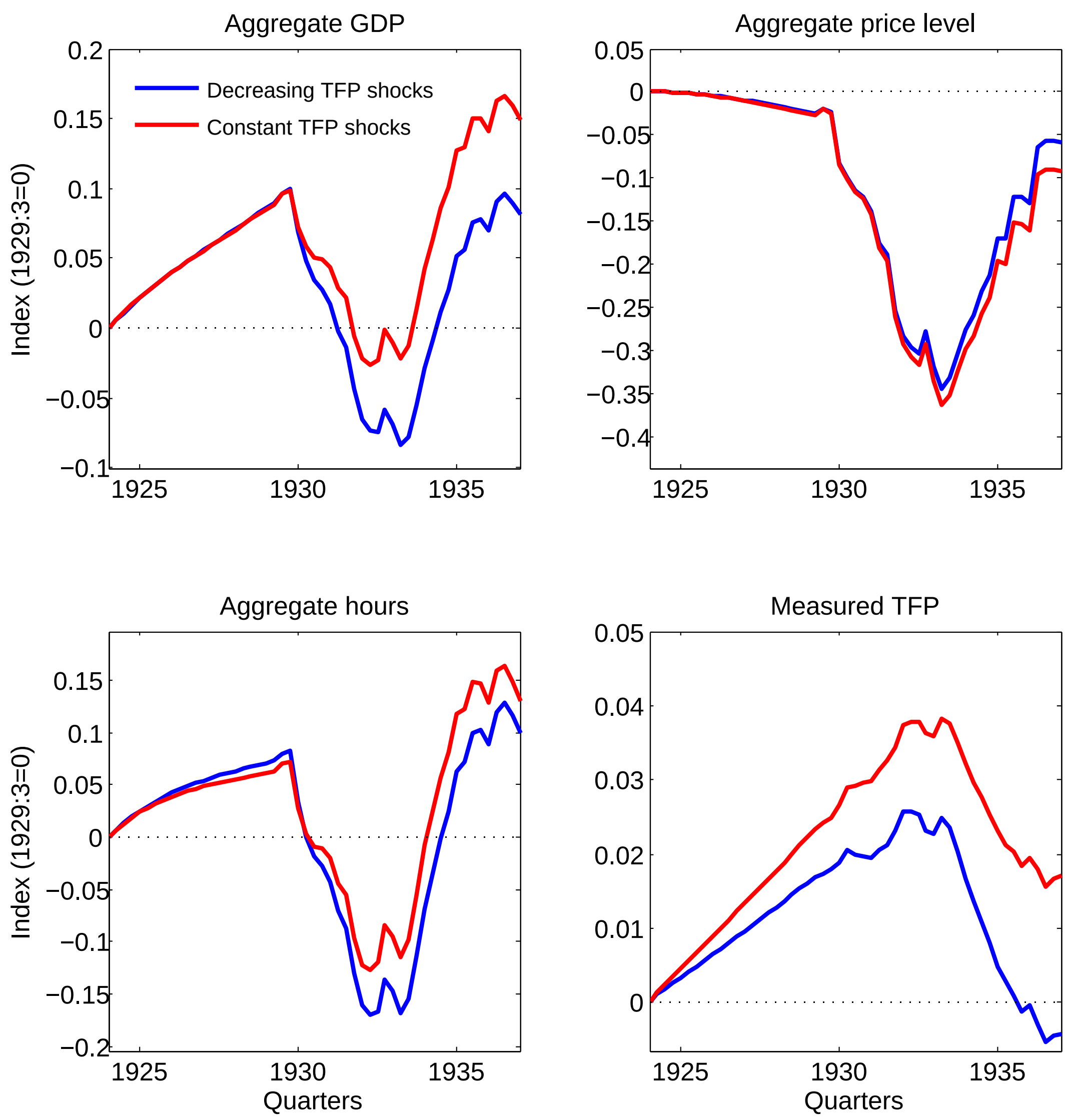

Figure 8: **Intermediates' shares**

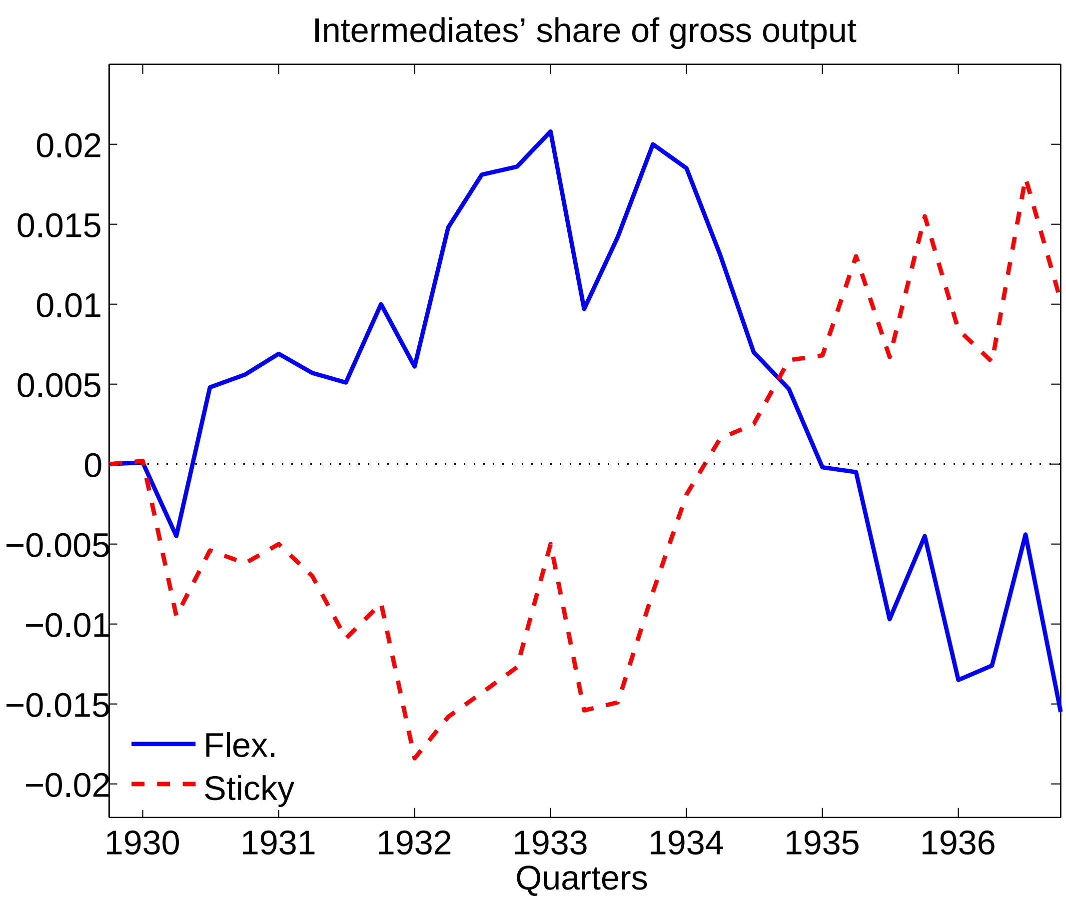

Figure 9: **Varying ρ_i: aggregate variables**

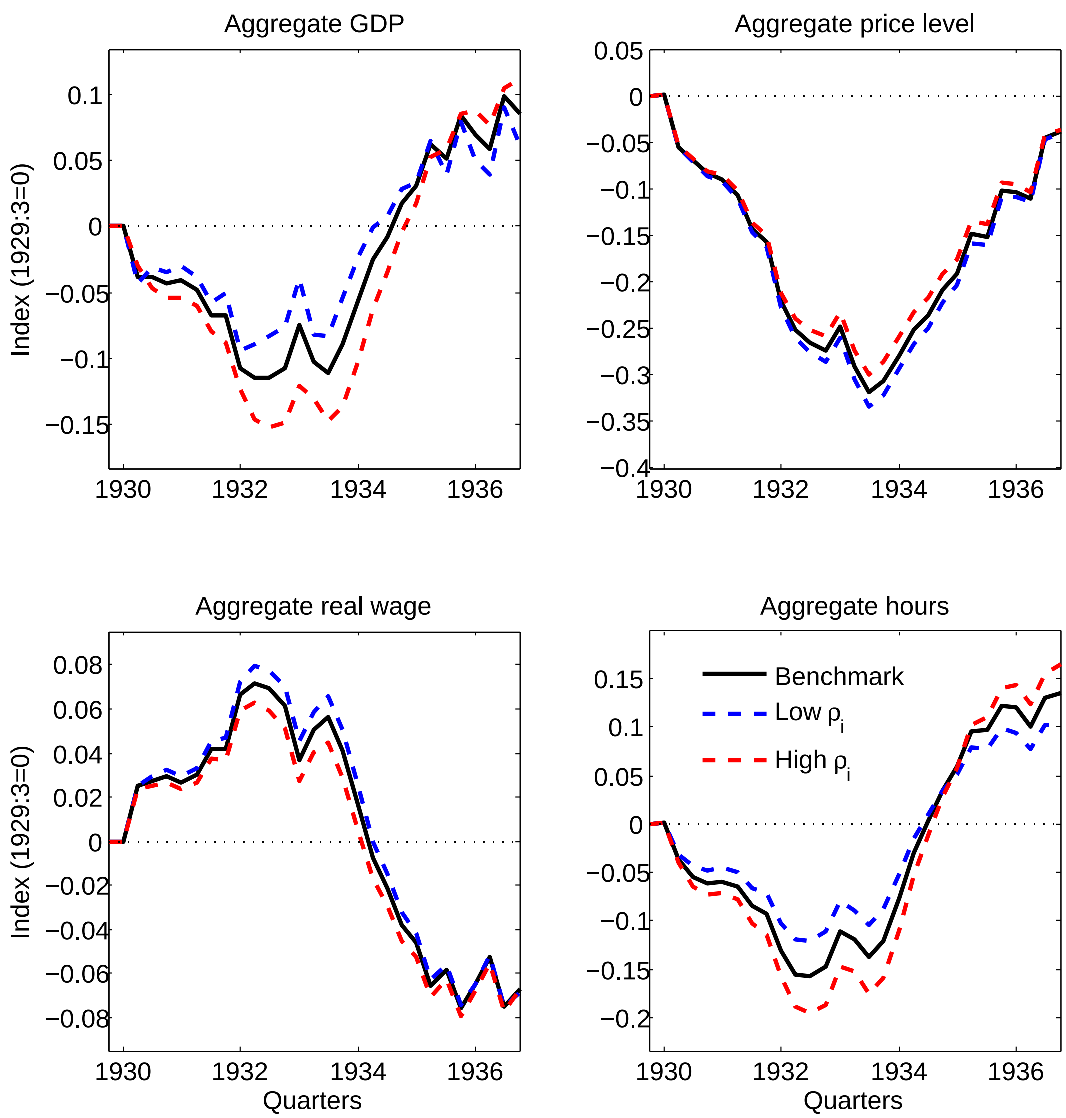

Figure 10: **Varying ρ_i: sectoral variables**

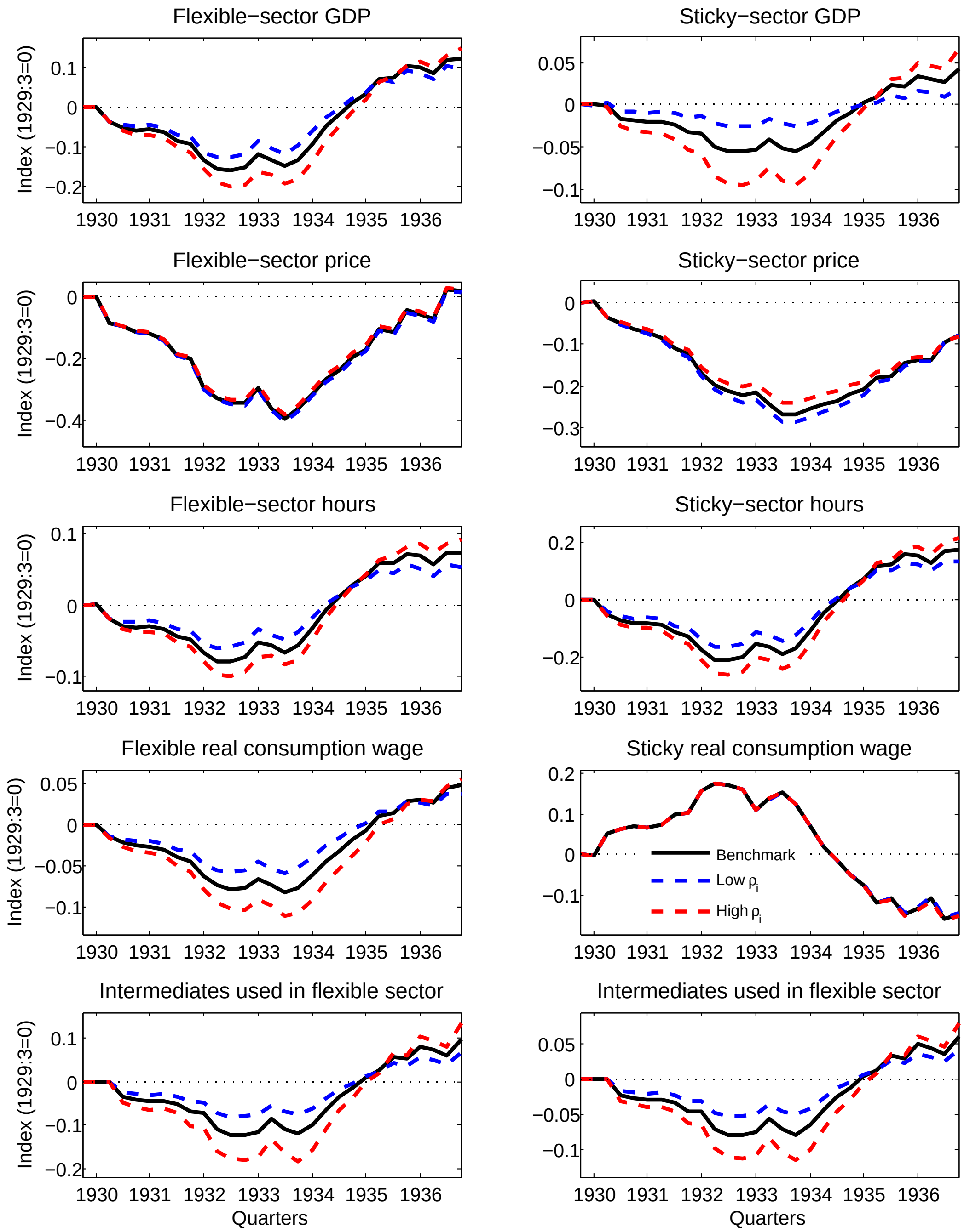

Figure 11: **FIRE in sticky sector**

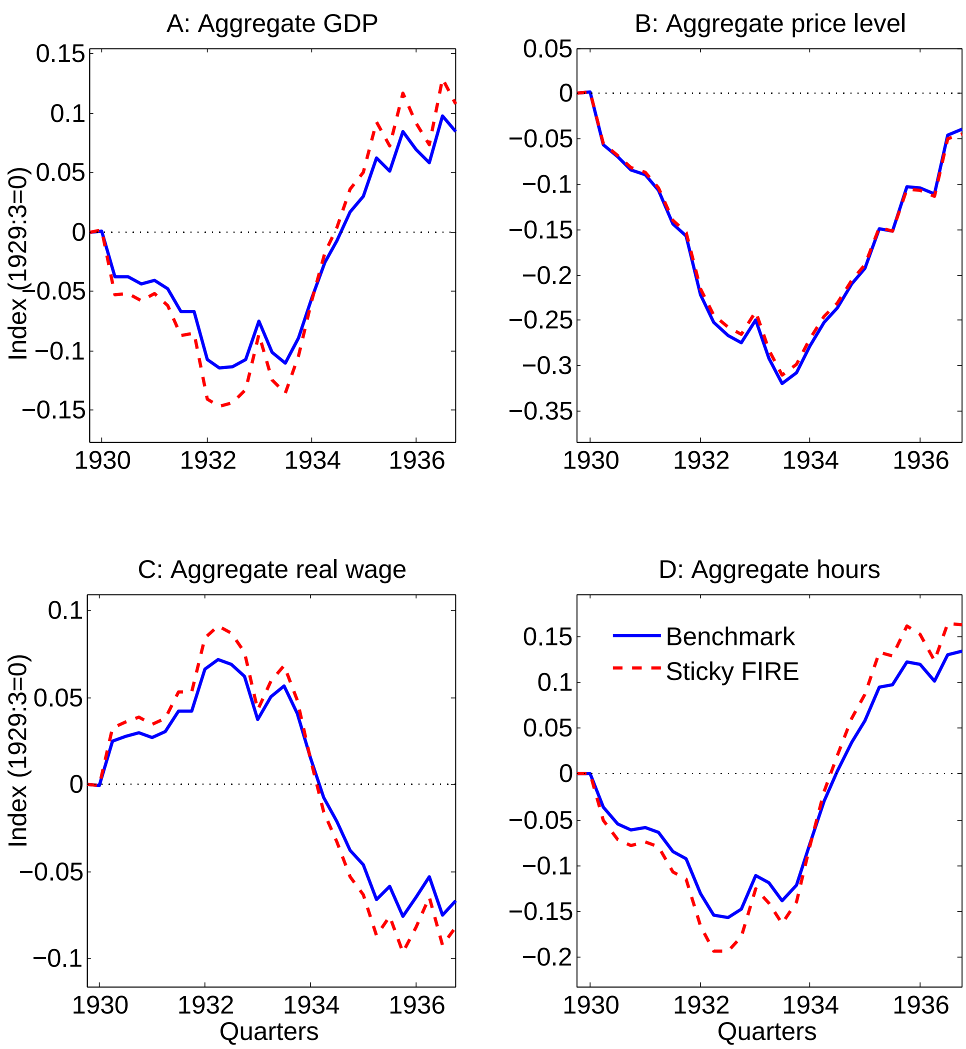

Figure 12: **FIRE in sticky sector**

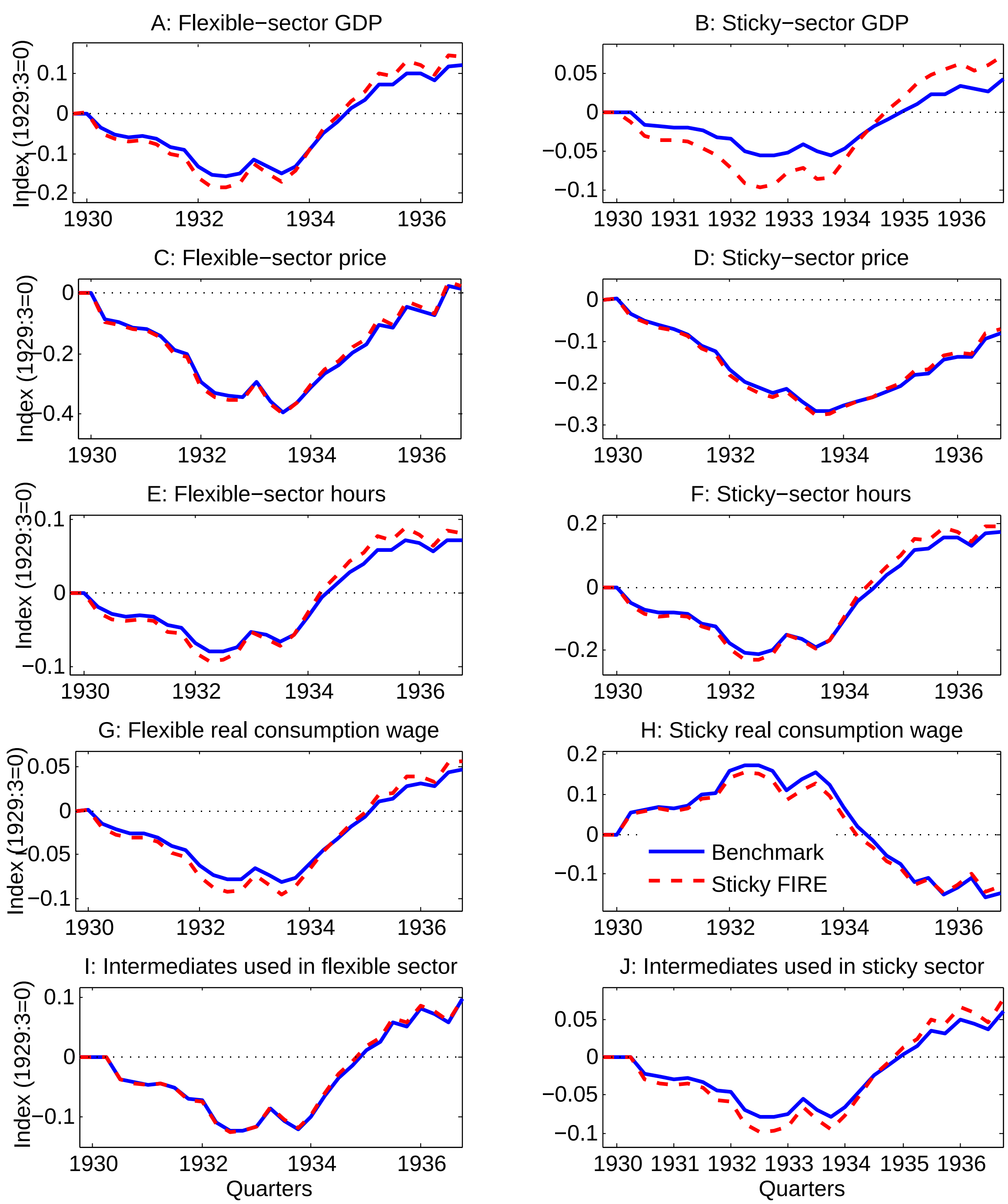

Table 19: **PCE Components Ordered by 1933 relative to 1929**

PCE Category	Index 1933/1929
Personal consumption expenditures	0.727281896
Musical instruments (part of 80)	0.359034808
Video, audio, photographic, & infor. processing equip. & media (75, 76, and part of 93)	0.384491178
Recreational goods and vehicles	0.506097352
Food produced and consumed on farms (6)	0.510768778
Financial services furnished without payment (107)	0.560718711
Air transportation (64)	0.609219148
Food and beverages purchased for off-premises consumption	0.62041058
Food & nonalcoholic bev. purchased for off-premises cons. (4)	0.635198921
Food furnished to employees (including military) (103)	0.645107794
Food services	0.653640929
Purchased meals and beverages (102)	0.654438622
Food services and accommodations	0.661024992
Household maintenance (parts of 31, 33, and 36)	0.661961548
Other clothing materials and footwear (13 and 17)	0.663856744
Rental value of farm dwellings (22)	0.686990728
Nondurable goods	0.691383301
Goods	0.697423266
Clothing and footwear	0.698015004
Recreational items (parts of 80, 92, and 93)	0.701497813
Motor vehicle maintenance and repair (60)	0.704978814
Garments	0.708310884
Imputed rental of owner-occupied nonfarm housing (21)	0.713088068
Motor vehicle services	0.715400994
Household appliances (part of 33)	0.720558778
Telephone and facsimile equipment (67)	0.72207328
Household supplies (parts of 32 and 36)	0.722273264
Durable goods	0.722672922
Luggage and similar personal items (part of 119)	0.722777513
Furniture and furnishings (parts of 31 and 32)	0.72762439
Housing	0.73635039
Furnishings and durable household equipment	0.739168317
Life insurance (110)	0.740091463
Financial services	0.740392648
Motor vehicle parts and accessories (58)	0.747474747
Tools and equipment for house and garden (35)	0.751607526
Financial services and insurance	0.754080813
Net health insurance (112)	0.758089034
Housing and utilities	0.76025974
Group housing (23)	0.760822511
Accommodations (104)	0.760930784
Professional and other services (121)	0.762508568
Household consumption expenditures (for services)	0.763597122
Services	0.764502762
Insurance	0.766291608

Audio-video, photographic, & infor. processing equip. services (parts of 77 and 93)	0.766337484
Rental of tenant-occupied nonfarm housing (20)	0.772754062
New motor vehicles (55)	0.785436684
Other services	0.785531479
Motor vehicles and parts	0.79056696
Dental services (45)	0.794117647
Hospital and nursing home services	0.796296296
Hospitals (51)	0.796308504
Nursing homes (52)	0.796356275
Glassware, tableware, and household utensils (34)	0.802239864
Fuel oil and other fuels (29)	0.80242579
Sports and recreational vehicles (79)	0.803450863
Other motor vehicle services (61)	0.808210157
Health care	0.809432515
Social services and religious activities (120)	0.809754522
Outpatient services	0.81216458
Physician services (44)	0.818876878
Transportation services	0.81955567
Paramedical services (46)	0.820376523
Gasoline and other energy goods	0.821306906
Sporting equipment, supplies, guns, and ammunition (part of 80)	0.823358106
Other nondurable goods	0.824668305
Motor vehicle fuels, lubricants, and fluids (59)	0.832663821
Recreational books (part of 90)	0.837724898
Educational books (96)	0.837860543
Nursery, elementary, and secondary schools (98)	0.839836925
Recreation services	0.84155284
Membership clubs, sports centers, parks, theaters, & museums (82)	0.842981059
Higher education (97)	0.844930417
Other durable goods	0.845079233
Education services	0.846822131
Commercial and vocational schools (99)	0.847086346
Tobacco (127)	0.851648352
Public transportation	0.868241598
Ground transportation (63)	0.868890287
Personal care and clothing services (14 and parts of 17 and 118)	0.873502467
Water supply and sanitation (25)	0.880414887
Pharmaceutical and other medical products (40 and 41)	0.889776004
Electricity (27)	0.89294329
Therapeutic appliances and equipment (42)	0.896141891
Magazines, newspapers, and stationery (part of 90)	0.897901049
Postal and delivery services (68)	0.911010558
Gambling (91)	0.913881485
Net household insurance (111)	0.917647059
Personal care products (part of 118)	0.92083052
Jewelry and watches (part of 119)	0.927489491
Household utilities	0.929024656
Electricity and gas	0.940742802
Other recreational services (81, 94, and part of 92)	0.953257447
Water transportation (65)	0.970279905
Communication	0.992842998

Natural gas (28)	1
Telecommunication services (71)	1.007901248
Net motor vehicle and other transportation insurance (116)	1.034101174
Financial service charges, fees, and commissions (108)	1.064879247
Net purchases of used motor vehicles (56)	1.46122449

Source: See the Excel data file.

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